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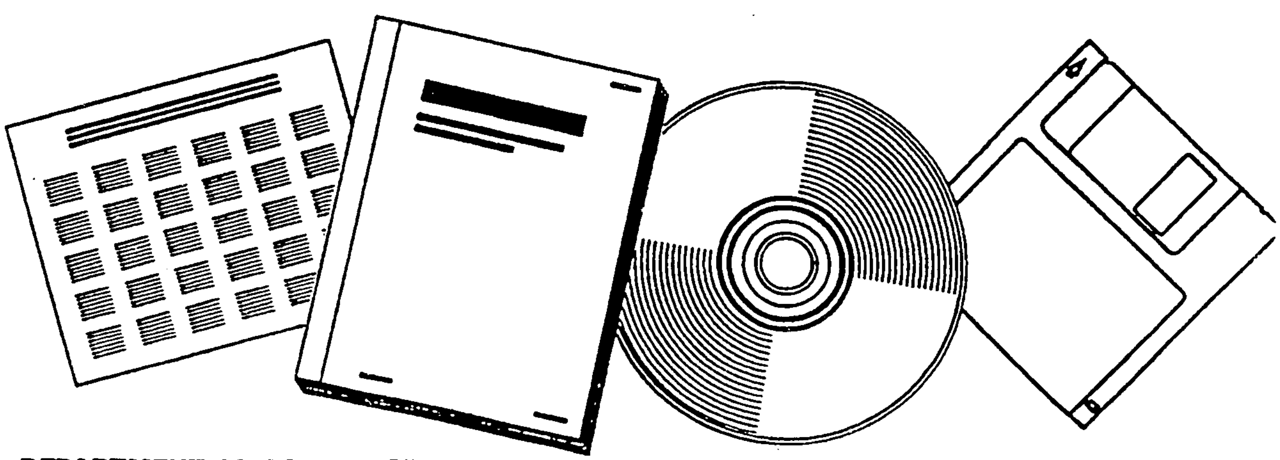
FINAL ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS. VOLUME 1

DEPARTMENT OF THE NAVY
WASHINGTON, DC

MAY 1984



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

FINAL ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

VOLUME 1 OF 3

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by the

United States
Department of the Navy (Lead Agency)
and
Department of Energy (Cooperating Agency)

Location of Department of Energy sites if land disposal were to be implemented:
Savannah River Plant, Aiken County and
Barnwell County, South Carolina
Hanford Site, Benton County, Franklin County,
and Grant County, Washington

The Department of Energy (DOE) is participating as a cooperating agency with regard to the land disposal option at DOE burial sites.

Abstract This statement describes two methods for permanent disposal of decommissioned, defueled reactor plants: land disposal by burial at existing Federal sites and deep sea disposal. The "no action" alternative of long-term protective storage prior to permanent disposal at some time in the future is also discussed. Based upon the research work performed in support of this effort, and review of the public comments received, the Navy considers that permanent disposal can be conducted in an environmentally safe manner. Largely as a result of the highly uncertain regulatory status of sea disposal, the Navy considers land burial at existing Federal sites to be the preferred alternative. The "no action" alternative would only delay the decision for permanent disposal and would result in increased costs without significantly changing the environmental impact.

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FOREWORD

This Final Environmental Impact Statement (EIS) is issued by the U.S. Department of the Navy, Environmental Protection, Occupational Safety and Health Division (OP-45) in accordance with the Navy Manual, OPNAV Instruction 6240.3E, which implements the requirements of the National Environmental Policy Act of 1969 (NEPA). The format used in this statement is that recommended by the Council on Environmental Quality (CEQ), as published in the Code of Federal Regulations, 40CFR1502.10.

Prior to a major federal action that might significantly affect the quality of the human environment, the National Environmental Policy Act requires the preparation of a detailed statement on:

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Pursuant to OPNAV Instruction 6240.3E, it was determined that a detailed statement on the foregoing considerations with respect to the disposal of decommissioned, defueled reactor plants should be prepared. A Notice of Intent to prepare an EIS was published in the Federal Register on January 14, 1982 (47FR2151). Input on the scope of the EIS was solicited from the public, interested organizations, States, and Federal agencies.

The Draft Environmental Impact Statement was published on December 22, 1982 and widely circulated. Over 1500 copies of the statement were distributed to individuals, environmental organizations, State and local officials, and other Federal agencies. Over six months were allowed for interested parties to comment on the Draft EIS. Over 500 letters were received providing comments.

The Navy held four public hearings in different parts of the country at which over 150 persons testified.

All substantive comments received by the Navy were analyzed and are addressed in the final statement. Volume 1 of the final statement is similar to the draft statement. Where changes have been made to the draft statement, the outer margins of Volume 1 are marked by vertical lines. Typographical changes and minor clarifications of the text are not marked.

Given the comprehensive technical work which has gone into preparing the statement, and the extensive public input which has been received, the Navy considers that there is an adequate basis upon which to make a decision as to how to proceed.

The U.S. Department of Energy (DOE) is a cooperating agency in the preparation of this statement in accordance with the CEQ regulations (40CFR1501). By participating as a cooperating agency, DOE obligations under NEPA will be fulfilled and no separate DOE EIS will be required with regard to the land disposal option at DOE burial sites.

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SUMMARY

INTRODUCTION

This Final Environmental Impact Statement describes the alternate ways the Department of the Navy and the Department of Energy (DOE) have considered for disposing of nuclear-powered submarines after they are no longer useful. The practical choices are: (1) bury the submarine reactor compartment at an existing DOE land disposal site at the Hanford Site in the state of Washington, or at the Savannah River Plant in South Carolina, and dispose of the non-radioactive remainder of the submarine either by sinking at sea or by cutting up for sale as scrap metal, (2) place the entire submarine on the bottom of the ocean in deep water (deeper than 2.5 miles), far from the United States coast, or (3) keep the submarine in protective storage at a Navy inactive ship facility after decommissioning for disposal on land or at sea at a later time.

In all of these choices there would be no radioactive nuclear fuel left in the submarine. All the radioactive nuclear fuel would be removed before disposal. Nevertheless, there would be some low level radioactive materials left within the submarine. Therefore, this Final Environmental Impact Statement concerns disposal of the rest of the submarine after all the radioactive nuclear fuel has been removed.

On December 22, 1982, the Navy published its Draft Environmental Impact Statement on the disposal of decommissioned, defueled Naval submarine reactor plants. The Navy's intent since the outset of this Environmental Impact Statement process has been to identify and fully evaluate the reasonable alternatives so that an informed decision could be made on which approach to pursue. The Navy's Draft Environmental Impact Statement was widely circulated and a large number of public comments were received. Over 1500 copies of the statement were distributed to individuals, environmental organizations, State and local officials, and other Federal Agencies. Over six months were allowed for interested parties to comment on the Navy Draft Environmental Impact Statement. Over 500 letters were received providing comments. The Navy held four public hearings in different parts of the country at which over 150 people testified. All substantive comments received by the Navy were analyzed and are addressed in the final statement. Given the comprehensive technical work which has gone into preparing the statement, and the extensive public input which has been received, the Navy considers that there is an adequate basis upon which to make a decision as to how to proceed.

BACKGROUND

The Navy has about 120 nuclear-powered submarines now in operation. Approximately 100 of these submarines may be taken out of service in the next 20 to 30 years. Seven submarines have already been taken out of service and placed into protective storage.

A submarine is constructed with the nuclear power plant inside a single section of the ship called the reactor compartment. Figure 1 shows a typical submarine with the location of the reactor compartment identified. Figure 2 is a simplified picture of the nuclear power plant inside the reactor compartment. The components of the nuclear power plant include a high-strength steel container called the reactor pressure vessel, a heat exchanger (steam generator), and associated piping, pumps, and valves.

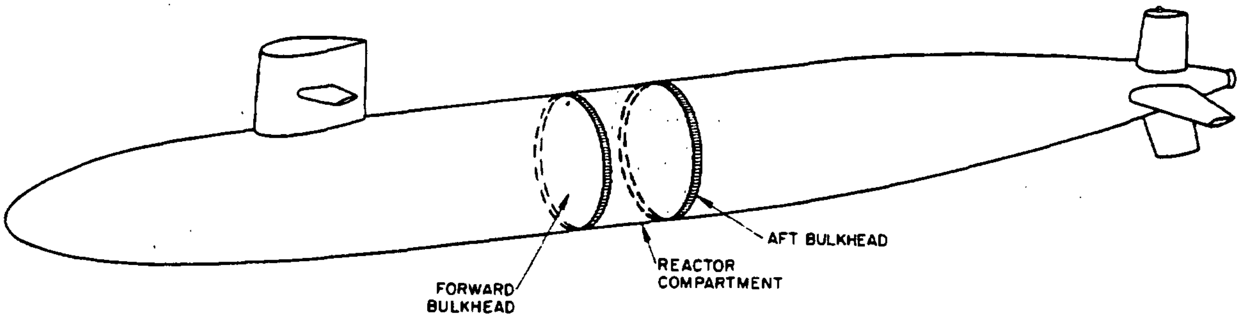


Figure 1. Typical Submarine with Reactor Compartment Identified

SCHEMATIC OF NUCLEAR PROPULSION PLANT

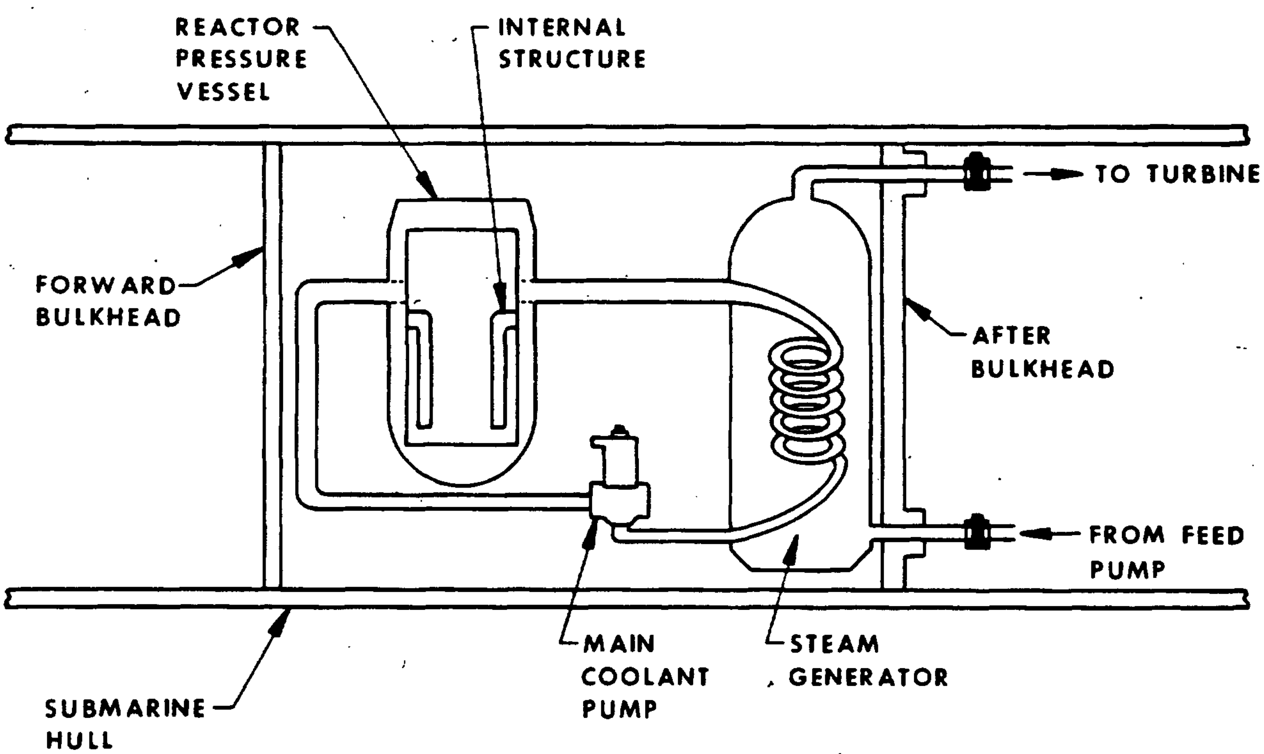


Figure 2. Nuclear Power Plant

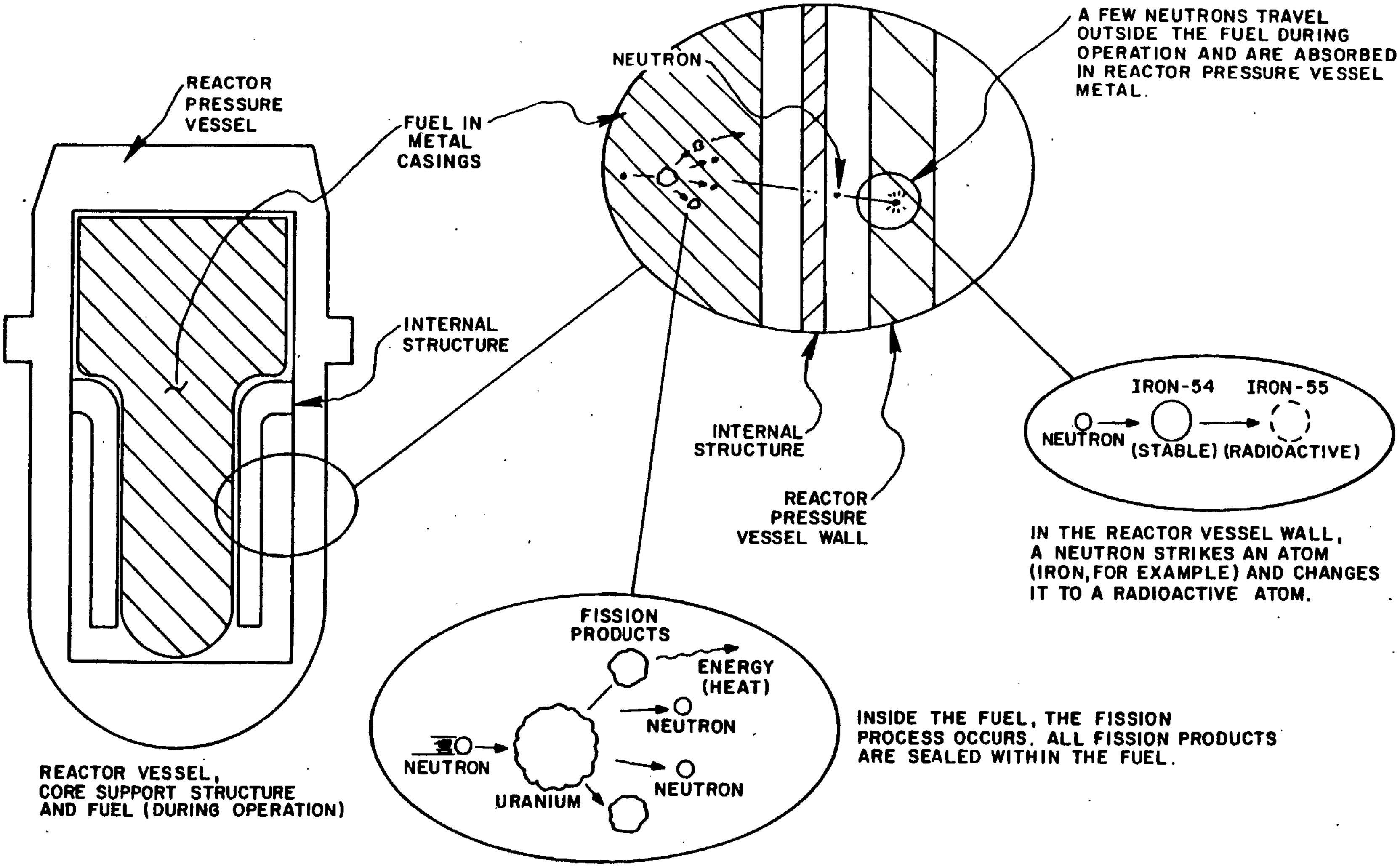
A brief description of the way energy is produced in a submarine's nuclear reactor will help to understand how the radioactivity in a submarine is generated. The fuel in a submarine reactor contains uranium atoms sealed within a metal casing. Uranium is one of the few materials capable of producing heat in a self-sustaining chain reaction. When a neutron causes fission in uranium, the nucleus splits into two parts called fission products (Figure 3). When formed, the fission products initially move apart at very high speeds, but they do not travel very far, only a few thousandths of an inch, before they are stopped within the fuel casing. Most of the heat produced in the fission process comes from stopping these fission products within the fuel and converting their kinetic energy into heat.

Nuclear fission creates highly radioactive fission products. Most of the radioactivity produced by nuclear fuel is in the fission products, which do not get outside the fuel casings. The uranium fuel is sealed within metal casings to prevent release of the fission products.

Fissioning of uranium also produces neutrons, as shown in Figure 3, while the nuclear power plant is operating. Most of the neutrons produced are absorbed by the atoms within the fuel casings and continue the chain reaction. However, some of the neutrons travel away from the fuel, go outside the fuel casings, and are captured in the metal structure or in the walls of the pressure vessel itself. The metal structure supports the fuel inside the reactor pressure vessel (Figure 3). These neutrons, when absorbed in the nucleus of a nonradioactive atom like iron, can produce a radioactive atom. For example, Iron-54 contains a total of 54 particles (neutrons and protons). Adding an additional neutron produces an atom containing 55 particles, called "Iron-55." This atom is radioactive. At some later time, it changes into a nonradioactive Manganese-55 atom by releasing energy in the form of radiation (Figure 4). This process is called radioactive decay.

Before a ship is taken out of service, the fuel is removed from the reactor pressure vessel of the submarine in a process called defueling (Figure 5). This defueling removes all of the uranium and all of the fission products. The removed fuel is shipped by the Department of Energy from the refueling shipyard to its facilities in Idaho. The shipment is performed under requirements of the Department of Transportation, the Nuclear Regulatory Commission, and the Department of Energy. The fuel is processed in the same manner as other expended nuclear fuel. It is not discussed in this statement because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

However, even after defueling, the radioactive atoms which were formed in the metal structure and the reactor pressure vessel will remain in the submarine. These atoms are an inseparable part of the metal and they are chemically just like the rest of the iron, nickel, or other metal atoms in the reactor plant. These radioactive atoms can only be released from the metal as a result of the slow process of corrosion, such as the rusting of common iron or steel (Figure 6). For each radioactive atom that would be released in this process, at least 1000 stable atoms of the same element would be released. This natural dilution effect can be important in limiting the intake of radioactive atoms by animals and man, because biological systems cannot discriminate between radioactive and stable atoms that have the same chemical form.



ACTIVATION

Figure 3. Neutrons and Fission Products from Uranium Fission

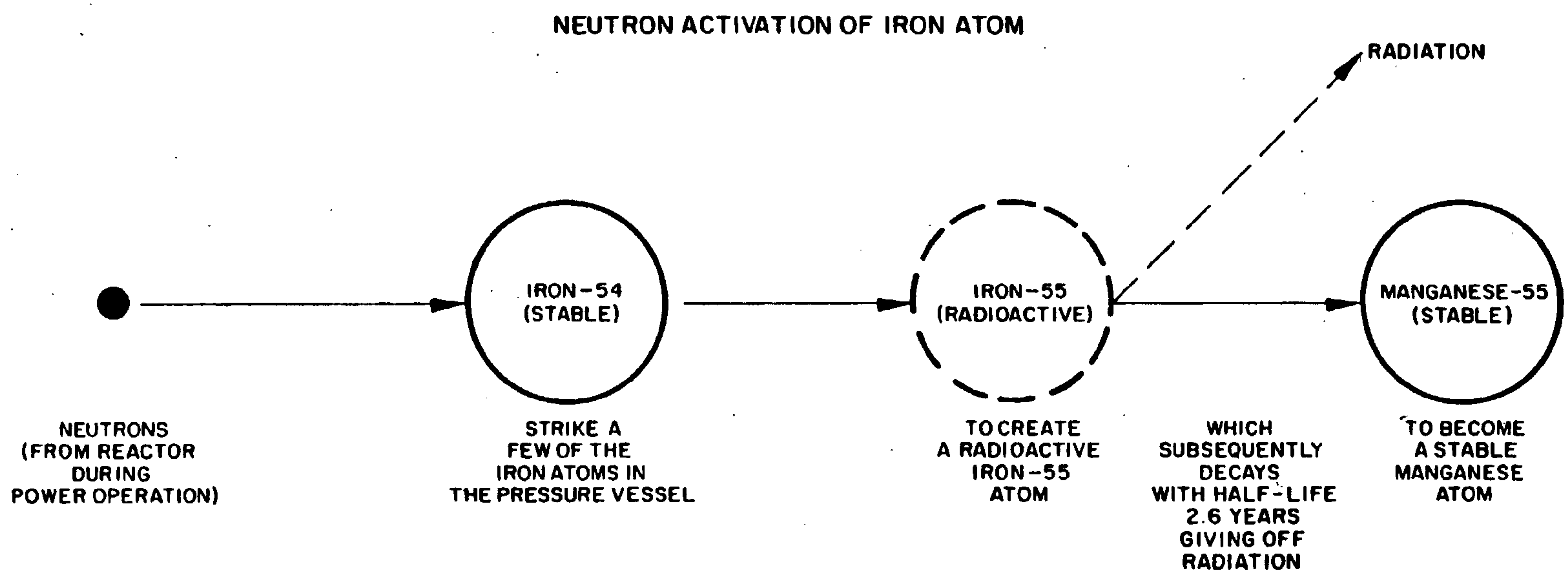


Figure 4. Capture of Neutrons in Iron of Pressure Vessel Wall

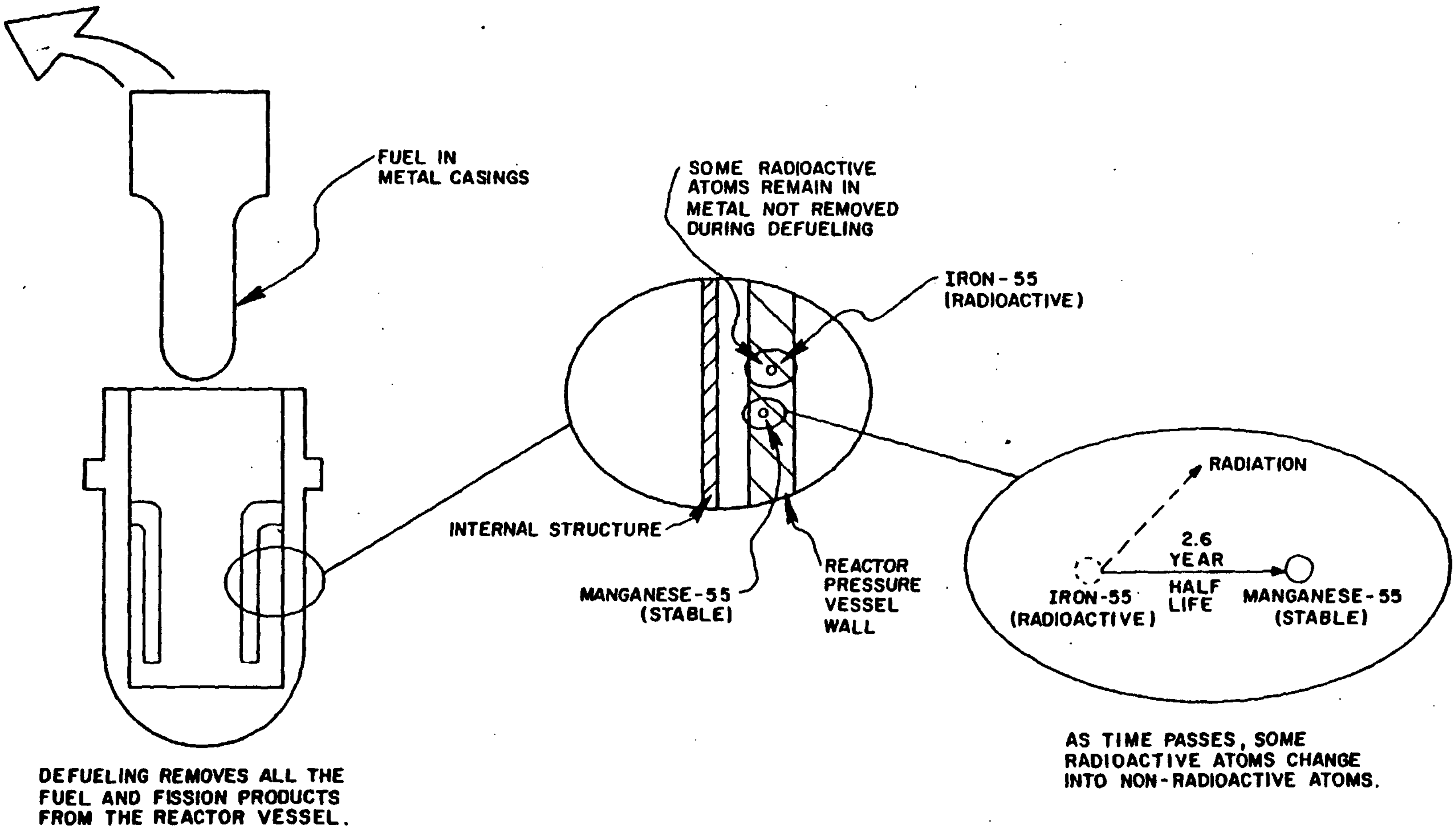
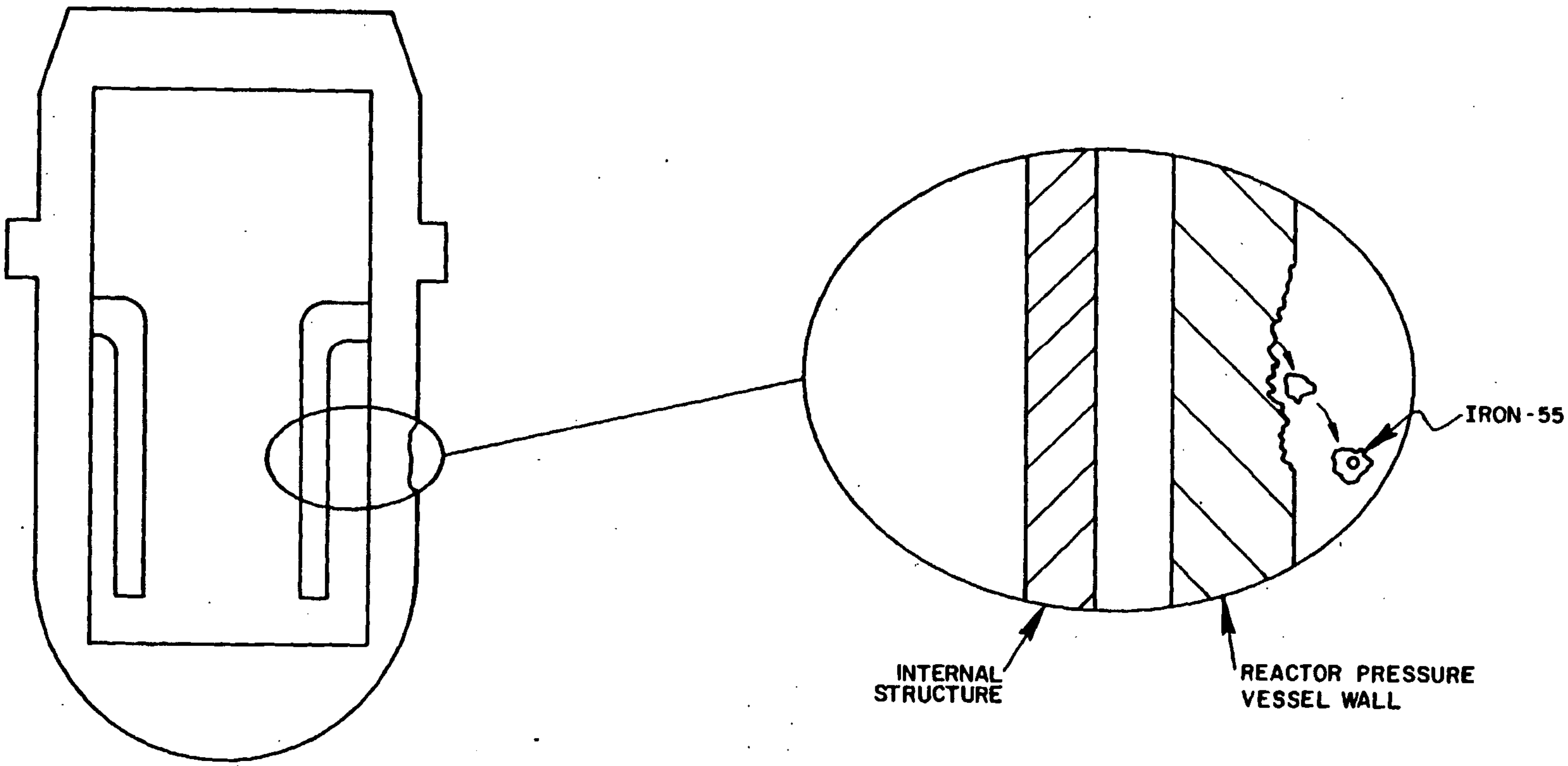


Figure 5. Activity in Pre re Vessel Wall After Defueling



AFTER DISPOSAL, THE VESSEL WALLS BEGIN TO CORRODE OR RUST

.... AND SOME RADIOACTIVE ATOMS THAT HAVE NOT YET CHANGED TO NON-RADIOACTIVE ATOMS ENTER THE ENVIRONMENT AS PART OF RUST FLAKES.

Figure 6. Rusting of Steel in Pressure Vessel Wall

Prior to disposal, both the reactor pressure vessel and the reactor compartment would be sealed. Thus, they would act as a container for the radioactive atoms and delay the time any of the radioactive atoms inside would be released to the environment as the metal corrodes or rusts. This is important because radioactivity "decays" away with time—which means that as time goes on, radioactive atoms change into nonradioactive atoms. Since radioactivity decays away with time, the effect of a delay is that fewer radioactive atoms would be released to the environment.

ALTERNATIVES

A submarine would not be assigned for disposal by the Navy unless and until an evaluation had shown that no future Naval use could exist for it. After a decision has been made that a submarine no longer has sufficient military value to justify maintaining it, it can be placed in protective storage for an extended period followed by permanent disposal or it can be permanently disposed of right away with a minimum of delay.

Nuclear submarines can be placed into storage for a long time without risk to the environment. About every 20 years, each ship would have to be taken out of the water for an inspection and repainting to assure continued storage. However, this protective storage does not provide a permanent solution. Eventually, permanent disposal would be required.

The alternative to long-term protective storage is to permanently dispose of the defueled, decommissioned submarine. Permanent disposal can be accomplished by burying the sealed reactor compartment in the ground at an existing land disposal site owned by the federal government, or by sinking the entire submarine in the deep ocean in accordance with international procedures. In each case, the best way to permanently dispose of the parts of the submarine that are still radioactive (after the nuclear fuel has been removed) would be to leave them installed in the reactor compartment. This is because the work needed to remove these parts would result in unnecessary radiation exposure to shipyard personnel. Also, the sealed reactor compartment provides a good container for permanent disposal.

LAND DISPOSAL

In the land disposal option, the reactor compartments would be buried at a Federal government (DOE) owned disposal site located either at the Hanford Site in the state of Washington or the Savannah River Plant located in South Carolina. These sites are already being used for disposal of low level radioactive waste. The disposal of the reactor compartments would be consistent with current practice at these sites. The size of the package to be buried would be larger than current practice. Total space requirements for the burial of 100 reactor compartments would be approximately 10 acres.

Other government owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration. The others were either not close enough to navigable waterways or the groundwater at these locations was too near the soil surface. Therefore, if the land disposal option were to be selected, the only practical sites in which to bury the compartments would be at Hanford in the state of Washington or the Savannah River Plant in the state of South Carolina.

The preparation of the reactor compartment for transportation to the disposal site and land burial would utilize techniques already proven and equipment already available. With the ship in dry dock, the reactor compartment would be cut free from the remainder of the submarine. Then the openings into the reactor compartment would be welded shut. The reactor compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. A transporter (Figure 7) would then haul the reactor compartment overland to the burial location. It would be buried in accordance with existing requirements for burial of low level radioactive wastes. Non-radioactive portions of the submarine could be disposed of either by sinking at sea or cutting up for sale as scrap metal.

The Hanford Site is a large federal government site, operated by the U.S. Department of Energy, occupying 570 square miles (365,000 acres) in eastern Washington. The burial ground has over 1000 acres designated for low level waste disposal in the middle of the site on a plateau, about 7 miles from the Columbia River. A Final Environmental Impact Statement on Waste Management Operations at Hanford has been issued. The National Research Council study in 1976 concluded that no measurable harm to human health has resulted from past and present waste disposal practices.

The Savannah River Plant is located in South Carolina, approximately 25 miles southeast of Augusta, Georgia. The plant is a large site, occupying 300 square miles (192,000 acres). The burial ground comprises approximately 195 acres near the center of the site which is located about 7 miles from the Savannah River. A Final Environmental Impact Statement has also been issued for the waste management operations on this site. The National Research Council study in 1976 concluded that no measurable harm to human health has resulted from past and present practices.

There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial, or after burial. This is because radiation outside the reactor compartment would be well below federal limits and the reactor compartment would have been welded shut at the shipyard to prevent entry. Even if the reactor compartment were somehow unearthed after burial, there would be little or no risk. The thickness of the submarine hull and reactor compartment bulkheads would prevent inadvertent entry. As time passes, the radioactivity "decays" away as the radioactive atoms change into nonradioactive atoms. After about 100 years, this radioactive decay would essentially eliminate external exposure to radiation even if someone were to enter the compartment.

In addition to the possibility of external exposure to radioactive material, there can also be a risk to people if the material enters the body through inhalation or ingestion. Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the body. In considering this potential risk, it is important to note that at least 200 years would pass before the reactor compartment bulkhead would be penetrated by corrosion (rust). Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for an additional long period, probably exceeding several thousand years. Corrosion or rusting of the metal inside the reactor vessel could then slowly release the remaining radioactive atoms.

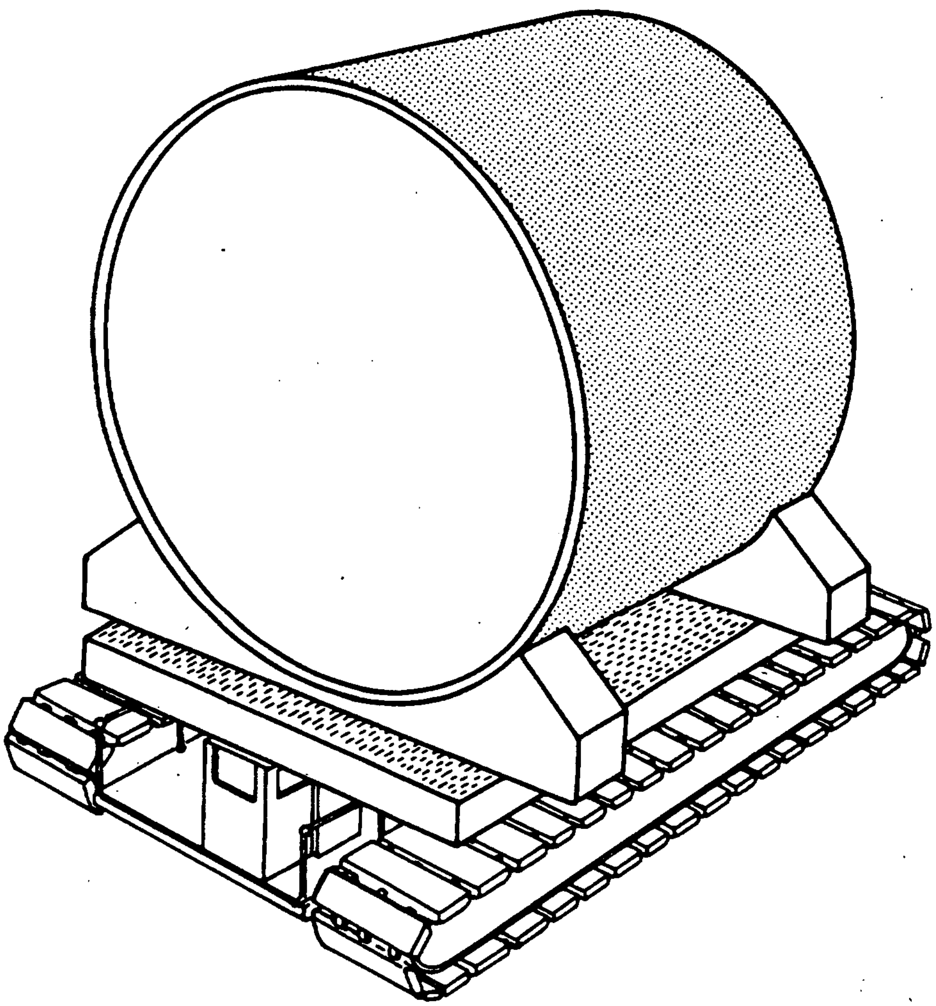


Figure 7. Concept for Land Transporter Movement of Reactor Compartment

An estimate of the amount of radioactive material which might enter the ground at the burial location has been developed. To make this estimate, it was assumed that the ground area would be continuously wet to provide conditions which would promote the most rapid corrosion. It was also assumed that a path was available to carry any radioactive atoms which corroded off the metal into a source of drinking and irrigation water. This is a conservative method to estimate the impact of the radioactivity released at the land disposal site. The result of this calculation showed that even if all 100 reactor compartments were buried at the same disposal site, an average individual living downstream of the burial ground would receive only 0.006 millirem per year of exposure. This is less than one ten-thousandth of the radiation exposure one normally receives from natural background radiation.

Natural background radiation is what all people receive every day from the sun or from cosmic radiation, and from the natural radioactive materials that are present in our surroundings, including the rocks or soil we walk on. The amount of radiation exposure a typical person in the United States receives each year from natural background radiation is 100 millirems. The amount of radiation that a person near the site would receive from land disposal of 100 submarines (0.006 millirem) would therefore be much less than he would receive from natural background radiation. An estimate has also been made for a "worst case" situation using the assumption that in the distant future a person might live and farm right at the disposal site. Even in this extreme case, this person would receive a whole body exposure not more than about 13 millirems per year of exposure.

A perspective on radiation exposure can be obtained by comparing the exposure a person would receive from natural cosmic background radiation if he lived in Denver, Colorado, instead of in New York City (near sea level). The exposure of the person in Denver would be approximately 20 millirems more every year than that of the person in New York. Because Denver is at a higher elevation than New York City, there is more cosmic radiation in the natural background in Denver.

OCEAN DISPOSAL

Locations for possible ocean disposal have not been selected. Locations are described in this statement but these are only study areas chosen to measure currents, biological activity, and other characteristics which are required in estimating the potential effects of ocean disposal. Study areas have been identified in the Atlantic and Pacific Oceans. These areas are typical of any that might be chosen under existing international rules for ocean disposal.

These study areas were selected based on criteria developed by oceanographic experts. The general approach was (1) to avoid areas which produce large amounts of seafood or which are the sources of food for seafood; (2) to avoid areas which are currently used by man for any purpose; and (3) to avoid areas which have potential for future use, such as oil or ocean mining locations. It was also desired to stay within 200 nautical miles of the coast of the United States, since this is the zone of economic control as established in concept under the United Nations Law of the Sea Convention. These criteria led to the examination of areas where very deep water exists and which are beyond the continental shelves. These areas are cold, dark, and tranquil with a sparse population of organisms.

The two Atlantic study areas are situated east of Cape Hatteras, North Carolina, about 200 nautical miles from the closest land point. The depth of the water in each area is between 13,000 and 16,000 feet (2.5 to 3 miles). The Pacific study area is centered approximately 160 nautical miles west of Cape Mendocino, California. The water in this area is between 14,000 and 15,000 feet deep (about 2.7 miles).

The animal life on or near the sea floor in these study areas is very sparse. None of the animals are used by man or form part of a food chain known to lead to man. No commercially exploited minerals are present on the sea floor. There are no plants because sunlight does not reach these depths. Bottom water current measurements indicate that the water movement is slow.

Preparations for ocean disposal would be made at one of the shipyards normally servicing nuclear-powered naval vessels. The reactor vessel would be sealed following defueling, and the reactor compartment would be sealed.

The submarine would be towed to the disposal location and sunk in a controlled flooding operation. When the submarine comes to rest on the ocean bottom, it would be intact. The additional containment of radioactive material provided by the intact reactor compartment is not crucial to the safety of the sea disposal option. This is because almost all of the radioactive material is also contained within the thick pressure vessel and is an integral part of the metal components.

Over a period of time, radioactive material would be released as the submarine slowly rusts away. Since the radioactive atoms inside the sealed reactor vessel are in turn inside the sealed reactor compartment, many years would elapse before these atoms are released to the water. Because of this delay, most of the radioactive atoms within the metal would have changed to nonradioactive atoms before corrosion could free them from the metal.

The nonradiological effects of disposal of these submarines would be similar to those associated with the sinking of surplus ships that are not nuclear powered. The disposal sites for nuclear submarines would be even deeper and more remote from land than sites used for surplus ships.

To evaluate the radiological effects, it was assumed that 100 submarines were sunk at a single location at a rate of three ships per year. These ships were then assumed to corrode and release radioactive materials to the ocean. The transport of radioactive material through the oceans included the effects of ocean currents, eddies, and water temperature and density variations, mixing in the water layers nearest the bottom, settling out of particles through the water column, etc.

The possible radiation exposure to members of the general public was calculated using realistic assumptions. The calculation was then repeated using very conservative assumptions; for example, that all the rusted particles were carried off by the water and none of them settled to the bottom.

The calculation using realistic assumptions gave a result of 0.000000000006 millirem per year of exposure to the typical affected person. For example, this person is assumed to eat all of his seafood from ocean fish caught at the fishing ground nearest the disposal site. This radiation exposure is approximately 0.06 trillionth of the average annual exposure to background radiation. The calculation using the very conservative assumptions gave a result of 0.0002 millirem per year of exposure, or approximately 2 millionths of normal exposure to background radiation.

To provide a "worst case" calculation, it was assumed that at some time in the future a person might eat a very large amount of seafood (145 pounds a year) all of which had somehow been caught right at the deep ocean disposal site. Even with this hypothetical shortcut of the food chain, this person would receive a whole body exposure of only 2 millirems per year of exposure. This is not considered to be an actual consequence of sea disposal but has been included to show that even a hypothetical short cut in the food chain would not result in significant exposure to any individual.

Exposure to individuals of other nations would be less than the exposures for persons living in the United States because the shortest distances to the location of people or fishing areas have been used in the calculations and the important exposure pathways have been included.

Although there is no technical basis for expecting that retrieval or further containment of an ocean-disposed submarine would ever become necessary, methods for doing so have been examined and found to be technically feasible. They are described in Appendix M.

PROTECTIVE STORAGE FOLLOWED BY LAND OR SEA DISPOSAL

If the submarine were kept in protective storage for years, this would delay the time at which a decision needs to be made between land burial or ocean disposal. However, protective storage is not a permanent solution. The submarine would eventually deteriorate at the floating storage site.

The potential radiation exposure to members of the public would not be significantly changed by protective storage—even if disposal were delayed for several decades. Ultimately the submarine must be disposed of by land burial or by sinking in the deep ocean. Whether the submarine is placed in protective storage or disposed of immediately, the containment provided by the hull and reactor compartment bulkheads would prevent the release of radioactivity until most of the radionuclides have decayed to stable atoms. Thus there would be no significant difference in the radiological exposure to the public.

COMPARISON OF DISPOSAL METHODS

The potential impacts on the environment from the permanent disposal of nuclear-powered submarines have been examined for each option. These impacts include the use of resources such as land or materials, the impact on animals or the ecology, the radiological effects on the general public or on shipyard workers, and the relative costs.

Permanent disposal by land burial requires considerably less space than ocean disposal. About 0.02 square mile (10 acres) would be required for land burial of 100 reactor compartments while ocean disposal of 100 submarines would require as much as 100 square miles. The larger area for ocean disposal assures that no submarine would fall on another already placed on the bottom. Additional area would be required for protective storage at a naval facility if permanent disposal were delayed, but this resource commitment would not be permanent.

One other resource commitment would be the loss of the metal in the submarine or part of it which is disposed. In ocean disposal as much as approximately 4000 tons of metal would be placed into the ocean for each submarine. In land disposal, one option would be to bury the approximately 1000 tons of the reactor compartment metal and salvage the rest of the metal. However, as seen later, it costs more to salvage the remaining 3000 tons of metal than the metal is worth as scrap. Thus, in the other option for land disposal, the remaining 3000 tons would be disposed of by sinking in the ocean while the reactor compartment would be buried on land.

The impacts on animals or the ecology would be small for either land or sea disposal. In land disposal, it is not likely there would be any effect on animals. In ocean disposal, it might be expected that the distribution of life in the localized area would be altered by sea life seeking shelter near the hull.

Preparations for either land or sea disposal would cause some amounts of noise and smoke or fumes from cutting or welding operations at the shipyards. However, this would be indistinguishable from other work at the shipyards.

The radiological exposures were reviewed above and are summarized in Table 1. These are listed for the year in which the largest impact on man would occur. This time would not occur until after 100 submarines had been disposed of and significant corrosion (rusting) had taken place. Even for this situation, however, it is seen that the radiological exposure is small and would have little impact on individuals or the population.

TABLE 1. RADIATION EXPOSURE OF A PERSON DURING YEAR OF LARGEST IMPACT

Option	Exposure
Land Disposal — 100 Reactor Compartments	0.006 millirem (conservative estimate)
Sea Disposal — 100 Submarines	0.0002 millirem (conservative estimate)
For Comparison	
One round trip airline flight Los Angeles to New York	1.9 millirem

An additional perspective on these very small exposures is obtained by comparing them to the radiation exposure received by an individual during a single round trip flight from Los Angeles to New York. During such a flight, a person receives more radiation from cosmic sources since he is at higher elevations where the atmosphere is less dense. Regardless of the option chosen, the potential exposure from the disposal of 100 reactor compartments at one location would be significantly less than one round trip flight.

Another viewpoint on the radiological impact can be made by comparing possible health effects due to the low level radiation from land or sea disposal with the possible health effects due to radiation received while watching television at home. Using an average exposure rate of 0.5 mrem per year to the gonads due to television viewing (NCRP Report #56, 1977) and a health effect correlation of one additional cancer case per 2200 man rem of exposure (Reference 4.15 of Chapter 4), an average of 0.023 additional cancer incidents can be expected each year, per one hundred thousand people who view television. Table 2 shows the comparison between the health effects of television viewing vs. land or sea disposal. As seen in Table 2, the potential health effects from either land or sea disposal of 100 submarines would be much less than the health effects caused by viewing television. Certainly the health effects from viewing television are not significant when compared to the approximately 300 cases of cancer per one hundred thousand people caused each year by other effects.

TABLE 2. COMPARISON OF HEALTH EFFECTS— YEAR OF LARGEST IMPACT

100 Submarine Reactor Compartments	Health Effects Per One Hundred Thousand People
Land Disposal	0.0003 (conservative estimate)
Sea Disposal	0.000009 (conservative estimate)
For Comparison	
Average television viewing for a year	0.023
Cancer cases normally experienced in a year	300

Based on these comparisons, either land or sea disposal of nuclear submarine reactor plants would have no significant radiological effect on man. Although small radiation exposures to the public have been conservatively estimated for both of the disposal options, the actual exposure to the public from either option would probably be zero.

Another impact which was considered is the occupational radiation exposure that would be received primarily by shipyard and Navy personnel. Individual exposure or total group exposure would be larger than the exposure of the general public but would be well within occupational limits for such work. Without protective storage, either land or sea disposal would result in a total occupational exposure of less than 18 man-rem per disposal. With protective storage, an additional total occupational exposure of approximately 3 man-rem would be received by these workers. In all cases, the occupational exposure for any individual worker would be consistent with other shipyard work.

Cost estimates have been prepared for the various cases and are listed in Table 3. Comparing the two land disposal options, it is seen that it would cost about $6 million more per submarine to salvage the remainder of the submarine after burying the reactor compartment than to sink the remainder. This is because it would cost much more to prepare the ship for salvage than would be recovered in salvage value (about $0.3 million) after the reactor compartment was removed.

TABLE 3. ESTIMATED COST TO DISPOSE OF ONE SUBMARINE (1981 Dollars)

	Bury Reactor Compartment and Salvage Remainder of Submarine	Bury Reactor Compartment and Sink Remainder of Submarine at Sea	Sea Disposal of Entire Submarine
20 Years of Protective Storage Before Disposal	16.2 million	10.2 million	8.4 million
Immediate Disposal	13.3 million	7.2 million	5.2 million

Extended protective storage before permanent disposal would increase the cost of disposal by approximately $3.0 million per submarine. Even this additional $3.0 million, however, would not cover the costs that might occur if new facilities for floating storage were required or extensive maintenance were needed during the storage period.

If the Navy decided to pursue ocean disposal, it could not lead to immediate implementation of this option, since additional administrative actions would be required. In accordance with the Marine Protection, Research and Sanctuaries Act, a permit from the U.S. Environmental Protection Agency would be needed. This means that the Environmental Protection Agency would have to proceed through their public decision-making process for evaluating and designating an appropriate sea disposal site.

In December, 1982, shortly after the Navy issued the Draft Environmental Impact Statement, an amendment to the Marine Protection, Research and Sanctuaries Act was included in legislation passed by the Congress. This amendment limited EPA's authority to issue permits for ocean disposal of radioactive wastes for two years except for research purposes. After this period expires, the amendment establishes a requirement for preparation of a Radioactive Material Disposal Impact Assessment of any permit requests submitted to the EPA and submission of such an assessment to the Congress. A joint resolution of Congress acting within 90 days of an EPA recommendation is required before the EPA may issue a permit. Further, EPA has stated it may need to revise its ocean disposal regulations.

COMMENTS RECEIVED ON THE DRAFT EIS

The Navy's Draft Environmental Impact Statement was widely circulated and a large number of public comments were received. Over 1500 copies of the statement were distributed to individuals, environmental organizations, State and local officials, and other Federal agencies. Over six months were allowed for interested parties to comment on the Navy Draft Environmental Impact Statement. Over 500 letters were received providing comments. The Navy held four public hearings in different parts of the country at which over 150 people testified.

The great majority of the comments dealt with the ocean disposal alternative. Many respondents were concerned about the possibility that radioactivity would enter the food chain and reach man in harmful quantities. Many people expressed an opinion that not enough was known about the deep ocean ecosystems to be able to adequately predict the environmental consequences of ocean disposal. The Navy's response to these comments was that the worst case analyses in the Draft EIS used many conservative assumptions which resulted in these analyses overestimating the actual environmental impact. The conservative nature of these analyses is corroborated by the demonstrated lack of any significant adverse environmental impact at the sites of the sunken nuclear powered submarines USS THRESHER and USS SCORPION.

A number of respondents expressed concern that the ocean disposal option was irreversible and did not allow for additional containment or retrieval if the submarines were determined to be causing an unacceptable environmental problem. Although the Navy's analysis demonstrated that there was no credible scenario that would require additional containment or retrieval, an appendix has been added which discusses methods which could be used to retrieve a submarine from the ocean bottom or to encase it in concrete on the bottom.

The Navy's ability to adequately monitor submarines disposed of in the deep ocean was questioned by some respondents. This capability exists and has been demonstrated; for example, by monitoring conducted at the THRESHER and SCORPION sites. Sections of the EIS covering monitoring for the ocean disposal alternative have been expanded to describe extensive monitoring of the THRESHER site which was conducted in 1983. Monitoring programs already exist at the land burial sites under consideration.

A number of respondents criticized the Draft EIS for not explicitly evaluating storage of the submarine reactor compartments above ground at an arid site. The Draft EIS did discuss floating storage of the submarine. Both floating storage and above-ground storage methods would only defer the need to make a decision about how to properly dispose of the reactor compartments. Above-ground storage at an arid site would incur essentially the same costs as land burial and provides less protection. Since no significant adverse impacts were identified for either disposal alternative, there is no reason to select above-ground storage over either permanent disposal alternative. Above ground storage is addressed in the Final EIS in Chapter 2.

All of these letters and the transcripts of the public hearings have been reprinted in Volume 2 of this EIS. The Navy's responses to the substantive issues raised in the letters and testimony are provided in detail in Volume 3.

PREFERRED ALTERNATIVE

Based on the research work performed in support of this effort, and review of the comments received as documented in the EIS, the Navy considers that permanent disposal can be performed in an environmentally safe manner. The highly conservative estimates used in conducting the analyses have amply compensated for any uncertainties that may exist in man's knowledge of the impacts of permanent disposal.

The Navy also examined the alternative of continued long-term floating protective storage of the submarine at a Navy facility. This is the "no-action" alternative because it represents the minimum action the Navy must take to ensure that decommissioned submarines are maintained without hazard to people or the environment. Although there would be no adverse environmental impact during storage, this alternative is not a permanent solution since it would require continued action to assure safety. Certain precautions are required for protective storage that are not needed for permanent disposal. These include the need for security measures because of the proximity of the submarines to human activity, the need to protect persons assigned to monitor the vessels, and the necessity to ensure continued acceptable storage conditions. Therefore, storage must be considered a temporary measure which ultimately would have to be followed by some method of permanent disposal to assure that the remaining radioactive material is isolated from human activities.

Since the Navy began its evaluation of disposal options, several developments associated with possible ocean disposal of low-level radioactive waste have occurred. These include Congressional action in December 1982 restricting the issuance of ocean disposal permits and requiring Congressional approval before any such permit may be issued by the EPA. In addition, the EPA has indicated additional regulations may be required before EPA could evaluate a permit request. In view of these and other related uncertainties associated with national acceptance of the ocean disposal option, the Navy considers that allocation of additional funds to pursue this option further is not warranted. Even though the analysis shows less cost for ocean disposal than for land disposal, the funds required to qualify and gain acceptance of an ocean disposal site and the costs of continuing to maintain excessed submarines in storage until ocean disposal was allowed by the Congress and the EPA would serve to narrow the cost differential between the two options.

Based on a consideration of all current factors bearing on a disposal action of the kind contemplated, the Navy's preferred alternative at this time is to dispose of the reactor compartments by land burial. Land burial is the method currently used in the United States for disposal of low-level radioactive waste and this disposal action would comply with existing requirements for use of the Government burial grounds. This approach will allow permanent disposal of this form of low-level radioactive material to proceed with no unacceptable environmental impacts. With most of the submarines to be decommissioned on the West Coast of the United States, it is expected that the Government burial ground to be used in the near future will be the low-level radioactive waste disposal site at Hanford in Washington State.

CHAPTER 1

PURPOSE AND NEED FOR ACTION

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CHAPTER 1

PURPOSE AND NEED FOR ACTION

This final environmental impact statement (FEIS) describes the options for the permanent disposal of a defueled, decommissioned nuclear-powered submarine. The options examined are disposal of the reactor compartment at an existing land burial site, with the non-radioactive remainder of the submarine disposed of either by sinking at sea or by cutting up for sale as scrap metal, and disposal by sinking the entire submarine in the deep ocean. The alternative of long-term protective storage followed by land or sea disposal is also examined. Although the U.S. Department of the Navy has not decided to dispose of any submarines at this time, the nuclear submarines commissioned in the 1950's and early 1960's are approaching their design life and this statement has been prepared to allow enough time to decide on the best disposal method. This FEIS provides the information necessary to assess the impact of each available course of action and will serve as the basis for making a decision on the method to be used.

I. REACTOR PLANTS TO BE DISPOSED OF

A. NUMBER OF REACTOR PLANTS AND TYPE OF RADIOACTIVITY INVOLVED

The U.S. Navy currently operates approximately 120 nuclear submarines. As a submarine reaches the end of its service life, it becomes more difficult to maintain and operate. At some point, the cost of continued operation is not justified by the ship's military capability. The general subject of this Environmental Impact Statement is the disposal of the reactor plants from these ships and others added in future years, after they are eventually retired from service, decommissioned, and declared excess. The most immediate concern, and the action to which this statement is directed, is the disposal of the reactor plants from the approximately 100 nuclear submarines that may be decommissioned during the remainder of this century. The expected growth in number of decommissioned submarines over this time is shown on Figure 1-1. The Navy has made no decision to dispose of any submarine at this time, but this statement is being prepared so that disposal

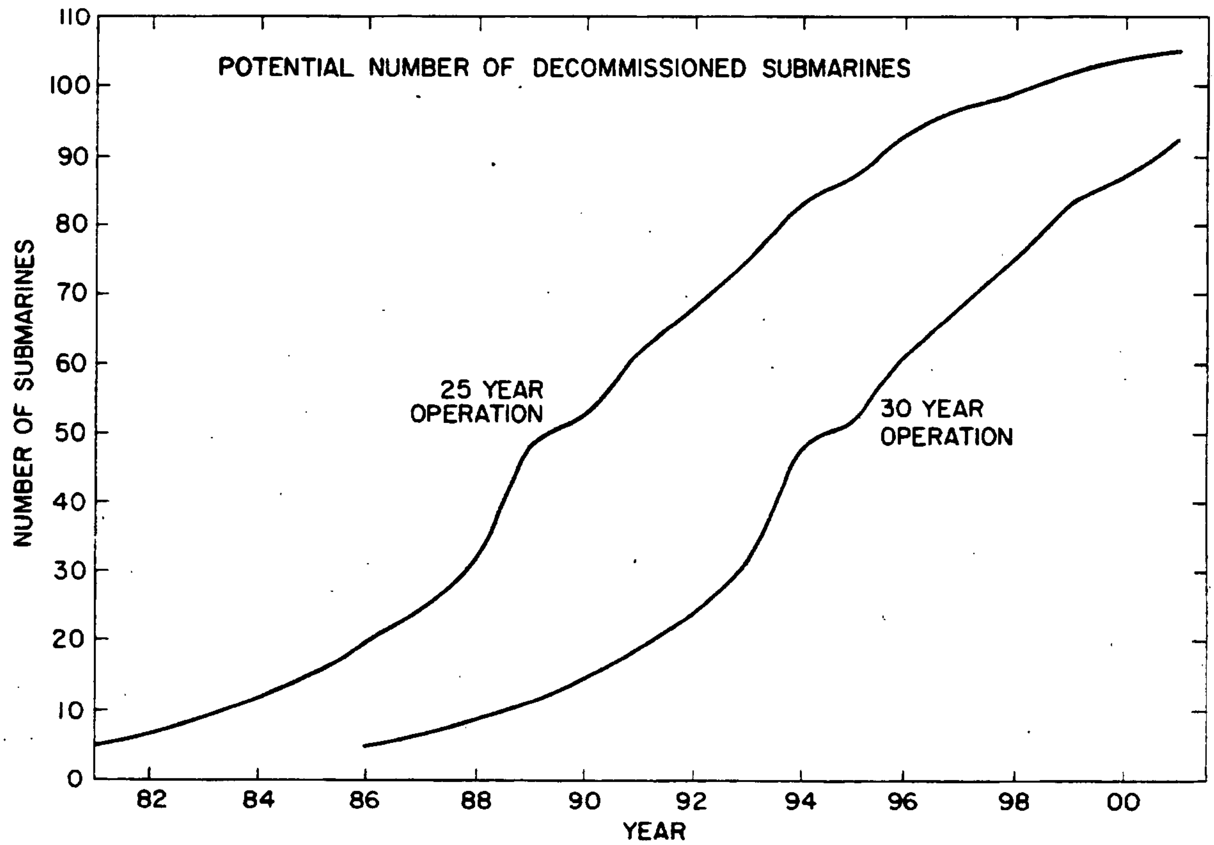

Figure 1-1. Number of Decommissioned Submarines vs. Time, To End of Century (Based on Either 25 or 30 Years of Operation)

methods can be identified and evaluated well in advance of any need. A submarine would not be assigned for disposal by the Navy unless and until an evaluation had shown that no future Naval use could exist for it.

Before a ship is decommissioned, all of the nuclear fuel (uranium) is removed. This defueling also removes the radioactive fission products from the reactor plant since they are contained within the fuel. The fuel is shipped by the Department of Energy from the refueling shipyard to its facilities in Idaho. The shipment is performed under requirements of the Department of Transportation, the Nuclear Regulatory Commission, and the Department of Energy. The fuel is processed in the same manner as other expended nuclear fuel. However, after defueling there remain portions of the reactor plant that are still radioactive; these must be disposed of in a way that will have a negligible impact on the environment.

There are several different design classes of nuclear submarines and a number of different reactor plant designs have been employed in the submarines. Each reactor plant has been or will be operated over different lifetimes and at somewhat different average power levels. To simplify the presentation of the radioactivity information while maintaining an accurate description of the amounts involved, one particular reactor plant has been selected to be typical of all. The plant selected is used in a large majority of the submarines, and its operating lifetime and average power level have been chosen to give a maximum radioactivity inventory for the type of reactor installed. It is therefore the most typical representative of all the reactor plants to be disposed of, and has a radioactivity inventory greater than the average of all reactor plants and one that is not significantly different from the absolute maximum of all the plants. The initial amounts of radioactive material remaining in a submarine after all fuel has been removed are provided in Table 1-1. The inventory is shown for both the earliest practicable disposal time, which is six months after final shutdown of the reactor, and after 100 years of radioactive decay.

Of the radioactive material that remains in the submarine, 99.9 percent is an integral part of the structural alloys forming the plant components (See Appendix G, Table G-1). The radioactivity was created by neutron irradiation of the iron and alloying elements in the metal components during operation of the ship. The predominant radioactive nuclide present is Cobalt-60, which decays by a factor of two every 5.3 years. As shown in Table 1-1, there are a total of 16 different radioactive nuclides, and the initial amount of radioactive material is approximately 62,000 curies. The only mechanism for release of this radioactivity to the environment would be through corrosion of the metal components of the reactor plant. Most of the radioactive nuclides would have decayed to stable atoms before they could possibly be released to the environment by the slow corrosion process. Figure 1-2 shows the relation between the total amount of radioactivity remaining in the submarine and the time after final reactor operation.

The remaining 0.1 percent of the radioactive material that remains in the decommissioned submarine is corrosion product activity (referred to as "crud") that was deposited as an adherent film on interior surfaces of the reactor pressure vessel, primary piping, pumps, and steam generator during reactor operation. Most of this tightly-adherent deposited activity (about 60 percent) is on surfaces within the reactor pressure vessel, which contains all but a few tenths of one percent of the radioactivity that is within metal components. Therefore, 99.7 percent of the total radioactivity would be contained within the reactor pressure vessel, which is a steel container several inches thick and capable of being completely sealed. As will be described in detail in Chapter 2, "Alternatives", the entire nuclear reactor is further contained in a separate submarine compartment enclosed by the ship's pressure hull and the compartment's two bulkheads.

Radioactive nuclides other than those shown in Table 1-1 are not present in quantities of one millicurie (10^{-3} curie) or more. However, since it is not possible to be certain that traces of nuclides such as Strontium-90, Cesium-137, and Plutonium-239 are absent from the corrosion deposits on the interior walls of reactor components, estimates have been made of the maximum effect of one millicurie of each of these nuclides. The maximum effects are not large enough to influence any of the total estimated radiation exposures that are based solely on the 16 nuclides of Table 1-1. Therefore it is judged that trace quantities of nuclides not included in Table 1-1 have been adequately accounted for in this statement and are not considered further.

The measurement of radioactivity in disintegrations per second or curies (as in Table 1-1 and Figure 1-2), does not adequately convey the potential radiation hazard of a mixture of nuclides because of the varying forms and amounts of energy associated with each disintegration. For example, Cobalt-60 (which is not only the principal gamma emitter but also a relatively rapidly-decaying nuclide) emits highly penetrating energetic gamma radiation, Chromium-51 emits relatively low energy gamma radiation, while Nickel-63 emits no gamma radiation, only beta particles, which would be essentially harmless to humans unless the nuclides

TABLE 1-1. RADIOACTIVITY[1] BY INDIVIDUAL RADIONUCLIDE PRESENT IN TYPICAL DECOMMISSIONED REACTOR PLANT SIX MONTHS AFTER FINAL REACTOR SHUTDOWN AND 100 YEARS LATER

Radionuclide	Co-60	Ni-63	Fe-55	Co-58	Cr-51	Mn-54	Ni-59	Fe-59
Half-life (years)[7] from Reference 1.1	5.27	100	2.69	0.19	0.076	0.85	75,000	0.12
Radiation Emitted[2]	gamma and beta$^-$	beta$^-$ only	X-rays	X-rays, beta+ and gamma	X-rays, beta$^-$ and gamma	X-rays, gamma	X-rays	gamma and beta$^-$
Maximum Energy per Disintegration (MeV), from Reference 1.1.	2.82	0.067	0.232	2.31	0.75	1.38	1.07	1.57
Prominent Gamma Energies (MeV), from Reference 1.1	1.17 1.33	None	Continuous I.B.* to 0.22	0.51 0.81	0.32	0.84	Continuous I.B.* to 1.06	1.10 1.29
Resulting Stable Nuclide	Ni-60	Cu-63	Mn-55	Fe-58	V-51	Cr-54	Co-59	Co-59
External Exposure Hazard[3] per Curie, Relative to Cobalt-60	1.00	0	<0.01	0.39	0.02	0.33	<0.01	0.48
Internal Exposure Hazard[4] per Curie, Relative to Cobalt-60	1.00	0.92	0.09	0.35	<0.01	0.18	0.35	0.83
Initial Radioactivity (curies)[5] [6]	2.2×10^4	1.8×10^4	1.7×10^4	3.2×10^3	1.0×10^3	6.5×10^2	1.2×10^2	5.1×10^1
Radioactivity after 100 years (curies)	4×10^{-2}	9×10^3	—	—	—	—	1.2×10^2	—

Total initial curies: 6.2×10^4 all nuclides

*I.B.—Inner Bremsstrahlung (see Glossary).

TABLE 1-1 (Cont'd)

Radionuclide	Zr-95 Nb-95	C-14	S-35	Sc-46	Hf-181	Nb-94	Mo-93	Tc-99
Half-life (years)(7)	0.18	5730	0.24	0.23	0.12	20,300	3500	214,000
Radiation Emitted(2)	$beta^-$ and gamma	$beta^-$ only	$beta^-$ only	$beta^-$ and gamma	$beta^-$ and gamma	$beta^-$ and gamma	X-rays	$beta^-$ only
Maximum Energy per Disintegration (MeV), from Reference 1.1.	2.04	0.156	0.167	2.37	1.023	2.06	0.42	0.29
Prominent Gamma Energies (MeV), from Reference 1.1	0.72 0.76 0.77	None	None	0.89 1.12	0.13 0.35 0.48	0.70 0.87	Continuous I.B.* to 0.37	None
Resulting Stable Nuclide	Mo-95	N-14	Cl-35	Ti-46	Ta-181	Mo-94	Nb-93	Ru-99
External Exposure Hazard(3) per Curie, Relative to Cobalt-60	0.30	0	0	0.76	<0.01	0.67	0.03	0
Internal Exposure Hazard(4) per Curie, Relative to Cobalt-60	<0.01	0.12	0.55	<0.01	<0.01	0.03	0.04	0.01
Initial Radioactivity (curies)(5)(6)	1.04	1.0	4.5×10^{-1}	3.9×10^{-1}	1.2×10^{-1}	8.2×10^{-2}	1.3×10^{-2}	3.6×10^{-3}
Radioactivity after 100 years (curies)	—	1.0	—	—	—	8.2×10^{-2}	1.3×10^{-2}	3.6×10^{-3}

*I.B.—Inner Bremsstrahlung (see Glossary).

TABLE 1-1 (Cont'd)

NOTES: (1) Radioactivity values are the maximum predicted values (worst case) for the most representative reactor plant.

(2) X-rays — emitted when nucleus captures an orbital electron
gamma — emitted from nucleus accompanying most beta emissions
$beta^-$ — electron emitted from nucleus
beta+ — positron emitted from nucleus

(3) Based on Appendix I, Table I-6, Surface Dose Rate Conversion Factors (Total Body).

(4) Based on Appendix I, Table I-4, Adult Ingestion 70 Year Dose Commitment Conversion Factors (Total Body).

(5) One curie of activity produces 3.7×10^{10} disintegrations per second.

(6) The initial radioactivity is defined to be the amount present six months after final reactor shutdown, which is the shortest time in which the disposal could be accomplished. All radionuclides with an initial activity $\geq 1 \times 10^{-3}$ curie are included.

(7) With the exception of Figure 1-2, the half-life values used in radioactive decay calculations in this statement are the same as in the Draft EIS. In the Draft EIS, the half-life values for the following radionuclides were slightly different than those above: Co-60, 5.26 years; Ni-63, 92 years; Fe-55, 2.60 years; Co-58, 0.20 years; Mn-54, 0.83 years; Ni-59, 80,000 years; Nb-94, 20,000 years; and Tc-99, 212,000 years. Those not listed were the same in the Draft EIS as in this statement. Changes to the calculated radioactive decay were not necessary because they would have no significant effect on the results.

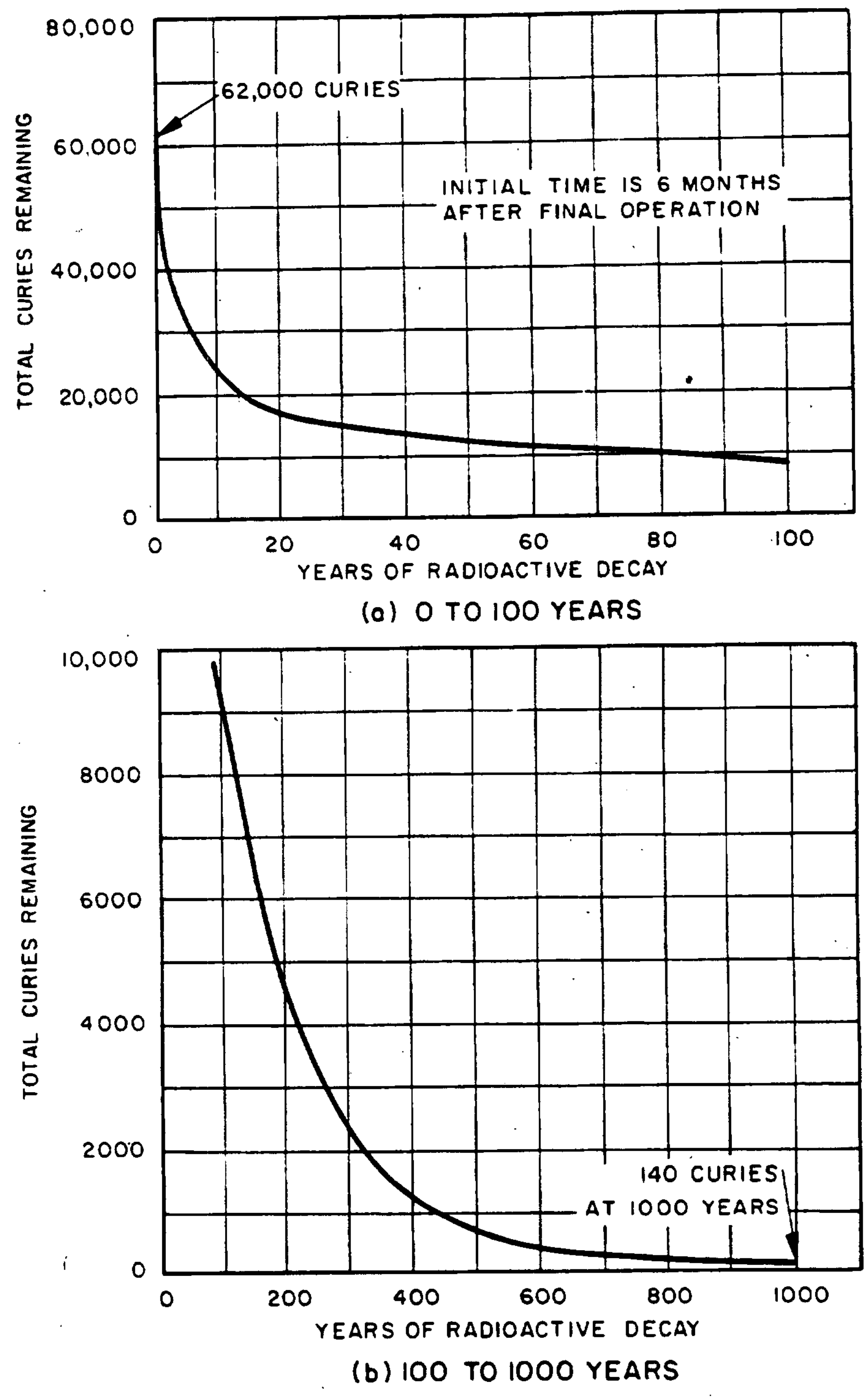

Figure 1-2. Total Radioactivity Present in One Decommissioned Reactor Plant vs. Time After Final Operation

were ingested or inhaled. To show the relative importance of each curie of activity in Table 1-1, entries are included for each nuclide, showing how each compares with Cobalt-60, the predominant nuclide. Both external hazard and internal hazard are shown. Section II of this chapter describes these two general categories of radioactivity hazard.

B. HEAT GENERATION

The radiation from the activated structural components produces a total thermal power of less than 800 watts at six months following final reactor operation. This is approximately the amount of heat given off by a small hair dryer, with the heat distributed over many tons of metal. This heat generation rate is primarily caused by Cobalt-60. Therefore it will decrease with approximately the same time dependence as Cobalt-60; for example, it falls to a rate of less than 400 watts after a period of about 5.3 years, and to less than 200 watts after about 10.6 years. A heat generation rate of this magnitude is not sufficient to cause any significant effects as far as long-term radioactive material release is concerned. The effect of such heat generation is considered, however, in the use of the reactor compartment as a shipping container (Appendix B).

C. NEED FOR SPECIAL PROCEDURES

Special procedures must be used during the disposal of the reactor plant of a nuclear-powered ship to prevent uncontrolled radiation exposure to the general public and to workers participating in disposal operations. The potential for inadvertent exposure remains until the radioactive components are finally placed in a permanent disposal site.

Even after permanent disposal, there would remain a small potential for future radiation exposure to individuals from long-lived radioactivity that eventually may be released to the environment. This statement provides estimates of the potential radiation exposure associated with each of the available disposal options.

II. RADIATION EXPOSURE

A. EXTERNAL GAMMA EXPOSURE

There are two general categories of radiation exposure associated with the decommissioned reactor plants. External exposure to gamma radiation is limited to the immediate vicinity of the reactor plant. The principal source of gamma radiation is the Cobalt-60 activity which is relatively short-lived, decreasing by a factor of two every 5.3 years. Hence, in 53 years the initial rate of gamma exposure is reduced by a factor of 2^{10} or about 1000. The exposure rates within accessible areas of the reactor compartment, which would be sealed to prevent entry after disposal, will decrease to about 0.1 mrem per hour after 53 years.

The initially large total number of curies of other nuclides (Table 1-1) has no significant effect on external gamma exposure in comparison to Cobalt-60. For example, the nuclides ranking second and third to Cobalt-60 in initial activity are Nickel-63, which emits a short-range beta particle when decaying to stable Copper-63, and Iron-55, which emits a low energy X-ray when decaying to stable Manganese-55. Other nuclides which emit gamma radiation, such as Cobalt-58 and Manganese-54, are initially present in much smaller quantities of activity than Cobalt-60, and also have shorter half-lives than Cobalt-60. Thus the external gamma radiation decreases with time according to the 5.3 year half-life of Cobalt-60. After about 100 years, the external gamma radiation would be reduced by a factor of more than 100,000 from its initial rate and would thereafter be essentially constant due to the presence of Niobium-94 (20,000 year half-life).

B. EXPOSURE DUE TO INGESTION OR INHALATION OF RADIOACTIVITY

The second general category of radiation exposure is the exposure to radiation from sources that have been taken into the body by ingestion or inhalation. The exposure would occur over the entire period in which the radioactivity remains in the body. For this reason, the term "dose commitment" is used to discuss internal exposure, since the individual would be committed to receiving a dose when the material is ingested or inhaled. The dose would be received until all of the radioactivity has decayed to stable form or left the body. The time period in which the dose would be received would depend on the nuclide's radioactive half-life and on the element's biological half-life.

Because the radioactive material present in the defueled reactor plant is present as a part of the structural metal itself (99.9 percent) or as adherent deposits (crud) on the structures (0.1 percent), it would not be readily available for release to the environment with the subsequent potential for ingestion or inhalation, even in the unlikely event that the material were not securely contained. The radioactive material would be released from the metal matrix only by the slow process of corrosion, a small fraction being released each year. Because of this delay effect, most of the radioactive atoms within the metal matrix would decay to stable atoms before corrosion release could occur. Radioactive nuclides with long half-lives are an exception. In the extreme case of Nickel-59 (80,000 year half-life), relatively little radioactive decay would occur prior to corrosion release. For this reason, Nickel-59 and the shorter-lived Nickel-63 (92 year half-life) represent the principal source of radioactivity with the potential for being released into the environment.

The maximum dose commitment due to intake of radionuclides is estimated by determining the maximum radioactivity (microcuries) that could be ingested or inhaled. This quantity is then multiplied by a "dose commitment factor" (mrem per microcurie) to calculate the lifetime dose commitment (mrems) resulting from that number of microcuries taken into the body. Dose commitment factors and complete information on the dose commitment estimates are provided in Appendix C, "Dose Commitment Estimates, Land Disposal" and Appendix J, "Dose Commitment Estimates, Sea Disposal".

III. MATERIALS OTHER THAN RADIOACTIVE MATERIALS

The following non-radioactive solid materials would be present in the decommissioned submarine's reactor compartment and other compartments: chromium and nickel metal as constituents of structural alloys; cadmium as plating material on certain fasteners; lead as ballast and radiation shielding installed on bulkheads and components; asbestos as thermal insulation on piping and components. These materials would be hazardous or toxic if they were available in a chemical or physical form that could be ingested or inhaled. However, the solid form of these wastes when disposed of would minimize the opportunities for their return to the environment as hazardous material. These materials would also be present in obsolete U.S. Navy ships that are not nuclear powered and such ships may currently be sunk at sea according to regulations of the U.S. Environmental Protection Agency (Reference 1.2). Burial of these materials at land disposal sites would be consistent with normal practice and would be performed in such a way that the end result would be at least as good as other available means for disposing of this material.

No liquids would remain in the reactor compartment or other compartments. The waste would not include materials considered to be ignitable, corrosive, or reactive. Other than the materials described above, the waste would not include materials considered to have the potential to become hazardous or toxic. The combination of any of the materials with water would not produce any consequences other than the slow process of corrosion.

IV. CURRENT STATUS OF DISPOSAL PROGRAM

The Navy's program for disposal of defueled and decommissioned reactor plants is at the stage where the earliest nuclear submarines, commissioned in the late 1950's and early 1960's, are now being taken out of active service. The actual disposal of an inactive ship would not occur until after it had been declared excess. No inactive nuclear submarine has as yet been declared excess and there are no disposals currently planned or scheduled.

Seven submarines, six of which are included in the action described by this environmental statement, have been decommissioned and are in protective storage at naval shipyards: TRITON, decommissioned in 1967; HALIBUT, decommissioned in 1976; ABRAHAM LINCOLN and THEODORE ROOSEVELT, decommissioned in 1981; ETHAN ALLEN and THOMAS A. EDISON, decommissioned in 1983. NAUTILUS, the first nuclear-powered submarine, was decommissioned in 1980 and will be designated an historic ship. The measures used to prepare these ships for inactive status ensure that no radiological concern exists either for Navy personnel, shipyard employes, or the general public. These ships can remain in protective storage for an indefinite time without hazard to the environment.

Additional submarines are expected to be placed in protective storage in 1984. During the remainder of the decade 1980-1989, it may be expected that an average of three additional nuclear submarines will be decommissioned each year. Thereafter an average of at least five decommissionings per year are expected based on the number of ships reaching retirement age (25 or 30 years) as shown on Figure 1-1.

Although, as noted above, a decommissioned submarine can be placed in protective storage for some period prior to ultimate disposal of the reactor plant, it is more efficient in terms of shipyard work and dry-dock time (and resulting costs) to perform all of the pre-disposal work during the period that the ship is in dry dock for the defueling and decommissioning work and then accomplish the disposal, because a number of inactivation tasks can therefore be eliminated (e.g., ensuring that the ballast tanks cannot accidentally flood during the protective storage period), as well as the routine work required during storage.

A decision on ultimate disposal of the reactor plants is needed in the near future to avoid costs that may be unnecessary and to avoid a large backlog of ships that must be processed for disposal at a later time. Storage space at inactive ship facilities is limited, and by 1990 action would be required to dredge additional piers and repair other piers. This would add appreciably to the cost of protective storage. To avoid the buildup of a large backlog of ships, the possibility of employing some combination of the two permanent disposal options has been considered and would appear to be acceptable if needed. For example, if the sea disposal option were preferred but was unavailable for some period of time, land disposal could be employed for a selected group of ships to be permanently disposed of.

Overall costs for delayed disposals will not decrease even though radioactive decay will reduce the radiation levels and the quantities of radioactive material present in each plant. The costs of protective storage followed by ultimate disposal are estimated to be about $3.0 million per ship more than immediate ultimate disposal. Details of estimated costs are provided in Appendix A, "Cost Analysis".

The options for ultimate disposal are discussed in the next chapter.

V. REFERENCES

1.1 Lederer, C. Michael, Virginia S. Shirley, ed., "Table of Isotopes," Seventh Edition, John Wiley and Sons, Inc., New York. 1978.

1.2 Code of Federal Regulations, Title 40, "Protection of Environment", Part 229.2.

CHAPTER 2

ALTERNATIVES

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CHAPTER 2

ALTERNATIVES

After a defueled and decommissioned nuclear submarine has been placed in the excess category, two general alternatives are available. These alternatives are: (1) disposal with a minimum of delay or (2) disposal after an extended period of protective storage. Even after an extended period of protective storage, the quantity of radioactive material remaining in the reactor plant would require permanent disposal. The alternative of disposal with minimum delay would accomplish the objective of safe, permanent, and environmentally acceptable removal of the radioactive material from human activities, without additional storage costs and without placing the responsibility for disposal on a future generation. The radiological impact on the environment would be comparable for either alternative, since no significant exposure to the public would occur in either case.

Two practical options exist for the safe and permanent disposal of radioactive nuclear reactor plants. One disposal option is to bury the ship's reactor compartment as low level radioactive waste at an existing Federal land disposal site, with the non-radioactive remainder of the submarine disposed of either by sinking at sea or by cutting up for sale as scrap metal. The second disposal option is to place the entire ship on the deep ocean bottom (greater than 13,000 feet) at a site considered acceptable for such disposal. Either of these options would be carried out in a manner that would provide containment of the radioactive material in the reactor plant and isolation from human activities.

Figure 2-1 shows a typical submarine with the reactor compartment identified. It is this part of the ship that would be removed and buried in the land disposal option. Figure 2-2 shows a view of the reactor compartment itself, simplified for the purpose of indicating both the location of the radioactive material (99 percent is within the reactor vessel), and the containment provided by the ship's hull and the forward and aft bulkheads of the compartment. Figure 2-3 shows a simplified view of the reactor vessel, empty of fuel but permanently containing the support structure that is the principal source of the radioactivity that remains after the fuel has been removed.

I. THE LAND DISPOSAL OPTION

If the land disposal option were selected, it would be implemented at Department of Energy waste disposal sites within either the Hanford Site in the southeastern corner of the state of Washington, or the Savannah River Plant located on the southern boundary of South Carolina. Such disposal would be identical to current practice, and the magnitude of the radioactivity inventories would be similar to those already being disposed of by land burial. However, the size of the reactor compartment disposals would be significantly larger than current disposal packages. Descriptions of these sites are provided in Chapter 3 with additional details in Appendix B. Other Department of Energy waste disposal sites that were considered for this project are also described in Appendix B.

Final preparation for land disposal of each reactor compartment would be made at a shipyard currently involved in radiological work. These shipyards include U.S. Navy shipyards at Portsmouth, New Hampshire; Norfolk, Virginia; Charleston, South Carolina; Pearl Harbor, Hawaii; the Mare Island Naval Shipyard at Vallejo, California; the Puget Sound Naval Shipyard at Bremerton, Washington; and commercial shipyards at Groton, Connecticut and Newport News, Virginia. The approximate distances from these shipyards to the burial sites, utilizing over-water routes, range from 250 to 6000 miles and may be at sea or through the Intercoastal Waterway on the U.S. East Coast. The disposal action could be carried out at the Department of Energy site on the same coast as the shipyard performing the preparatory work, or the barge loaded with a removed reactor compartment could be towed at an additional cost from one coast to the other.

A. METHOD OF DISPOSAL

Each submarine would have been defueled and decommissioned, with salvageable equipment removed.

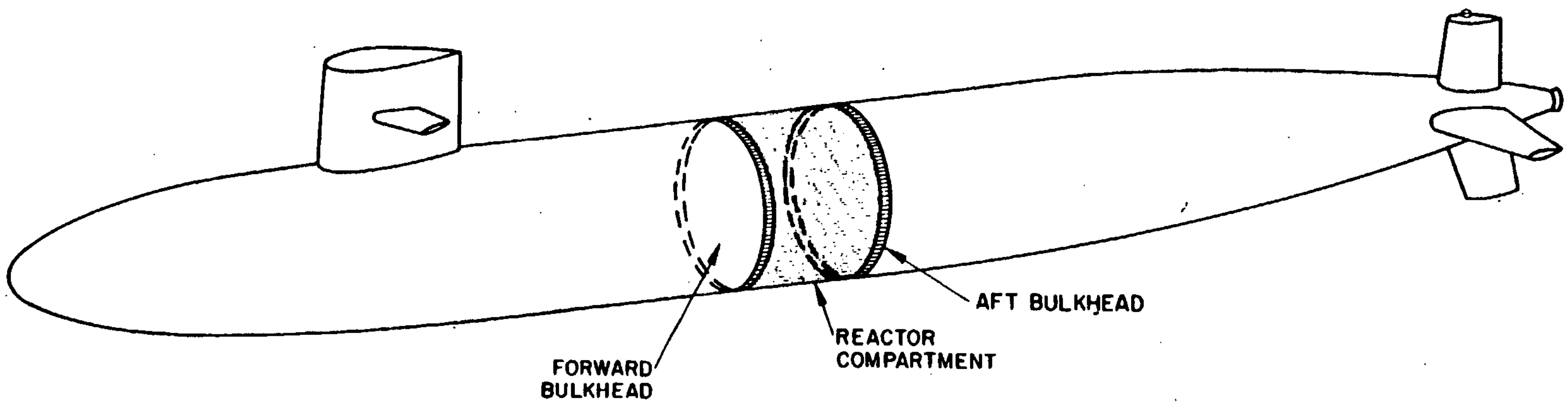


Figure 2-1. Typical Submarine with Reactor Compartment Identified

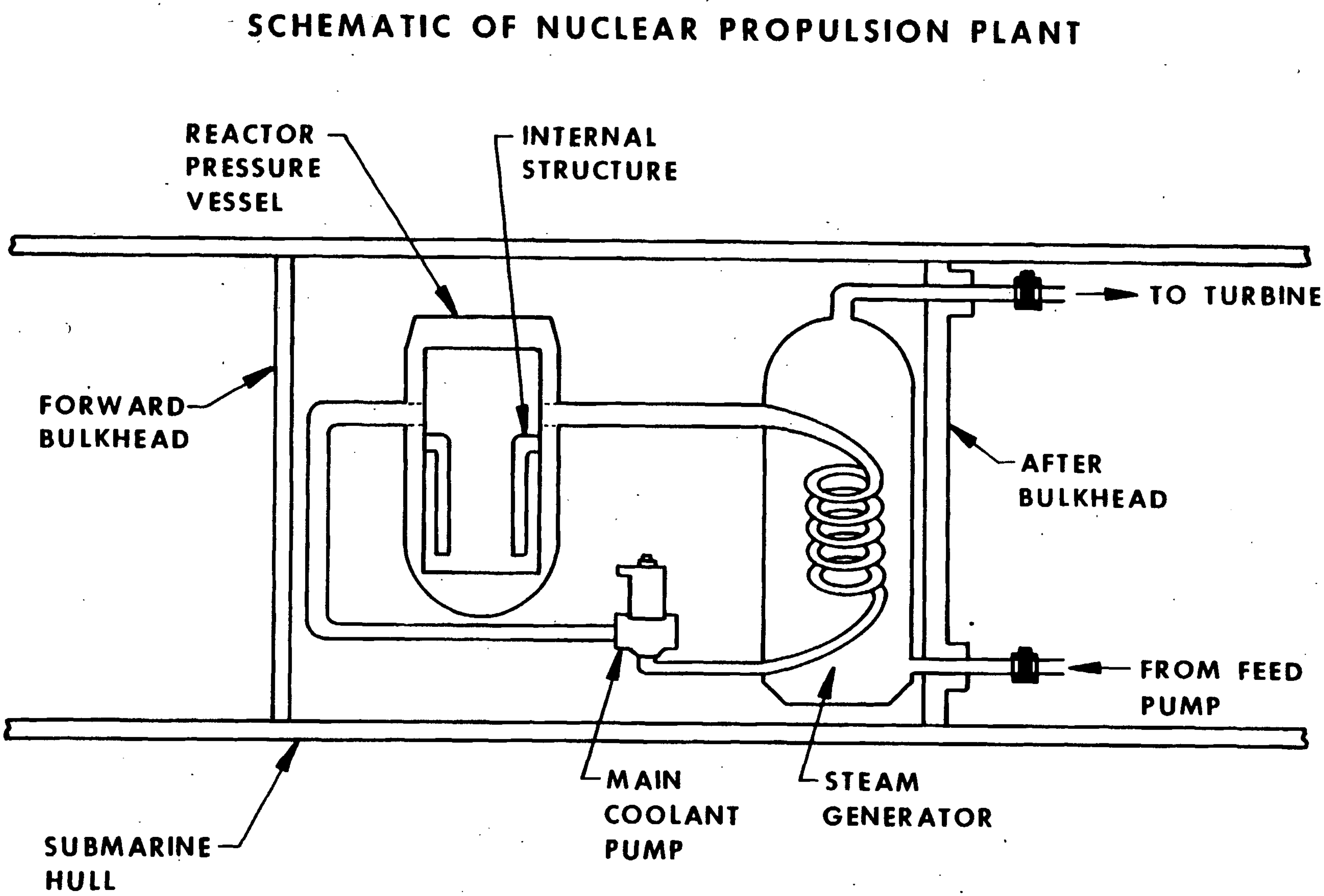


Figure 2-2. Reactor Compartment

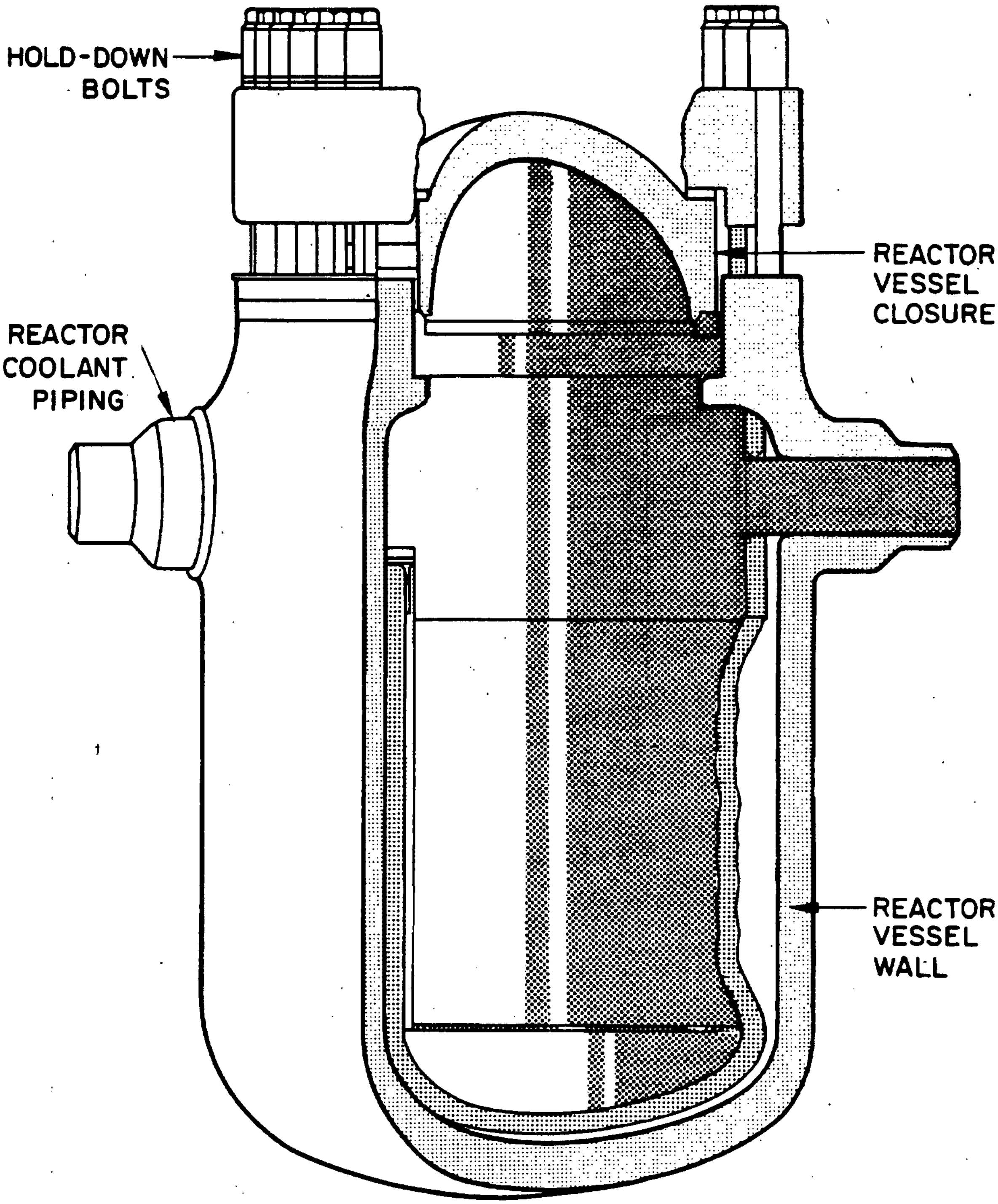


Figure 2-3. Reactor Vessel

With the ship in dry dock, the reactor compartment would be cut free from the remainder of the ship with cutting torches and all hull and bulkhead penetrations sealed by welding (see Figure 2-4). The weight of the reactor compartment in this condition would be approximately 1000 tons or less. Movement of the compartment onto a special purpose barge would be achieved by jacking up and supporting the compartment, placing rollers underneath and pulling the compartment horizontally onto the barge. The load would be welded securely to the steel barge deck for maximum security of the barge load during the trip to the disposal site.

The first part of the trip to the disposal site would be accomplished by towing the barge to the mouth of the Savannah River (South Carolina) or the Columbia River (Washington) using an ocean-going tug. A shallow-draft tug would then be employed to move the barge up the river to a landing site within a few miles of the final disposal site. At the river landing site, the barge would be grounded and the load would be freed from the deck of the barge. The compartment would then be jacked up to permit a crawler transporter to move under the compartment to assume the load and drive off the barge, as shown in Figure 2-5. The transporter would move the compartment overland to the burial ground for unloading in the disposal trench where the transporter would be driven into the trench and the load lowered onto previously prepared supports. After the reactor compartment had been removed from the transporter and the latter driven out of the trench, the trench would be backfilled to cover the reactor compartment with a minimum of four feet of earth at Savannah River and eight feet of earth at Hanford. The radiation level at the surface of the earth cover would be substantially less than the maximum allowable one mrem per hour. Since each two foot thickness of earth cover reduces the exposure rate by a factor of at least 10, the radiation level at the surface would be less than 0.1 mrem per hour.

Total space requirements for the burial of all 100 reactor compartments is approximately 10 acres. Details of the land disposal method are described fully in Appendix B.

B. COSTS

Detailed cost estimates for the land disposal option are provided in Appendix A. For a submarine just removed from active service, the total cost following decommissioning to completion of the burial operation would be approximately $7.2 million, assuming no period of protective storage. For an inactive ship, after 20 years of protective storage and periods of time in dry dock at the beginning and end of the time interval, the total cost would be approximately $10.2 million. Costs associated with missile compartment removal, where required, are not included. The costs cited here are based on the assumption that the remainder of the ship would be sunk at sea. If the hull were to be cut up and scrapped, the total cost per reactor compartment would increase by an estimated $6.0 million as described in Appendix A. Costs are in 1981 dollars.

Land disposal could result in a total occupational radiation exposure estimated to be approximately 17 man-rems for a ship that is disposed of promptly upon being retired from service, and approximately 20 man-rems for a ship which is prepared for interim storage and is disposed of later. For comparison, the occupational exposure limit for a shipyard work force of 200 persons is 1000 man-rems per year and 600 man-rems per quarter-year, with individual exposure limits of 5 rem per year and 3 rem per quarter-year.

C. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS

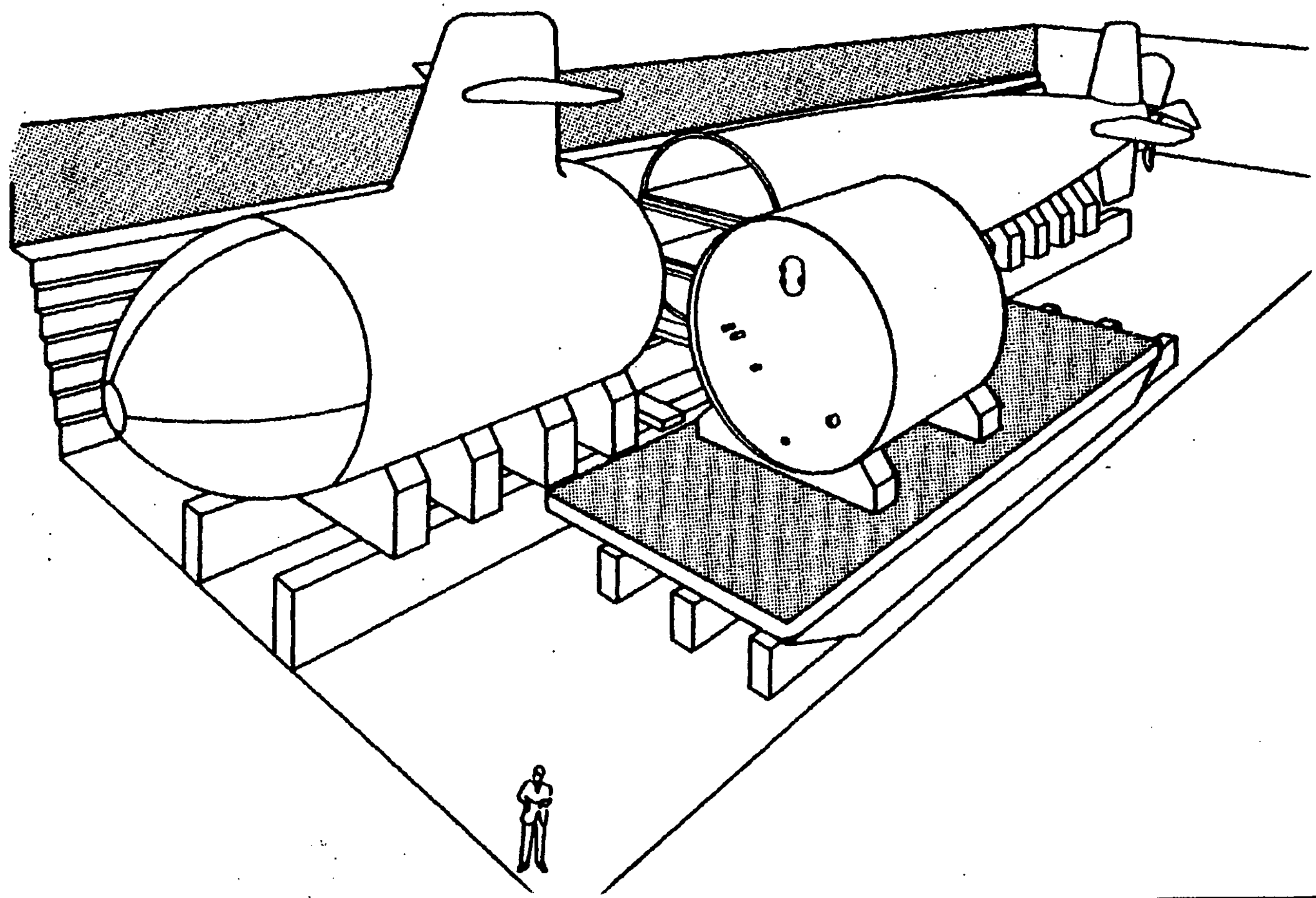
If the land disposal option were selected, the unavoidable adverse environmental effects would be:

1. Usage restrictions for approximately ten acres of DOE disposal site land for 100 reactor compartments.

2. Temporary removal from use of less than two acres of Savannah River site land for the construction of a landing slip at the site.

3. Temporary and minor environmental impacts associated with the construction of the Savannah River landing slip.

4. Temporary changes in river water levels if required to facilitate the passage of the loaded barge.



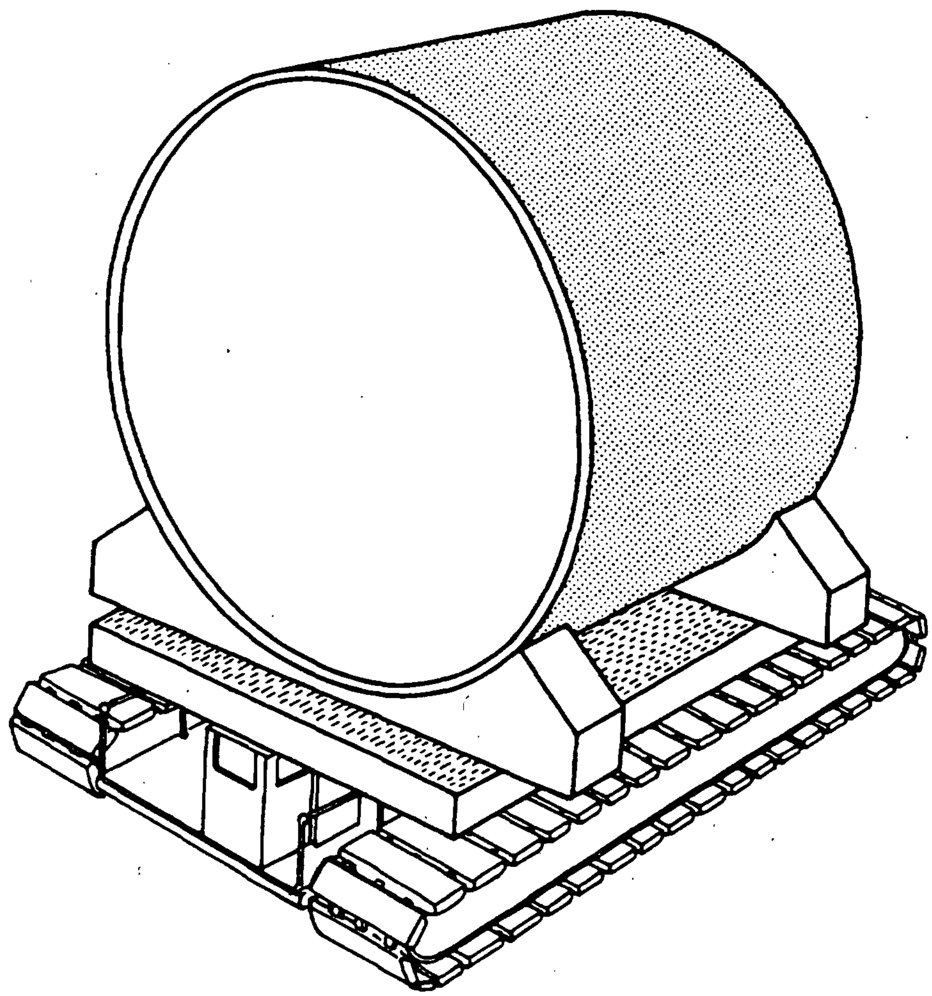


Figure 2-5. Concept for Land Transporter Movement of Reactor Compartment

5. Eventual addition (in several thousand years) to the soil underlying the disposal ground of as much as 120 curies of long-lived radioactivity (principally Nickel-59, with a half-life of 80,000 years) from each reactor compartment.

The population exposure to radiation which might occur has been estimated (Chapter 4 and Appendix C) and would be very small. This is based on a conservative estimate of the release of long-lived radioactive material from all 100 reactor compartments to water supplies after a period of several thousand years, when the reactor vessel containment is assumed to have been eliminated by corrosion. Exposure estimates, described in detail in Appendix C, are as follows:

The total body exposure to an average individual is estimated to be approximately 6×10^{-3} mrem per year from all 100 disposals at the same site.

The maximum total body exposure to a hypothetical "agricultural intruder" at some time in the distant future has been estimated to be less than 13 mrem per year, considering all 100 reactor compartments are buried at the same site.

The population exposure has been estimated to be less than 2.1 man-rems per year from all 100 reactor compartments buried at the same site. This estimate is based on a future population of 350,000 persons in the Savannah River area served by the potentially affected water supply. This population exposure estimate is conservative (high) for the Hanford area.

The potential adverse effects of land disposal are very limited and considered to be negligible. The potential radiation exposure to an average individual, even if all 100 reactor compartments were buried at the same site, would be less than 0.00006 of the normal background radiation.

Appendix L, "Floodplain/Wetlands Assessment," discusses the effects of possible disposal at the Savannah River Plant on floodplain management and protection of wetlands. Significant adverse environmental effects are not expected.

D. MEASURES TO MITIGATE ADVERSE EFFECTS

Even though the potential for adverse environmental effects would be very limited, the following steps would be taken to minimize the radiation exposure potential and land usage effect of the land disposal option. The reactor vessel would be closed and sealed after defueling. The reactor compartment would be welded shut prior to being transported to the disposal site. Department of Energy disposal sites currently used for the disposal of radioactive wastes would be used for the burials to minimize the removal of new land area from unrestricted usage. The reactor compartments would be buried in trenches with at least 10 feet of undisturbed earth between the bottom of the trench and the water table, to minimize corrosion of the containment exterior, and covered with at least four feet of earth. An additional mitigating effect would be provided by the sorptive properties of the soil, which would retard the rate of radioactivity movement from the burial site.

E. RETRIEVABILITY AND INSPECTABILITY

Any or all of the buried reactor compartments could be retrieved if necessary, following removal of the surrounding earth, using methods similar to those used to emplace the compartments. Furthermore, it is reasonable to expect that the compartments would be in condition to be moved for more than 200 years after initial burial. The gamma radiation level of the contents would have decayed to less than 0.1 percent of the initial gamma level by 53 years.

Inspection of the burial sites would be accomplished as a part of the normal monitoring of the existing disposal sites.

Routine inspection of the buried compartments themselves would not be possible, although if desired at some time in the future, it would be possible to inspect a compartment interior by removing the earth cover and cutting open the welded-shut door in either the forward or aft bulkhead. No routine maintenance of the earth cover would be required.

F. ENVIRONMENTAL MONITORING

The environmental monitoring associated with land disposal of nuclear submarine reactor compartments would be the same as the normal program already being conducted by the Department of Energy radioactive waste management operation at the Savannah River Plant (Reference 2.2) or the Hanford Site (Reference 2.3). Monitoring considerations for the disposal of submarine reactor plants are discussed in Appendix K. Extensive monitoring for radioactive material release is already performed at these DOE sites, as described in the respective Environmental Impact Statements (References 2.2 and 2.3) and subsequent review of this effort by the National Research Council (Reference 2.4). These monitoring and review actions have demonstrated that the operations of the low-level waste burial sites had no adverse environmental effects.

G. PERMITS

The land disposal of reactor compartments would be consistent with current practice in which irradiated components in shipping containers are shipped to the Hanford Site and Savannah River Plant for disposal. No new rule making by any agency would be required for transportation or disposal. Department of Transportation certification of compliance with shipping regulations would be obtained for shipment of the compartments and DOE authorization would be obtained for the use of the burial facilities. U.S. Coast Guard authorization would be required for the inland water transportation portion of the disposal action, and U.S. Army Corps of Engineers cooperation would be required in the event that dredging is required. No dredging of the channels is currently foreseen.

H. COMPARISON WITH NRC WASTE CONCENTRATION LIMITS FOR LAND BURIAL (10CFR61)

Table 2-1 shows how the reactor compartment radioactivity concentrations compare with limits established by the Nuclear Regulatory Commission for land burial of low level waste at licensed disposal sites (Reference 2.1). The activity concentrations in the defueled nuclear submarine reactor compartment were calculated by dividing the total activity for each isotope, as shown in Table 1-1 of Chapter 1, by a minimum volume of 400 cubic meters. This nominal volume is somewhat smaller than the actual reactor compartment, and is based simply on a right circular cylinder having a diameter of 30 feet and a length of 20 feet.

The concentrations of all isotopes in the submarine reactor compartments would be less than the least restrictive limits of the proposed regulation except for Nickel-63, which exceeds the "Class A waste" limit by 30 percent. Thus, the disposal package would be in the category of "Class B Waste" and would be required to provide structural stability of the waste in addition to certain minimum requirements of Reference 2.1 on the waste form and its characteristics. The thick steel hull and the very thick steel reactor vessel would provide a very strong burial container which would meet NRC stability requirements.

I. ADVANTAGES AND DISADVANTAGES OF THE LAND DISPOSAL OPTION

The land disposal option's advantages and disadvantages may be summarized as follows:

1. Advantages

a. Complete control exists over the disposal package for an indefinite time. Any or all of the buried reactor compartments could be retrieved, if necessary. The compartments would be in condition to be moved for at least 200 years after initial burial.

b. No new regulations by any agency would be required for transportation or disposal.

TABLE 2-1. NUCLIDE CONCENTRATIONS vs CONCENTRATION LIMITS FOR LAND BURIAL OF LOW LEVEL WASTE (10CFR61)

Nuclide (or Isotope)	Concentration in Reactor Compartment (Curies per cubic meter)	Concentration Limits (Curies per cubic meter)		
		Class A Waste	Class B Waste	Class C Waste
Cobalt-60	55	700	no limit	no limit
Nickel-63 in activated metal	45*	35	700	7000
Carbon-14 in activated metal	2.5×10^{-3}	8	8	80
Nickel-59 in activated metal	0.3	22	22	220
Niobium-94 in activated metal	2.1×10^{-4}	0.02	0.02	0.2
Technetium-99	9×10^{-6}	0.3	0.3	3
Any with half-life less than 5 years	<55	700	no limit	no limit

*The Nickel-63 concentration would decrease to 35 curies per cubic meter at 34 years.

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c. The land disposal sites are currently used by the Navy and the Department of Energy for other wastes.

d. Land disposal would be a continuation of current low level radioactive waste disposal.

e. The method of overland transportation involves a proven vehicle (crawler transporter) and technique for the size and weight involved.

f. Land use would be small since about 12 reactor compartments could be buried per acre and only 10 acres would be required for 100 separate disposals.

2. **Disadvantages**

a. Land disposal would be more expensive than other options,

(1) approximately $2.0 million per ship more than sea disposal, provided that the remainder of the ship is disposed of at sea and

(2) approximately $8.0 million per ship more than sea disposal, if the remainder of the ship is salvaged.

b. Land disposal would be more complex than other options, since more shipyard production work would be required through completion of the disposal operation.

c. Use of ten acres of DOE disposal site land would be restricted in the future.

II. THE SEA DISPOSAL OPTION

If the sea disposal option were selected, it would be accomplished at ocean sites considered acceptable for such disposal and designated by the U.S. Environmental Protection Agency (EPA). Typical sites which might satisfy the criteria established by the International Atomic Energy Agency (IAEA) in Reference 2.5 exist in both the Atlantic Ocean and the Pacific Ocean. For the purposes of developing analysis models of possible environmental effects and estimating the magnitude of such effects, study areas in the Atlantic Ocean approximately 200 nautical miles southeast of Cape Hatteras, and in the Pacific Ocean approximately 200 nautical miles west of Cape Mendocino, California were selected, with the Pacific Ocean study area used for the principal analysis of environmental impacts. The nature of such study areas and the basis for the criteria used to identify them are described in Chapter 3 and in Appendix E. The study areas described in this statement are not sites that have been selected or proposed for sea disposal, but rather they have been chosen for data collection and study since they are representative of sites which would meet IAEA criteria. These study areas and the values of the key parameters measured at their locations have been used in the evaluation of possible environmental effects since it was judged that they would be as close to human activities as any sites which might be selected under the IAEA criteria.

Disposal at sea would also comply with requirements established by the U.S. Environmental Protection Agency in consideration of U.S. and international laws and treaties. International standards for disposal of radioactive material at sea are established by the IAEA, Reference 2.5, in compliance with all articles of the 1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. These standards are implemented in the United States by the Marine Protection, Research and Sanctuaries Act of 1972 and are enforced by the EPA, which is authorized to issue ocean dumping permits.

Disposal at sea would not directly or indirectly affect land or water use in the coastal zone of any state, which is the zone extending seaward for three nautical miles. Nor would activities conducted in or on the water in the coastal zone, and in or on the shorelands within the zone, be affected.

A. METHOD OF DISPOSAL

Final preparation for disposal at sea would be carried out at a shipyard normally servicing nuclear-powered naval vessels. These shipyards are listed in Section I of this chapter. Each ship would have been defueled and decommissioned, with salvageable equipment removed. The ship's battery would be drained and removed and the contents of tanks (including oil tanks) would be replaced with water. The reactor vessel integrity would have been restored to normal following the defueling operation and the entire reactor plant would be filled with water. The reactor compartment would be sealed and filled with water. A check valve or one-way valve in the reactor compartment bulkhead would ensure that the reactor compartment pressure would be equal to the pressure in adjacent compartments during the sinking.

The submarine would be towed to the disposal site and prepared for final submergence. Here, covers would be removed from holes previously cut in the top of the hull to ensure rapid flooding. Ballast tanks would be flooded from the deck area and personnel would leave the submarine as it began to settle in the water and the tow line was disconnected. When the submarine submerged to the point where the hull openings were covered, rapid flooding would occur. It is estimated that complete flooding would occur less than one minute after the sinking is initiated, and that the submarine would free-fall at a constant vertical velocity of 45 feet per second (27 knots) or less.

When the submarine reached the bottom, well within 1500 feet of the release point (horizontally), the magnitude of the resulting shock would be less than 2g*, and would depend on the type of sediment and its thickness. For this reason, areas without thick deposits of sediment would be avoided as disposal sites. Based on the results of similar sinking operations and extensive related experiments and analysis, when the submarine settles on the ocean bottom, the reactor compartment containment integrity would be maintained and the reactor vessel and the remainder of the reactor plant would be intact.

*Deceleration from 45 feet per second to zero feet per second in 0.7 seconds is equivalent to 64 feet per second per second, or approximately 2g. The deceleration time interval is determined by the material that is struck.

The release of radioactive material to the ocean would occur only after at least 100 years, due to the slow process of corrosion of the hull and bulkheads and the reactor vessel walls. In the meantime, radioactive decay would convert much of the radioactive material to stable forms which are harmless and are identical, in most cases, to the metallic elements already present in the oceans.

B. COSTS

Detailed cost estimates for the sea disposal option are provided in Appendix A. (This includes cost estimates for, and a brief discussion of, sea disposal of the reactor compartment alone.) For an active ship, the total cost following decommissioning to completion of the disposal is estimated to be $5.2 million,* assuming no period of protective storage. For an inactive ship, after 20 years of protective storage and periods of shipyard time at the beginning and end of the time interval, the total cost is estimated to be $8.4 million. An allowance for monitoring costs is included, but costs associated with missile compartment removal for compliance with strategic arms limitation agreements, where required, are not included.

Sea disposal would require a total occupational radiation exposure estimated to be approximately 17 man-rems for an active ship, and approximately 20 man-rems for an inactive ship. For comparison, the occupational exposure limit for a shipyard work force of 200 persons is 1000 man-rems per year and 600 man-rems per quarter-year, with individual exposure limits of 5 rem per year and 3 rem per quarter-year.

C. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS

If the sea disposal option were selected, the unavoidable adverse environmental effects would be as follows:

1. Some restrictions on the use of one or more remote areas of the ocean floor. Use of overlying waters would not be restricted. A circular area having a diameter of approximately 11 statute miles would be involved if all 100 submarines were placed in the same general area. (See Appendix D.) The total affected area would be less than 100 square miles and would represent approximately 1.3×10^{-4} percent of the sea floor that lies under 4000 or more meters of water. This area would be less than 3 percent of the maximum sea disposal site area (10,000 square kilometers) specified by the International Atomic Energy Agency.

2. Loss of approximately 3000 tons of recyclable material, mostly steel, per ship. None of the material is in short supply nor are the resources of these materials expected to be exhausted in the near future. Although the material is recyclable, the cost to the government to recover it would be far greater than the scrap value, as described in Appendix A.

3. Eventual addition to the ocean environment (primarily the sediment) of approximately 4000 tons of corrosion products per submarine. This would include a small quantity of intermediate and long-lived radioactive material, of which about 120 curies of Nickel-59 (80,000 year half-life) per submarine would be expected eventually to be released to the environment. Seawater already contains these stable elements in solution, as well as a quantity of natural radioactivity (primarily Potassium-40) amounting to approximately 1800 curies per cubic mile (derived from Reference 2.6), or 120 curies of natural radioactivity in a 700 meter cube.

As described in detail in Chapter 4, the following adverse effects might occur, based on a conservative estimate of the radiological exposure due to a fraction of the released radioactive material entering one or more pathways to humans.

1. Annual radiation exposures to the average individual and to the most-exposed individual, due to the disposal of all 100 submarines, would be less than 2×10^{-4} mrem per year and 3×10^{-3} mrem per year, respectively, based on a very conservative estimate. The corresponding population exposure has been estimated to be less than 6 man-rems per year, based on all 100 disposals at the same site and an

*Cost estimates in 1981 dollars.

affected population of 30 million persons. In the event of an extreme occurrence following which the reactor compartment and reactor vessel are assumed to provide no containment barrier to release, the maximum annual exposure could be 6×10^{-2} mrem per year, based on a very conservative estimate.

2. Minimal effects on sea life in the neighborhood of the disposal site would be expected because of the very low external radiation levels (0.001 mrem per hour or less outside the hull), and because of the limited potential for internal exposure, primarily by ingestion of sediment. In the unlikely event that a disposal site became of commercial or other interest in the future, it is likely that the ability to exploit the site would not be affected outside of the small area that would actually be occupied by the disposed submarines. Even in the close proximity of the hulls, the radiation levels would be very low.

D. MEASURES TO MITIGATE ADVERSE EFFECTS

Several measures in the implementation of the sea disposal option would mitigate any adverse effects associated with the option.

The disposals would be made only at a site considered acceptable on the basis of remoteness, low biological activity, depth, sedimentation, tranquility, and predictability of geologic properties, and where no human activity is expected for the foreseeable future.

Multiple barriers of containment would minimize radioactivity release. These barriers include the reactor compartment exterior walls, the reactor vessel walls, the containment provided by the radioactive metal itself, most of which is corrosion-resistant alloy (stainless steel), and the ocean sediment which can retain by adsorption some of the radioactive material which comes in contact with it (though no credit was taken for this latter barrier in the calculations). The reactor compartment would be sealed; pressure equalization devices would be provided to ensure that containment integrity would be maintained; and the method of emplacement on the sea floor would preserve the integrity of containment.

These measures provide effective isolation and containment of the radioactive waste.

In the unlikely event that further measures to mitigate adverse effects were to be required after disposal had occurred, containment of the residual radioactive material in concrete could be accomplished at any time, as described in Appendix M. Freshly mixed concrete could be delivered from the ocean surface by means of a long pipe to envelop the entire submarine in concrete. This is feasible using current technology and would require no advance preparation of the submarine.

E. RETRIEVABILITY AND INSPECTABILITY

Retrievability and inspectability would be feasible with current technology or with reasonable extensions of proven technology. Retrieval of the entire submarine should be possible for at least 50 years after disposal because of the strength and thickness of the structures, as described in Appendix M.

Inspection would be possible with deep submergence vehicles to determine the condition of the hull at the location of the reactor compartment. Photographic or television techniques could be used with either a submersible vehicle or a remotely-operated device deployed from a surface ship.

F. ENVIRONMENTAL MONITORING

Environmental monitoring would be performed before, during, and after the period of disposal in accordance with EPA regulations. The purpose of such monitoring would be to determine the possible extent of radioactive material dispersal in the nearby sediment and water column, and the concentrations of such material present in bottom-dwelling forms of life as well as those inhabiting the water column at various depths. Monitoring requirements are discussed in Appendix K.

G. PERMITS

Authorization would be required from the U.S. Environmental Protection Agency. The EPA would be responsible, under the Marine Protection, Research and Sanctuaries Act of 1972, to issue a disposal permit. Other nations would be informed in accordance with international requirements.

H. COMPARISON WITH IAEA LIMITS FOR OCEAN DISPOSAL OF RADIOACTIVE WASTE

International limits on ocean disposal of radioactive waste have been developed by the International Atomic Energy Agency (IAEA) for the London Convention (Reference 2.5). The activity concentration limit that would be applicable to submarine disposal at sea is 100 curies per metric ton for beta/gamma emitters (excluding tritium, H-3) with half-lives of at least 0.5 year. A metric ton equals 1000 kilograms or approximately 2200 pounds. The activity concentrations are to be averaged over a gross mass not exceeding 1000 metric tons, and the total tonnage of radioactive waste that can be disposed of each year at a single site is 100,000 metric tons.

As shown in Table 1-1, Chapter 1, the radioactivity contained in the reactor compartment of a defueled submarine six months after final operation would be approximately 62,000 curies, all of which would be beta/gamma emitters. The activity of beta/gamma emitters with half-lives exceeding 0.5 year is approximately 58,000 curies. Since the gross mass of each submarine reactor compartment is about 1000 metric tons, the activity concentration is approximately 58 curies per metric ton. Therefore, the limit of 100 curies per metric ton would be satisfied.

The single site limit of 100,000 metric tons per year would not be approached if sea disposal were implemented since the mass of a submarine reactor compartment is about 1000 metric tons. If up to five submarines per year were disposed of at a single site, the total would be less than 5000 metric tons or 5 percent of the limit.

Controls on disposal at sea would include those recommended by the IAEA and administered by the EPA. These controls include standards for selection of a disposal site, packaging of wastes, approval of the delivery ship and its equipment, supervision of disposal operations, and recordkeeping.

I. ADVANTAGES AND DISADVANTAGES OF THE SEA DISPOSAL OPTION

The sea disposal option's advantages and disadvantages may be summarized as follows:

1. Advantages

a. The cost of sea disposal would be significantly lower than either of the land disposal options, approximately $1.9 million per ship less than land disposal with sea disposal of the remainder of the ship and approximately $8.0 million per ship less than land disposal with the remainder of the ship scrapped.

b. Sea disposal would be simpler than land disposal, requiring less shipyard production work to prepare and sink the ship compared with the work required for land disposal.

c. The radioactive waste would be far from human activities and unlikely to be inadvertently disturbed.

2. Disadvantages

a. The environmental aspects of sea disposal are more controversial than those of land disposal. However, disposal at sea of low level radioactive waste is not prohibited by laws of the United States. Controversy has recently been focused on ocean dumping activities of the United States from 1946 to 1970, resulting in a review of the issues by the General Accounting Office (GAO) (Reference 2.7). This review determined that the "overwhelming body of scientific research and opinion shows that concerns over the potential public health and environmental consequences posed by past ocean dumping activity are unwarranted and overemphasized". The conclusions of Reference 2.7 were subsequently reviewed by the GAO at the request of the Chairman of the House of Representatives' Subcommittee on Oceanography, Committee on Merchant Marine and Fisheries. In Reference 2.8, the GAO stated that Reference 2.7 was accurate and, after careful reexamination, considered to be valid.

b. The sea disposal option would take longer to put into use than the land disposal option because sea disposal sites would have to be designated by the U.S. Environmental Protection Agency, and a permit from that agency would be required.

c. An amendment to the Marine Protection, Research, and Sanctuaries Act (Public Law 97-424, January 6, 1983) limits EPA's authority to issue permits for ocean disposal of radioactive wastes for two years except for research purposes. After this period expires, the amendment establishes a requirement for preparation of a Radioactive Material Impact Assessment and submission of such an assessment to the Congress.

III. THE "NO ACTION" ALTERNATIVE

The general alternative of taking no immediate permanent disposal action can be selected and successfully applied as a short term option, as shown by the protective storage status of seven decommissioned submarines (TRITON, since 1967; HALIBUT, since 1976; NAUTILUS, since 1980; THEODORE ROOSEVELT and ABRAHAM LINCOLN, since 1981; and ETHAN ALLEN and THOMAS A. EDISON, in 1983). The measures used to prepare these ships for protective storage and maintain them in such storage ensure that no radiological concern now exists or will exist for many years as long as periodic maintenance is performed.

This protective storage option is considered satisfactory as an interim measure, but does not provide permanent disposal. Continued maintenance in storage will be an increasing problem for the Navy as the ships age and the number of inactivated ships increases. For this reason protective storage is not a permanent solution to the disposal problem.

The option can continue to be used while other options are being developed. Other alternatives may be developed over the next 20 to 30 years. This is the major attraction of the "no action" alternative. However, it is unlikely that other options as yet unidentified could be significantly more advantageous in terms of environmental impact than immediate land or sea disposal, or in terms of cost or occupational exposure.

The delay period allows a major part of the radioactive material to decay under controlled conditions without release to the environment. The radioactive inventory of the reactor compartment would be decreased over a 20 year wait period to about 25 percent of its initial value (Chapter 1, Figure 1-2). While this would appear to be significant, it would not have a significant effect on environmental impact because the radioactive material would be contained within the reactor compartment for at least 100 years for sea disposal or 200 years for land disposal even with no delay period. The delay period could have an effect only on the eventual release of Nickel-63 which has a 92 year half-life. A 20 year delay period would decrease the Nickel-63 inventory at the disposal time by 14 percent, so that the eventual release of Nickel-63 would be 14 percent less than what it would be in the absence of delay. However, because of the long period of containment provided by the package and the metal itself, the eventual releases of Nickel-63 would be very limited even without protective storage. Since only about one-third of the total amount of radioactivity expected to be released in sea disposal is Nickel-63 and the remainder is Nickel-59, which would not decay significantly during storage, the total reduction in release due to a storage period of 20 years would be less than 5 percent. For land disposal almost no Nickel-63 would be expected to be released, so there would be no reduction in release due to a storage period of 20 or more years. Therefore, for sea disposal, the reduction in environmental effects attributable to protective storage would be minor and for land disposal it would be essentially zero.

The option is initially less costly than the other options. Initial costs would be: $1.2 million less than sea disposal, $3.2 million less than land disposal with sea disposal of the remainder of the ship, and $9.3 million less than land disposal with scrapping of the remainder of the ship. However, the extra costs involved in the two step process of placing the ship in protective storage and later disposing of it would be approximately $1.4 million per ship, not counting the annual cost of protective storage. See Appendix A for detailed cost estimates.

A. ADVANTAGES

1. The submarines would be easily retrievable.

B. DISADVANTAGES

1. The option only postpones the decision for permanent disposal, requiring the decision to be made at a future time.

2. Additional yearly costs of approximately $90,000 per year per ship would be involved for storage and retention at the inactive ship facility.

3. After approximately 20 years of waterborne storage, the ship would have to be placed in dry dock for inspection of the hull and necessary maintenance. Such re-docking would involve additional costs.

4. Additional occupational exposure to radiation would be required primarily to conduct radiation surveys during the storage period.

5. Security measures would be required to ensure that unauthorized persons do not have access to the ships.

6. Storage space at inactive ship facilities is limited. Based on projected decommissionings, pier space with sufficient water depth would become limiting by about 1990 without actions to dredge additional piers and repair piers. This would add appreciably to the cost of waterborne storage and the disposal of the dredged material would in itself be an environmental impact possibly requiring separate evaluation.

7. While initial cost is less, overall costs for future disposal will not decrease due to radioactive decay, since even after 100 years the reactor compartment would contain significant radioactivity (primarily Nickel-63 and Nickel-59) that would require permanent disposal.

IV. OTHER ALTERNATIVES THAT WERE ELIMINATED FROM CONSIDERATION

Land disposal and sea disposal, along with the "no action" alternative, are considered to cover all practical alternatives at the present time. Other approaches that may be feasible for certain radioactive waste disposal applications but are not considered practical in the present case are the following:

A. LAND DISPOSAL AT OTHER SITES

1. **Commercial Sites.** Land disposal of submarine reactor compartments at commercial radioactive waste burial sites would be unacceptable due to the classified nature of the waste package.

2. **Other Government Sites.** Burial of the reactor compartments at other Government-owned sites would not have any significant environmental benefit when compared to the two sites considered in detail since the environmental impacts are so small at those two sites. Other existing Government-owned burial sites have the significant disadvantage of lack of access by water transportation. Selecting and qualifying a new Government-owned site would involve unnecessary costs and duplication of effort.

B. LAND DISPOSAL OF SUBDIVIDED PORTIONS OF THE REACTOR PLANT

As described in Appendix B, "Land Disposal," three types of land disposal concepts were considered. As alternatives to land burial of the entire reactor compartment, the plant could be dismantled and the components could be either packaged in specially-built containers with concrete, or cut into pieces that could be packaged in steel drums with concrete. Of these three concepts, burial of the entire reactor compartment is preferred because no specialized facility would be required, costs would be less, and there would be less occupational exposure.

C. ABOVE-GROUND STORAGE OR DISPOSAL

Placement of the reactor compartments above ground in specially designed buildings or in an arid atmosphere was evaluated as an interim storage measure, and as a permanent disposal method.

As an interim measure, such storage would incur all of the impacts and costs associated with land disposal with no added benefit, since when buried, the thick submarine hull and bulkheads would remain intact for hundreds of years. This is much longer than typical storage buildings last.

As a permanent measure, long-term dry storage, whether above ground in an arid atmosphere or in a special building, has no real advantage over burial. Even assuming that the buried hull and reactor would corrode as rapidly as if they were in seawater, Table C-1 shows that only those nuclides with half-lives in the thousands of years are released to the ground in any appreciable fraction and only 80,000 year half-life Nickel-59 has more than 1 curie released over all time. Therefore, Nickel-59 is the only significant contributor to radiation exposure to people, as shown in Appendix C, Sections III and IV. Because of its long half-life, the radioactivity from Nickel-59 would be expected to be present long after any above-ground structures have deteriorated and vanished and after the hull and the reactor vessel and its contents have all turned to rust. Therefore, above-ground storage would still need to contend with exposure from Nickel-59 just as land burial would. These options would not constitute permanent disposal in compliance with current regulations since they do not permanently isolate the radioactivity from inadvertent contact with people, but they would incur all the environmental impacts associated with land burial, including those associated with worker exposure, transportation, and eventual deposition of radioactive material in the soil. In fact, placement above ground would increase the possible exposure because the radioactive material would end up on the surface where humans and foodstuff could be most directly affected.

In addition, the conservatively calculated estimated radiation exposure from land burial of 100 submarines, 0.006 mrem per year to an average individual, is so small in relation to the normal variation in background radiation levels that its effect on people is insignificant.

D. DISPOSAL BY TRANSMUTATION OR BY PUTTING WASTES TO BENEFICIAL USE

This "disposal by conversion" alternative is a future possibility for separated and concentrated solid forms of radioactive waste. Transmutation would generally involve extremely long-lived actinides, which would be subjected to neutrons (as in a reactor environment) and converted ("transmuted") to other radionuclides having shorter half-lives. As discussed in Chapter 1, Section I.A, no significant amounts of actinides are present in decommissioned and defueled nuclear propulsion plants. It should also be noted that the neutron environment required with this method would also activate some of the stable isotopes, thus defeating the purpose of the method.

The beneficial uses of radioactivity (such as Cobalt-60 used as a gamma-ray source in medical applications or food processing) would not apply to all isotopes and more economical sources of Cobalt-60 are available.

E. EXTRATERRESTRIAL DISPOSAL

This option may become attractive in the future for small volumes of highly concentrated waste. Decommissioned nuclear propulsion plant components are too massive for this to be practical. Also, an aborted launch might cause radioactive material to fall into an undesirable location.

F. LAND DISPOSAL OF THE ENTIRE SUBMARINE

Because of the excellent containment properties of the thick submarine hull, there could be incentive to dispose of the entire submarine on land, thus making available the otherwise unused volume of the ship for the disposal of other radioactive waste.

The movement of the entire submarine to the Hanford site is feasible. The submarine could be floated in the relatively shallow water of the Columbia River, landed at the terminal point of the river tow and transported overland to the disposal site. However, this would require a barge or flotation attached to the submarine hull capable of floating the entire ship in water of about 14 feet minimum depth; a dry dock for use in transferring the submarine to land transporters, and large, high-capacity transporters to move the submarine out of the dry dock and to the land disposal site. All of the necessary operations would be similar to the option of reactor compartment land burial, but on a much larger scale.

The environmental impacts from the burial of the whole decommissioned, defueled submarines would be similar to those for burial of only the reactor compartment. However, additional environmental impacts would occur as the result of construction of the large dry dock required and by the increased and inefficient use of land. Less than half the volume inside the submarine hulls could be used for other wastes because of difficult access to tanks and other spaces and interferences with piping, cables and machinery, meaning that at least twice as much burial ground space would be needed for this approach as for burial of the other waste in purpose-designed containers. This would represent extremely inefficient land use.

Therefore, while this would apparently represent an acceptable disposal method, it has not been pursued further in this statement.

V. PREFERRED ALTERNATIVE

Based on the research work performed in support of this effort, and review of the comments received as documented in the EIS, the Navy considers that permanent disposal can be performed in an environmentally safe manner. The highly conservative estimates used in the analyses of impacts have amply compensated for any uncertainties that may exist in man's knowledge relative to the impacts of permanent disposal.

Since the Navy began its evaluation of disposal options, several developments associated with possible ocean disposal of low-level radioactive waste have occurred. These include Congressional action in December 1982 restricting the issuance of ocean disposal permits and requiring Congressional approval before any such permit may be issued by the EPA. In addition, the EPA has indicated additional regulations may be required before EPA could evaluate a permit request. In view of these and other related uncertainties associated with national acceptance of the ocean disposal option, the Navy considers that allocation of additional funds to pursue this option further is not warranted. Even though the analysis shows less cost for ocean disposal than for land disposal, the funds required to qualify and gain acceptance of an ocean disposal site and the costs of continuing to maintain excessed submarines in storage until ocean disposal was allowed by the Congress and the EPA would serve to narrow the cost differential between the two options.

Based on a consideration of all current factors bearing on a disposal action of the kind contemplated, the Navy's preferred alternative at this time is to dispose of the reactor compartments by land burial. Land burial is the method currently used in the United States for disposal of low-level radioactive waste and this disposal action would comply with existing requirements for use of the Government burial grounds. This approach will allow permanent disposal of this form of low-level radioactive material to proceed with no unacceptable environmental impacts. With most of the submarines to be decommissioned on the West Coast of the United States, it is expected that the Government burial ground to be used in the near future will be the low-level radioactive waste disposal site at Hanford in Washington State.

VI. REFERENCES

2.1 Final Environmental Impact Statement on 10CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste," Appendix F, U.S. Nuclear Regulatory Commission, NUREG-0945, November 1982 (ERA-8-7056).

2.2 Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, Aiken, South Carolina, ERDA-1537, September 1977 (NSA-3-2599).

2.3 Final Environmental Statement, Waste Management Operations, Hanford Reservation, Richland, Washington, ERDA-1538, December 1975 (NSA-33-17893, NSA-33-17894).

2.4 "The Shallow Land Burial of Low-Level Radioactively Contaminated Solid Waste," Panel on Land Burial, Committee on Radioactive Waste Management, Commission on Natural Resources, National Research Council, National Academy of Sciences, 1976 (621.4838 Na).

2.5 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, International Atomic Energy Agency Information Circular INFCIRC/205/Add. 1/Rev. 1, August 1978.

2.6 "Radioactivity in the Marine Environment," National Academy of Sciences, 1971 (ISBN 0-309-01865-X).

2.7 "Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized," U.S. General Accounting Office, Report EMD-82-9, October 21, 1981.

2.8 "Evaluation of a Critique of General Accounting Office Report, Hazards of Past Low-Level Radioactive Waste Ocean Dumping have been Overemphasized," U.S. General Accounting Office, December 17, 1982 (Enclosure I of GAO-B-204946).

CHAPTER 3

AFFECTED ENVIRONMENT

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CHAPTER 3

AFFECTED ENVIRONMENT

The affected environments for each of the two permanent disposal options are described in this chapter. For land disposal, two sites are under consideration: the Hanford Site in the state of Washington, and the Savannah River Plant in the state of South Carolina. For sea disposal, the sites can only be approximately characterized because (1) specific sites would have to be designated by the EPA and (2) applications for sea disposal permits to use the sites would also have to be approved by the EPA.

I. LAND DISPOSAL SITES

A. HANFORD SITE

The Hanford Site is located in the southeastern corner of the state of Washington, about 30 miles east of Yakima and 3 miles north of Richland. (See Figure 3-1.)

Hanford is a federal government site, operated by the U.S. Department of Energy, occupying 570 square miles (365,000 acres). The area designated as suitable for solid radioactive waste burial (Areas 200-W and 200-E in Figure 3-1) occupies over 1000 acres in the middle of the site in an isolated area on a plateau, about 7 miles from the Columbia River. A detailed description of the site, its geology and hydrology, and the associated plant and animal life is presented in the site's Final Environmental Statement on Waste Management Operations, Reference 3.1; therefore, only a brief summary is presented here. These burial grounds are currently being used, without adverse effect on the environment, for the disposal of solid radioactive wastes similar in isotopic content to those considered in this statement. A National Research Council study in 1976 on shallow land burial (Reference 3.2) included in its principal findings the conclusion that "no measurable harm to human health has resulted from the past and present practices in the land burial of solid low-level radioactive waste at the sites managed by the U.S. Atomic Energy Commission" (now the U.S. Department of Energy). A more recent (1978) study by the National Research Council, Reference 3.3, concludes, "that there has not been in the past, and is not at present, any significant radiation hazard to public health and safety from waste-management operations at Hanford." This includes the solid radioactive waste disposal operations.

The site is in the Pasco Basin, a semi-arid region in the rain shadow of the Cascade Range. Average annual precipitation is 6.25 inches, about 45 percent of which occurs during the months of December through February in the form of snow. Under the burial area, the groundwater table is 150 to 300 feet below the surface. Precipitation does not percolate to the water table, hence radioactive contamination remains immobilized in soil between the ground surface and the water table since there is no means for transporting the material out of the dry sand-gravel soil.

The eastern part of Washington, including the Hanford Site, is classified by the U.S. Coast and Geodetic Survey as being in Seismic Zone 2. This implies a potential for moderate damage from earthquakes, but underlying sands and gravels provide excellent protection from damage.

Tornadoes are relatively rare in this region and tend to be small with little damage when they do occur. Data analyzed to determine the probability of a tornado hitting a particular facility on this site yielded the estimate that the probability during a year is six chances in one million.

The Columbia River flows through the northern edge of the Hanford Site and forms part of the eastern boundary of the reservation. Farms near the site generally depend on water from the Columbia or Yakima River for irrigation. The long-term annual average flow of the Columbia River at Hanford is about 120,000 cubic feet per second (cfs) while the minimum flow is 36,000 cfs. The estimated population within 50 miles of the waste management area was approximately 246,000 persons based on 1970 census data (Reference 3.1). Based on current regional increase rates of about 2 percent per year (Reference 3.13), the population within 50 miles would be approximately 310,000 in 1982. Population downstream served by the Columbia River as a water source is estimated to be several hundred thousand persons. In the public radiation exposure estimates of Appendix C, it is conservatively assumed that any radioactive material released from the burial site would be transported via groundwater and streams to the Columbia River without delay, and that the water available to the downstream users would be an exposure pathway, along with fish taken from the river and food grown on irrigated land. This assumption is extremely conservative for the Hanford Site since: 1) there has been shown to be no water moving through the solid waste burial ground to groundwater because of the minimal rainfall and the distance to the groundwater; 2) due to the lack of water, no movement of radionuclides from the solid waste burial ground has been observed; and 3) migration via groundwater to the Columbia River would be substantially delayed due to chemical interaction between the radionuclides and the soil. Maximum-exposed individuals are assumed to obtain all water from local wells or streams and all food from locations close to the disposal Site. When these assumptions are applied, as shown in Appendix C, the diluting flow is assumed to be that of the Savannah River (7500 cfs) rather than that of the Columbia River (36,000 cfs). Hence, individual exposures that are estimated for the land disposal option have an additional large factor of conservatism when applied to burials at the Hanford Site.

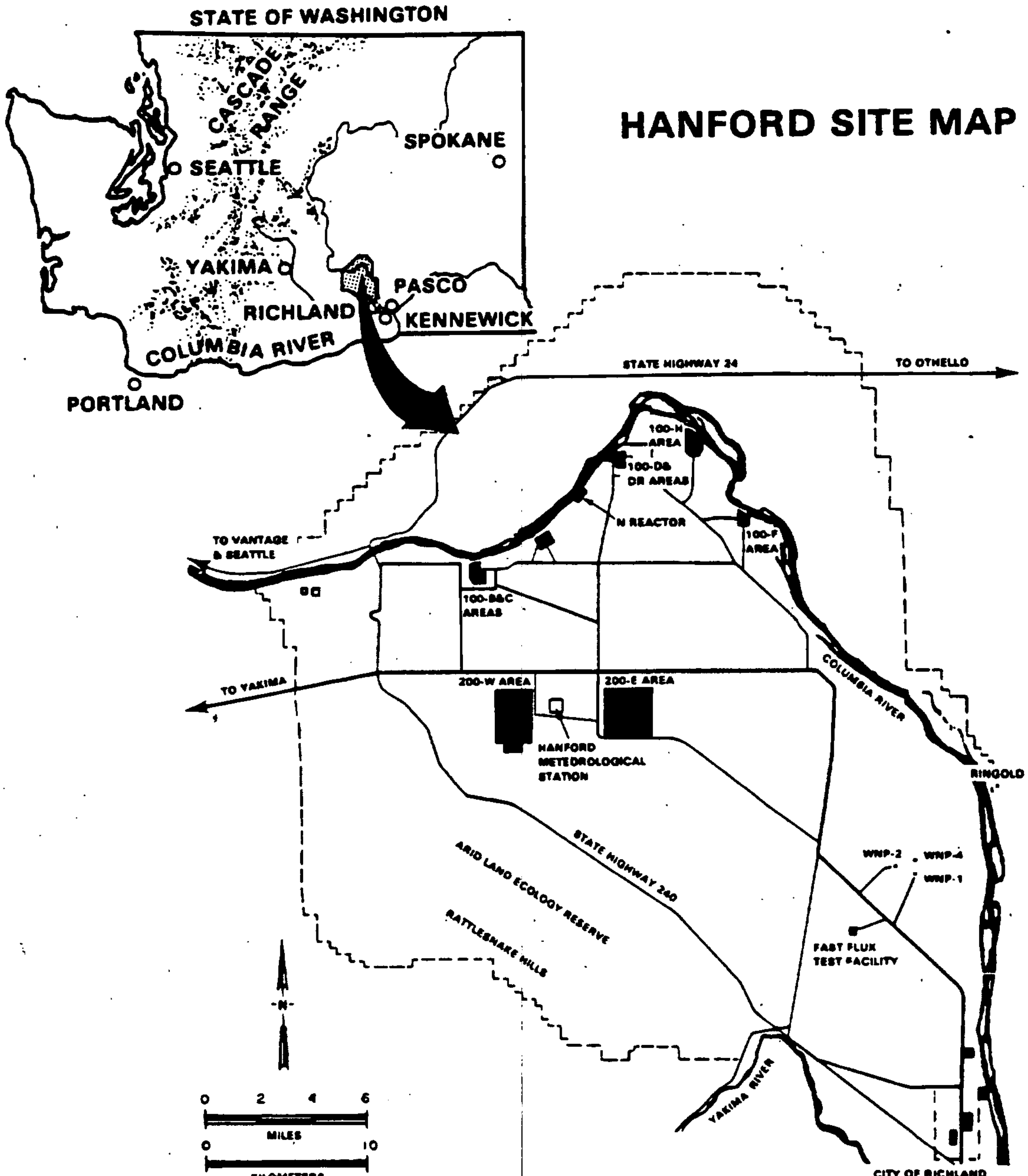


Figure 3-1. Hanford Site Map

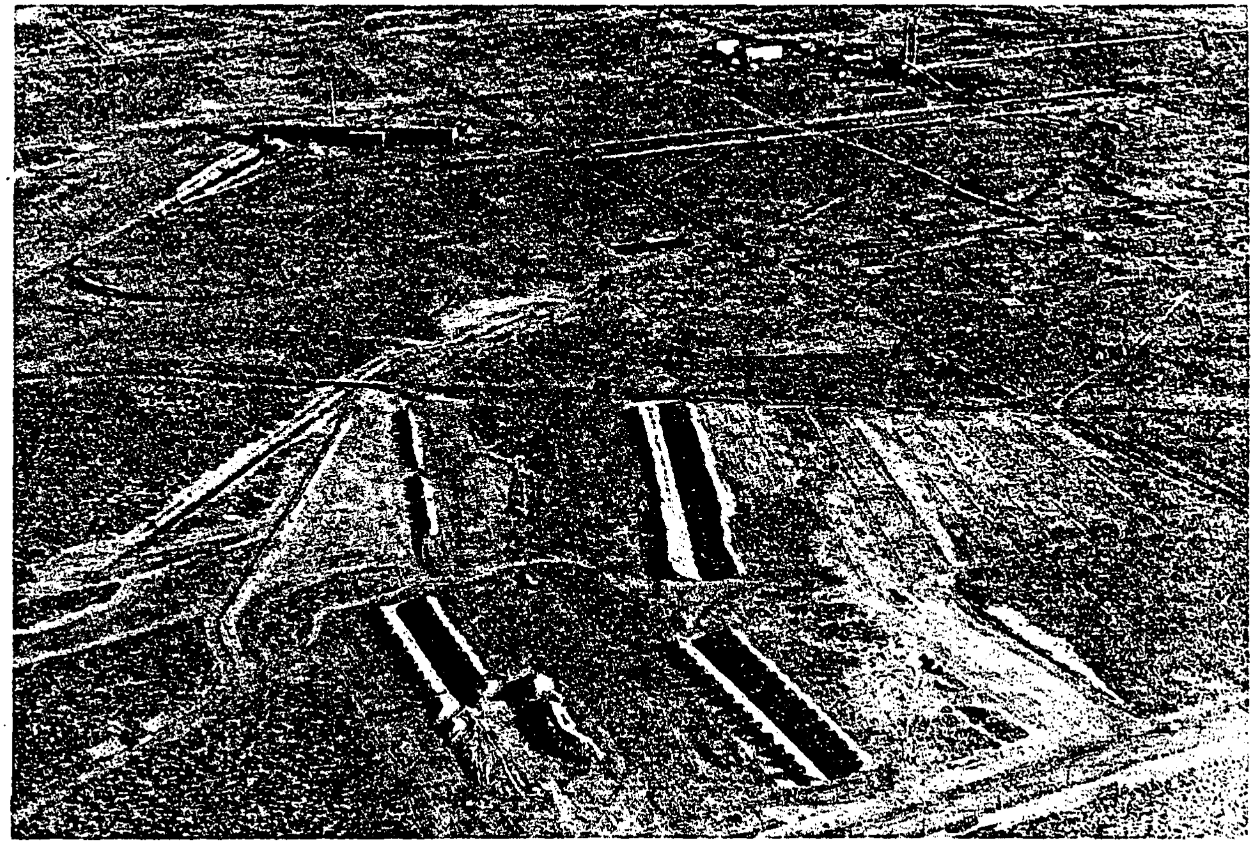


Figure 3-2. Aerial Photograph of Hanford Burial Ground (200-W Area)

The burial site is currently used for the disposal of low-level radioactive waste such as contaminated clothing, rags, and tools contained in 55 gallon drums, as well as activated metal reactor components buried within their shipping containers. No changes to the current use or procedures would be needed. The site maintains an active monitoring program that provides the basis for current population dose estimates. These estimated doses are only a small fraction of natural background.

Additional data on the physical characteristics and environmental monitoring program at the Hanford Site are included in Appendix B, "Land Disposal". Extensive information on the Site is available in Reference 3.1.

B. SAVANNAH RIVER PLANT

The Savannah River Plant is located on the Savannah River in South Carolina, approximately 25 miles southeast of Augusta, Georgia. (See Figure 3-3.) The plant is a Department of Energy site, occupying 300 square miles (192,000 acres). Approximately 195 acres (near the center of the site, about 7 miles from the Savannah River) are used for the burial of solid radioactive waste. (See Figure 3-4.) A detailed description of the site, its geology and hydrology, and the associated plant and animal life is presented in the site's Final Environmental Impact Statement on Waste Management Operations, Reference 3.4; therefore, only a brief summary is presented here. Solid radioactive wastes similar to isotopic content to those considered in this statement are currently being disposed of at the Savannah River burial ground. As noted in the description of the Hanford Site, the National Research Council has concluded that no measurable harm has resulted from past and present practices in these disposal operations.

The site is near the inner western edge of the Atlantic Coast Plain at about 500 feet above mean sea level, in an area protected by the Blue Ridge Mountains from the more vigorous winters prevailing in the Tennessee Valley. Average annual precipitation is 47 inches; snowfall and freezing rain are infrequent.

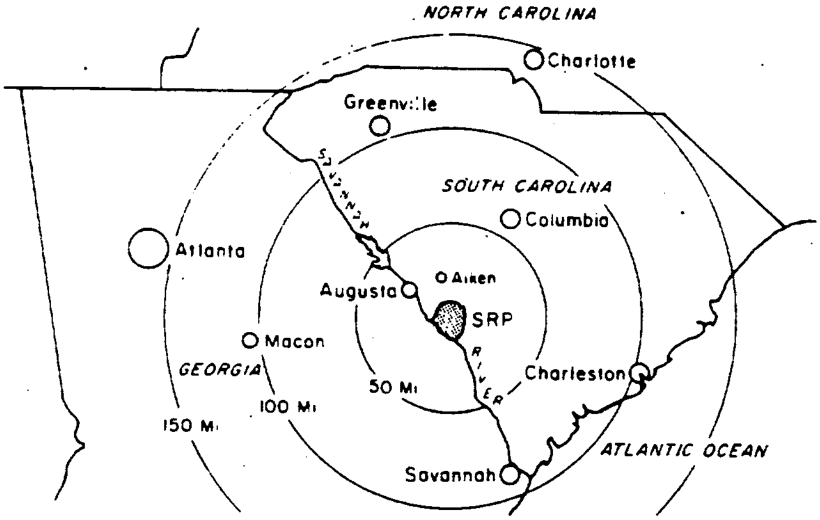


Figure 3-3. Location of Savannah River Plant (SRP) in South Carolina

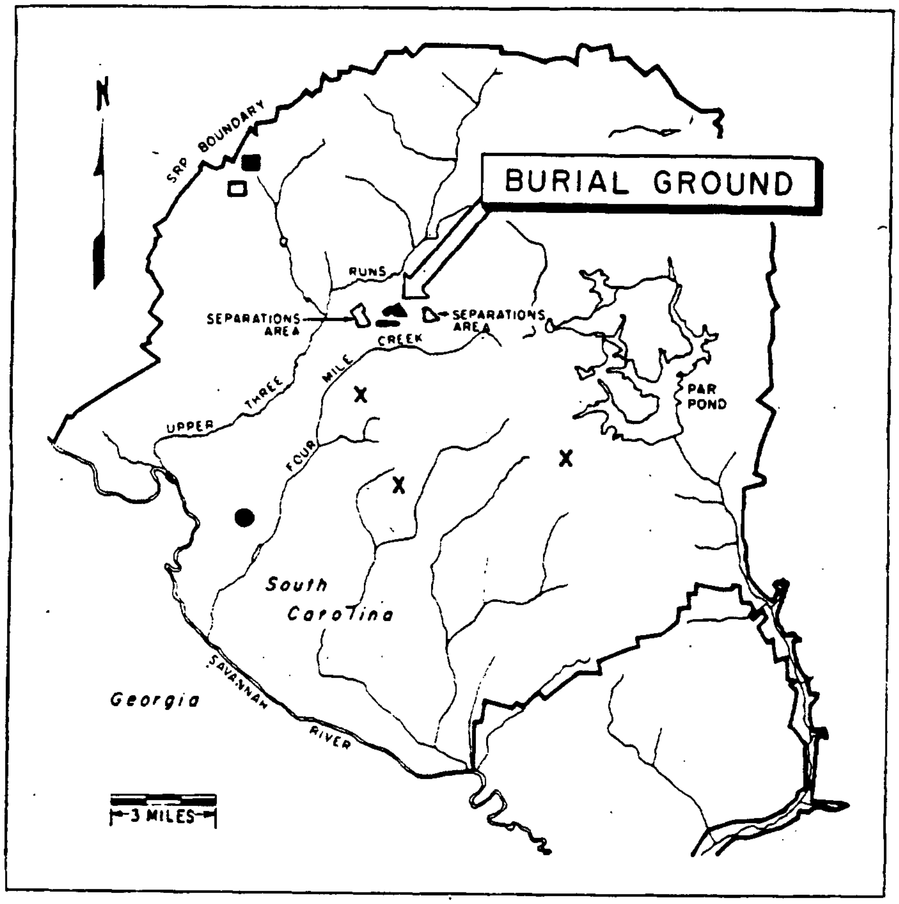
Under the burial area, the groundwater table is 40 to 45 feet below the surface. No flowing streams cross the burial area. Surface runoff is through drainage ditches. Underlying sediments consist of sandy clay and clay beds with a predominance of sandy clays. Almost all of the plant site, including the burial site, is eventually drained by tributaries of the Savannah River. Each of the tributaries is fed by small streams, and no location on the site is very far from continuously flowing streams. The yearly average flow of the Savannah River in the vicinity of the plant is 10,420 cfs with a minimum yearly flow of 7500 cfs. The 7-day, 10 year low flow is calculated to be 5600 cfs.

The Savannah River Plant is located in Seismic Zone 2, where moderate damage might occur from earthquakes, according to the U.S. Coast and Geodetic Survey.

The plant is in an area where occasional tornadoes are to be expected. During the history of the plant, there has been no tornado damage to any production or support facility; however, there have been several unconfirmed sightings of tornadoes in unpopulated areas.

The estimated population within 50 miles of the center of the plant was approximately 460,000 people, based on 1970 census data (Reference 3.4). Based on current regional increase rates of 1.5 percent per year, (Reference 3.13), the population within 50 miles would be approximately 550,000 in 1982. Population downstream currently served by the Savannah River as a water source was estimated (Reference 3.4) to be 70,000 persons, although as described in Appendix C, a user population in the far-distant future of 350,000 persons was assumed for the purpose of estimating a general land disposal site population exposure. It is conservatively assumed in the exposure estimates of Appendix C that any radioactive material released from the burial site would be transported via groundwater and streams to the Savannah River without delay, and that the water available to the downstream users would be an exposure pathway, along with fish taken from the river and food grown on irrigated land. Maximum-exposed individuals are assumed to obtain all water from local wells or streams and all food from locations close to the disposal site.

The burial site is currently used in a way similar to that described above for the Hanford Site and no changes to present usage or procedures would be necessary. However, as described in Chapter 4, Section I.A.1, "Effect on Land Use," the 195 acre burial area is projected to be filled in the year 1994, and additional area would have to be designated if reactor compartment disposals are to be carried out at the Savannah River site beyond 1994. The Savannah River Plant also has an extensive environmental monitoring program with monitoring results reported on an annual basis.



LEGEND
- ■ SAVANNAH RIVER LABORATORY
- □ FUEL FABRICATION AREA
- ● HEAVY WATER PRODUCTION PLANT
- X REACTOR AREA

Figure 3-4. Map of the Savannah River Plant

Additional data on the physical characteristics and environmental monitoring program at the Savannah River Plant are included in Appendix B, "Land Disposal". Extensive information on the site is available in Reference 3.4.

C. OTHER SITES THAT WERE CONSIDERED FOR LAND DISPOSAL

As described in Appendix B, "Land Disposal", all Department of Energy land disposal sites have been considered for reactor compartment burial. However, all except the Hanford and Savannah River sites were eliminated from consideration after an initial assessment.

The potential site at Oak Ridge Reservation, Tennessee is considered impractical because of its shallow water table (14 feet from the surface) and because of the great distance required for transport from the ocean. The potential sites at the Idaho National Engineering Laboratories and the Los Alamos Scientific Laboratory in New Mexico are considered impractical because of the lack of suitable rivers for barge transportation.

II. OCEAN STUDY AREAS

Sea disposal sites have not been selected because a decision to pursue the sea disposal option has not as yet been made. The areas described in this section are only representative of the kinds of locations and the associated characteristics which would meet IAEA criteria. Such area descriptions have been included to provide the basis for determining the likely consequences of sea disposal if that option were to be selected.

At the present time three general areas have been identified for study purposes. These areas have been used in this statement for the purpose of estimating any possible adverse environmental effects associated with sea disposal since they appear to be as limiting as any that might be chosen in light of existing international rules for such sites.

The Atlantic areas are identified on Figure 3-5. The center of one study area, the Lower Continental Rise Area, is approximately 220 nautical miles east of Cape Hatteras, North Carolina. The center of a second Atlantic study area is approximately 280 nautical miles southeast of Cape Hatteras, in the Hatteras Abyssal Plain. The Pacific area is identified on Figure 3-6. Its center is approximately 160 nautical miles west of Cape Mendocino, California. All three of these study areas are much larger than would be required for a site for sea disposal of nuclear submarines.

Each of the three general areas is described in the background material supplied as Appendix E, "Description of Ocean Study Areas". The characteristics of each area are consistent with the particular "area identification criteria" that are explained below.

A. STUDY AREA IDENTIFICATION CRITERIA

In identifying the marine areas to be utilized for studying the possible effects in the event that sea disposal were implemented, consideration is given to the safety of man and his environment, national security, and economic matters. Study area identification criteria have been developed based primarily on the requirements of the International Atomic Energy Agency (Reference 3.5), as reproduced below:

"C.2. Requirements for Selection of a Dumping Site

C.2.1. In addition to the factors specified in Annex III to the Convention*, the following requirements shall be met by the appropriate national authorities in the selection of a site for the dumping of packaged waste:

(1) The chance of recovering the waste by processes such as trawling shall be minimized;

(2) Dumping shall be restricted to those areas of the oceans between latitudes 50°N and 50°S. The area shall have an average water depth greater than 4000 metres. Recognizing that variations in sea-bed topography do exist, this restriction should not be interpreted to exclude these sites within which there are localized areas with water depths of 3600 metres;

(3) Sites should be located clear of continental-margins and open sea islands, and not in marginal or inland seas. Nor should they be situated in known areas of natural phenomena, for example volcanic activity, that would make the site unsuitable for dumping;

(4) The area must be free from known undersea cables currently in use;

(5) Areas shall be avoided that have potential sea-bed resources which may be exploited either directly by mining or by the harvest of marine products, or indirectly (e.g., spawning) as feeding grounds for marine organisms important to man;

*See page 3-9.

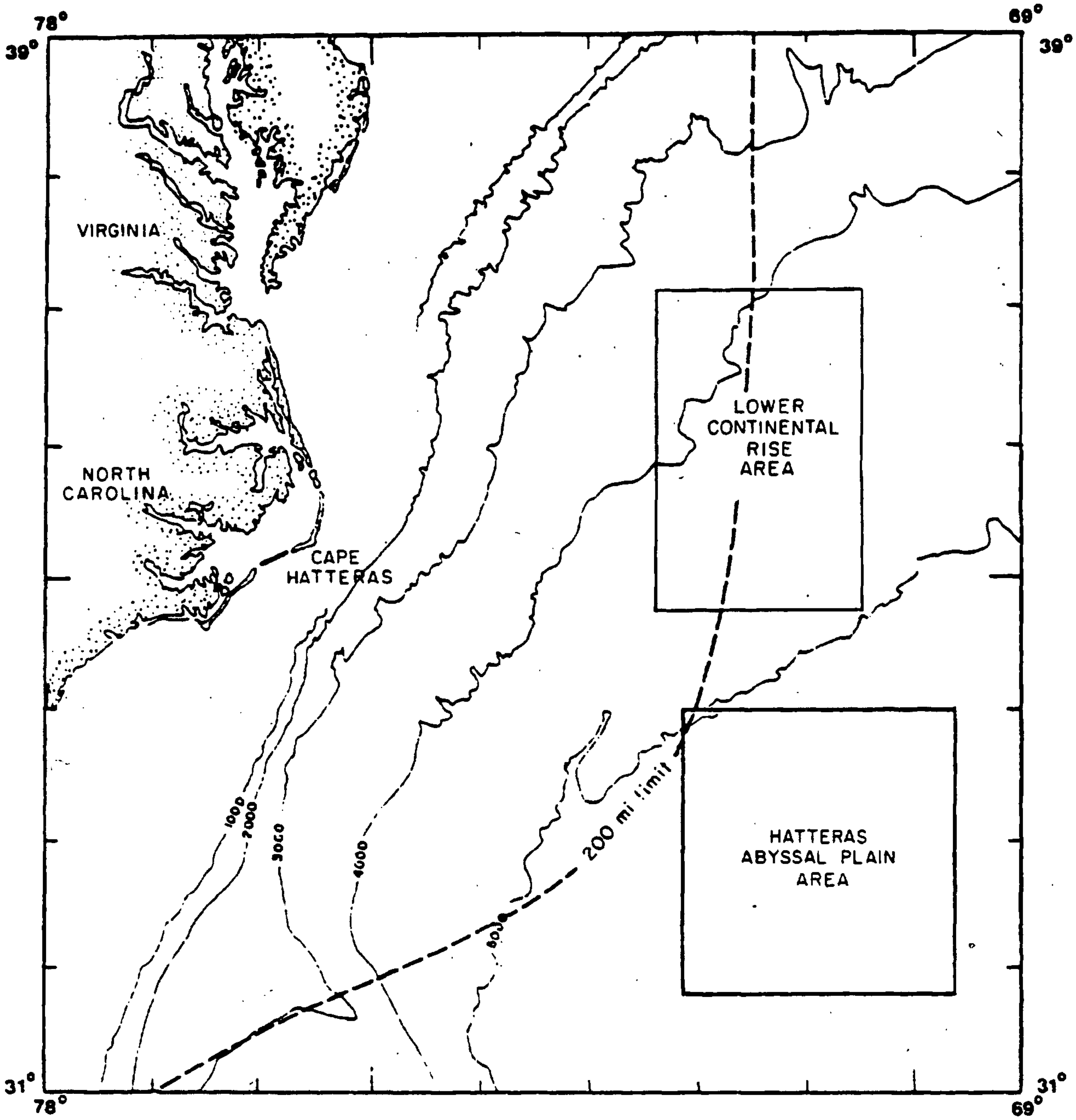


Figure 3-5. Atlantic Study Areas (Depth contours in meters)

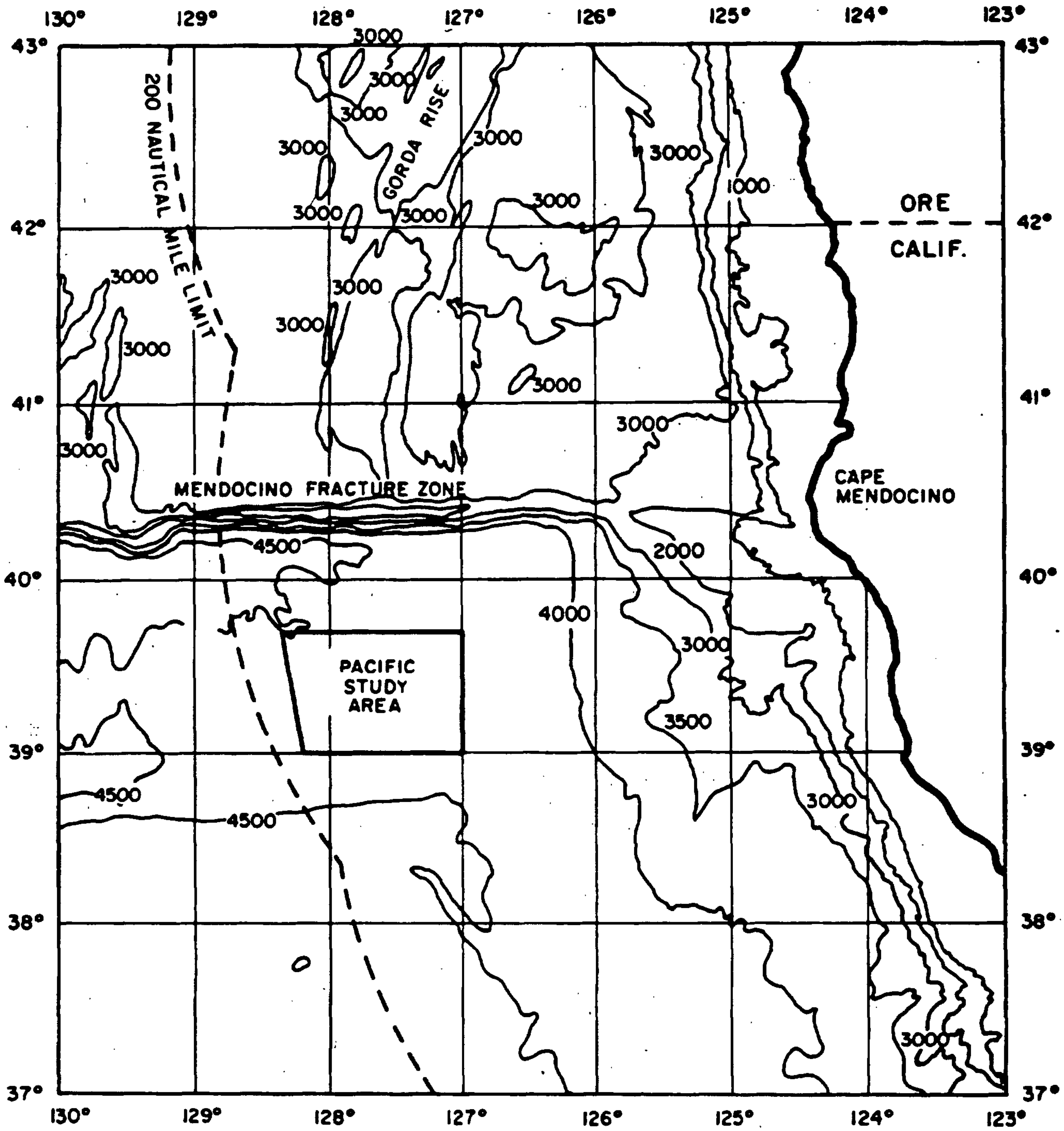


Figure 3-6. Pacific Study Area (Depth contours in meters)

(6) The number of dumping sites shall be strictly limited; and

(7) The area must be suitable for the convenient conduct of the dumping operation and so far as possible shall be chosen to avoid the risk of collision with other traffic during manoeuvring and undue navigational difficulties. The area chosen should preferably be one covered by electronic navigational aids.

C.2.2. The dumping site shall be defined by precise co-ordinates. In order to ensure a reasonable operational flexibility, it should have an area as small as practicable, but no larger than 10^4 square kilometres."

Annex III of the 1972 London Convention also lists general provisions to be considered in establishing the criteria to govern the issuance of sea disposal permits. Those provisions pertinent to site selection are as follows:

1. Depth and distance from the coast.

2. Location in relation to other areas, e.g., amenity areas, spawning, nursery and fishing areas, and exploitable resources.

3. Effects of currents, tides, and wind.

4. Water characteristics, e.g., temperature, pH, salinity, stratification, and chemical properties.

5. Bottom characteristics, including biological productivity.

6. Effects of other dumpings which may have been made in the area.

7. Possible effects of disposal on amenities, e.g., appearance of the water and its odor.

8. Possible effects on marine life, its culture, and harvesting.

9. Possible effects on other uses of the sea.

These IAEA requirements are self-explanatory in most cases. The 50° north and south latitude requirement is designed to avoid the sources of bottom water and the high biological productivity of the polar regions, and to avoid areas where debris may be deposited by ice-rafting, while the 4000 meter depth requirement is derived from the fact that biological, chemical, physical, and topographical changes generally diminish below 4000 meters and bottom water circulation is slower. Such depths are well below those penetrated by commercial fishing activity and are beyond the effects of major surface currents. Continental margins are excluded to avoid regions of high biological productivity, increased likelihood of resource exploitation, and the greater unpredictability and instability associated with the continental slope, rise, and associated alluvial fans.

The IAEA requirements were expanded in developing study area selection criteria by consultants from the Woods Hole Oceanographic Institution and the Oregon State University School of Oceanography (Reference 3.7). The added criteria are as follows:

1. Sites should be away from areas, such as submarine canyons, which have a high rate of exchange of the deep waters with surface layers of any adjacent continental shelf. This criterion is intended to avoid shortening of pathways to man, and is cited in Reference 3.5 as a factor to be considered, although it is not an IAEA requirement.

2. Bottom current shear stress should not exceed critical erosional shear stress. This is desired to prevent high rates of resuspension of sediments at the site, therefore preventing rapid movement of material.

3. Sites should be away from areas of intense mesoscale eddy activity. This is intended to avoid areas of enhanced eddy diffusivity which could shorten pathways to man.

A final factor that has been considered in identifying study areas is that they be within the 200 nautical mile Economic Control Zone boundary of the United States. Since such areas might be more desirable than areas that are well beyond the Economic Control Zone, it was felt that the study areas should represent the feasible locations closest to coastal regions. This would be expected to yield larger estimates of impacts on man than sites more distant from shore. Sites beyond 200 miles should not necessarily be excluded when determining an appropriate site for sea disposal. For example, the current Northeast Atlantic disposal site used by several European nations is well beyond 200 miles of any coast.

B. ATLANTIC STUDY AREAS (See Figure 3-5)

The first Atlantic study area (designated as the Lower Continental Rise Area) is situated east of Cape Hatteras, North Carolina, centered near 36° north, 71.5° west, approximately 220 nautical miles (410 kilometers) from the closest land point.

The second Atlantic study area (designated as the Hatteras Abyssal Plain Area) is situated southeast of Cape Hatteras, centered near 33° north, 71° west, approximately 280 nautical miles (520 kilometers) from the closest land point.

The depth in the study areas is approximately 4000 meters or 13,100 feet at the center of the Lower Continental Rise Area, and approximately 5000 meters or 16,400 feet at the center of the Hatteras Abyssal Plain Area. The ocean bottom is flat, having a slope of about 3 feet per 1000 feet at the Lower Continental Rise Area, and 1 foot per 1000 feet at the Hatteras Abyssal Plain Area. Sub-bottom profiles and precision echograms are available for enough of the general area to indicate that either of the study areas would probably satisfy disposal site selection criteria. However, additional field work and evaluation would be required to verify that a suitable location within the general area would meet all selection criteria.

Sediment deposition in the region of the two study areas occurs largely as a result of the seaward movement of material washed away from the land and deposited on the abyssal plain. Average depositional rates are approximately 8.5 centimeters per 1000 years. The sediment is composed of clay, silt, and sand deposits and sediment thickness is about 3.0 kilometers in the Lower Continental Rise Area, and about 1.5 kilometers in the Hatteras Abyssal Plain Area (Reference 3.6).

No recorded or known earthquakes were centered within the region of the two study areas, and the likelihood of future earthquakes is small. The closest active volcanoes are located in the Lesser Antilles Islands, about 900 miles to the southeast. It is highly improbable that the area would be affected directly or indirectly by a volcano.

The Gulf Stream moves roughly from southwest to northeast in this area. The Western Boundary Under-Current flows southward in this general area with the major portion of the current in depths greater than about 3500 meters but does not extend to the areas that would be typical of potential disposal sites. Bottom waters in the area tend to move slowly toward the northeast. An accurate measurement of bottom currents is underway, and preliminary results show that bottom water movement in the Hatteras Abyssal Plain area is moderate (approximately 8 centimeters per second mean net current velocity) with a direction to the northeast. The Hatteras Abyssal Plain study area does not appear to have been swept by strong bottom currents, although the possibility of intermittent turbidity currents is being studied. (Turbidity currents are a phenomenon natural to abyssal plains, where landslides from the continental slope and upper continental rise cause occasional seaward silt-laden currents of up to 50 knots or 93 kilometers per hour.) Portions of the Lower Continental Rise study area may have strong bottom currents, although a tranquil location may exist within this area and also within the 200 mile economic zone.

Some animal life is present on the sea floor in the study areas with low population density. None of the life forms are known to be used by man or are known to be a part of the food chain leading to man. No commercially exploited minerals are present on the sea floor in the Hatteras Abyssal Plain study area. However, the Lower Continental Rise study area lies adjacent to a recently mapped region that shows potential hydrocarbon resources (Reference 3.14). The waters in this general area are not exploited commercially and one of the bases for its selection was the likelihood that it will never attract commercial or other interest.

No undersea cables are known to pass through the Hatteras Abyssal Plain study area. One working telephone cable crosses the northeastern corner of the Lower Continental Rise Area but does not cross the subregion identified for further study (Appendix E, Section IV.B.1). None of these study areas is crossed by any major shipping lanes.

See Appendix E for a more detailed description of the Atlantic study areas.

C. PACIFIC STUDY AREA (See Figure 3-6)

The center of the Pacific study area is approximately 160 nautical miles (300 kilometers) west of Cape Mendocino, California, at 39° 20' north, 127° 40' west. The site characteristics, condensed from References 3.8 through 3.12, and from Appendix E, are as follows.

The area is beyond the continental margin, with depths varying from 4100 to 4500 meters (13,500 to 14,800 feet). The terrain is gently rolling with broad irregularities; the average slope in the center of the area is about 1 foot per 300 feet. Details of the sea floor characteristics have been obtained with sufficient detail to indicate that the area would probably satisfy the established selection criteria. As noted above for the Atlantic study areas, however, additional field work and evaluation would be required to verify that a suitable site within the general area would meet all selection criteria.

Sediment deposits in the area are in the form of silty clay with an average thickness of about 300 meters. The deposits probably result from particle settling from the water column rather than from bottom currents. Core samples indicate that the area has been stable for millions of years.

No recorded earthquakes were centered within the area, and the likelihood of future earthquakes is small. The general area is at least 40 miles south of the seismically active Mendocino Fracture Zone. On-site seismometer data may be of value to assess accelerations of the sea floor due to distant earthquakes. No seamounts or evidence of volcanic activity within the past million years are known to exist in the area.

Bottom water current measurements indicate that the water movement is slow with similar movement throughout at least the bottom 1250 meters, with a general overall direction toward the south-southeast or south-southwest and an average speed of about 1.0 kilometer per day. Surface velocities average less than 1/2 knot (approximately 1 kilometer per hour) and the direction of the current tends from the east (southeast to northeast).

The biology of the deep waters and the sea floor, which are not exploited commercially, has been studied to a limited extent, primarily by capturing specimens of fish and bottom-dwelling animals through bottom trawling and secondarily by analysis of the results of bottom photography. Both techniques indicate that the population density is low, relative to near-shore areas, with none of the sea life known to be used by man or known to be part of the food chain leading to man. The surface effects of burrowing animals have been visible in the examinations of core samples taken from the area. Commercial fishing has been carried out in surface waters in this area, which is on the outer fringe of the general fishing area. The estimated average annual fish catch (albacore) in this fringe area is low, being only 0.5 percent of the estimated average annual catch in the peak productivity area west of Cape Mendocino (see Appendix E, Figure E-20). No commercially exploited minerals are present on the sea floor (Reference 3.14).

There are no known undersea cables that pass through the area, and the area is well clear of major U.S. shipping routes.

See Appendix E for a more detailed description of the Pacific study area.

D. CHARACTERISTICS OF THE STUDY AREAS RELATED TO MODELING ENVIRONMENTAL EFFECTS

All of the existing data on the Atlantic and Pacific study areas described above indicate that it is likely that acceptable sites can be identified which meet IAEA criteria.

The information from the study areas has been used to model environmental effects of the sea disposal option. For example, dissolved oxygen concentrations, temperature data, and chemical properties of the sediment have been considered in selecting appropriately conservative corrosion rates for the metal components that would be placed on the sea floor. Sediment depth and physical properties (shear strength) have been considered in determining upper limits on the likely bottom impact resulting from free fall of the submarine. Bottom current speed and direction have been taken into account in modeling potential transport of radioactive material away from the disposal site by advection and diffusive processes.

The general locations of the study areas have been taken into consideration in selecting exposure pathways, seafood consumption rates, and the size of potentially exposed populations since it is expected that sites meeting the IAEA criteria would be no closer to man's activities. Available knowledge of the bottom-dwelling life in the study areas has been employed with the result that no exposure pathway to man has been identified, that is, beginning with bottom-dwelling animals and proceeding along a chain of predators to an end point resulting in human consumption of fish containing radioactive contamination. However, such pathways have been included in radiation exposure calculations, even if they are only hypothetical, to assure that no unforeseen pathway could cause an underestimate of environmental impacts.

The approach used in modeling the environmental impact of sea disposal has been two-fold. A best estimate of the radiation exposure is based on realistic values of the physical parameters at each step, and a conservative estimate of the radiation exposure is based on values of the physical parameters that are selected to provide an estimate that is conservatively high under actual conditions.

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences resulting from the permanent disposal of approximately 100 defueled and decommissioned submarine reactor plants. The two practical permanent disposal options are (1) land disposal by burial of the submarine's reactor compartment at existing Department of Energy waste disposal sites and (2) sea disposal of the submarine at a site approved by the Environmental Protection Agency. Each option is discussed in a separate section. The effects of the "No Action Alternative" (an indefinite period of protective storage prior to either of the permanent options) are discussed in a third section. A final section provides a summary and conclusions.

I. LAND DISPOSAL OPTION

A. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE LAND DISPOSAL OPTION BE IMPLEMENTED

1. Effect on Land Use

Land disposal of the reactor compartments from all of the approximately 100 submarines considered in this statement would require an area of less than ten acres that would be indefinitely removed from unrestricted use. A ten acre area is 435,600 square feet, or about 3 1/2 times the total reactor compartment cross-section area of approximately 125,000 square feet that would actually be occupied by the buried compartments. It represents a small fraction of the land area of the Hanford Site (365,000 acres) or the Savannah River Plant (192,000 acres). The land that would be used is already part of low level waste disposal sites, which occupy over 1000 acres at the Hanford Site and about 195 acres at the Savannah River Plant.

The usable designated area available for low level waste burial at the Hanford Site appears to be adequate for all foreseeable operations. The usable designated area at the Savannah River Plant is currently approximately 55 to 60 acres. Department of Energy Nuclear Waste Management Program estimates (Reference 4.24) show that the Savannah River Plant capacity will be filled in 1994, based on an average use rate of about 4.5 to 5 acres per year. The effect of adding three reactor compartments per year (0.3 acre per year) to the total disposal rate would result in the existing burial area being filled approximately half a year earlier than the current estimate. At that time, another burial site would have to be designated either at Savannah River or elsewhere for both the remaining reactor compartments and the routine Savannah River radioactive solid waste.

For the construction of a river landing slip and barge unloading facilities at the Savannah River Plant, an additional area of approximately two acres would be temporarily withdrawn from use. No additional land would be required at the Hanford Site because such facilities are already available.

From the foregoing discussion, it is concluded that the land use impact of the land disposal option would be negligible.

2. Radiological Effects

(a) **Direct Radiation.** Direct radiation effects would be almost entirely occupational exposures (see Sections I.A.2.(c)(1) and (c)(2) below). The possible sources of direct radiation exposure to members of the general public would be the minimal exposure associated with normal transportation of the disposal package (less than 10^{-3} man-rem population exposure as described in Section I.A.2.(c)(3)), and the remote possibility of exposure resulting from an extreme transportation accident (see Section B.1.(a) below). Direct radiation levels at the disposal site would be less than 0.1 mrem per hour because of the low radiation levels that would normally exist on the compartment exterior, and the shielding effect of the earth cover.

(b) **Radioactive Material Release Due to Corrosion of Metals.** Although the number of curies of radioactivity in the decommissioned reactor plant could be substantial at the time of burial (Chapter 1,

Table 1-1), the actual release into the disposal site ground would be small because of the multiple containment of the radioactive material and the short radioactive decay half-lives of the nuclides making up the majority of the material. The thickness and durability of the containment barriers, combined with the fact that the radioactive material is almost entirely an integral part of the metal components, lead to the conclusion that all but the longest lived radionuclides (principally Nickel-59 with a half-life of 80,000 years) will have decayed to stable form before any release can occur.

A conservative estimate of the possible release of radioactive material has been developed in Appendix C, based on the conservative assumptions that the ground area in the vicinity of the buried compartment would be continuously wet and that sufficient water flow would be available to carry any corrosion products away from the burial site to a river which is a major source of water. The exterior containment would remain intact for at least 200 years, an estimate based on the minimum bulkhead thickness (one-half inch walls) and an average annual corrosion rate of 0.0025 inch for low alloy steel. Following an eventual penetration of the exterior containment, which would thereafter allow water into the reactor compartment, the reactor vessel would remain intact for an additional period of several thousand years. The structures within the reactor vessel would then be subject to corrosion release, with Nickel-59 being the only radioactive nuclide remaining in significant curie quantity.

The subsequent annual release rate of the Nickel-59 is estimated to be no greater than 0.057 curie for each reactor compartment, based on an average annual corrosion rate of 0.0003 inch per exposed surface for corrosion-resistant alloy (both surfaces of components within the reactor vessel are assumed to be exposed). Total Nickel-59 release to the burial site over all time would eventually be about 120 curies per reactor compartment. The maximum annual releases of all nuclides, and the corresponding releases over all time, are shown in Table 4-1 below. This approach is conservative for the estimate of radioactivity release at the Savannah River burial site, and even more conservative for the Hanford burial site where it is likely that the reactor compartments would remain dry for an indefinitely long period of time because of the low annual precipitation (6.25 inches per year) and the fact that the groundwater table is at least 150 feet below the surface. The effects would be further mitigated by the sorptive property of the soil which slows down the migration of the released radioactive material.

The release of radioactive material into the burial ground that could eventually occur compares favorably with what is expected using current practices. The principal difference with the buried reactor compartments would be the considerably longer-lasting containment relative to most low-level burial packages.

(c) **Radiation Exposure**

(1) **Exposure to Shipyard Personnel.** The total radiation dose to shipyard workers during preparations for the disposal action would be approximately 17 man-rem for each submarine reactor compartment processed for disposal under this option. This exposure would be to individual workers who are trained for radiation-related work. Each worker's exposure would not exceed established limits (3 rem per quarter and 5 rem per year to the total body). The exposure would be a consequence of the necessary tasks carried out in the gamma radiation field of the reactor compartment, such as removing salvageable components and draining reactor plant systems. The total occupational exposure associated with protective storage for 20 years followed by land disposal is estimated to be approximately 20 man-rem, as discussed in Section III.A.1. Additional information on occupational exposure is provided in Appendix A, Section III.D.1.

(2) **Exposure to Personnel Involved in Movement to Disposal Sites and Burial Operations.** The total radiation exposure to personnel involved in moving the reactor compartment from the shipyard to the burial site is estimated to be less than 1.0 man-rem, involving external exposure only. The estimate is based on approximately 600 man-hours of work actually in close proximity to the compartment, during which the average exposure rate would be approximately 1.5 mrem per hour. This exposure would not be to members of the general population but to workers whose exposure is monitored and controlled.

(3) **Exposure to the Public from Transportation of Reactor Compartments.** The radiation exposure to the public that might result from transportation of a reactor compartment from the shipyard to land

TABLE 4-1. RADIOACTIVE MATERIAL RELEASED TO THE DISPOSAL SITE RESULTING FROM LAND DISPOSAL OF ONE REACTOR COMPARTMENT

Nuclide	Maximum Release In Any Year (Curies per Year)	Approximate Time at Which Maximum Occurs (Years After Disposal)	Total Release Over All Time (Curies)
Ni-59	0.057	2800	120
C-14	0.0004	2800	0.6
Ni-63	0.0026	200	0.25
Nb-94	3.9×10^{-5}	2800	0.07
Mo-93	5.1×10^{-6}	200	0.0083
Tc-99	1.6×10^{-6}	200	0.0036
Fe-55	1.4×10^{-4}	1*	6.3×10^{-4}
Co-60	2.2×10^{-5}	1*	1.7×10^{-4}
Mn-54	3.2×10^{-6}	1*	5.7×10^{-6}
Co-58	1.8×10^{-7}	1*	1.8×10^{-7}
Fe-59	7.9×10^{-8}	1*	7.9×10^{-8}
Cr-51	2.8×10^{-8}	1*	2.8×10^{-8}
S-35	5.8×10^{-10}	1*	5.8×10^{-10}
Sc-46	6.4×10^{-11}	1*	6.4×10^{-11}

Corrosion rates: Low-alloy steel: 0.0025 inch per year per exposed surface
Corrosion resistant alloy: 0.0003 inch per year per exposed surface

*These early releases result from the radioactive material contained in the metal of the exterior boundary (hull and bulkheads), and the assumption that the activity is uniformly distributed in the metal.

disposal sites is estimated to be less than 10^{-3} man-rem (see Section IX of Appendix C). This estimate was developed by applying the estimating techniques contained in Reference 4.1, supplemented by Reference 4.2. The latter document describes the shipment by barge of a commercial nuclear plant steam generator that was similar to the shipment by barge of a submarine reactor compartment. The low radiation exposure expected from transportation of reactor compartments is consistent with the judgment expressed in Reference 4.1 that the population exposure associated with transport by barge is expected to be negligible. (See Section B.1 for a discussion of the consequences of a hypothetical accident during the transportation of a reactor compartment.)

(4) **Exposure to the Public from Release of Radioactive Material.** Exposures to the public resulting from the radiological waste disposal programs at the Hanford and Savannah River sites have been shown to be small fractions of natural background exposures. The maximum potential dose to an individual from effluents released at Hanford in 1972 was estimated to be 0.6 mrem/yr (Reference 4.3, page I-3). For effluents from the Savannah River Plant in 1975, the calculated whole-body dose to a hypothetical individual who resided at the plant boundary and consumed river water and 0.5 lb. of river fish per week was

1.2 mrem (Reference 4.4, page I-1). Doses to average individuals were much smaller than these maximum estimates. Depending to some extent on the population over which the average is determined, the average dose rate varied from 0.01 mrem per year in 1972 within 50 miles of the Hanford Site (Reference 4.3, page I-3), to 0.22 mrem per year in 1975 to the water-consuming population downstream of the Savannah River Plant (Reference 4.4, page I-1).

Exposures at Hanford or Savannah River as a result of the burial of defueled, decommissioned submarine reactor plants would similarly be very small. The reactor compartment would provide excellent containment, exceeding current requirements for such material, and the reactor plant would provide an additional level of containment of similar quality.

As described in Section I.A.2.(b) above and with additional details in Appendix C, radioactive material release from the buried reactor compartments would be small and most releases would be delayed for centuries. Assuming that all 100 reactor compartments were at the same disposal site, the average annual whole body exposure* to an individual would be approximately 0.006 mrem per year of exposure, or approximately 0.006 percent of natural background. This exposure would occur several thousand years after burial. The corresponding population dose commitment would be 2.1 man-rem to the total body per year of exposure, based on an assumed population at the time of exposure of 350,000 persons. The maximum number of health effects (cancers) predicted for this year of highest exposure would be about 0.001, calculated using the conservative linear relationship of 0.00045 additional cases of cancer in a population for each man-rem (Reference 4.15).

A maximum individual whole body exposure of 1.5 mrem per year has also been estimated for the period beginning several thousand years after burial, an exposure rate equal to about 1.5 percent of normal background. This maximum exposure is estimated with the assumption that a few individuals might live on or near the disposal site in the far-distant future (2000 to 3000 years from the present), and be exposed to radioactive material (Nickel-59, with an 80,000 year half-life) released to the local streams or wells (see Section V of Appendix C).

(d) **Engineered Improvements to Minimize Radioactivity Release.** When compared with the usual low level radioactive waste disposal packages placed in land disposal sites, the reactor compartment "package" has the following important advantages which may be regarded as engineered improvements.

(1) The reactor compartment hull and bulkheads provide an extremely thick, strong exterior steel container. The hull itself is high-strength steel designed to be suitable for deep submergence during submarine operations. The steel end walls (bulkheads) of the reactor compartment containment have a minimum thickness of 1/2 inch. All penetrations in the hull and bulkheads would be sealed shut by welding.

(2) The reactor vessel provides a secondary or inner containment that is even thicker and stronger than the exterior containment. Even when the exterior containment is penetrated by corrosion, over 99 percent of the radioactivity will still be held within the second sealed containment. The reactor vessel would remain isolated from the environment for at least 200 years and thereafter would be subject to corrosion from the exterior but not the interior.

3. Non-Radiological Effects

(a) **Irreversible or Irretrievable Commitment of Resources.** For each disposal, approximately 1000 tons of material that is primarily steel would be buried. Approximately 3000 additional tons would be discarded if the remainder of the ship were disposed of at sea. The materials are not in short supply and would represent a very small fraction of such materials produced annually in the United States. The 1000 tons of reactor compartment material is not considered salvageable in its present state because of the presence of low level radioactivity. Scrap value of the salvageable portion of the ship would be approximately $0.3 million per ship.

For the total of approximately 100 disposals, ten acres of land would be indefinitely removed from unrestricted use.

*All exposure estimates due to ingestion or inhalation are dose commitments over the entire lifetime of an individual (70 years).

(b) **Effects of Work in the Shipyard.** Shipyard preparations for land disposal would be accompanied by smoke and fumes from cutting and welding torches, noise, and the generation of quantities of scrap metal. These effects are expected to be no different from similar normal shipyard activities. They would affect only a small area in the immediate vicinity of the shipyard and would be in accordance with existing regulations and practices.

(c) **Burial of Non-Radioactive Solid Waste.** The solid material that would be buried is primarily steel, but also includes quantities of plastic, asbestos, and metal such as lead, nickel, chromium, cobalt, and cadmium. The disposal of all non-radioactive solid waste would be consistent with normal practice at the land burial sites and would be performed in such a way that the end result would be at least as good as other available means for disposing of this material. The waste to be disposed of would not contain liquids.

Lead shielding built into the reactor compartment would eventually be exposed to corrosion through moisture in the soil and could subsequently release lead corrosion products into the ground and groundwater systems; but the maximum concentrations of lead in the water at potential biota access locations, such as a downstream well or surface stream would be less than the water quality criteria published by the EPA for protection of human health and aquatic life. Corrosion data for lead exposed to land burial conditions are provided in Appendix F. Calculational methods for estimating the maximum concentrations of lead in groundwater are described in Reference 4.26. The EPA water quality criteria were obtained from Reference 4.27.

(d) **Other Pollutants.** Barge transportation of the reactor compartments from shipyard to burial site would result in some air and water pollution due to the burning of fuels and operating the tug and barge over the coastal waterways and rivers. Such added pollution would be within existing limits and its environmental consequences would be minor.

(e) **Secondary or Indirect Effects.** Implementation of the land disposal option would require the construction of a river landing slip and barge unloading facilities at the Savannah River Plant. This would require the removal of a volume of earth from the river bank of approximately 7800 cubic yards (Appendix L). The work would be carried out in accordance with applicable environmental and other regulations, and removed material would be disposed of in accordance with existing regulations and practices. Appendix L, "Floodplain/Wetlands Assessment," discusses the effects of possible disposal at the Savannah River Plant on floodplain management and protection of wetlands. Significant adverse environmental effects are not expected.

The permanent raising of overhead utilities along the overland route at both sites would be required. Underground pipe crossings along either of the land routes from the unloading site to the burial site may require strengthening to bear the weight of a loaded transporter but would entail only minor localized trenching and similar work. The environmental consequences of these activities would be minor.

The occurrence of endangered and threatened species at the Hanford Site and Savannah River Plant burial grounds is discussed in Reference 4.25, where it is concluded that disposal activities would not be expected to affect those species that are found in the two general areas. At Hanford, the bald eagle is found on the reservation, but not on the burial site, so its habitat would not be impacted. At Savannah River, the red-cockaded woodpecker, the American alligator, the wood stork and the short-nose sturgeon are known to occur, but suitable habitat for these species is not present at the burial ground or the barge slip that would be required at Savannah River.

Concerning archaeological sites of interest, no occurrence of such sites has been revealed at either the Savannah River Plant or Hanford Site burial grounds, even though extensive burial operations have been conducted at both sites for over 30 years. Therefore no impact on archaeological sites would be expected.

Socioeconomic impacts at the disposal sites would be minimal since the work would be similar to burial operations which are currently conducted at these sites. There would be no significant increase in the size of the workforce at the disposal sites.

B. ADVERSE ENVIRONMENTAL EFFECTS OF POSSIBLE ACCIDENTS INCIDENT TO THE LAND DISPOSAL OPTION

1. Accidents Involving Radioactive Material

(a) **Immediate Effects.** The most severe conceivable accident involving radioactive material during land disposal operations would be one that might cause both penetration of the containment normally provided by the reactor compartment hull and bulkheads and the fracture of the primary coolant system outside the isolated reactor vessel. This accident is considered highly unlikely (see Section I.B.2(c) below) and could occur only as the result of a worst-case sequence of events with the most severe consequences. An accident that would cause penetration of the isolated reactor vessel, which contains 99 percent of the initial radioactivity, is not considered credible because of the strength of the materials which make up the reactor vessel.

This hypothetical worst-case accident, which could release a small fraction of the contained radioactive material to the environment, has been analyzed in accordance with the standards for packaging radioactive material for transport, specified in Appendix B of Part 71 of Title 10, Code of Federal Regulations (10CFR71), Reference 4.5. Specific details concerning the analysis are presented in Appendix B, Section III.F.2. The analysis shows that less than 3.5 curies of surface-deposited radioactive material (crud) could be released from the reactor compartment due to hypothetical shipping accidents.

The consequences of an accidental release of 3.5 curies of radioactive crud have been estimated. All of the radioactivity was assumed to be Cobalt-60 since this nuclide would cause the highest exposure. If 0.1 percent of the release were to the atmosphere, a maximum individual dose commitment of 0.3 mrem (total body) and 49 mrem (lung) could result assuming that the exposed maximum individual were to remain 100 meters directly downwind for a 2-hour period (see Section X.A of Appendix C). This exposure includes the exposure resulting from inhalation, immersion in the contaminated cloud, and direct radiation from the accident-damaged reactor compartment. If the airborne release were deposited and uniformly distributed in a small body of water 100 meters in diameter and 3 meters deep, the dose commitment to a maximum individual could be 1.4×10^{-3} mrem (total body) and 2.3×10^{-2} mrem (GI tract) (see Section X.B of Appendix C). This assumes that the exposed individual would drink one full day's normal intake of water from this body of water before it was known to be contaminated.

For comparison purposes, the U. S. Nuclear Regulatory Commission (Reference 4.6) uses a 25 rem total body dose to evaluate proposed reactor sites with respect to such low-probability accidents. Therefore, the maximum organ dose commitment due to a worst-case accident involving the reactor compartment (49 mrem) would be less than 0.2 percent of this reference accident exposure.

The sequence of events required to cause these hypothetical accident dose commitments would be extremely unlikely to occur. It is expected that an actual accident of this type would result in much lower release values.

(b) **Delayed Effects.** In the unlikely event that a reactor compartment were accidentally sunk during transit to the burial site and not recoverable following breaching of the exterior containment (hull or bulkhead), there could be a delayed release of radioactive material due to the slow effects of corrosion. For the reactor compartment to be non-recoverable, the accident would have to occur in off-shore waters of at least 500 feet depth, since at shallower depths recovery could be accomplished within a short time relative to the time required for corrosion release. The magnitude of the release is assumed to be the same as the upper limit release estimated for an unrecoverable loss during transit for sea disposal (see Table 4-5) with the location of release as close to land as 25 kilometers (16 miles).

Assuming that the delayed release from a lost reactor compartment were to occur 25 kilometers from land, at highly productive fishing grounds, a conservative dose commitment has been calculated (Appendix J, Section III.E.3). The total body dose commitment would be approximately 3 mrem per year of exposure to the most-exposed individual. This conservative estimate further assumes that despite the close proximity of the sinking location to human activities, no interruption would occur in normal activities at the affected area.

The accident postulated here is very unlikely in view of the precautions that would be taken to prevent sinking of the barge or loss of the reactor compartment from the barge. The barge would be compartmented so that accidental flooding could occur without sinking. The compartment would be welded to the barge. A backup tug would be available during the sea portion of the trip.

Because of the very pessimistic assumptions made in the analysis of this accident, any other radiological accident associated with land disposal or sea disposal is considered to have even less significant immediate or delayed effects.

2. Non-Radiological Accidents

The following accidents and their consequences have been considered.

(a) **Fire or Explosion in the Shipyard.** No abnormal potential for fires or explosions would exist with this option. The hazards encountered during a normal submarine overhaul or refueling are not unusual and are of very low probability. Prevention of and recovery from fires and explosions are adequately covered by existing shipyard instructions. Flamecutting of large steel plates is a normal shipyard operation.

The proposed transport barges for this project are of all-steel construction including a steel deck and contain no fuel or volatile substances. Barge damage by fire or explosion is not considered to be probable, either in the shipyard or during transit.

(b) **Stability of the Removed Reactor Compartment.** The methods and structures that would be employed to remove the cylindrical reactor compartment from the submarine make it unlikely that the removed compartment would be unstable or have a tendency to roll out of control. Structures would be welded to the compartment exterior for support in its original attitude and for handling during transit which would make it difficult for the reactor compartment to roll or topple. The structural attachments would be required to meet paragraph 71.31(d)(1) of Title 10, Code of Federal Regulations (Reference 4.5).

Jacking and moving operations on the reactor compartment, in preparation for securing it to the barge, would be relatively less routine than other shipyard operations for early disposals, although the shipyards have extensive related experience. Adequate safety equipment and procedures exist for these operations.

(c) **Barge Transportation Accidents.** Barge transportation accidents include collisions such as with another vessel or with bridge supports, conceivably resulting in the sinking of the barge with its reactor compartment cargo. This accident is considered in Section B.1.(b) above.

An expected number of barge accidents can be estimated for the entire program. The calculated number of accidents, including minor collisions, is 0.3 based on an assumed 100 barge trips averaging 500 miles each for a total of 50,000 miles (80,600 kilometers), and an estimated domestic accident rate of 3.6 per million kilometers of cargo barge traffic (based on Reference 4.1). The calculated number of expected accidents in the "severe" or "extra-severe" categories of Reference 4.1 is 0.00009, since only about 0.03% of cargo barge accidents are in these categories. This implies that there would be only a very small probability of a serious barge accident throughout the entire land disposal program.

Nonradiological effects of accidents involving the barge shipment of reactor compartments would not be expected to be significantly different from those involving other barge shipments of large items of equipment.

(d) **Land Transportation Accidents.** An accident which might be hypothesized to occur during movement of the reactor compartment from the river dock to the burial site is that the load could fall off the crawler transporter and roll down hill. Such an accident is considered very unlikely for the following reasons:

(1) The crawler transporter is very stable due to the large area of its track pads (300 square feet). It is capable of operating on grades up to 12 percent with full load, and would not be required to operate at a grade greater than 6 percent for the burial sites considered. Load testing to 150 percent of the rated capacity would be performed.

(2) The structural supports and attachments to the package for securing the reactor compartment to the crawler transporter would be designed to ensure that the transporter and its load would remain fastened together.

(3) If the cylinder were to drop from the transporter to the ground, it would probably, because of its great weight, implant itself in the ground instead of rolling. The loading on the ground would be several tons per square foot. If the cylinder did begin to roll, it would stop before moving more than two-thirds of one revolution because the structural support pads that are welded to the package would dig into the ground. Figure B-1 of Appendix B shows a view of the support pads on the reactor compartment.

Collisions between the loaded crawler transporter and other vehicles would be extremely unlikely due to the limited speed of the transporter (approximately 1 mile per hour) and the use of escorts over roadways which would either be unused or temporarily blocked off from all other traffic.

C. CUMULATIVE EFFECTS OF REACTOR COMPARTMENT LAND DISPOSAL

The incremental environmental impact of disposal of all one hundred submarine reactor compartments at one land disposal site would be so small that there would be no significant cumulative impact resulting from this action. For example, based on very conservative calculations, the effect of land disposal might produce at most an incremental exposure of 0.006 millirem/year to a typical member of the population most directly affected. This potential exposure is very small in comparison to fluctuations in exposure resulting from variations in individual activities and geographic location. There is no potential for reactor compartment land disposal to contribute to a significant cumulative impact.

Considering the total of all land disposal activities, at the same Federal burial site as well as at other locations, the additional environmental impact of reactor compartment disposal would not cause a significant increase in the total environmental impact.

A synergistic effect between radiation and other physical, chemical, or biological agents is not likely. Such an effect would be one in which the combined effect of two or more agents would exceed the sum of the effects of the individual agents. As stated in Reference 4.31, "Except for the case of tobacco smoke, which may act synergistically with radiation in producing lung cancers under some working conditions, this study has been unable to document in man any clear case of interaction, at least of the kind which may result in substantial modifications of the estimates of risk for significant sections of the population."

II. SEA DISPOSAL OPTION

A. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE SEA DISPOSAL OPTION BE IMPLEMENTED

1. Effect on Future Use of the Sea

If sea disposal were selected, it would be required that the disposal sites be designated by the U.S. Environmental Protection Agency and that site-specific environmental assessments be prepared. As described in Chapter 3, Section II.A, potential sites would be excluded from consideration if they were near (a) major shipping lanes, (b) communication cable routes, (c) defense areas or strategic routes, or (d) areas of potential seabed resources. This last item would eliminate sites in the vicinity of potentially valuable deposits of manganese nodules, gas or oil deposits, or significant feeding grounds for marine organisms important to man, or grounds where such organisms are harvested. Areas which have a high probability of such uses in the future would also be excluded.

In the unlikely event that a remote disposal site designated by the EPA were to become of interest for other purposes at some time after the site had been used, it would be highly improbable that the presence of defueled nuclear submarines would have any significant effect on usage of the water column. The submarines would be at a depth of at least 4000 meters and would produce no detectable radiation field. Even usage of the sea floor would likely be unaffected because of the small areas actually involved since each submarine would cover less than 10,000 square feet. The radiological effects of disposal would be very limited even at the immediate disposal site. For these reasons and because the total area of a disposal site, including space allowed between submarines for emplacement, would probably be less than 100 square miles, or less than 1.3×10^{-6} of the ocean floor deeper than 4000 meters, it is concluded that the impact of this option on uses of the sea would be negligible.

2. Effect on National Environmental Policy

Sea disposal has not been practiced by the United States since 1971, and many individuals and groups are opposed to the consideration of its resumption, as illustrated by the responses of some members of the public to the draft version of this document (see Volume 2). After the draft of this document was issued in December 1982, a two-year moratorium on sea disposal of low-level radioactive waste was included in legislation that became federal law in January 1983 as an amendment to the Marine Protection, Research and Sanctuaries Act of 1972 (Reference 4.8).

The two-year moratorium does not directly affect the Navy's possible use of the sea disposal option since no disposals would have been considered in the time period in which the moratorium is in effect. However, other provisions of the amendment place restrictions on the EPA's granting of a sea disposal license. These restrictions go beyond the National Environmental Policy Act and make the sea disposal option uncertain. Such is the case even though the sea disposal option is permitted under existing international treaties to which the United States is party, and under which other nations have conducted disposal of low level radioactive wastes into the ocean.

All actions taken in carrying out the sea disposal option would be consistent with the recommendations of the International Atomic Energy Agency, which acts as advisor to the International Maritime Organization (IMO). The latter organization administers the 1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Reference 4.7) to which the United States is signatory. The necessary regulations to enforce the convention requirements in this country are provided by the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, and administered by the U.S. Environmental Protection Agency. Implementing regulations for the Act are contained in Reference 4.17, Subchapter H—Ocean Dumping. Therefore, sea disposal of defueled, decommissioned submarines would not violate existing law and would require no new laws, although as noted above it is uncertain when a sea disposal permit could be granted to the Navy by the EPA. The EPA is authorized to issue permits for radioactive waste disposal in the ocean according to Sections 220 through 229 of Part 40 of the Code of Federal Regulations, Reference 4.17. However, the 1983 Amendment referred to above requires approval of such EPA permit granting by both the U.S. Senate and House of Representatives. The EPA would be responsible for providing reports of all such disposal activity to the International Organization for Economic Cooperation and Development (OECD).

3. Radiological Effects

(a) **Radiation Effects on Bottom-Dwelling Sea-Life.** Direct radiation levels at the disposal site, even within the reactor compartment itself, would be negligible even in the earliest years following disposal, because of the shielding effect of water, which reduces the exposure rate caused by gamma radiation by a factor of approximately 10 for every 2 feet of additional distance from the source. The radiation levels inside the reactor compartment would be less than 100 mrem per hour before the compartment is filled with water during disposal preparations. With the compartment filled with water, the radiation level would be less than 10 mrem per hour at any position 2 feet away from the reactor vessel, less than 1 mrem per hour 4 feet away, and so forth. Outside the filled reactor compartment, the exposure rate would be approximately 0.001 mrem per hour or less. Since the reactor compartment would be inaccessible, no animals could be exposed to radiation exceeding their natural background radiation by any significant amount. After 100 years, when the reactor compartment containment is assumed to be penetrated, the radiation would be less than 0.001 mrem per hour throughout the entire compartment because the Cobalt-60, which is the principal source of gamma radiation, and most other radioactive sources would have decayed to stable nuclides.

In the unlikely event that bottom-dwelling sea life did inhabit the reactor compartment continuously, and received an exposure of 1 millirad per hour (corresponding to 1 mrem per hour) 4 feet from the reactor vessel, the resulting exposure would be less than 9 rad per year. Scientific studies have shown that "it requires, as the lower limit, an acute dose of about 100 rad to produce some mortality in a number of organisms but not in all," and "when experimental and field dose rates are less than 1 rad per day it becomes very difficult to observe effects which can be used as indicators of damage." (Reference 4.9, page 89). Therefore the effect of the hypothetical exposure would not be expected to result in any damage to deep ocean populations. This hypothetical exposure would be limited to the small number of animals assumed to inhabit the reactor compartment continuously, and the exposure rate would decrease by a factor of 2 every 5.26 years (the Cobalt-60 half-life).

Internal radiation exposure to sea life in the immediate vicinity of the disposal site would occur, with the expected maximum effect taking place after many centuries of gradual release of radioactive material had occurred. The means of exposure would be ingestion of the sediment or water containing the radionuclides released from the submarine. The maximum rate of internal exposure is estimated to be approximately 0.3 rad per year, assuming that Nickel-59 is the only radionuclide actually released to the environment in any significant curie amount (see Section II.A.3.(b) below).

All of the originally available long-lived Nickel-59 (120 curies) is assumed to be dispersed within a volume of sediment 560 meters by 140 meters, 15 cm thick. The surface area is the area associated with one day's tidal currents (Reference 4.23) and is the area in which all of the dispersed material is assumed to be distributed. Since sediment density is approximately 1.4 grams per cm^3, the average radioactive Nickel-59 concentration in the sediment, ψ, would be:

$$\psi = \frac{120 \text{ curies } (10^{12} \text{ picocuries/curie})}{(560 \text{ m})(140 \text{ m})(0.15 \text{ m})(1.4 \text{ g/cm}^3)\left(\frac{10^6 \text{ cm}^3}{\text{m}^3}\right)}$$

$$\psi = 7300 \text{ picocuries per gram.}$$

The maximum rate of exposure to animals on the sea floor is estimated by assuming that a large fraction of the animal would contain 7300 picocuries of Nickel-59 per gram. This fraction is assumed to be 25 percent to represent the fraction of the animal's weight equivalent to its gut. The calculation is made as follows:

$$D = f k \epsilon \psi$$

where

D = dose to animals dwelling in the sediment at the disposal site, rads per year

f = grams of sediment per gram of affected animal (0.25)

k = conversion constant (1.9×10^{10} disintegrations per year per curie multiplied by grams-rad per MeV)

ϵ = effective energy per disintegration (7.7×10^{-3} MeV per disintegration, for Nickel-59, based on Table B-5 of Reference 4.22)

ψ = 7300 picocuries per gram of sediment

D = 0.3 rad per year.

This estimate is comparable to that obtained by using the method outlined in Appendix D of Chapter 1 of Reference 4.9. An exposure rate of 0.3 rad per year is small compared to the annual internal exposure to the naturally-occurring radionuclide Polonium-210 that may be received by some mid-water-dwelling species (600 to 1500 meter depth). Reference 4.29 estimates that the natural doses to the most-affected organ (hepatopancreas) of certain species of shrimp (Gennadus valens) may be greater than 195 rem per year.

(b) **Release of Radioactive Material to the Marine Environment.** Since virtually all (99.9 percent) of the radioactive material associated with the proposed disposal was formed within structural metals as the result of neutron activation, it is integrally contained and could be released to the environment only through corrosion of the metals themselves. The slow rate of metal corrosion would therefore control the rate of release of radioactive material from the metal to the seawater, providing one of several forms of containment which are among the numerous barriers to movement from the disposal site to the human environment at some distant location. This containment provided by the solid metal in which the radioactive material is formed cannot be compromised by any event during emplacement.

The radioactive material that is not an integral part of the structural metal (about 0.1 percent of the total) consists of corrosion product activity deposited on and adhering to the interior surfaces of components. This material is fully contained within the reactor plant and would remain within the containment until it was penetrated.

Corrosion of metals in seawater at great depths is slower than corrosion near the surface because of the low temperature (1° to 2°C) and the absence of disturbing influences that might tend to damage corrosion films or disrupt the slow process of low temperature corrosion. The annual rates of corrosion employed in release-rate estimates for this statement have been conservatively estimated based on available research results (References 4.10 and 4.11). The background and basis for the corrosion rates chosen are provided in detail in Appendix F, "Corrosion of Structural Alloys."

The corrosion rates employed in release rate estimates are 0.0025 inch per year per exposed surface for low-alloy steels, and 0.0003 inch per year per exposed surface for corrosion-resistant alloys, such as stainless steel. Corrosion rates actually measured in deep ocean experiments have been lower than the assumed rates, as discussed in Appendix F. Since corrosion-resistant alloys such as stainless steel are subject to relatively rapid pitting, the analysis of radioactive material release due to corrosion takes into account the degradation of complete containment by pits that penetrate portions of the reactor vessel closures. The rate of pitting attack is assumed to be 0.0138 inch per year, a factor of 46 greater than the average surface rate of 0.0003 inch per year, based on information obtained from existing literature, as described in Appendix F.

To estimate the rate of release of corrosion products and the total amount of radioactivity released to the environment from disposal of defueled submarines, two different cases of radioactivity containment were selected for analysis. Details of each are provided in Appendix G. One case postulates only the minimum containment that is provided as a result of the fact that most of the radioactive material is an integral part of the metal. This case is intended to define an upper-bound estimate on any possible effects, including an accident, at a very high level of certainty. The second case is the expected result of a normal disposal, with the reactor compartment and reactor vessel containment intact. Other particular cases of interest would be expected to yield release rates and total releases that are less than the minimum containment estimate. It is important to note that the expected result of a sea disposal action would be the placement of the submarine in intact condition on the sea floor, a condition which would be consistent with the lower radioactivity release estimate. The basis for this expectation is provided in Appendix D, "Description of the Sea Disposal Method."

To estimate annual rates of radioactive material release and the total amount of radioactive material which might be released to the environment from all of the disposed submarines, the calculated releases from a total of 100 ships have been combined on the basis of three disposals per year for 33 years. This estimated release of radioactive material from submarine disposal is based on the following assumptions. (Also see Table 4-2.)

(1) Containment of the radioactivity is provided not only by the metal matrix, but also by the reactor vessel and the reactor compartment boundary. The latter containment is provided by the ship's pressure hull and the forward and aft reactor compartment bulkheads.

(2) Corrosion rates are conservative estimates compared to the rates that are actually expected. Surface-deposited radioactivity (i.e., the small fraction of the activity that is not an integral part of the metal) is added to the first year's corrosion release.

(3) All of the radioactive corrosion products are available to the surrounding water column or sediment immediately after release from containment. The material may then either settle to the sea floor in the immediate vicinity or be transported by the water movements. It is expected that most of the corrosion products would be deposited into the sediment within the immediate vicinity of the release point.

In contrast to the above, the extremely conservative minimum containment estimate of radioactivity release from submarine sea disposal is based on the following assumptions. (Also see Table 4-3.)

(1) The only containment for the radioactive material is its existence as an integral part of the metal itself.

(2) All of the radioactive corrosion products are immediately available to the surrounding water column as they are liberated from the metal components by corrosion. The released material may then either settle to the sea floor in the immediate vicinity or be transported by the water movements. To maximize the radioactivity concentration in the water, all of the corrosion products are assumed to enter the water in transportable form.

(3) As described above, surface-deposited radioactivity is added to the first year's corrosion release. This treatment is very conservative as indicated by monitoring data obtained in the vicinity of the THRESHER and SCORPION sites (Annex to Appendix D). Surveys conducted in the vicinity of these lost submarines have shown no significant release of radioactivity.

The estimated releases obtained with the minimum containment assumptions have been applied not only to the analysis of a postulated unforeseen event during disposal operations (which might cause the ship's hull at the reactor compartment location or the reactor compartment bulkheads to be damaged during emplacement), but also to that of an accidental sinking at a near-shore location. Even though it is incredible that the reactor vessel would be broken open in view of its strong construction, it has been assumed for this analysis that the reactor vessel containment is also penetrated. If the sea disposal option were used with the result that damage was likely to have occurred in the reactor compartment containment, the emplacement method would be reexamined and, if necessary, changed to prevent a second occurrence.

Based on the two different approaches outlined above, the most important events following disposal are the releases to the environment of radioactive materials as described in Tables 4-2 through 4-6. All of the release estimates by individual nuclide are summarized in Tables 4-4 and 4-5. The estimated maximum annual radioactive material release to the environment from a postulated unforeseen event during disposal is higher than the annual release from a normal disposal by a factor of approximately 150 as shown in Tables 4-4 and 4-5. The total release over all time is higher by a factor of approximately 8. Table 4-6 shows the estimate of the total and maximum annual releases by nuclide for all 100 ships when normal disposals are carried out at a rate of three per year for 33 years.

The limited significance of the expected radioactive material releases in Table 4-6 can be seen by comparing them with the approximately 54 curies of naturally-occurring radioactive thorium and uranium discharged to the oceans each year by the major rivers of the United States. This radioactive material is deposited near the ocean shore and in shallow water, in contrast to the releases estimated in Table 4-6, which would occur remote from shore in the deep ocean. As shown in Table 4-7, the relative radiation exposure effect of the natural radioactivity deposition would be about 25 times that of the material released from the 100 disposed submarines, if the releases from the submarines occurred at the same near-shore locations as the river discharges.

The basis for the estimate of 54 curies of thorium and uranium is as follows. The total annual flow into the oceans from the 12 largest U.S. rivers is 1.5×10^{12} cubic meters (Reference 4.12) which, when combined with the element concentrations in stream waters (Reference 4.14) and the fractional abundance of the radioactive nuclides (Reference 4.13), yields the annual discharge of 54 curies, U^{234} and U^{238} being assumed to be present in equal curie amounts. This estimate is limited to thorium and uranium and therefore does not include approximately 2800 additional curies of naturally-occurring radioactivity in the form of Potassium-40 deposited each year in the oceans by U.S. rivers.

(c) **Corrosion Release of Stable Elements.** For each atom of a radioactive nuclide that is released to the environment by corrosion, there would be a corresponding release of a large number of atoms of the same element in stable form. Calculations similar to those that produce Tables 4-4 through 4-6 show that when an atom of radioactive Cobalt-60 is released, at least 25,000 atoms of stable Cobalt-59 are also released, and when an atom of radioactive Nickel-63 is released, at least 700,000 atoms of stable Nickel-58, Nickel-60, Nickel-61, Nickel-62, or Nickel-64 are also released, with these ratios increasing over time as radioactive nuclides decay to stable nuclides. Values of these ratios for each nuclide are provided in Table 4-8 to illustrate this effect. This factor can be important because of its role in limiting the assimilation of a particular radioactive species. For example, if the maximum possible absorption of the element cobalt by a human or an animal were 1 milligram, the corresponding absorption of Cobalt-60 could be no more than 1/25000th of 1 milligram, since a biological system could not selectively take in one particular isotope of these elements. Biological systems do not discriminate between radioactive and stable isotopes of these elements in the same chemical form because all isotopes of each of these elements behave the same in the chemistry of the biological system. This effective dilution of radioactive isotopes by the stable isotopes, combined with the body's capacity for only limited amounts of certain elements, can serve to limit radiation dose commitments. It should be noted that the dilution of radioisotopes by stable isotopes has been used in only one of the radiation exposure estimates of this environmental statement, namely the hypothetical direct biological path via sediment at the deep ocean disposal site, described in Section II.A.3.(d)(4), "Individual Exposure Via a Hypothetical Pathway," and in Appendix J, III.D.2.

(d) **Radiation Exposure to Man**

(1) **Exposure to Shipyard Personnel.** The total radiation exposure to shipyard workers involved in the preparations for sea disposal would be approximately 17 man-rem for each submarine. This exposure would be to individual workers who are trained for radiation-related work. Each worker's exposure would not exceed established limits (3 rem per quarter and 5 rem per year to the total body). The exposure would be a consequence of working in the gamma radiation field in the reactor compartment, performing tasks such as removal of salvageable components and draining of reactor plant systems, filling the reactor plant with water to prevent crushing during the descent to the ocean bottom, and installing or positioning valves or other equipment as required for disposal. The total occupational exposure associated with protective storage for 20 years followed by sea disposal is estimated to be approximately 20 man-rem, as discussed in Section III.B.1. Additional information on occupational exposure is provided in Appendix A, Section III.D.1.

(2) **Exposure to Personnel Involved in Movement to the Disposal Site.** The total radiation exposure to personnel who would be involved in moving the submarine from the shipyard to the disposal site and in completing the necessary steps prior to the actual sinking of the ship is estimated to be less than 0.1 man-rem, involving external exposure only. The estimate is based on approximately 100 man-hours of work actually in the immediate vicinity of the submarine outside the reactor compartment during which the average exposure rate would be less than 1 mrem per hour. Such work would primarily be associated with preparations to sink the ship at the selected disposal site. There would be no need to enter the submarine after departure from the shipyard.

TABLE 4-2. SEQUENCE OF EVENTS FOR EXPECTED RADIOACTIVITY RELEASE ESTIMATE—SEA DISPOSAL

t = 0	Submarine would be placed intact on the sea floor. Corrosion would begin on all surfaces. Release to the environment would be limited to minute traces of activity contained in the reactor compartment exterior walls (hull and bulkheads).
t = approximately 75 years	Reactor vessel containment is assumed to be partially penetrated by initial pitting through the corrosion-resistant alloy that makes up part of the containment barrier. Release is assumed to begin from the reactor vessel interior into the reactor compartment by slow diffusion through pitting holes. Reactor compartment containment would still be intact.
t = approximately 100 years	Reactor compartment containment barrier is assumed to be penetrated by general surface corrosion of the compartment's bulkheads. Sea bottom currents are assumed to begin flowing through the reactor compartment. Immediate release to the environment occurs for all water-transportable corrosion products that have accumulated within the reactor compartment outside the reactor vessel. Release to the reactor compartment and the environment continues for all water-transportable corrosion products that have accumulated within the reactor vessel. Immediate release to the environment continues for all subsequent corrosion products formed outside the reactor vessel and released from the reactor vessel.
t = approximately 400 years*	Sea bottom currents are assumed to begin flowing through the reactor vessel.
t = approximately 4300 years	Radioactivity release to the environment would be 99 percent complete.

Corrosion rates for above sequence of events (average rates from Table F-1 and Section III.D.1 of Appendix F):

0.0025 inch per year per exposed surface (low alloy steel)
0.0003 inch per year per exposed surface (corrosion-resistant alloy)
0.0138 inch per year for pitting (corrosion-resistant alloy).

*In the conservative release estimate, this was changed to 100 years.

TABLE 4-3. SEQUENCE OF EVENTS FOR MINIMUM CONTAINMENT (ACCIDENT) RADIOACTIVITY RELEASE ESTIMATE—SEA DISPOSAL

t = 0	Submarine would be placed on the sea floor. All containment is assumed to be completely open to the sea, including the reactor vessel. Release to the environment is assumed to occur as soon as corrosion takes place. All surface-deposited activity is assumed to be released in the first year.
t = approximately 1800 years	Radioactivity release to the environment would be 99 percent complete.

Corrosion rates for above sequence of events (average rates* from Table F-1 of Appendix F):

0.0025 inch per year per exposed surface (low alloy steel)
0.0003 inch per year per exposed surface (corrosion-resistant alloy)

Pitting of corrosion-resistant alloy is not considered in this sequence since no containment is assumed to exist.

*In the conservative release estimate, the maximum corrosion rates from Table F-1 of Appendix F were used: 0.0050 inch per year per exposed surface for low-alloy steel and 0.0005 inch per year per exposed surface for corrosion-resistant alloy.

TABLE 4-4. RADIOACTIVE MATERIAL RELEASED TO THE DISPOSAL SITE RESULTING FROM SEA DISPOSAL OF ONE SUBMARINE

Nuclide	Maximum Release In Any Year (Curies per Year)	Approximate Time at Which Maximum Occurs (Years After Disposal)	Total Released Over All Time (Curies)
Ni-63	0.65	100	63.2
Ni-59	0.07	1300	119.9
Mo-93	7.2×10^{-4}	100	0.01
C-14	5.7×10^{-4}	1300	0.78
Fe-55	2.9×10^{-4}	1*	1.3×10^{-3}
Tc-99	2.2×10^{-4}	100	3.1×10^{-3}
Co-60	1.1×10^{-4}	100	4.7×10^{-4}
Nb-94	5.2×10^{-5}	1300	7.8×10^{-2}
Mn-54	6.5×10^{-6}	1*	1.2×10^{-5}
Co-58	3.7×10^{-7}	1*	3.7×10^{-7}
Fe-59	1.6×10^{-7}	1*	1.6×10^{-7}
Cr-51	5.6×10^{-8}	1*	5.6×10^{-8}
S-35	1.2×10^{-9}	1*	1.2×10^{-9}
Sc-46	1.3×10^{-10}	1*	1.3×10^{-10}
Total	0.65	100	183.9

Corrosion rates: Low-alloy steel: 0.0025 inch per year per exposed surface.
Corrosion-resistant alloy: 0.0003 inch per year per exposed surface.
Pitting rate: Corrosion-resistant alloy: 0.0138 inch per year.

*These early releases result from the radioactive material contained in the metal of the exterior boundary (hull and bulkheads), and the assumption that the activity is uniformly distributed in the metal.

(3) **Exposure to the Public from Movement to the Disposal Site.** Radiation exposure to the public from movement of the submarine to a sea disposal site would be negligible because the reactor compartment would be filled with water that would absorb virtually all radiation from the reactor compartment interior and reduce the exposure rate on the surface of the hull to less than 1 mrem per hour. Over half of the exterior of the floating submarine hull would be under water and every two feet of this water would cause the exposure rate to be reduced by a factor of approximately 10. For that portion of the submarine above water, the geometry of the ship and the location of the reactor plant (relatively low in the reactor

TABLE 4-5. MINIMUM CONTAINMENT RADIOACTIVITY RELEASE FROM ONE SHIP ACCIDENT CONDITION RELEASE ESTIMATE

Nuclide	Maximum Release in Any Year (Curies per Year)	Year in Which Maximum Occurs	Total Released Over All Time Curies
Ni-63	9.9	1	1170.4
Ni-59	0.06	1	120.4
Mo-93	1.0×10^{-5}	1	0.01
C-14	5.1×10^{-4}	1	0.83
Fe-55	48.0	1	77.0
Tc-99	2.8×10^{-6}	1	3.6×10^{-3}
Co-60	31.4	1	105.3
Nb-94	4.4×10^{-5}	1	7.9×10^{-2}
Mn-54	1.8	1	1.9
Co-58	2.4	1	2.9
Fe-59	0.37	1	0.37
Zr-95	0.33	1	0.33
Cr-51	0.13	1	0.13
Hf-181	0.12	1	0.12
S-35	7.6×10^{-5}	1	8.1×10^{-5}
Sc-46	6.0×10^{-5}	1	6.3×10^{-5}
Total	94.6	1	1480

Corrosion rates: Low-alloy steel: 0.0025 inch per year per exposed surface.
Corrosion-resistant alloy: 0.0003 inch per year per exposed surface.

TABLE 4-6. EXPECTED RADIOACTIVITY RELEASE FROM 100 SHIPS—SEA DISPOSAL

Nuclide	Maximum Release in Any Year (Curies per Year)	Approximate Time at Which Maximum Occurs (Years After First Disposal)	Total Released Over All Time Curies
Ni-63	39.0	420	6320
Ni-59	7.0	1300	12,000
Mo-93	2.8×10^{-3}	130	1
C-14	0.053	1300	78
Fe-55	4.1×10^{-3}	30	0.1
Tc-99	8.3×10^{-4}	130	0.4
Co-60	1.1×10^{-3}	30	5×10^{-2}
Nb-94	5.2×10^{-3}	1300	7.8
Mn-54	4.0×10^{-5}	30	1×10^{-3}
Co-58	2.4×10^{-6}	30	4×10^{-5}
Fe-59	1.6×10^{-6}	30	2×10^{-5}
Cr-51	9.2×10^{-7}	30	6×10^{-6}
S-35	6.5×10^{-9}	30	1×10^{-7}
Sc-46	7.5×10^{-10}	30	1×10^{-8}
Total	45.0	420	18,400

TABLE 4-7. COMPARISON OF EXPECTED RADIOACTIVE MATERIAL RELEASES FROM 100 SHIPS WITH NATURAL THORIUM AND URANIUM RADIOACTIVITY DEPOSITED EACH YEAR IN OCEANS BY MAJOR RIVERS OF THE UNITED STATES

	Nuclide	Annual Deposition or Release (Curies per Year)	Relative Ingestion Exposure per Curie*	Relative Annual Exposure Effect (Product of Two Previous Columns)
Natural Radioactivity from Rivers	Thorium-232	16**	1.000	16.00
	Uranium-234	19**	0.0035	0.07
	Uranium-238	19**	0.0030	0.06
	TOTAL	54 (each year)		16.13
Radionuclides from 100 Submarine Disposals	Nickel-63	39	0.0145	0.57
	Nickel-59	7	0.0055	0.04
	Carbon-14	0.05	0.2000	0.01
	TOTAL	46.05 (based on maximum year for each nuclide)		0.62

Relative radiation exposure effect if deposited at comparable sea locations = 16.13/0.62 = 25 (approximately)

*Thorium-232 is assigned the value 1.000; all other nuclides are assigned values based on the product of fish concentration factor (Reference 4.21) and total body ingestion dose conversion factor (Reference 4.22), relative to Thorium-232.
**Based on References 4.12, 4.13, and 4.14.

compartment) would combine to preclude any significant exposure on the water surface or on land even within a few feet of the submarine. Passage under bridges, if required, would not result in significant radiation exposure to persons on the bridge surface because of the combined effects of the shielding water within the reactor compartment, the minimum distance between the submarine hull and the bridge surface, and the brief time interval of passage.

With the exception of passage under bridges, as discussed in the preceding paragraph, members of the public would be separated from the submarine by the distance from the waterway channel to the nearest land (on the order of several hundred feet) during towing to sea. Once at sea, the general public would be far removed from the submarine. Therefore, the radiation exposure to the population during transportation from the disposal shipyard to any disposal location at sea would be negligible and would have no effect.

(4) **Exposure to the Public from Release of Radioactive Material**

Individual Exposures. Radiation exposure to the public from the release of radioactive material resulting from submarine disposal at sea would be minimal. This is based on the likelihood that the radioactive material would remain at or close to the deep and remote disposal site, isolated from man and his activities. Activities at such distances and depths are not practical because of the costs and physical obstacles involved. However, it is not possible to be totally certain that no exposure would occur since corrosion would eventually release some radioactivity which might be transported to areas of human activity. Therefore, even though it is unlikely that any exposure would occur, potential exposures have been estimated using conservative methods so that an upper limit on exposure to the public can be established.

TABLE 4-8. MINIMUM RATIO OF STABLE ELEMENT MASS RELEASE TO RADIOACTIVE MASS RELEASE (GRAMS PER GRAM)
(This Ratio Represents a Natural Dilution Factor of the Radioactive Atoms of Each Element)

Nuclide	Normal Disposals	Unforeseen Event
Ni-63	1×10^6	7×10^5
Ni-59	1×10^3	1×10^3
C-14	3×10^5	1×10^5
Mo-93	2×10^7	2×10^7
Co-60	1×10^{10}	2×10^4
Fe-55	4×10^{13}	6×10^8
Mn-54	3×10^{13}	3×10^8
Co-58	1×10^{13}	7×10^6
Fe-59	5×10^{17}	1×10^{12}
Cr-51	2×10^{16}	3×10^{10}
S-35	1×10^{16}	2×10^{11}

For minor nuclides not listed, dilution by the stable element was not estimated.

Twelve pathways by which individuals might be subjected to radiation exposure from radionuclides in seawater were analyzed. Seven of these pathways were direct ingestion paths: consumption of fish, crustacea, molluscs, seaweed, plankton, and salt; and the use of desalinated seawater for drinking water, cooking, and other uses. Four of these pathways were external: immersion in seawater, exposure to shore sediments, exposure to equipment such as fishing lines or nets, and immersion in air. Air inhalation was also included as an exposure pathway.

The analytical model used to estimate ocean transport has incorporated scientific thought concerning the movement of ocean waters, including the existence of eddies, a benthic boundary layer, upwelling, and long term horizontal currents. The existence of these phenomena has been recognized in the definition of the probability that concentrations in a particular region may be in a given range. The analysis also recognizes that any usage of ocean products or water by man would result in exposure to concentrations which would vary over the range of concentrations possible in the locality and would therefore have the effect of causing the net consumption to approximate the probable average.

Radiation exposure to the public has been estimated on the basis of the release of radioactive material summarized in Table 4-6* for 100 normal disposals and the releases summarized in Table 4-5** for an unforeseen event. Since, as assumed here, the unforeseen event would result in a reduction of containment effectiveness, the extreme condition of minimum containment was assumed for the calculations on which Table 4-5 is based. This accident situation has been assumed to occur either at the disposal site, to represent an unforeseen event during the emplacement operation, or at a location 25 kilometers from shore to represent an accident in which the submarine is sunk during transit in such a way that recovery is not possible (described in Section II.B.1).

With the radioactive material releases specified (either Table 4-6 for 100 normal disposals or the sum of releases from Tables 4-5 and 4-6 for one accident among approximately 100 disposals), the best estimate radiation exposure for an individual with average consumption and occupancy rates was determined. This best estimate was calculated using the most realistic value for each parameter. Next a conservative estimate (unrealistically high) was calculated assuming that no benefit would be derived from several processes which are known to exist but are difficult to evaluate, such as the removal of material from the water column by detritus. The beneficial effects of other processes were treated in a manner which would yield exposure estimates higher than expected. Finally, the radioactivity release rates were increased, as indicated in the notes of Tables 4-2 and 4-3, and as shown in Appendix G (Tables G-9 through G-15 and G-23 through G-29), to provide additional conservatism. The conservative estimate shows that even if unrealistic assumptions are used, similar to those used by the IAEA in development of the criteria for ocean disposal of low level radioactive waste (Reference 4.21), the exposures still would not present any hazard.

In all cases, the exposure for the average individual was calculated using the maximum concentration at any time at the assumed pathway entry locations, even though the entire coastal population would not be subject to the maximum concentration. This was used for simplicity in the mathematical treatment; even though it overestimates the total exposure of the population, the discrepancy is so small that the additional complication of calculating an average concentration would not be merited.

After the radiation exposure was estimated for a hypothetical average individual, a similar estimate was calculated for hypothetical individuals assumed to have the maximum seafood consumption rates of Reference 4.21 and who reside or work in the shore areas with the highest concentrations for greater-than-average fractions of the time. These maximum individual exposures were calculated by best estimate and conservative estimate methods, as described above, the only differences being the consumption rates and occupancy times.

In addition, a direct biological path to humans has been assumed in another calculation even though no such path has ever been found, to assure that this could present no hazard. The shortcut path is based on a hypothetical case in which seafood might be obtained from the ocean floor in the immediate vicinity of the postulated deep ocean disposal site and consumed at the maximum rates of Reference 4.21 by a limited number of individuals. The number of affected individuals in this hypothetical case would be small because the population of sea life in the vicinity of the disposal site would be small and would not support a large number of individuals.

The total body exposure estimates have been calculated for residents of the United States West Coast. Exposure to residents of the East Coast would be expected to be comparably small for disposal locations in the Atlantic. As a result of the greater ocean stirring and dilution effects and the greater distance offshore to areas which might satisfy site selection criteria, exposure estimates for East Coast residents would probably be even lower.

*See Appendix G, Tables G-3 through G-8, for time-dependent release rates of major nuclides (best estimate, expected containment).

**See Appendix G, Tables G-17 through G-22, for time-dependent release rates of major nuclides (best estimate, minimum containment).

The average individual exposure estimates are summarized in Table 4-9. For 100 normal disposals, the best estimate of total body exposure to an average individual is 6×10^{-12} mrem per year. If one of these disposals resulted in the minimum containment accident case, the corresponding best estimate would be 1×10^{-9} mrem per year. The conservative estimates of these average individual exposures are 0.0002 mrem per year and 0.003 mrem per year, respectively. These unrealistically high estimates are still very small.

Details of the methods used to develop these estimates and detailed results of the calculations for all pathways and nuclides are provided in Appendix H, which explains the method used to estimate the dispersion of released radioactivity in the ocean waters; Appendix I, which describes the exposure pathways and the methods used to estimate the radiation exposure to individuals and to the general population, based on the concentration of radioactivity in the seawater; and Appendix J, which summarizes the estimated annual dose commitments associated with sea disposal.

Exposure of the hypothetical "maximum-exposed individuals" would be as shown in Table 4-10. In each case the maximum individual exposures are higher than those for the average individual by a factor of at least 15 to 1, due to the much higher consumption rates and occupancy factors. Nevertheless, the highest exposure value for maximum-exposed individuals is only 0.06 mrem per year, the conservative estimate associated with one minimum containment accident case included among 100 disposals.

Exposure to individuals of other nations would be similar to, or less than, the limited exposures tabulated in Table 4-9, for persons living in the United States. The distances from the release point to the locations of human activities have already been minimized in the analysis, all exposure pathways of importance have been considered, and representative consumption rates have been employed. Where larger average individual consumption rates of some foods might be appropriate for certain other nations, the consumption increases would tend to offset the lower radionuclide concentrations that would be appropriate when the distance from the release point to the fishing area is greater.

Individual Exposure Via a Hypothetical Pathway. The exposure estimates in Tables 4-9 and 4-10 are based on the most likely path from the disposal site to man being the transport of radioactive material through the water to distant fishing grounds or to the shore.

TABLE 4-9. EXPOSURE TO RADIATION FROM SEA DISPOSAL — AVERAGE INDIVIDUAL

Scenario	Total Body Radiation Dose Commitment from One Year's Exposure (Highest Year)
a) 100 Submarines, 3 Disposals per Year for 33 Years, normal disposal	6×10^{-12} mrem per year (best estimate) 0.0002 mrem per year (conservative estimate)
b) 100 Submarines, 3 Disposals per Year for 33 Years, one disposal* results in a minimum containment accident	1×10^{-9} mrem per year (best estimate) 0.003* mrem per year (conservative estimate)

*Note that if *all 100* disposals resulted in a minimum containment accident, the corresponding conservative estimate of dose would not exceed 0.3 mrem per year.

TABLE 4-10. EXPOSURE TO RADIATION FROM SEA DISPOSAL—MAXIMUM EXPOSED INDIVIDUAL

Scenario	Total Body Radiation Dose Commitment from One Year's Exposure (Highest Year)
a) 100 Submarines, 3 Disposals per Year for 33 Years, normal disposal	1×10^{-10} mrem per year (best estimate) 0.003 mrem per year (conservative estimate)
b) 100 Submarines, 3 Disposals per Year for 33 Years, one disposal results in a minimum containment accident	2×10^{-8} mrem per year (best estimate) 0.06 mrem per year (conservative estimate)

The hypothetical direct biological path would involve exposure to radioactivity at or near the immediate disposal site, where the effects of dispersion and diffusion would be minimal. Although no biological pathway from the deep ocean directly to man has been identified, an estimate of exposure to man has been developed based on the assumption that fish or other sea life are continuously exposed to the maximum radioactivity concentrations either in the water or in the sediment at the deep ocean disposal site, and that one or more humans consume such seafood at the unusually high annual rates of Reference 4.21. The resulting total body exposure estimates are 0.2 mrem per year for the maximum radioactivity concentrations in the water and 3 mrem per year for the maximum radioactivity concentrations in the sediment at or near the disposal site. These conservative approaches for estimating exposures via a hypothetical pathway are described in Appendix J. These exposures are not considered to be a consequence of sea disposal of defueled submarines, but were included to show that this hypothetical pathway would not result in large exposures to the few individuals who might be affected.

Population Exposures. The maximum possible radiation exposure estimates for the year of highest concentration in coastal waters for the entire population of the United States West Coast, resulting from disposal of 100 submarines at sea, is estimated to be less than 6 man-rem. This estimate was obtained by multiplying the conservatively estimated (unrealistically high) exposure to individuals with average consumption and occupancy rates, shown in Table 4-9, by 30 million to represent the approximate 1980 population of all three West Coast states. The actual maximum year population exposure would be less than this because the entire population would not be exposed to the highest water concentrations.

The estimated maximum year exposure of 6 man-rem to the assumed population of 30 million would be less than 0.0002 percent of the annual exposure (3,000,000 man-rem) of the same population due to naturally-occurring background radiation, based on an average rate of 100 mrem per year (Section I of Appendix J). The maximum number of health effects (cancers) predicted for this year of highest exposure would be about 0.003 for the entire assumed coastal states' population, calculated using the conservative linear relationship of 0.00045 additional cases of cancer in a population for each man-rem (Reference 4.15). Even if the sensitivity to low level radiation were 10 to 20 times greater than this, as argued by some scientists (Reference 4.18, for example), only 0.03 to 0.06 additional cancers would be predicted. As mentioned earlier, the actual annual effects would be expected to be even less than 0.003 additional cases of cancer because part of the population would be expected to be exposed to lower concentrations of radioactive material in the pathways. Also note that if the best estimate exposure to average individuals were used, from Table 4-9, the population exposure would be 2×10^{-7} man-rem with a corresponding decrease in health effects.

The predicted effects are extremely small when it is recognized that in a country such as the United States, a population of 30 million would be expected to experience about 54,000 fatal cancers each year from all causes (Reference 4.19). The additional fractional case of cancer predicted to result from 100 submarine disposals at sea, for the conservative estimate of the year of maximum effect, would be less than 0.000006 percent of the total cases (i.e., 0.003 ÷ 54,000). This would be substantially less than the statistical fluctuation.

In the above discussion, health effects were estimated on the basis of total body exposure of the population. If the maximum organ exposure were used instead of total body exposure, the estimated health effects would be approximately the same or smaller.

(e) **Engineered Improvements to Minimize Radioactivity Release.** Disposal of decommissioned nuclear submarines could be accomplished merely by restoring the full containment integrity of the reactor vessel following defueling, and then towing the ship to the disposal area where the hull could be perforated to sink the ship. In this case, the radioactivity would be effectively contained since over 99 percent of the radioactivity is an integral part of the structural metal components contained within the reactor vessel, which would be expected to remain intact and closed even under the most severe conditions.

An additional consideration is that the containment that results solely from the inherent property of the activated metal places this material in the category defined by the Department of Transportation (Reference 4.16) as "special form radioactive material" which presents little hazard due to radiotoxicity and little possibility of contamination. Even though the disposal package would not present a significant hazard if predisposal preparations were minimal, a number of engineered improvements over the minimum have been developed in order to reduce the probability of release of even small amounts of radioactivity.

Of these improvements, several would be incorporated if the sea disposal option were selected. In addition, several other engineered improvements have been evaluated with the conclusion that they should not be given further consideration for the disposal action because of their low effectiveness relative to the worker's exposure and costs involved.

Those improvements that are considered to be of value and which would be implemented if sea disposal were selected, include the following:

(1) Restoration of the full integrity of the reactor compartment after defueling to provide maximum containment.

(2) Isolation of the reactor compartment from adjoining ship's compartments. A one-way valve would allow inward flow to the reactor compartment.

(3) Completely controlled filling of the reactor vessel, the remainder of the reactor plant, and the reactor compartment prior to sinking. This step would ensure that the reactor compartment is completely filled with water to avoid subsequent crushing by high pressures at great depth.

(4) Modifications of the hull outside the reactor compartment to ensure that the entire submarine would be flooded uniformly and early in the sinking operation, thereby avoiding crushing of any compartment. This precaution would also contribute to the objective of maintaining the ship at a normal angle during sinking.

These improvements would be intended to provide multiple containments for the radioactive material and preserve the integrity of those containments. This approach would provide a defense in depth against premature release of radioactive material to the environment.

Other engineered improvements that were evaluated but were not selected for further consideration because of expected high costs and essentially no gain in containment effectiveness include the following:

(1) The use of a special-purpose surface vessel such as the GLOMAR EXPLORER to lower the submarine to the sea bottom, thus providing exact placement of the hull and avoiding impact with the ocean floor.

(2) The use of drogues or parachutes to limit the impact when the submarine reaches the ocean floor.

(3) The addition of solid filler material (such as concrete) to the reactor vessel as a method of further retarding the release of radioactive material to the environment.

Since Navy experiments and calculations show that the hulls would not be damaged by impact with the clay sediment bottom typical of potential disposal sites at the maximum velocities expected, the first two measures would only increase the cost without benefit. For the third measure, in addition to cost considerations, the additional radiation exposure to shipyard workers involved in adding the solid filler material (approximately 10 man-rem per ship) would be greater than any reduction in exposure due to this engineered improvement.

(f) **Removal or Containment.** Although there is no technical basis for expecting that retrieval or containment of the radioactive waste would ever become necessary, methods for doing so have been examined and found to be technically feasible, as described in Appendix M. A practical and effective way to provide containment would be to envelop the entire submarine with freshly mixed concrete delivered from a ship on the ocean surface through a long pipe. This would draw on established technology and equipment. Alternatively, the submarine could be recovered from the ocean floor by a special, heavy-lift ship. Such a ship would have to be constructed or an existing vessel would have to be extensively modified, but this approach would also use existing technology as demonstrated by the Glomar Explorer. Costs of either approach would not be impractical.

4. Non-Radiological Effects

(a) **Irreversible or Irretrievable Commitment of Resources.** A total of approximately 4000 tons of potentially salvageable material per ship would be discarded. The material would be primarily low-alloy steel, with lesser quantities of stainless steel, copper, bronze, lead shielding, and other metals and plastics. During shipyard preparations prior to disposal, readily removable equipment of value and items in short supply or with long procurement times would be salvaged for reuse. Some material such as the batteries or ballast lead would be removed for salvage.

The amount of non-salvaged material, while substantial in total quantities, would not approach a significant fraction of the United States production during the disposal period. None of the materials is in short supply nor are the resources of these metals expected to be exhausted in the near future. The lost scrap value of the salvageable metal would be approximately $0.3 million per ship.

One or more limited and remote areas of the seabed would be irreversibly committed to use as a disposal site. An area probably less than 100 square miles required for a single disposal site accommodating the entire group of 100 ships would be identified, representing 1.3×10^{-4} percent of the ocean floor deeper than 4000 meters. For most practical purposes, the presence of sunken submarines on the ocean floor in areas such as those studied would have no adverse effect on usage of the sea, the seabed, or the sub-seabed. In general, a disposal area would in fact be selected for its lack of attraction for human activities, assuring that its use as a disposal site would have little effect.

(b) **Secondary or Indirect Effects**

(1) **Non-Radioactive Material Added to Ocean Waters.** The principal non-radiological effect associated with sea disposal would be the addition of quantities of dissolved and insoluble substances, primarily iron oxides and other metallic oxides, and smaller amounts of plastics and asbestos, to the water column and the sediment. These substances would not be added in unusual or significant amounts in comparison to the quantities of such materials added to the oceans by intentional dumping of construction

and demolition rubble, dredge spoils, and miscellaneous materials by maritime accidents, and by natural runoff of water from the land. On the basis of 100 submarines each contributing 4000 tons of iron to an ocean basin such as the nominal North Atlantic with a volume of 10^{17} cubic meters, it may be estimated that the total potential addition to the iron concentration in seawater would be on the order of 10^{-5} μg per liter, which is a small fraction of the normal seawater concentration of 3 μg per liter (Table 2 of Reference 4.14). However, most of the corroding iron would be expected to mix with the sediment instead of going into solution.

The addition of the heavy metal lead to the ocean environment would not cause any unacceptable environmental impact. For submarine disposal at sea, the non-salvageable lead would be in solid slabs of at least 95 percent purity, and very resistant to corrosion. The lead would not be in the form of soluble salt compounds or in the form of tetraethyl lead which are of greater environmental concern. The form of the lead therefore would prevent its becoming a significant source of toxicity (Reference 4.20).

The maximum concentrations of lead in the seawater at locations downstream from the disposal site would be less than the water quality criteria published by the EPA for protection of seawater aquatic life, Reference 4.27. Corrosion data for lead exposed to seawater are provided in Appendix F. Calculational methods for estimating the maximum concentrations of lead in seawater are described in Reference 4.28.

Small quantities of inert materials such as asbestos, shielding polyethylene, electrical insulation, and other plastics would be included along with the larger quantities of metal. Prior to disposal, all of the submarine's tanks containing liquids other than water would be drained and all other liquids and gases would be removed with only small residual quantities of fuel and oil remaining. For instance, as noted above, the ship's batteries would be drained and removed. Little or no mercury would be contained in the submarine, and the quantities of heavy metals such as lead, cadmium, and chromium would be reduced as far as practicable with no significant effects expected. These metals would be present as inert, insoluble, solid material. The small quantity of cadmium would not be in the "prohibited material" category of Reference 4.17, Section 227.6.

These non-radiological effects are the same as those associated with the sinking of surplus ships that are not nuclear powered. Such disposal by the Navy is already permitted by U.S. Environmental Protection Agency regulations (Part 229.2 of Reference 4.17). The disposal sites for these surplus ships must be at least 50 nautical miles from land with water depth of at least 6000 feet (1800 meters).

(2) **Effects on the Ocean and Seabed Ecology.** The presence of one or more submarine hulls on the ocean floor would provide an attraction to the small population of sea life in the area local to the disposal. For example, it could be expected that some part of the area population would seek shelter on or near the hulls. This phenomenon has been observed in shallow coastal waters where automobiles and other objects have been placed on the ocean floor. Observations made of the nuclear submarine SCORPION hull in 1979, eleven years after the submarine was lost off the Azores in over 10,000 feet of water, included the fact that some colonization had occurred, but the number of animals residing on or near the hull appeared to be approximately as small as that in the surrounding area. Grassy-looking small animals were observed to be present over much of the hull surface, but few higher animals were seen.

Visual and photographic observations of marine life were made in August 1983 at the THRESHER debris site. These observations indicate that the debris has not produced a significant reef effect during the approximately 20 years that it has rested on the bottom. There were no discernible differences in biomass concentrations between the debris site and the surrounding area. (See "Recent Results" in Appendix D, Annex.)

Radioactivity measurements were conducted on 63 individual fish (primarily rattails) obtained in August 1983 from the immediate vicinity of the THRESHER site, and on 15 samples containing hundreds of assorted marine macrofauna and benthos. No radioactivity above natural background or fallout levels was observed. This information is also provided in the "Recent Results" section of Appendix D, Annex.

For bottom-dwelling sea life that might inhabit the immediate area of a disposal site, the maximum radiation effect was estimated (Section II.A.3.(a) above) to be 0.3 rads per year. This rate would not be expected to have any significant effect, since it would be small in comparison to the natural radiation exposure received by some mid-water dwelling species, and in comparison to the dose rates that would be expected to produce any detectable change or significant deleterious genetic effects. (See Section II.A.3.(a)).

The non-radiological effects of submarine disposal on the local ecology would be expected to be less than or comparable to the local effects associated with any of the hundreds of large merchant vessels sunk each year throughout the world (Reference 4.19) as a result of storms, collisions, fires, or other mishaps. The planned sinkings of obsolete, conventionally-powered U.S. Navy ships are permitted by the U.S. Environmental Protection Agency (Reference 4.30) at depths of at least 6,000 feet, and at locations at least 50 miles from land. Sea disposal of decommissioned, defueled nuclear submarines would therefore occur only at deeper, more remote sites than currently approved for conventionally powered excess naval vessels.

(3) **Effect on the Economy of Coastal Areas.** Any acceptable sea disposal site would be remote from land and, as discussed in the preceding sections, submarine disposal at such a site would not impact coastal areas. Therefore the economy of coastal areas would not be subjected to any limitations on the use of land, water, fisheries, or other resources.

However, since the economies of many coastal regions depend on recreation, tourism, and fisheries, an effective environmental monitoring program would be essential to assure the public that no adverse impact had occurred.

(4) **Effects of Work in the Shipyard.** As with land disposal, as discussed in Section I.A.3.(b) but to a lesser extent, shipyard preparations for sea disposal would be accompanied by smoke and fumes from cutting and welding torches, noise, and the generation of scrap metal. These effects are expected to be similar to those from normal shipyard activities. They would affect only a small area in the near vicinity of the shipyard.

The overall effects of this action on the local environment and ecology are expected to be negligible.

B. ADVERSE ENVIRONMENTAL EFFECTS OF POSSIBLE ACCIDENTS INCIDENT TO THE SEA DISPOSAL OPTION

1. Accidents Involving Radioactive Material

There is one category of radioactivity-related accident involving a defueled and decommissioned nuclear submarine that stands out as having the potential to raise concern for the environment. This accident, which has been analyzed on a worst-case basis and found to have a very limited impact, would be the premature sinking of the submarine in waters close to areas that attract human activities with the submarine lost in such a way that recovery would not be possible. Although a non-recoverable premature sinking accident is unlikely, it is not impossible. However, it would require a collision that would open the submarine to rapid flooding, and the probability of such a collision would be minimized by a combination of precautions including traffic restrictions, weather requirements, and accompanying vessels.

The environmental consequences of this remote accident would be similar to those described for the land disposal transportation accident involving irrecoverable loss of the reactor compartment in the sea within approximately 25 kilometers (16 miles) from land (Section I.B.1.(b)). For the latter accident involving a barge shipment of the reactor compartment, the expected number of serious accidents during the entire land disposal program would be approximately 0.00009, as discussed in Section I.B.2.(c). The expected number of sinkings of a submarine being towed to a sea disposal site would similarly be much less than one, although statistics comparable to those for barge towing are not available.

A location 25 kilometers from shore was selected for the accident impact analysis because it would represent a region on the continental shelf, with water depth great enough that recovery might be difficult, and about as near to land as highly productive fishing grounds might be located. For that case, a conservative dose commitment of approximately 3 mrem per year was estimated for the most exposed individual, while the best estimate of this exposure is 0.9 mrem per year. For details of these exposure estimates, see Appendix J, Sections III.C and III.E.

If recovery were practical, it would be accomplished in a short time (estimated to be less than one year) so that any release of radioactive material would be less than that considered above for the irrecoverable loss accident, regardless of the effects of the accident on the reactor compartment containment or the reactor vessel containment.

2. Non-Radiological Accidents

The following accidents and their consequences have been considered.

(a) **Fire or Explosion in the Shipyard.** No abnormal potential for fires or explosions are foreseen with this option. This area of possible concern is discussed in Section I.B.2.(a).

(b) **Towing Accidents.** Towing accidents include collisions with another vessel or loss of the tow, with the most severe being the premature sinking of the submarine. The primary concerns would involve personnel safety. The environmental concerns associated with possible penetration of the hull and sinking the submarine closer to land than the normal disposal site have been discussed in Sections II.B.(1) and II.A.4.(b)(1). The personnel safety aspects of the towing operation would be adequately covered by operating instructions dealing with the prevention of accidents and response to emergencies. It is not expected that personnel would be aboard the submarine while it is being towed to the disposal site.

C. CUMULATIVE EFFECT OF SUBMARINE DISPOSAL AT SEA

The incremental environmental impact of disposal of all one hundred submarine reactor plants at one ocean disposal site would be so small that there would be no significant cumulative impact resulting from this action. For example, based on very conservative calculations, the effects of ocean disposal might produce at most an incremental exposure of 0.0002 millirem/year to a typical member of the population most directly affected. This potential exposure is very small in comparison to fluctuations in exposure resulting from variations in individual activities and geographic location. There is no potential for submarine disposal at sea to contribute to a significant cumulative impact.

Considering the total of all past and present sea disposal activities, the additional environmental impact of submarine disposal at sea would not cause a significant increase in the total environmental impact.

As described in Section I.C.a, synergistic effect between radiation and other physical, chemical, or biological agents is not likely.

III. NO ACTION ALTERNATIVE (PROTECTIVE STORAGE PRIOR TO PERMANENT DISPOSAL)

It would be possible to safely store nuclear powered submarines after defueling and decommissioning at one of the existing sites for protective storage of inactive naval vessels. In fact, such storage can be classified as the "No Action" alternative for this environmental statement. However, this storage is not a satisfactory permanent solution of the need for safe disposal because it only postpones the disposal. At the end of the storage period the submarine reactor plants would have to be disposed of as radioactive waste on land or at sea since these remain the only available options.

The containment for the radioactive material that is provided for both the land and sea disposal options would prevent the release of radioactive material to the environment for a period as long as or longer than it would be feasible to maintain the submarines in protective storage. Therefore, the net release to the environment following disposal from storage would be approximately the same as for immediate disposal by the same means. During the protective storage period, regular maintenance and inspection would be needed, resulting in costs and radiation exposure in addition to those associated with disposal. It would also be necessary every 20 years to move each ship into drydock for hull maintenance. Consequently, protective storage of the submarines should be considered only as a way of preserving the ships for future use, in accordance with national policy, and not as a disposal option.

This section summarizes the environmental impacts associated with protective storage in combination with both of the ultimate disposal options. An indefinite period of protective storage may be viewed as the "No Action" alternative within the context of the National Environmental Protection Act. The impacts associated with this would be as presented in the following sections.

A. LAND DISPOSAL OPTION COMBINED WITH PROTECTIVE STORAGE

The environmental consequences of the land disposal option, if carried out after an extended period of protective storage, would be the same as described in Section I, with the following exceptions.

1. Occupational radiation exposure would be increased from approximately 17 man-rem per submarine to approximately 20 man-rem if disposal preparations were conducted after a protective storage period of 20 years. This increase results from some duplication of effort plus necessary maintenance and surveys during the protective storage period which would add approximately 2 man-rem to the total exposure.

2. Direct radiation exposure to members of the public would be reduced by a small amount because of the radioactive decay of the principal source of external radiation (Cobalt-60). However, this exposure is insignificant in any case (10^{-3} man-rem population exposure if land disposal occurs immediately).

3. The radiation effects of hypothetical accidents would be essentially eliminated because of the decay of Cobalt-60, which is the principal radionuclide that might cause the hypothetical accident-related exposure. However, this exposure is small in any case (hypothetical maximum individual exposure would be less than 0.3 mrem to the total body and 49 mrem to the lungs if land disposal occurs immediately), and the probability of the extreme accident is very small.

4. The quantity of radioactive material that would be placed in the burial site would be decreased through radioactive decay by a factor of at least 4 (as shown in Figure 1-2 of Chapter 1). However, this would have no effect on the environmental aspects of land disposal because the only radioactive nuclides that would be released to the environment (principally Nickel-59, with a half-life of 80,000 years) would not be affected by any practical delay period. Those radioactive nuclides that would decay to stable form during the protective storage period would not be released to the environment even if land disposal were carried out immediately.

B. SEA DISPOSAL OPTION COMBINED WITH PROTECTIVE STORAGE

The environmental consequences of the sea disposal option, if carried out after an extended period of protective storage, would be the same as described in Section II, with the following exceptions.

1. Occupational radiation exposure would be increased from approximately 17 man-rem per submarine to approximately 20 man-rem if preparations for disposal were carried out after a protective storage period of 20 years. This increase results from some duplication of effort plus necessary maintenance and surveys during the protective storage period which would add approximately 2 man-rem to the total exposure.

2. Direct radiation exposure to members of the public would be reduced by a small amount because of the radioactive decay of the principal source of external radiation (Cobalt-60). However, this exposure is insignificant in any case (less than 10^{-3} man-rem population exposure if sea disposal occurs immediately).

3. The radiation effects of hypothetical accidents would be essentially eliminated because of the decay of Cobalt-60, which is the principal radionuclide that might cause the hypothetical accident-related exposure. However, this exposure is small in any case (hypothetical maximum individual exposure would be 4 mrem per year if sea disposal occurs immediately), and the probability of the extreme accident is very small.

4. The quantity of radioactive material that would be placed in the sea disposal site would be decreased by a factor of about 4 (as shown in Figure 1-2 of Chapter 1). However, the only environmental effect of this decrease would be a reduction in the release of Nickel-63, which has a half-life of 92 years. For a 20-year protective storage period the reduction would be 14 percent and for a 40-year protective storage period the reduction would be 26 percent. Since the environmental effects of the release of Nickel-63 would be very small even if sea disposal were to occur immediately (0.0002 mrem per year is the conservative, unrealistically high estimate of exposure to the average member of the population), these reductions are not significant. For radionuclides other than Nickel-63, the shorter-lived nuclides such as Cobalt-60 and Iron-55 would not normally be released to the environment even if sea disposal were carried out immediately, and for the longer lived nuclides (principally Nickel-59, with a half-life of 80,000 years) their eventual release to the environment would not be affected by any practical delay period.

IV. SUMMARY AND CONCLUSIONS

The expected environmental impacts of submarine disposal have been described in this chapter. The best estimate radiation exposures associated with sea disposal are of negligible magnitude, and even the unrealistically high estimates are extremely small. Table 4-11 shows a summary of all these conservative estimates of radiation exposure for both permanent disposal options. Normal exposures as well as accident-caused exposures are included in the table. These exposures are all of very limited magnitude; for example, the conservatively high estimate of population dose commitment for all 100 disposals is estimated to be 2.1 man-rem per year for land disposal and 6 man-rem per year for sea disposal. These estimates show no significant difference between the two disposal options, and no significant impact of either option. Comparisons of the other exposure estimates lead to the same observation.

Because of these very low radiation-related impacts, it is concluded that either option would be acceptable, and that the choice of options should not be based on radiological considerations.

The non-radiological impacts of the two disposal options are summarized in Table 4-12. Of these impacts, the only significant difference between the land and sea disposal options appears to be in the dollar costs, which are $1.8 to $2.0 million per ship greater for the land disposal option, assuming that with the latter option the rejoined hull would be sunk at sea. The difference between the two options increases to $7.8 to $8.1 million per ship if the hull is to be scrapped in the land disposal option.

It may be concluded that either option would have negligible environmental impact.

TABLE 4-11. TOTAL BODY EXPOSURE—SUMMARY OF ESTIMATES ASSOCIATED WITH LAND DISPOSAL AND SEA DISPOSAL OF DEFUELED, DECOMMISSIONED SUBMARINE REACTOR PLANTS

(Dose Commitments are from one year's exposure, highest year)

(Conservative estimates rather than "best estimates" have been used in this table.)

	Number of Disposals	Exposure to Average Individuals		Population Exposure		Exposure to Maximum-Exposed Individuals	
		Land Disposal	Sea Disposal	Land Disposal	Sea Disposal	Land Disposal	Sea Disposal
A Occupational Exposure							
1 At shipyard	1	≤3 rem/qtr*	≤3 rem/qtr*	17 man rem	17 man-rem	≤3 rem/qtr*	≤3 rem/qtr.*
2 During movement to and at disposal site	1	<1 0 rem	<0 1 rem	<1 0 man-rem	0 1 man-rem	<1 0 rem	<0 1 rem
B Public Exposure							
1 During transportation to disposal site	1	0.00006 mrem	<0 00006 mrem**	<0 001 man-rem	<0.001 man-rem**	0.0007 mrem	0.0007 mrem**
2. As a result of normal expected disposal	100	0 006 mrem/yr	0 0002 mrem/yr	2 1 man-rem/yr	6 man-rem/yr	1.5 mrem/yr	0.003 mrem/yr
3 As a result of sea disposal where only minimum containment results	99 normal plus one minimum containment	Not applicable	0 003 mrem/yr	Not applicable	90 man-rem/yr	Not applicable	0 06 mrem/yr
4. As a result of accident-related release							
a Immediate exposure	1	0.0014 mrem	Not applicable	0.0014 man-rem	Not applicable	0.3 mrem	Not applicable
b Delayed exposure	1	0 1 mrem/yr	0 1 mrem/yr	3 man rem/yr	3 man-rem/yr	3 mrem/yr	3 mrem/yr

*Exposures shown are occupational limits, which would not normally be approached, for shipyard workers trained for radiation-related work.

**Transportation exposures to the public associated with sea disposals are expected to be negligible. The tabulated values indicate that such exposures would be less than for land disposal.

TABLE 4-12. SUMMARY OF NON-RADIOLOGICAL IMPACTS OF THE TWO PERMANENT DISPOSAL OPTIONS

Environmental Aspect	Adverse Impact of Land Disposal: Hull Scrapped	Adverse Impact of Land Disposal: Hull Sunk at Sea	Adverse Impact of Sea Disposal
1. Commitment of Resources			
a. Costs* active ship	$13.3 million	$ 7.2 million	$5.2 million
inactive ship	$16.2 million	$10.2 million	$8.4 million
b. Material lost to possible future use (primarily steel)	1000 tons per ship	4000 tons per ship	4000 tons per ship
c. Area of radioactive waste disposal site removed from general use	Up to ten acres total plus temporary use of less than two acres additional area at Savannah River Plant for river landing slip and barge unloading facilities		Less than 100 square miles total (less than one million square feet actually covered by 100 hulls)
2. Material added to the radioactive waste disposal site	1000 tons per ship		4000 tons per ship
3. Preparation of landing slip and barge unloading facilities (land disposal only)	Removal of approximately 7800 cubic yards of earth at Savannah River Plant, requiring disposal in accordance with applicable regulations		Not applicable
4. Pollution Effects			
a. At and near shipyard	Localized noise pollution; smoke and fumes from cutting and welding torches; generation of scrap metal		Localized noise pollution; smoke and fumes from cutting and welding torches
b. From shipyard to disposal site	Limited air and water pollution due to burning of fuels and operating the tug and barge over the coastal waterway and rivers		Limited air and water pollution due to burning of fuels and operating ocean-going tug
c. At disposal site	Addition to site of asbestos, plastics, lead, and other metals, primarily steel		Addition to site of asbestos, plastics, lead and other metals, primarily steel
	No effect on local plant and animal life at land disposal site. If hull sunk at sea, the non-radiological impacts at the sea disposal site would be expected to be similar to those described for sea disposal of the entire submarine.		Disposed hulls might be expected to alter the distribution of life in the localized area. Effects should be the same as the small localized effects caused by other vessels sunk in deep water.

*Costs in 1981 dollars.

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APPENDIX A

COST ANALYSIS

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APPENDIX A

COST ANALYSIS

I. INTRODUCTION

This appendix provides information on the estimated costs associated with the options for disposal (by land or by sea) or for protective storage prior to disposal. Economic costs and radiation doses are both considered. Additional information is provided on the costs associated with certain activities within these options where significant alternatives were identified. These factors are important to deciding which alternatives should be considered further and which option should be considered most appropriate for disposal in a safe and environmentally acceptable manner.

Following the completion of normal service, a submarine would pass through a process that consists of six principal steps, in sequence:

1. Defuel the reactor and decommission the submarine.

2. Inactivate the submarine.

3. If applicable, prepare the submarine for protective storage and maintain it during protective storage.

4. Prepare the submarine for disposal by land or by sea.

5. Transport it to the disposal site.

6. Complete the disposal.

The first two steps are common to both land and sea disposal and to any storage plan, and have no significant alternative. The last four steps have significant alternatives that depend upon whether protective storage or land or sea disposal would be selected and upon which of the several alternatives would be chosen.

Defueling is a standardized operation for nuclear submarines, and would not differ significantly whether it would be followed by refueling for further service or by inactivation. Defueling and, where appropriate, removal of the missile compartment are not considered to be part of the disposal process, and the costs associated with defueling and missile compartment removal are excluded from consideration in this appendix.

In order to minimize radiation exposures to the workers and to minimize the costs of disposal, the plant would be prepared for disposal with little or no effort expended on maintaining the internal cleanliness of the reactor coolant systems or the functions of the various components that would be retained for disposal. Significant effort would be devoted to assure that radioactive material within the reactor plant would not be released to the environment during the preparations that would be made in the shipyard. Reasonable care and effort would be required to preserve intact the pressure boundaries of the reactor vessel and of the reactor compartment to provide long-term containment for residual radioactive material that would be involved in the disposal action.

Protective storage would be an alternative to immediate disposal, but eventually would be followed by disposal. Maintenance of proper storage conditions during the period of protective storage would incur significant costs. Storage would be in a naval inactive ship maintenance facility. Preparations for storage would include those actions necessary to assure storage in a safe and environmentally acceptable manner for at least 20 years, and periodic actions required during storage would include monitoring the decaying radiation levels and maintenance of essential storage conditions.

The alternatives within the land disposal option are few; they involve the choice of whether the rest of the ship's hull would be disposed of by towing it to sea and sinking it or by cutting it up for scrap. In either event, significant effort would be required to ensure that the rest of the ship's hull would be free of radioactive contamination before disposal. All of the other steps would not have significant alternatives because the actions involved in transport to the burial site by barge and by overland transporter were found to be essentially unique for each of the two potential burial sites: the Hanford Site, Richland, Washington and the Savannah River Plant, Aiken, South Carolina.

Among the numerous alternatives considered for the sea disposal option, one was found to be best in terms of technical feasibility, operational feasibility, and estimated cost: controlled sinking in the flooded free-fall condition. The alternatives considered involve methods for transferring the reactor compartment from the surface of the ocean to the bottom, ranging from free-fall sinking to controlled lowering. Depending upon whether the reactor compartment would be disposed of alone or with other sizeable portions of the submarine, there would also be corresponding alternatives in the necessary preparation and transport techniques.

The costs of the alternatives that appeared to be technically and operationally feasible with respect to safety and environmental considerations were evaluated.

II. SUMMARY

Disposal of submarine nuclear reactor compartments by sinking the entire ship at sea would be safe and environmentally acceptable, and it would be the least costly method of disposal. The estimated cost of disposal by this method is $5.2 million per ship. Other disposal methods considered in detail are estimated to cost as much as $16.2 million per ship.

For burial on land, the least costly method for disposal of reactor compartments is estimated to cost $7.2 million per ship, approximately $2.0 million more per ship than the least costly method of sea disposal. This method of land disposal would involve sea disposal of the rest of the ship's hull.

Alternative land disposal by burial of the reactor compartment and cutting up the rest of the ship's hull for scrap is estimated to cost $13.3 million per ship. Alternative disposal methods that would involve interim storage of the defueled and inactivated ship (including the reactor compartment) for a prolonged period of time, such as 20 years, would cost approximately $3.0 million more per ship, for preparation for storage, storage, and removal from storage before final preparations for disposal.

Interim storage without disposal for an extended period such as 20 years would cost approximately $5.8 million per ship, including inactivation of the ship, preparation for storage, and storage for 20 years. Since interim storage would only defer disposal and would not represent a permanent solution to the need for safe and environmentally acceptable disposal, additional costs would be required for disposal at the end of the storage period. With interim storage for 20 years, the total costs of disposal were estimated to be $8.4 million per ship for sea disposal, $10.2 million per ship for land disposal of the reactor compartment and sea disposal of the remainder of the ship, or $16.2 million per ship for land disposal of the reactor compartment and scrapping of the remainder of the ship. The estimated costs of disposal are summarized in Table A-1.

The estimated costs of monitoring the environment to determine periodically the concentrations of radioactive material associated with sea disposal are identified as a part of the costs of disposal. Monitoring of land disposal is part of existing programs at the land disposal sites and would not involve additional costs. Total costs for the effort required to qualify a sea disposal site are estimated to be approximately $6 million. Total costs for the effort required to monitor the environment in the regions that may be affected by a sea disposal site are estimated to have a present-value cost of nearly $9 million.

Radiation doses would be incurred as a result of any of these methods of disposal, and precautions would be necessary to ensure that the doses would be as low as is reasonably achievable. Radiation doses to the general population and to the hypothetical maximum individual associated with sea disposal are discussed in Appendix J and those for land disposal are discussed in Appendix C. Radiation doses to workers associated with disposal actions are discussed in this appendix; estimated doses amount to approximately 20 man-rem per ship, due mostly to exposures incurred by the shipyard workers during inactivation and preparations of the reactor compartment for either storage or direct disposal.

All of these methods of disposal are considered to be technically and operationally feasible, safe, and environmentally acceptable. Alternatives were identified and evaluated for technical and operational feasibility and for estimated costs before the selected options were chosen and evaluated in detail. The estimated costs and worker radiation doses for the selected options are summarized in Table A-1.

Land disposal of the reactor compartment would be accomplished by burial at either of the two Department of Energy sites, depending upon whether burial was scheduled to occur at Hanford or at Savannah River. These two sites are approved for the burial of low level radioactive wastes. The reactor compartment would be moved onto a barge by jacking and with rollers, transported by water route to the disposal site, and moved overland by a crawler transporter to the burial site.

Sea disposal would consist of sinking the ship with the reactor compartment in place, using the flooded free-fall method. After the reactor was defueled and the ship was inactivated and otherwise prepared for disposal, the control surfaces of the hull would be modified so that the ship would follow a nearly vertical path during descent and would land in a predictable location with rather small uncertainty. An intact landing would be expected to occur, based on model testing and on data obtained from study sites in the Atlantic and Pacific Oceans that were chosen to meet preliminary site selection criteria.

All of the disposal methods that are considered to be technically and operationally feasible are also considered to be safe and environmentally acceptable. None of the disposal methods involve any dose commitment that would approach an unacceptable level. Sea disposal of the entire ship, including the reactor compartment, would have the lowest estimated cost: $5.2 million per ship. Table A-1 summarizes the alternatives.

TABLE A-1. ESTIMATED COSTS OF DISPOSAL

	Estimated Cost per Ship(1)	
Disposal Alternative	Active Ship(2)(4)	Inactive Ship(3)(4)
Sea—Reactor Compartment and Hull Together	$ 5.2 M	$ 8.4 M
Land—Reactor Compartment and Sea-Ship's Hull	7.2	10.2
Land—Reactor Compartment and Scrap Ship's Hull	13.3	16.2

NOTES: (1) Excludes defueling and missile compartment removal.
(2) Estimated worker doses total 17 man-rem per ship.
(3) Includes preparation for and removal from storage as well as estimated costs for 20 years of storage. Estimated worker doses total 20 man-rem per ship, including doses due to preparation (17 man-rem), final actions (1 man-rem), and radiation surveys during storage (2 man-rem).
(4) An Active Ship is one that would be disposed of following completion of active service without protective storage. An Inactive Ship is one that would be disposed of after inactivation and protective storage.

III. DISCUSSION

This section discusses the details summarized above. Requirements are cited for analyzing costs and benefits, the plan of the analysis is described, and the results from the analysis of the alternatives are discussed in detail. Protective storage and the land and sea disposal options and alternatives within these options are discussed.

A. REQUIREMENTS

The primary need for careful disposal is to ensure that the radioactive material associated with the reactor plant is disposed of in a safe and environmentally acceptable manner. Careful disposal will isolate the radioactive material from man's environment until it has decayed to innocuous levels. Among the candidates for disposal methods that are technically and operationally feasible, the preferred ones would be those with the lowest economic costs and the lowest health effects.

The body of this environmental impact statement presents the environmental impacts of the reasonable alternatives in comparative form to sharply define the issues and provide a clear basis for choice among options. Among the alternatives, those that were eliminated from detailed study are identified and the reasons for their having been eliminated are briefly discussed. Substantial treatment is provided to each alternative considered in detail. The alternatives of no action and of appropriate mitigation measures are included. The details of the affected environments and the environmental consequences are described in the body of this document and in other appendices.

B. PLAN

The main considerations would be the choices between protective storage and prompt disposal, and between land and sea disposal, since extraterrestrial disposal is not considered to be a viable alternative. Either land or sea disposal or protective storage for approximately 20 years would be environmentally acceptable because detailed evaluations of both options have shown that no adverse environmental effect would approach an unacceptable level.

All of the alternatives that have been considered for disposal are identified schematically on Figure A-1. It starts at the point where the submarine to be disposed of has been defueled and decommissioned. It proceeds through the alternatives of disposal location and when it would be accomplished. Extraterrestrial disposal is cited, but is not considered to be feasible because of the great size and weight of the material and the large costs that would be involved. Interim and long-term storage are alternatives to prompt disposal which would lead ultimately back to the same considerations; although the amount of short-lived radioactivity would be decreased markedly and the costs would be increased markedly.

The focus of the evaluation is on prompt disposal because it is less costly, but storage is also considered. Long-term storage is considered to be a less desirable alternative because it avoids the responsibility for the disposal decision by assuming that a future technology might be superior to that of the present, and that the actual cost of long-term storage would be offset by potential benefits to be realized at the future time. This is considered to be unlikely. On this basis, long-term storage was not evaluated in detail, but the cost of storage for 20 years has been estimated. The remaining six alternatives have been evaluated in detail:

1. Sea disposal of the entire ship immediately
2. Sea disposal of the entire ship after interim storage
3. Land disposal of reactor compartment, rest of ship disposed of by sea; immediately
4. Land disposal of reactor compartment, rest of ship disposed of by sea; after interim storage
5. Land disposal of reactor compartment, rest of ship disposed of by scrapping; immediately
6. Land disposal of reactor compartment, rest of ship disposed of by scrapping; after interim storage.

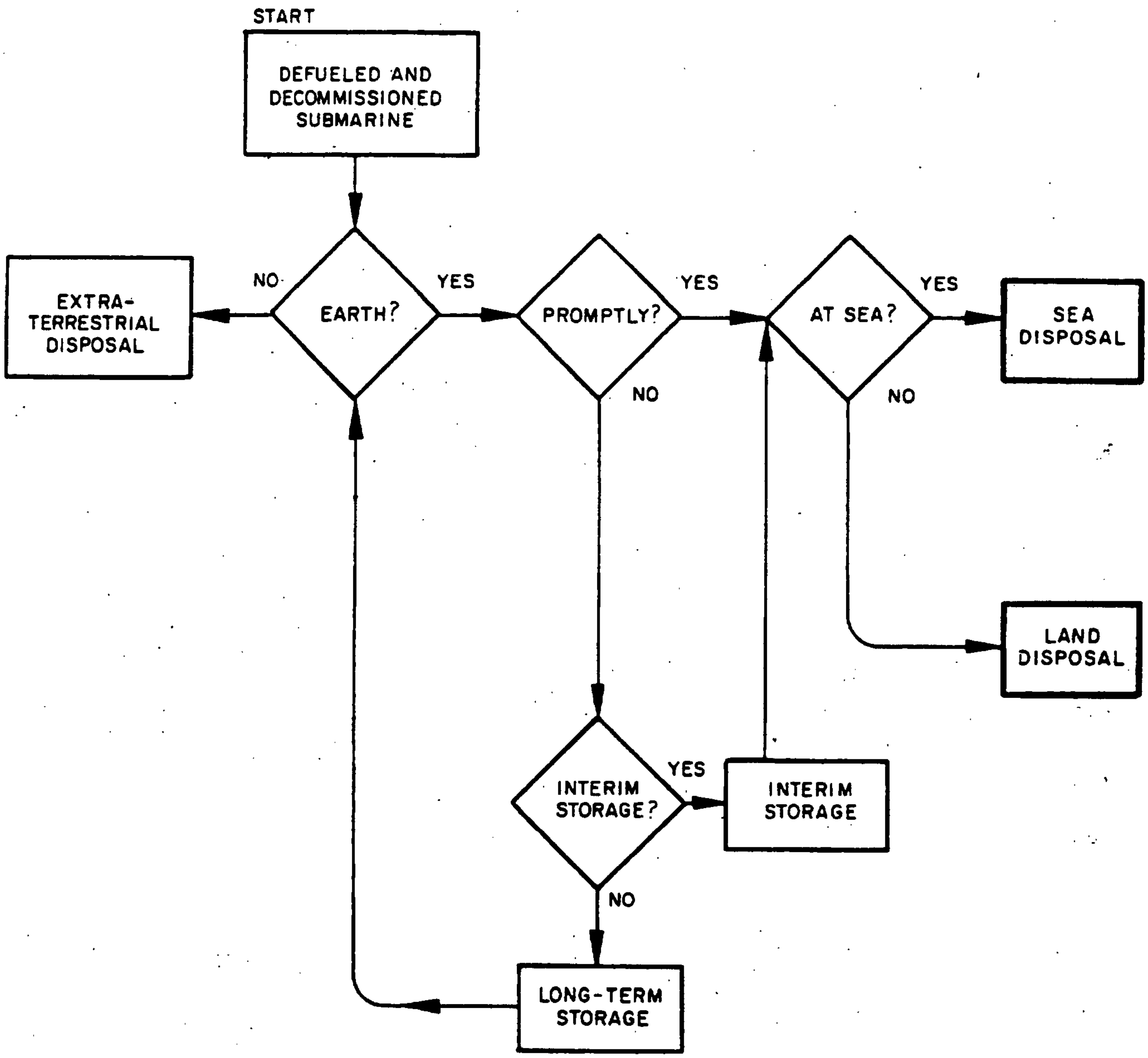

Figure A-1. Disposal Alternatives

Other factors were considered and the corresponding alternatives were evaluated. Some of these alternatives would have small environmental consequences; others would affect only the technical or operational feasibility of the disposal plan or its cost. The results are discussed below.

C. RESULTS

This section describes the alternatives that were considered within the land and sea disposal options.

1. Land Disposal

Land disposal would include removing desired equipment, inactivation of the ship and the reactor plant, and cutting the reactor compartment free from the rest of the ship. Remaining radioactive material would be removed from the rest of the ship and sealed within the reactor compartment. The rest of the ship would be surveyed to identify radioactive materials to be removed before disposal. The reactor compartment would then be moved by barge and overland transporter to an approved Department of Energy site for burial. The only two available sites are in South Carolina (Savannah River Plant) and Washington (Hanford Site). Radiation levels associated with the entire operation would meet all requirements of the Department of Transportation and the Department of Energy for radioactive waste and its disposal. The remaining bow and stern sections of the ship, after inactivation and removal of desired equipment, would be disposed of by either cutting them up for scrap or welding them together for sinking at sea.

There are few viable alternative methods for land disposal. After defueling and inactivation of the submarine, the reactor compartment would be prepared, removed, and transferred to a barge for shipment to the disposal site. Alternative methods for movement of the reactor compartment to the barge were identified and evaluated for technical and operational feasibility and comparative costs were estimated, as described in Appendix B (Section III.B.5). Of the six methods considered, the use of jacks and rollers was found to be optimum and would be preferred for disposals at either Savannah River or Hanford. There would be no significant difference in environmental consequences among the alternative methods for moving the reactor compartment.

Shipment by barge to the disposal site does not have a feasible alternative. The reactor compartment would be too large for either rail or truck transport to be suitable. The route to the site would be uniquely determined by the locations of the shipyard and the corresponding burial site.

At the disposal site, the reactor compartment would be removed from the barge and transported to the burial site by a commercially-available crawler transporter that would be capable of supporting the load and traveling over available routes. Tentative routes at Hanford and at Savannah River were chosen to minimize the cost and the interference with local traffic. Details are provided in Appendix B.

The dominant cost element for land disposal would be the shipyard effort for inactivation and preparation for disposal. Capital equipment and other one-time items would be needed to support land disposal operations. Jacks and rollers would be needed to move the reactor compartment to the barge, a barge would need to be built or modified, and the land route to the disposal site would need to be modified and upgraded. Recurring items for land disposal operations would include towing the barge, leasing a barge or amortizing the cost of building it, and leasing the crawler transporter. The estimated costs are discussed in detail below.

2. Sea Disposal

Sea disposal would include removing desired equipment, inactivation of the ship and the reactor plant, preparations for towing and controlled sinking, and placing the entire submarine on the ocean bottom at a specified deep ocean location. It is anticipated that the sites would be within the U.S. economic zone and located approximately 200 miles from the east or west coasts of the contiguous states.

Sites would be selected on the basis of geological stability, remoteness from human activity and food supplies, and low expectation of future human activity. Selected sites would be unlikely to be disturbed by seismic or volcanic action, or by ocean movement. At the selected sites, the ocean currents near the bottom would be very low, and the sea floor itself would be stable, with a thick layer of sediment over the underlying rock formation.

Controlled sinking of the entire submarine, including the reactor compartment and reactor plant, would be the preferred method of sea disposal. Other methods are described below. The reactor plant and reactor compartment would be filled with water to resist the crushing pressure of the deep sea, and the rest of the ship would be provided with sufficient holes to ensure rapid flooding of all spaces during sinking before the crush depth would be reached. The ship's control surfaces would be modified to control placement on the bottom. Both the reactor compartment and the reactor plant within the compartment would be intact on the ocean bottom. Corrosion of the metal of the hull and reactor plant would be the only way that undecayed radioactivity would be released because the reactor compartment, the reactor plant, and the reactor vessel would all be welded shut before disposal, and almost all of the radioactive nuclides present at disposal would decay to stable forms before any significant release to the ocean environment could occur.

There are a number of practical ways to dispose of the reactor compartment at sea. As with land disposal, preparation for disposal would be preceded by defueling and inactivation of the submarine. Preparation and transport methods would depend upon which alternative would be selected for transferring the reactor compartment from the surface to the bottom of the ocean. These methods are described below and estimated costs are tabulated for the more practical ones.

Methods for transferring the reactor compartment from the surface of the ocean to the bottom were considered from among three possibilities, depending upon the balance of applied forces:

a. It could be lowered to the bottom. Existing line and winch technology, with and without buoyancy assistance, and a ship such as the Glomar Explorer, with special features for raising and lowering heavy loads at great depths in the ocean, were considered.

b. It could be drawn down to the bottom. With buoyancy assistance to nearly balance the forces, a retrievable anchor could be used as a base to pull the unit to the bottom, using existing line and winch technology. After the unit was on the bottom, the buoyant transporter would be remotely detached and the anchor winched up for recovery and re-use.

c. It could be allowed to fall freely to the bottom. Flooded free-fall sinking was considered extensively because of the apparent simplicity. Additional consideration was given to modifications that would improve the accuracy of placement on the bottom and that would reduce the impact loads upon landing on the bottom. This is the lowest-cost method for emplacement, and has been evaluated in detail.

The dominant cost element for sea disposal would be the shipyard effort for inactivation and preparation for disposal. Capital equipment would be required to instrument the ship to measure ship attitudes and accelerations during the disposal process. The instrumentation would be recoverable for use in the ensuing disposals. One-time costs would be needed to support the effort that would be required to qualify potential sites for sea disposal, to ensure that they meet the criteria identified in Appendix E. Recurring items for sea disposal operation would be limited to towing the fully prepared ship to the selected site for sinking and to monitoring the sites, as described in Appendix K, to determine the extent of radioactive material in the environment due to the disposals. The estimated costs are discussed in detail below.

3. The No-Action Alternative

The closest reasonable approach to the "no-action" alternative would involve some minimal actions that would be considered prudent to provide minimal protection of the public safety and to prevent unacceptable environmental consequences. This alternative would include the minimum work which must be accomplished to inactivate the ship and the reactor plant and to prepare them for waterborne storage in a safe and environmentally acceptable manner. No specific action would be taken to enhance the ability to reactivate the ship. The work would include removing hazardous materials and fluids, removing strategic equipment, blanking sea connections, ensuring the preservation of containment barriers such as the hull, and installing fire and flooding alarms. This alternative would not include dehumidification of equipment or tank preservation beyond that needed for ship integrity for 20 years of waterborne storage. Extensive salvage of useful equipment and materials would be performed. Up to 20 years of waterborne storage is considered feasible before docking would be required. For convenience in citing estimated costs, up to one 20-year period of protective storage is considered interim storage, and more than one such period is considered long-term storage.

4. Summary of Other Sea Disposal Methods

Accurate placement on the bottom would minimize the area of the disposal site needed for multiple disposals. On this basis, the Glomar Explorer and buoyancy-assisted lowering were identified as alternatives. Standard line and winch technology would be inadequate for this application because of excessive line size requirements and problems associated with the dynamic loads that would be involved. The Glomar Explorer could handle three reactor compartments in one trip, or one reactor compartment attached to other parts of the submarine, but it would not be feasible to handle an entire submarine because of the need for costly modification that would be required. The Glomar Explorer is currently "mothballed" in the U.S. Maritime Administration's West Coast Reserve Fleet.

If the Glomar Explorer were not available because of other commitments such as the Ocean Margin Drilling Program, accurate placement of a reactor compartment could be achieved with buoyancy-assisted lowering. This method would be too costly to use with configurations larger than just the reactor compartment alone.

Since accurate placement is not necessary because adequate disposal area would be available, any of various flooded-free-fall methods would be suitable. The lowest-cost method was found to be the flooded free fall of an entire submarine. With only the stern planes removed to reduce gliding, the landing site would be between 2000 and 5000 feet from the launch point. The horizontal excursion may be reduced to approximately 1500 feet, thereby minimizing the area needed for disposal, by removing the sail planes and the stern planes and by shifting the center of gravity to obtain a nearly-vertical descent.

Because of the lack of sufficient self-buoyancy, flooded free fall of either a reactor compartment alone or a reactor compartment attached to the aft portion of the submarine would require a barge to move the unit to the disposal site. The barge would need to be designed so that the unit could be suitably launched from it at the disposal site. For the reactor compartment alone, the launch-barge method would allow placement within approximately 55 feet of the launch point, but the estimated cost of this method is undesirably high, as discussed below.

A method of very accurate placement of an entire submarine was not found unless extensive development and technological risk were assumed. Buoyancy-assisted lowering, Glomar Explorer, and a buoyant transporter were considered, but were not found to be suitable because of the high cost.

The relative costs for these sea disposal alternatives are summarized in Table A-2. The table lists the alternatives in approximate order of increasing unit disposal costs, and the corresponding capital costs and recurring costs are included. The unit cost is based on ten disposals at approximately three disposals per year. The costs in Table A-2 are partial costs based on preliminary evaluations and are used only to establish the rank of the relative costs among these alternatives; they include pre-disposal preparations, but not the costs of inactivation or work in the reactor compartment because these would be essentially constant.

The lowest-cost sea disposal method would use flooded free fall of an entire submarine. The next lowest-cost method, buoyancy-assisted lowering of an entire submarine, would not be suitable because of the high development costs and the associated technical risk.

obtain bottom water samples for dissolved oxygen measurements. At both the THRESHER and SCORPION sites, samples of water were transferred to Winkler bottles within 15 minutes after the submersible surfaced for measurement of dissolved oxygen.

Dissolved oxygen was measured using the method of Reference D.A9. Values obtained for the THRESHER and SCORPION debris sites were 7.8 ± 0.1 mg/l and 6.6 ± 0.3 mg/l, respectively. Five samples of water from the THRESHER site and a single sample of water from the SCORPION site were transferred to 500 ml Marinelli sample containers and analyzed at a shoreside laboratory. A sensitive, 150 cc solid state, lithium-drifted germanium detector and gamma spectrum analysis system was used to count and analyze the samples. The Marinelli counting container is a molded, plastic beaker having an inverted concentric well in the center. The depth and diameter of the well allows the detector to fit inside the well when the sample container is in the counting position, thus allowing greater sensitivity than would be possible by simply placing the same amount of sample material in an ordinary container directly upon the detector. The spectral data obtained as a result of the counting of the samples are analyzed by computer techniques to identify the radionuclides present in the samples. Results of the analyses are contained in Table D-A1.

TABLE D-A1. GAMMA SPECTRUM ANALYSIS RESULTS FOR WATER SAMPLES OBTAINED AT THE THRESHER AND SCORPION DEBRIS SITES, JULY 1977
(From Germanium (Lithium) Crystal Detector)

Debris Site	Radioactivity Concentration and 90 Percent Confidence Limits, pCi Per Liter		
	Potassium-40	Cesium-137	Cobalt-60
THRESHER(1)	328 ± 90(2)	ND	ND
SCORPION	236 ± 96(2)	ND	ND

ND = Not Detected. The minimum detectable activity ranged from 3 to 10 pCi per liter.
(1) Results are average values for five samples.
(2) Ninety-percent confidence interval.

B. SEDIMENTS

In-Situ Sediment Gamma Ray Spectrometry, Sediment Sampling, and Analysis

The first type of measurement at each of the two sites consisted of direct measurement of the gamma-emitting radionuclides in the sediments and on debris by employing an underwater gamma detector mounted on the outside of the submersible. The gamma detector used at the THRESHER site consisted of a 10-centimeter diameter by 10-centimeter high cylindrical crystal of cesium iodide. The crystal, its photomultiplier tube, and the associated electronics were contained in a pressure housing made of aluminum with a 2.5-centimeter thick hemispherical front end, cylindrical walls, and a 5-centimeter thick back end plate. The signals from the detector were wired into the diving sphere of the deep submergence vehicle TRIESTE, where a multichannel gamma spectrometer was used to monitor the signals. The multichannel analyzer displayed the gamma ray spectra and was connected to a printer such that each of the spectra could be recorded.

For the survey at the SCORPION site, a sodium iodide detector was used in addition to the cesium iodide detector. The sodium iodide detector consisted of two extruded NaI(Th) polycrystalline "scintillators," each 5 centimeters in diameter and 40 centimeters long. These scintillators, along with their photomultiplier tubes and associated electronics, were each contained in a separate pressure housing. The pressure housings were cylinders 7.5 centimeters in diameter and 100 centimeters long with hemispherical ends. The walls and ends were made of 0.63 centimeter thick alumina ceramic. The open ends were capped with 3.8 centimeter thick plates of monel. The two cylindrical vessels are held parallel, about 5 centimeters apart, by a supporting frame.

The detectors were deployed from the bow winch of the TRIESTE. This arrangement allowed the detectors to be lowered one to two inches into the bottom sediment at the various sampling stations.

A total of 13 sampling stations were selected to be monitored in the immediate vicinity of the THRESHER debris in 1977. At two of the stations direct probe measurements were made within a meter or two of the debris. The area surveyed was approximately 100 meters by 300 meters or roughly 30,000 square meters. For the SCORPION survey, a total of 17 sampling stations were monitored in the vicinity of the debris in 1979. The area surveyed was approximately 150 by 220 meters or roughly 33,000 square meters. Figure D-A4 shows the distribution of sample stations at the THRESHER site, and Figure D-A5 shows the distribution of sample stations at the SCORPION site. Cobalt-60 was the only radionuclide present in sufficient amounts to be detected with the gamma detectors. Tables D-A2 and D-A3 present the estimated Cobalt-60 concentrations in the sediment at the two sites as inferred from the direct gamma measurements.

In addition to in-situ measurement of gamma ray radioactivity on the surface of the sediments with the underwater detectors, samples of sediment from most of the same locations were taken by inserting 5-centimeter or 7-centimeter diameter core tubes into the sediment with the submersible's mechanical arm. At the surface, the water was removed from the top of the core and the sediment samples were kept under refrigeration until analyzed at a shoreside laboratory. Pore water was analyzed with the sediment. At the laboratory the core tubes were sectioned into 1 centimeter to 5 centimeter segments and analyzed for gamma-emitting radionuclides by placing the sediment samples into suitable counting containers ranging from 15 to 150 cubic centimeters. Samples from the SCORPION site were freeze-dried prior to counting to reduce sample size and to increase sample counting efficiency. Nickel-63 analyses were conducted only on those sediment samples that contained detectable concentrations of Cobalt-60 and on the marine life samples. The technique utilized included a radiochemical separation followed by beta spectrometry using liquid scintillation counting.

TABLE D-A2. ESTIMATED COBALT-60 CONCENTRATIONS IN SEDIMENT AT THRESHER SITE AS DETERMINED BY IN-SITU CESIUM IODIDE GAMMA RAY MEASUREMENTS, JULY 1977

Station No.*	Cobalt-60 Radioactivity (pCi/cm^2)	Station No.	Cobalt-60 Radioactivity (pCi/cm^2)
1	1.4	8	1.4
2	1.4	9	ND
3	1.3	10	1.1
4	1.9	13	ND
5	1.7	14	4.0
6	1.1	15	10.1
7	2.1		

ND = Not Detected. The minimum detectable activity was 0.3 pCi/cm^2.

*See Figure D-A4.

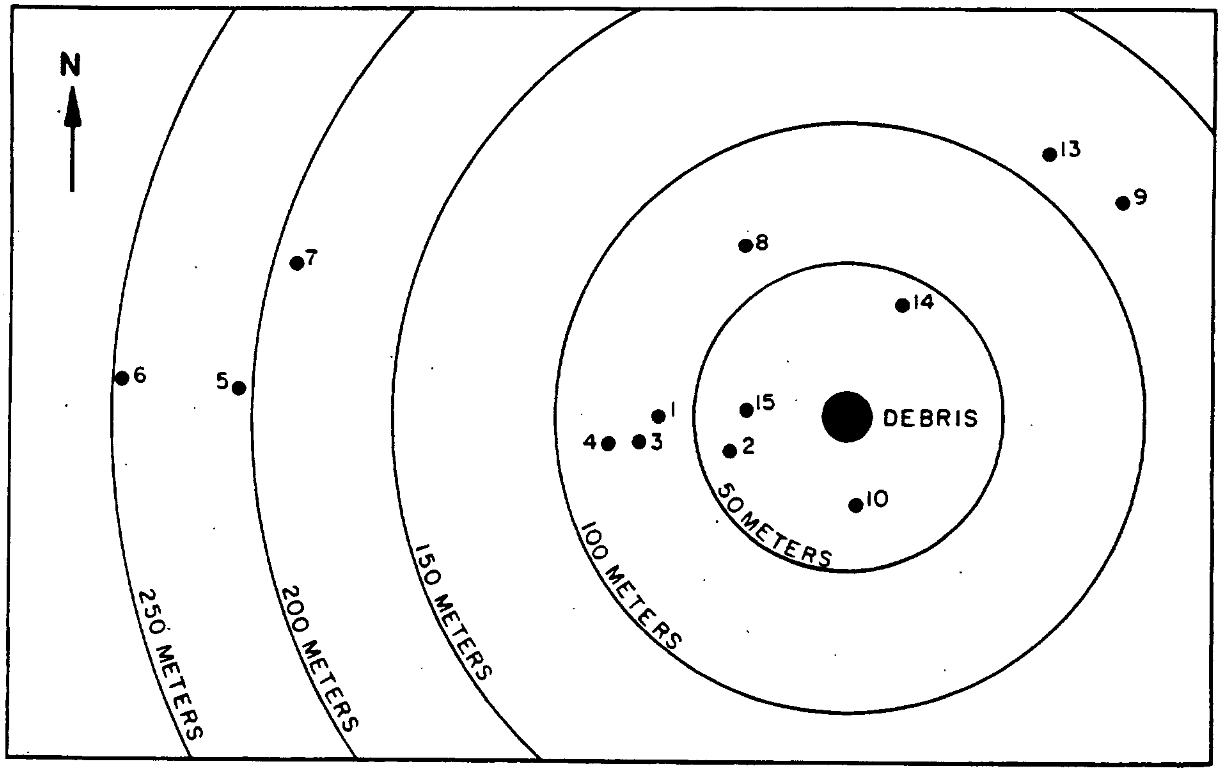

Figure D-A4. Distribution of Sampling Stations in Vicinity of THRESHER Debris, July 1977

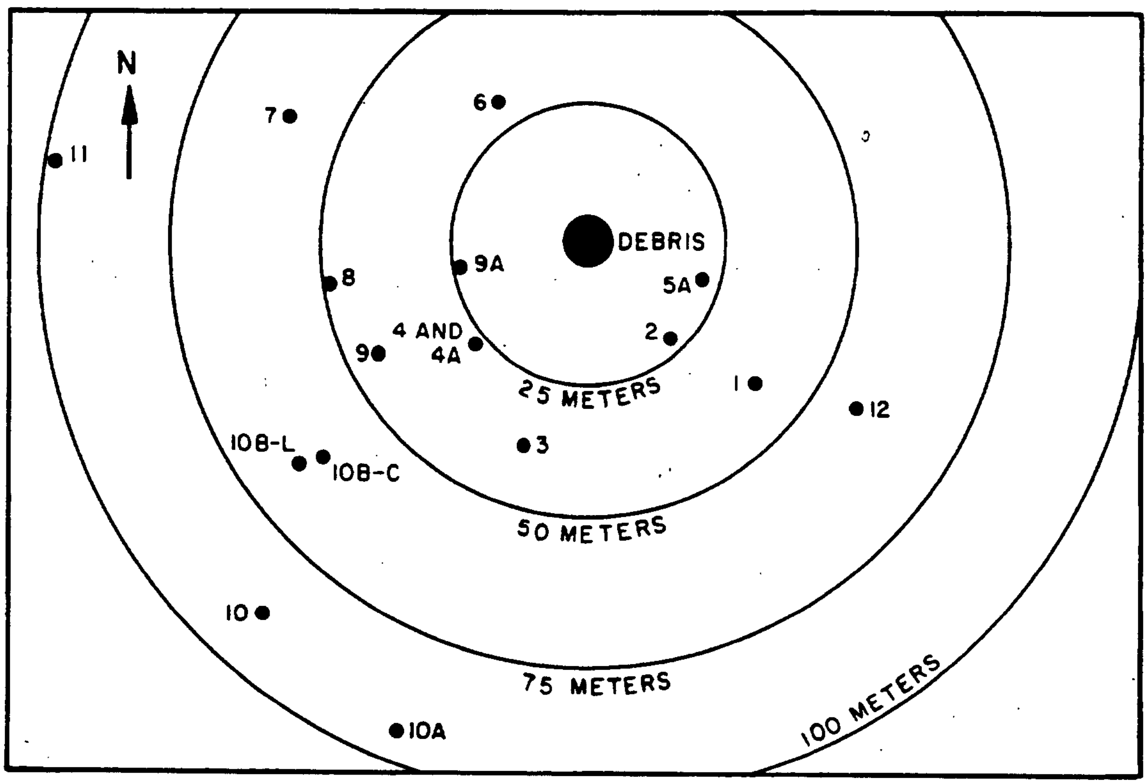

Figure D-A5. Distribution of Sampling Stations in Vicinity of SCORPION Debris, September 1979

TABLE D-A3. ESTIMATED COBALT-60 CONCENTRATIONS IN SEDIMENT AT SCORPION SITE AS DETERMINED BY IN-SITU CESIUM IODIDE AND SODIUM IODIDE GAMMA RAY MEASUREMENTS, SEPTEMBER 1979

Station No.*	Cobalt-60 Radioactivity Concentration, pCi/cm^2	
	Underwater Detector	
	Cesium Iodide	Sodium Iodide
1	1.1	0.9
2	0.7	1.4
3	ND	18.9
4	ND	ND
4A	ND	ND
5A	1.6	7.3
6	ND	ND
7	ND	ND
8	1.4	ND
9	3.2	6.8
9A	5.6	7.4
10	ND	ND
10A	ND	ND
10B-L	ND	ND
10B-C	ND	ND
11	ND	ND
12	ND	ND

ND = Not Detected. The minimum detectable activity was 0.3 pCi/cm^2 for the Cesium Iodide (Cs-I) detector and 0.1 pCi/cm^2 for the Sodium Iodide (Na-I) detector.

*See Figure D-A5.

Results of the gamma spectrum and Nickel-63 analyses of the ocean bottom sediments from the THRESHER and SCORPION sites are shown in Tables D-A4 and D-A6, respectively. Activity concentration data for the upper 5 centimeter layer of bottom sediment cores are summarized in the tables. The tables also show the total Cobalt-60 radioactivity measured in the ocean bottom cores expressed in units of pCi/cm^2 in order to facilitate comparisons with activity concentrations that were estimated based on direct scintillation probe measurements obtained approximately 5 meters away from the individual sediment sampling locations (see Tables D-A2 and D-A3).

The results obtained with the underwater detector(s) and by gamma spectrometry analyses of sediment core samples are in general agreement for the THRESHER site but in poor agreement for the SCORPION site. At the SCORPION site, the sediments collected in the core tubes were so fine that a portion of the sediment leaked through the bottom closure of the core tube; the fine texture and floculent nature of the sediment also resulted in loss of some of the sample material from the top of the core tube as well as some mixing of material within the tube.

As shown in Table D-A4, all cores obtained at the THRESHER site indicated the presence of naturally-occurring uranium and thorium series radionuclides as well as the predominant natural radionuclide Potassium-40. With one exception, the sampled THRESHER site stations indicated the presence of low level Cobalt-60 in the top layers of sediment, i.e., in the top 5 centimeters of sediment. The only other radioactivity detected in any of the THRESHER site sediment core sections was due to Cesium-137. This radionuclide was detected in the surface layer of sediment at less than half of the stations, at extremely low values typical of that attributable to fallout from nuclear weapons testing as shown in Table D-A5 for deep Atlantic ocean sediments. Fallout Cesium-137 in the vicinity of the THRESHER debris ranged from 0.029 pCi per gram to 0.104 pCi per gram (dry weight) in the upper five centimeters of sediment as shown by the data for the Northwestern Atlantic Slope, Reference D.A10. The maximum value of 0.02 pCi per gram (wet weight) obtained at the THRESHER debris site is well within the fallout range when converted to equivalent dry weight radioactivity.

Table D-A6 indicates a generally similar pattern of activity for SCORPION site sediment. However, at the SCORPION site, Cobalt-60 was detected in less than half of the core samples. The infrequent occurrence of detectable Cobalt-60 from below the top 5 centimeters of sediment indicates minimal bioturbation below this depth and shows the relative impermeability of the sediments to the migration of the metallic corrosion products (Tables D-A7 and D-A8).

In order to estimate the total amount of Cobalt-60 activity present in the upper layer of ocean bottom sediment at the THRESHER site, the approximately 30,000 square meter sampling area was divided into several smaller areas based on the Cobalt-60 activity concentrations actually measured in the ocean bottom core sediment samples. The total Cobalt-60 sediment activity estimated in this way for the THRESHER site is 0.3 millicurie. Alternatively, based on in-situ measurements (Table D-A2), the total Cobalt-60 inventory is estimated to be 0.7 millicurie. These two estimates are considered to be in good agreement. However, the same approach applied to SCORPION site data does not yield consistent estimates of the Cobalt-60 activity in the site sediment. As indicated previously, the results of gamma spectrometry analyses of SCORPION site sediment core samples are in poor agreement with the results obtained with the independent in-situ measurements made using sodium iodide and cesium iodide detector systems. The lower results were obtained from the analyses of core sediment samples at the SCORPION site and may be attributable either to partial loss and mixing of core samples or to the fact that the in situ detector locations differed by approximately 3 meters from the sediment core sample locations. As evident from Table D-A3, the non-uniformity of the radionuclide distribution is demonstrated even at the distances separating the Cesium Iodide and Sodium Iodide in situ detectors. The higher estimates of the total amount of Cobalt-60 in the sediment at the SCORPION site, as based on cesium iodide and sodium iodide detector measurements, are 0.2 and 0.4 millicurie, respectively. Thus, it may be estimated that about 0.3 millicurie of Cobalt-60 were (in 1979) spread over an area of approximately 13,000 square meters of the SCORPION site (or about 40 percent of the total area of 33,000 square meters that were surveyed).

1. Source of the Released Cobalt-60

Samples of sediment from the THRESHER and SCORPION sites were also analyzed in an attempt to assess the magnetic properties of the contained Cobalt-60. Sediment was mixed with water and the resultant slurry

TABLE D-A4. SUMMARY OF RADIOACTIVITY CONCENTRATIONS IN SEDIMENT CORE SAMPLES OBTAINED FROM THE THRESHER SITE, JULY 1977

Station No.*	Measured Radioactivity Concentration in Upper 5 Centimeter Sediment Core Samples, Picocuries Per Gram						Total Core Cobalt-60 Activity Concentration pCi/cm²
	Uranium	Thorium	Potassium-40	Cesium-137	Nickel-63	Cobalt-60	
1	0.4	0.5	10.0	<0.01	<0.28	0.10	0.79
2	0.4	0.6	10.8	<0.01	<0.27	0.13	1.12
3	0.4	0.6	9.9	0.02	<0.26	0.13	1.17
3	0.4	0.5	10.6	0.01	<0.26	0.07	0.69
4	0.4	0.6	9.6	0.01	<0.26	0.10	1.00
5	0.5	0.5	8.8	0.01	<0.26	0.05	0.43
6	0.4	0.6	10.4	0.02	<0.26	0.09	0.86
7	0.5	0.5	10.2	0.01	<0.26	0.05	0.54
8	0.4	0.5	9.2	<0.01	<0.23	0.03	0.29
9	0.4	0.6	11.3	<0.01	<0.22	0.02	0.19
10	0.4	0.6	13.0	<0.02	NM	<0.01	<0.10
14	0.5	0.7	13.9	<0.01	<0.26	0.09	0.75
14	0.4	0.6	11.7	0.02	<0.25	0.27	2.80
15	0.4	0.8	13.7	<0.01	<0.23	0.07	0.58
15	0.4	0.6	12.5	<0.01	<0.22	0.03	0.28

NOTE: The uranium, thorium, and Potassium-40 are naturally-occurring radioactive materials. The concentrations of Cesium-137 are consistent with levels due to fallout. Only the Cobalt-60 concentrations are attributable to the presence of the THRESHER debris. (NM = Not Measured).

*See Figure D-A4.

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stirred in the presence of a strong permanent magnet that was housed in a glass tube suspended in the slurry. Material attached to the glass tube was periodically removed and the separation process continued. Although this separation method is considered to be only semi-quantitative, the results of applying the method are an important indicator of the source of the Cobalt-60, since most, if not all, of the Cobalt-60 was determined to be magnetic in nature. Cobalt-60 in magnetic form is associated with the magnetic corrosion products formed during previous operation of the THRESHER and SCORPION reactor plants and, as previously discussed, is distinguishable from the neutron-activated cobalt contained within the nuclear reactor pressure vessel internal structure. Therefore, the source of almost all of the Cobalt-60 in the sediment is the reactor coolant and the activity deposited by the coolant on the inside surfaces of piping and components. Corrosion that occurred after the sinkings does not represent a significant source of the Cobalt-60 found in the sediment. Although Nickel-63 was not detectable in individual samples of sediment and marine life, it was possible to detect Nickel-63 by performing a magnetic separation and concentration of corrosion products by combining those sediment samples from each site that contained the highest levels of Cobalt-60 contamination. The relative Cobalt-60 and Nickel-63 concentrations obtained from the SCORPION and THRESHER debris sites were then compared with expected relative concentrations for corrosion products in the reactor coolant and confirmed the origin of the radioactivity.

TABLE D-A5. FALLOUT CESIUM-137 IN DEEP OCEAN SEDIMENTS

Location		NW Atlantic Slope	Atlantic Dumpsite (No longer used)	Atlantic Dumpsite (No longer used)	Atlantic Dumpsite (No longer used)	Atlantic Dumpsite (No longer used)	N. Atlantic Ocean	NE Atlantic Ocean	SE Atlantic Ocean	SE Atlantic Ocean
Position		40°06.7'N 68°01'W	38°25.8'N 72°8.2'W	38°22.8'N 72°9.8'W	38°30.7'N 72°13.7'W	38°30 7'N 72°7.8'W	39°02'N 42°36'W	21°54'N 18°17'W	29°59'S 04°55'E	15°49'S 02°08'E
Water Depth		2080m	2880m	2820m	2860m	2820m	4810m	1410m	4920m	5349m
Cesium-137 Activity (pCi/g dry)	0-1 cm	0.033 ± 0.001	0.076 ± 0.006	— —	0.021 ± 0.001	0.095 ± 0.003	0.016[a] ± 0.003	0.009[a] ± 0.002	0.002[a] ± 0.001	BD[b]
	1-3 cm	0.029 ± 0.001	0.042 ± 0.002	0.111 ± 0.004	0.034 ± 0.001	0 195 ± 0.004	↓	↓	↓	↓
	3-5 cm	0.104 ± 0.002	0.010 ± 0.002	0.044 ± 0.003	0.020 ± 0.002	0.014 ± 0.002	↓	↓	↓	↓
Reference		Livingston and Bowen 1979 Reference D.A10	Bowen and Livingston 1981 Reference D.A11				Noshkin and Bowen 1973 Reference D.A12			

(a) Assumes wet sediment density of 1.5 g/cm^3 averaged over a depth of 10 centimeters.
(b) BD = Below Detection Limits

TABLE D-A6. SUMMARY OF RADIOACTIVITY CONCENTRATIONS IN SEDIMENT CORE SAMPLES OBTAINED FROM THE SCORPION SITE, SEPTEMBER 1979

Station No.*	Maximum Measured Radioactivity Concentration in Upper 5 Centimeter Sediment Core Samples, Picocuries Per Gram						Total Core Cobalt-60 Radioactivity Concentration pCi/cm²
	Uranium	Thorium	Potassium-40	Cesium-137	Nickel-63	Cobalt-60	
1	1.5	0.1	1.8	<0.02	NM	<0.02	<0.15
2	1.1	0.1	2.1	<0.02	NM	<0.02	<0.13
3	0.9	0.4	1.8	<0.07	NM	<0.07	<0.12
4	0.9	0.8	2.2	<0.08	<0.24	0.80	1.08
6	1.4	0.1	1.3	<0.02	NM	<0.02	<0.15
6	1.1	0.1	1.4	<0.02	NM	<0.02	<0.14
7	1.2	0.1	1.3	0.02	NM	<0.02	<0.15
8	1.2	0.1	1.3	0.03	NM	<0.02	<0.16
8	1.0	0.1	1.0	0.04	<0.18	0.15	0 46
9	2.2	0.2	2.5	<0.02	<0.21	0.08	0.41
9A	1.3	0.2	1.3	<0.02	NM	<0.02	<0.17
10	1.2	0.1	1.3	0.03	NM	0.03	0.21
10A	1.2	0.1	2.3	<0.02	NM	<0.02	<0.14
10B-L	1.2	0.1	1.2	<0.02	<0.19	0.02	0.21
10B-C	1.3	0.1	1 8	<0.02	NM	<0.02	<0.14
11	1.3	0.2	1.9	0.05	<0.19	0.03	0.13

NOTE: The uranium, thorium, and Potassium-40 are naturally-occurring radioactive materials. The concentrations of Cesium-137 are consistent with levels due to fallout. Only the Cobalt-60 concentrations are attributable to the presence of the SCORPION debris. (NM = Not Measured).

*See Figure D-A5.

The total Cobalt-60 estimated for the sediment at the THRESHER and SCORPION sites is in each case equal to approximately 0.3 millicurie, a small fraction of the total activity of this type (i.e., about 10 curies as described in Section III). As shown in Tables D-A4 and D-A5, the measured levels of Cobalt-60 are significantly lower than the naturally-existing radioactivity levels of potassium, uranium, and thorium present in the sediment at the debris sites. The only other non-natural radioactivity detected in sediments at the two sites, Cesium-137, is present at extremely low levels typical of levels associated with fallout from nuclear weapons testing.

TABLE D-A7. COBALT-60 SEDIMENT PROFILE FOR THRESHER DEBRIS SITE, JULY 1977 (PICOCURIES PER GRAM)

Sediment Depth (cm)	Station	1	2	3	3	4	5	6	7	8	9	10	14	14	15	15
	0-5	0.097	0.125	0.125	0.072	0.099	0.046	0.087	0.054	0.029	0.020	ND	0.088	0.271	0.068	0.025
	5-10	ND	0.050	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10-15	ND	ND	ND	ND	ND	–	ND	ND	ND	ND	ND	ND	ND	ND	ND
	15-20	ND	ND	ND	ND	ND	–	ND	ND	ND	ND	ND	ND	ND	ND	ND
	20-25	ND	ND	ND	ND	ND	–	ND	ND	–	ND	ND	ND	ND	ND	–
	25-30	–	ND	ND	ND	–	–	ND	ND	–	ND	ND	ND	ND	ND	–
	30-35	–	ND	–	ND	–	–	ND	–	–	–	ND	ND	ND	ND	–
	35-40	–	ND	–	–	–	–	–	–	–	–	ND	–	ND	–	–

ND = Not Detectable. The minimum detectable activity ranged from 0.010 to 0.081 pCi per gram wet weight.

TABLE D-A8. COBALT-60 SEDIMENT PROFILE FOR SCORPION DEBRIS SITE, SEPTEMBER 1979 (PICOCURIES PER GRAM)

Sediment Depth (cm)	Station	1	2	3	4	6	6	7	8	8	9	9A	10	10A	10B-L	10B-C	11
	0-5	ND	ND	ND	0.392	ND	ND	ND	ND	0.145	0.081	ND	0.030	ND	0.019	ND	0.023
	5-10	ND	ND	ND	0.044	ND	ND	ND	ND	–	ND	ND	–	ND	ND	ND	ND
	10-15	–	–	ND	ND	–	–	–	–	–	ND	–	–	–	–	–	–

ND = Not Detectable. The minimum detectable activity ranged from 0.014 to 0.068 pCi per gram dry weight.

C. DEBRIS

Debris from the THRESHER and SCORPION sites removed from the ocean bottom were monitored as a precaution aboard the support ship utilizing a sensitive survey meter equipped with a 5 centimeter by 5 centimeter sodium-iodide gamma ray scintillation detector. The detector system was set up to respond to a wide spectrum of gamma ray energies as well as to provide specific information for an energy interval covering the energies of the gamma rays emitted by Cobalt-60. This radioactivity monitoring of the recovered debris items did not disclose any activity above instrument background (50 counts per minute in the Cobalt-60 energy interval).

D. MARINE LIFE

Marine life, consisting of a holothurian (sea cucumber) and an echinoid (sea urchin) were collected adjacent to the THRESHER debris. Two macrourid fish (Coryphaenoides armatus), rat tails, were caught at the edges of the SCORPION debris field. As indicated by the results shown in Table D-A9, no corrosion product radioactivity or fission product activity attributable to the THRESHER or SCORPION was detected in the marine life samples. Laboratory experiments designed to investigate the biological accumulation of Cobalt-60 from irradiated stainless steel and its corrosion products have been conducted by Young (Reference D.A13), and the fact that these corrosion products are refractory (insoluble) in nature has been demonstrated (Reference D.A14). Results have indicated that Cobalt-60 is accumulated only to a very limited extent if at all by marine organisms, due primarily to the predominantly insoluble nature of these corrosion products (Reference D.A13). Other studies have also shown that this type of radioactivity is not readily assimilated in the tissues or skeletal material of marine organisms even after ingestion (Reference D.A15). Reference D.A1 and similar U.S. Navy reports issued over the past twenty years show no detected buildup of Cobalt-60 in marine life samples obtained from harbors frequented by U.S. naval nuclear-powered ships.

TABLE D-A9. RADIOACTIVITY ANALYSIS RESULTS FOR MARINE LIFE SAMPLES OBTAINED AT THE THRESHER AND SCORPION DEBRIS SITES

Month and Year	Debris Site	Sample Description	Radioactivity Concentration, Picocuries per Gram			
			Potassium-40	Cesium-137	Cobalt-60	Nickel-63
July 1977	THRESHER	Sea Urchin(1)	2.9	0.02*	<0.01	(5)
July 1977	THRESHER	Sea Cucumber(2)	<0.6	<0.01	<0.01	(5)
Sept. 1979	SCORPION	#1 Rat Tail(3), Stomach Contents	1.2	<0.02	<0.04	<0.23
		#1 Rat Tail(3), Flesh(4)	2.3	<0.05	<0.03	<0.19
Sept. 1979	SCORPION	#2 Rat Tail, Stomach Contents	6.3	<0.19	<0.21	<1.2
		#2 Rat Tail, Flesh(4)	2.1	<0.03	<0.04	<0.21

***The indicated level of Cesium-137 is attributable to fallout activity from nuclear weapons testing, References D.A17 and D.A18.**

(1) Echinoid
(2) Holothurian
(3) Coryphaenoides armatus
(4) Results are based on analyses of two samples, approximately 25 grams each.
(5) Sample consumed by prior analyses.

E. RECENT RESULTS

A comprehensive deep-ocean radiological environmental monitoring operation was conducted at the THRESHER site in August 1983 utilizing both surface ship deployed and submersible operated monitoring equipment as described in Appendix K. High resolution gamma spectrometry was conducted on sixty-three (63) individual fish, primarily rattails, obtained from the immediate vicinity of the THRESHER debris (Table D-A10). In addition, fifteen samples containing hundreds of assorted marine macrofauna and benthos including amphipods, sea urchins, snails, worms, cumaceans, and brittle stars were collected and analyzed for gamma-emitting radionuclides (Table D-A11). No radioactivity above background levels due to naturally-occurring radioisotopes or fallout was observed in any of the marine life samples analyzed. Figure D-A6 shows the stations at which the biological and seawater samples were obtained.

Sixteen sediment core tubes were collected by DSV ALVIN from twelve stations located in the area immediately adjacent to and surrounding the THRESHER debris (Figure D-A7). Cobalt-60 was detectable in eight of the sixteen core tubes to a maximum concentration of 0.266 picocurie per gram wet weight (Table D-A12). Cobalt-60 was not detectable in any of the samples of interfacial seawater obtained from the sediment-seawater interface by the core tubes. Nickel-63 analyses were performed only on those sediment samples that contained detectable concentrations of Cobalt-60 and on representative fish and marine life specimens. Nickel-63 was not detectable in individual samples of sediment, fish tissues and marine life. However, by performing a magnetic separation and concentration of corrosion products from the sediment sample that contained the highest level of Cobalt-60 contamination, it was possible to detect Nickel-63 in the sediment at a level slightly above the minimum detectable. The source of most of the Cobalt-60 and Nickel-63 in the sediment was again determined to be the reactor coolant and activity deposited by the coolant on inside surfaces of piping and components during prior operations of the submarine. This was confirmed by the magnetic properties of the corrosion products and their relative concentrations of Cobalt-60 and Nickel-63. Cesium-137 concentrations in excess of those attributable to fallout were not detected in any of the sediment samples indicating that the integrity of the reactor fuel inside the core has been maintained (Table D-A13).

Sediment core and interfacial seawater samples were also collected by the deployment of a box corer and tripod sphincter corer from the surface ship ORV CAPE FLORIDA. It was possible to obtain accurately positioned samples in the immediate vicinity of the THRESHER debris by the use of an acoustic transponder navigation network with verification of relative positions by DSV ALVIN. Cobalt-60 originating from the THRESHER reactor coolant was detectable in two of seven surface subsamples obtained from the box core and the upper two-inch segment from the tripod sphincter core at concentrations of 0.02 picocurie per gram wet weight in each. Cesium-137 concentrations in excess of fallout levels were not measured in any of the samples analyzed.

Seven in-situ gamma spectrometry measurements of the sediment were obtained by DSV ALVIN in the THRESHER debris area using the submersible mounted detector and multi-channel analyzer. None of the measurements obtained indicated any detectable concentrations of radioactivity above natural background levels.

Four large volume seawater samples of 441 liters, 392 liters, 587 liters, and 503 liters, respectively, were obtained by a submersible mounted and ship deployed pumping system including prefilters and chemisorptive cartridges for collection of radioactivity. In addition, two five-liter Niskin bottle samples were obtained in the THRESHER debris area. No radioactivity attributable to the THRESHER debris was found in any of the seawater samples analyzed (Table D-A14). Extremely low concentrations of Cesium-137 were detectable in samples obtained by the highly sensitive pumping systems. The Cesium-137 concentrations are typical of levels attributable to fallout from nuclear weapons testing.

Visual and photographic observations of the sessile marine life on submarine surfaces indicate little, if any, change in the extent of biological colonization since the 1977 observations. The THRESHER debris had not produced a significant "reef effect" during the approximately 20 years that it has rested on the bottom. There were no discernible differences in biomass concentrations between the THRESHER debris site and the surrounding area.

The currents in the THRESHER debris area were generally much lower in velocity than in 1977 and exhibited a tidal influence on speed and direction as shown in Figure D-A8. Maximum velocities of approximately 5 cm/sec were recorded.

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*This section was not part of the DEIS.

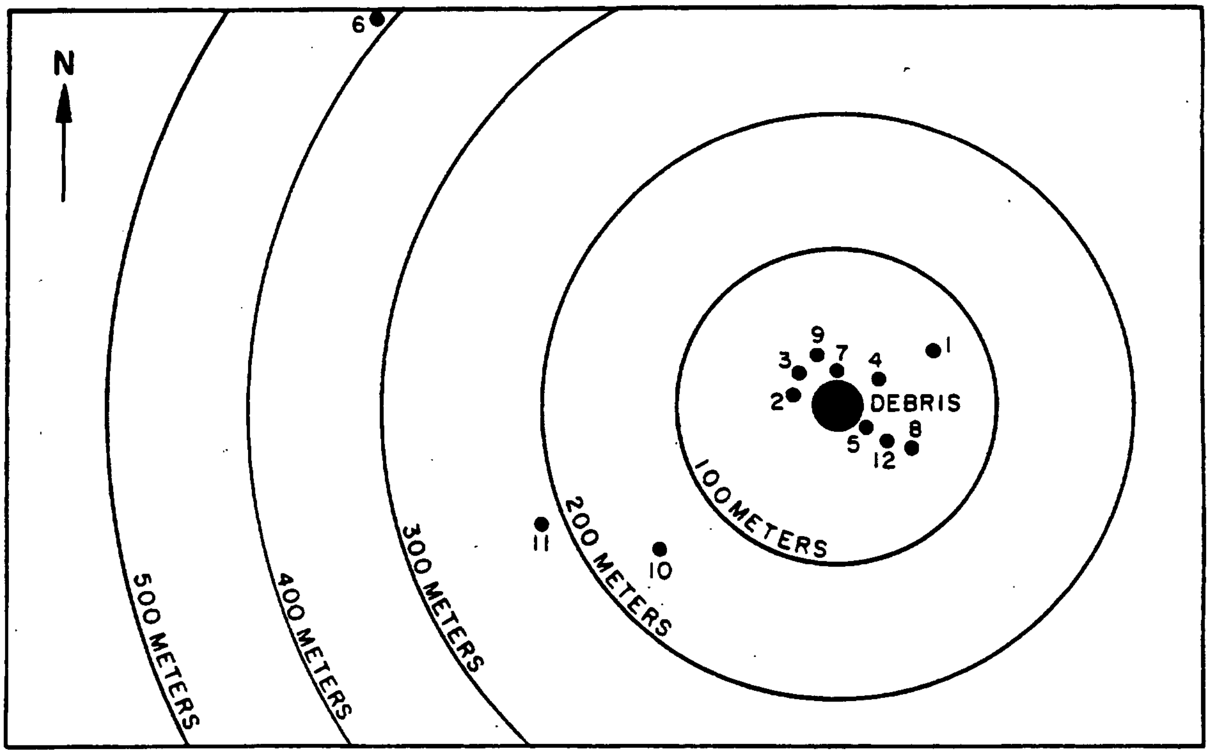

Figure D-A6. Distribution of Biological and Seawater Sampling Stations in Vicinity of THRESHER Debris, August 1983

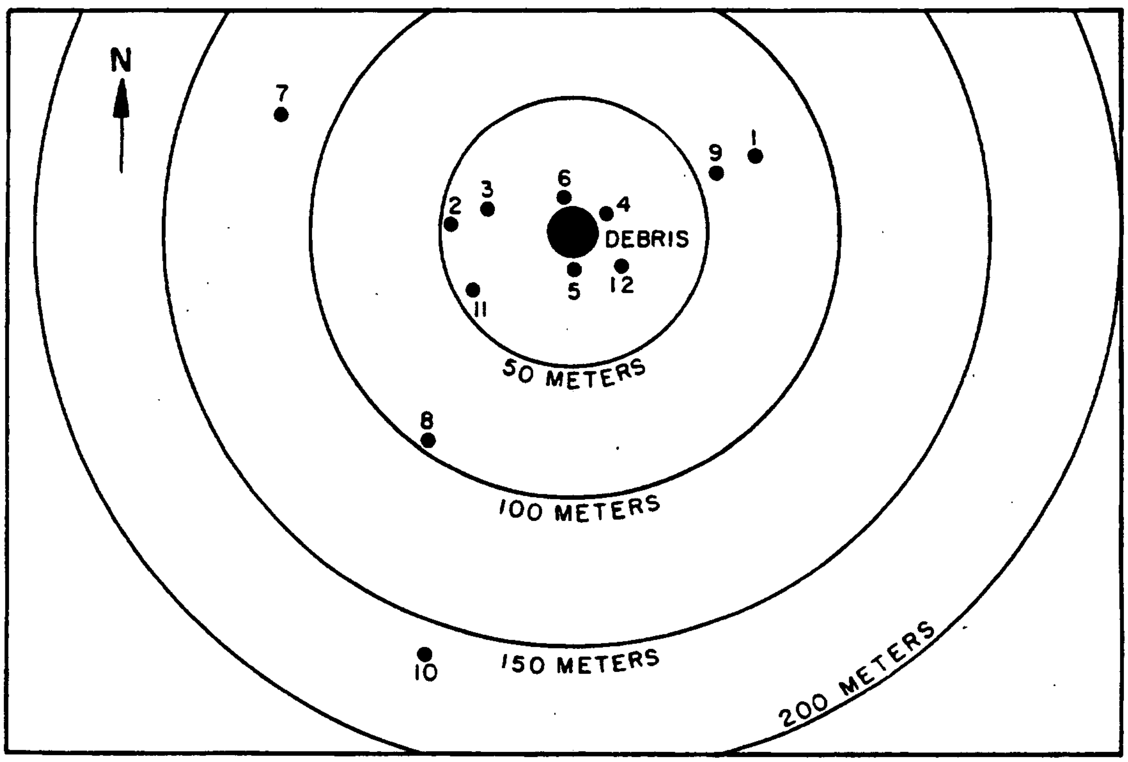

Figure D-A7. Distribution of ALVIN Sediment Sampling Stations in Vicinity of THRESHER Debris, August 1983

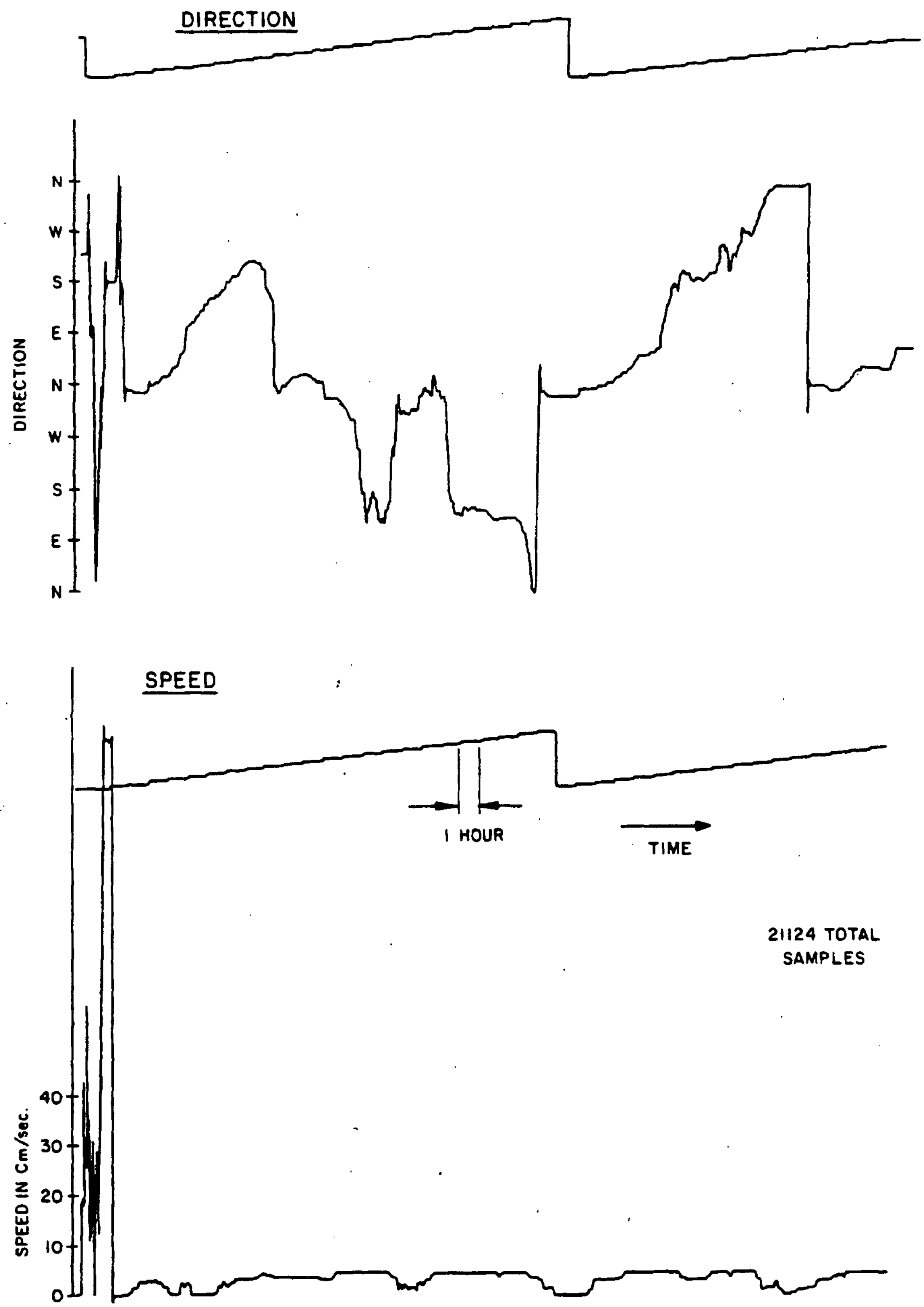

Figure D-A8. Bottom Current Data for the 43-Hour Period Taken at the THRESHER Debris Site Area in August 1983

TABLE D-A10. GAMMA SPECTRUM ANALYSIS RESULTS FOR FISH OBTAINED FROM THE THRESHER DEBRIS SITE

Sample ID	Station	Type	Length (cm)	Wet Weight (g)	Radioactivity Concentration Picocuries per Gram		
					K-40	Cs-137	Co-60
FT-103-1	2	Coryphaenoides armatus (rattail)	43	276.5	3.93 ± 0.26	<0.014(1)	<0.014(1)
-2	2	Coryphaenoides armatus (rattail)	41	259	4.33 ± 0.29	0.028 ± 0.003	<0.016
-3	2	Coryphaenoides armatus (rattail)	44.8	319	3.16 ± 0.22	<0.015	<0.012
-4	2	Coryphaenoides armatus (rattail)	40.4	244	1.44 ± 0.05	<0.02	<0.02
-5	2	Coryphaenoides armatus (rattail)	50	535	3.67 ± 0.19	<0.007	<0.008
-6	2	Coryphaenoides armatus (rattail)	46.5	409	1.57 ± 0.05	<0.01	<0.01
-7	2	Coryphaenoides armatus (rattail)	40	343	1.71 ± 0.05	<0.01	<0.01
-8	2	Coryphaenoides armatus (rattail)	35.3	263	1.80 ± 0.05	<0.02	<0.02
-9	2	Coryphaenoides armatus (rattail)	51	492	2.26 ± 0.15	<0.007	<0 008
-10	2	Coryphaenoides armatus (rattail)	26 (anus to tail)	118	2.02 ± 0.10	<0.009	<0.017
-11	2	Coryphaenoides armatus (rattail)	41	494	2.37 ± 0.15	<0.007	<0.008
-12	2	Antimora rostrada (codling)	39.5	445	2.64 ± 0.17	<0.008	<0.008
-13	2	Coryphaenoides armatus (rattail)	45.8	450	3.40 ± 0.20	<0.008	<0.009
-14	2	Coryphaenoides armatus (rattail)	7.5 (head only)	83.5	1.25 ± 0.04	<0.05	<0.05
-15	2	Coryphaenoides armatus (rattail)	52.4	623	3.11 ± 0.16	<0.006	<0.007
-16	2	Coryphaenoides armatus (rattail)	36	213	3.80 ± 0.28	0.022 ± 0.002	<0.017
-17	2	Coryphaenoides armatus (rattail)	51.2	623	3.53 ± 0.17	0.006 ± 0.001	<0.007
-18	2	Coryphaenoides armatus (rattail)	49.2	660	2.37 ± 0.14	<0.005	<0.006
-19	2	Coryphaenoides armatus (rattail)	50.3	491	3.26 ± 0.19	<0.007	<0.009
-20	2	Coryphaenoides armatus (rattail)	43	340.5	3.04 ± 0.21	<0.011	<0.012
-21	2	Coryphaenoides armatus (rattail)	28.5 (anus to tail)	301.5	3.38 ± 0.23	<0.011	<0.012
-22	2	Coryphaenoides armatus (rattail)	51	685.5	1.5 ± 0.1	<0.005	<0.005
-23	2	Coryphaenoides armatus (rattail)	48.5	500.4	2.01 ± 0.14	<0.007	<0.008
-24	2	Coryphaenoides armatus (rattail)	41.5	316.9	1.7 ± 0.2	<0.010	<0.010
-25	2	Coryphaenoides armatus (rattail)	51	453.6	2.1 ± 0.1	<0.006	<0.006
-26	2	Coryphaenoides armatus (rattail)	50	446.0	1.6 ± 0.1	<0.007	<0.006
-27	2	Coryphaenoides armatus (rattail)	55	676.9	1.3 ± 0.1	<0.004	<0.003
-28	2	Coryphaenoides ? armatus (rattail)	37 (missing tail)	397.3	1.7 ± 0.1	<0.008	<0.009

(1) The "less-than" symbol (<) indicates that radioactivity was not detectable, and the concentration value listed is the smallest amount which could be detected if any radioactivity were present.

TABLE D-A10. (Cont)

Sample ID	Station	Type	Length (cm)	Wet Weight (g)	Radioactivity Concentration Picocuries per Gram		
					K-40	Cs-137	Co-60
FT-103-29	2	Coryphaenoides armatus (rattail)	42	213.1	2.2 ± 0.2	<0.011	<0.012
-30	2	Coryphaenoides armatus (rattail)	42.5	291.6	2.5 ± 0.2	<0.011	<0.010
-31	2	Coryphaenoides armatus (rattail)	28.5 (anus to tail)	291	3.0 ± 0.22	<0.012	<0.013
-32	2	Coryphaenoides armatus (rattail)	45	312.5	3.39 ± 0.23	<0.011	<0.012
-33	2	Coryphaenoides armatus (rattail)	46.7	350	2.8 ± 0.2	<0.009	<0.007
-34	2	Coryphaenoides armatus (rattail)	41.3	265	3.0 ± 0.2	<0.012	<0.014
-35	2	Coryphaenoides armatus (rattail)	42.0	276	3.37 ± 0.24	0.013 ± 0.002	<0.014
-36	2	Coryphaenoides armatus (rattail)	24 (anus to tail)	240	3.82 ± 0.27	<0.015	<0.016
-37	2	Coryphaenoides armatus (rattail)	48.5	427.5	2.8 ± 0.2	<0.007	<0.008
-38	2	Coryphaenoides armatus (rattail)	45	432	3.14 ± 0.19	<0.014	<0.009
-39	2	Coryphaenoides armatus (rattail)	15 (head only)	141	1.11 ± 0.04	0.04 ± 0.02	<0.03
-40	2	Coryphaenoides armatus (rattail)	42	254	3.28 ± 0.24	<0.014	<0.016
-41	2	Coryphaenoides armatus (rattail)	37.6	266	3.9 ± 0.2	<0.011	<0.013
-42	2	Coryphaenoides armatus (rattail)	45.5	353	2.3 ± 0.2	<0.011	<0.008
-43	2	Coryphaenoides armatus (rattail)	49.6	566	1.1 ± 0.1	<0.006	<0.005
-44	2	Coryphaenoides armatus (rattail)	49.3	387	2.3 ± 0.2	<0.009	<0.007
-45	2	Coryphaenoides armatus (rattail)	41.5	308.5	3.0 ± 0.2	<0.010	<0.010
-46	2	Coryphaenoides armatus (rattail)	52.8	615	1.8 ± 0.2	<0.005	<0.006
-47	2	Coryphaenoides armatus (rattail)	44.0	527	2.2 ± 0.1	<0.006	<0.006
-48	2	Coryphaenoides armatus (rattail)	43.0	437	2.8 ± 0.2	<0.007	<0.007
-49	2	Coryphaenoides armatus (rattail)	26.0 (anus to tail)	186.5	3.2 ± 0.2	<0.016	<0.014
-50	2	Antimora rostrada (codling)	42.5	760	2.0 ± 0.1	<0.005	<0.005
-51	2	Coryphaenoides armatus (rattail)	48	429	1.8 ± 0.1	<0.007	<0.006
-52	2	Antimora rostrada (codling)	42.5	588	1.9 ± 0.1	<0.005	<0.004
-53	2	Coryphaenoides armatus (rattail)	46	488	1.1 ± 0.1	<0.008	<0.005
-54	2	Coryphaenoides armatus (rattail)	26 (anus to tail)	165	9.7 ± 0.4	<0.021	<0.014
-55	2	Zoarcidae Family (eel pout)	48.7	598	1.1 ± 0.1	<0.006	<0.005
-56	2	Antimora rostrada (codling)	45	827	1.7 ± 0.1	<0.004	<0.004

TABLE D-A10. (Cont)

Sample ID	Station	Type	Length (cm)	Wet Weight (g)	Radioactivity Concentration Picocuries per Gram K-40	Cs-137	Co-60
FT-106-1	11	Coryphaenoides armatus (rattail)	36.5	267.5	1.9 ± 0.1	<0.012	<0.011
-2	11	Coryphaenoides armatus (rattail)	44.0	405.5	1.22 ± 0.11	<0.008	<0.010
-3	11	Coryphaenoides armatus (rattail)	43.0	374.5	2.0 ± 0.1	<0.009	<0.009
FT-110-1	8	Coryphaenoides armatus (rattail)	51.5	507.3	1.6 ± 0.1	<0.006	<0.008
-2	8	Coryphaenoides armatus (rattail)	48.0	447.9	1.7 ± 0.1	<0.007	<0.007
-3	8	Coryphaenoides armatus (rattail)	44.5	384.0	2.77 ± 0.20	<0.009	<0.010
FT-1318-1	12	Coryphaenoides ? carapinus (rattail)	23.5	43.2	2.77 ± 0.27	<0.042	<0.043

TABLE D-A11. GAMMA SPECTRUM ANALYSIS RESULTS FOR MARINE LIFE OBTAINED FROM THE THRESHER DEBRIS SITE, AUGUST 1983

Sample ID	Station	Predominant Type	Quantity	Wet Weight (g)	Radioactivity Concentration (1) Picocuries per Gram	
					Cs-137	Co-60
FT-106	11	Amphipods, Copepods	171, 169	7.17	0.43 ± 0.004	<0.24
BC-108	5	Ophiuroids, Cumaceans, Amphipods	8, 3, 1	1.17	<1.86	<0.89
FT-110	8	Copepods, Cumaceans, Amphipods	515, 27, 26	30.6	<0.058	<0.061
SC-113	6	Foraminiferans	1500	0.19	<13.4	<5.95
HB-1317	7	Echinoid (Sea Urchin)	1	6.9	0.209 ± 0.012	<0.16
HB-1318	3	Epifauna	—	0.15	<1.06	<1.42
FT-1318-2	12	Amphipods, Cumaceans	42, 1	0.919	<2.06	<1.87
FT-1318-3	12	Gastropods (Snails)	28	111.4	<0.016	<0.019
FT-1318-4	12	Ophiuroids (Brittle Stars)	5	0.641	<1.77	<1.67
FT-1318-5	12	Gastropods (Snails)	2	1.2	<1.47	<1.53
FT-1320-1U	1	Eurythenes gryllus (Amphipod)	1	20.4	<0.093	<0.088
FT-1320-1	1	Amphipods	3	0.11	<18.4	<17.3
FT-1320-2	1	Gastropods (Snails)	15	94.5	<0.014	<0.018
FT-1320-3	1	Ophiuroids (Brittle Stars)	3	0.475	<4.23	<4.04
RK-1321-1	12	Polychaetes (Worms)	2	9.1	<0.12	<0.13

(1) The "less-than" symbol (<) indicates that radioactivity was not detectable, and the concentration value listed is the smallest amount which could be detected if any radioactivity were present.

TABLE D-A12. ALVIN CORE TUBES COBALT-60 SEDIMENT PROFILE, AUGUST 1983 (PICOCURIES PER GRAM)

Station	1	1	1	2	3	4	4	5	6	7	8	9	10	11	11	12
Sample ID	SED-1317-1	SED-1320-10	SED-1320-9	SED-1318-7	SED-1318-1	SED-1318-2	SED-1322-8	SED-1319-8	SED-1319-9	SED-1319-7	SED-1319-4	SED-1319-5	SED-1319-2	SED-1321-1	SED-1321-2	SED-1322-3
Interfacial Water[1]	NM[3]	<0.013[2]	NM	<0.021	<0.012	<0.011	<0.017	<0.013	NM	<0.013	<0.011	<0.010	<0.012	<0.008	<0.011	NM
Sediment Depth (cm) 0-5	0.266 ±0.046	<0.010	0.025 ±0.007	0.058 ±0.01	0.055 ±0.01	<0.074	<0.007	<0.014	<0.014	0.057 ±0.01	<0.013	<0.010	<0.010	0.078 ±0.031	0.097 ±0.009	<0.012
5-10	0.047 ±0.012	<0.011	<0.017	<0.014	<0.013	<0.010	<0.013	<0.013	<0.014	<0.016	<0.014	0.019 ±0.006	<0.020	0.078 ±0.013	<0.009	<0.008
10-15	0.072 ±0.014	<0.026	<0.014	<0.008	<0.015	<0.012	NM	<0.025	<0.011	<0.013	<0.013	<0.012	<0.019	<0.026	<0.010	<0.008
15-20	<0.010	NM	<0.015	<0.007	<0.016	<0.012	NM	<0.011	<0.011	NM	NM	NM	NM	NM	<0.016	<0.007
20-25	<0.010	NM	<0.012	NM	NM	NM	NM	NM	<0.010	NM	NM	NM	NM	NM	NM	<0.008

(1) pCi/ml for water samples
(2) The "less-than" symbol (<) indicates that radioactivity was not detectable, and the concentration value listed is the smallest amount which could be detected if any radioactivity were present.
(3) NM = not measured.

TABLE D-A13. ALVIN CORE TUBES CESIUM-137 SEDIMENT PROFILE, AUGUST 1983 (PICOCURIES PER GRAM)

Station	1	1	1	2	3	4	4	5	6	7	8	9	10	11	17	12
Sample ID	SED-1317-1	SED-1320-10	SED-1320-9	SED-1318-7	SED-1318-1	SED-1318-2	SED-1322-8	SED-1319-8	SED-1319-9	SED-1319-7	SED-1319-4	SED-1319-5	SED-1319-2	SED-1321-1	SED-1321-2	SED-1322-3
Interfacial Water[1]	NM[3]	<0.017[2]	NM	0.022 ±0.008	<0.011	<0.011	<0.016	<0.011	NM	<0.013	<0.010	<0.012	<0.018	<0.018	<0.017	NM
Sediment Depth (cm) 0-5	<0.038	<0.008	<0.006	<0.016	<0.015	0.034 ±0.017	<0.006	<0.010	<0.016	0.012 ±0.004	0.024 ±0.006	<0.009	0.021 ±0.005	0.034 ±0.016	0.013 ±0.006	<0.008
5-10	<0.008	<0.008	<0.011	<0.031	<0.012	<0.008	<0.010	<0.012	<0.020	<0.010	<0.016	<0.018	<0.015	<0.011	<0.009	<0.008
10-15	<0.008	0.042 ±0.013	<0.010	<0.006	<0.012	<0.008	NM	<0.013	<0.009	<0.008	<0.012	<0.010	<0.011	<0.019	<0.007	<0.008
15-20	<0.008	NM	<0.011	<0.006	<0.010	<0.012	NM	<0.008	<0.006	NM	NM	NM	NM	NM	<0.012	<0.007
20-25	<0.006	NM	<0.010	NM	NM	NM	NM	NM	<0.007	NM	NM	NM	NM	NM	NM	<0.007

(1) pCi/ml for water samples
(2) The "less-than" symbol (<) indicates that radioactivity was not detectable, and the concentration value listed is the smallest amount which could be detected if any radioactivity were present.
(3) NM = not measured.

TABLE D-A14. GAMMA SPECTRUM ANALYSIS RESULTS FOR WATER SAMPLES OBTAINED FROM THE THRESHER DEBRIS SITE, AUGUST 1983

Sample ID	Station	Type	Volume (liters)	Radioactivity Concentration (Picocuries Per Liter) K-40	Cs-137	Co-60
LVW-1319-1	10	Unfiltered	5	279 ± 25	<2.8[1]	<2.8[1]
LVW-1322-1	4	Unfiltered	5	379 ± 25	<3.5	<2.8
PUMP-1317	Composite	Particulate (>1μ)	441	NM[2]	<0.011	<0.011
		Dissolved	441	NM	0.035 ± 0.007	<0.094[3]
PUMP-1318	Composite	Particulate (>1μ)	392	NM	<0.003	<0.003
		Dissolved	392	NM	0.070 ± 0.007	<0.026[3]
PUMP-1322	Composite	Particulate (>1μ)	587	NM	<0.008	<0.007
		Dissolved	587	NM	0.023 ± 0.011	<0.069[3]
PUMP-109	9	Particulate (>1μ)	503	NM	<0.003	<0.003
		Dissolved	503	NM	NM	<0.079[3]

(1) The "less-than" symbol (<) indicates that radioactivity was not detectable, and the concentration value listed is the smallest amount which could be detected if any radioactivity were present.
(2) NM = not measured.
(3) Assumes 10% collection efficiency.

The radioactivity concentrations measured in the 1983 sediment samples agree with expected results when compared with decay-corrected values for the 1977 samples including spatial variations in radioactivity levels. When compared with 1977 results, a smaller percentage of the core samples exhibited detectable concentrations of Cobalt-60 in the surface (0 to 5 cm) sediment segment. Similarly, a larger percentage of the cores exhibited detectable concentrations of Cobalt-60 in the deeper, 5 to 10 cm, segment and one core had detectable Cobalt-60 in the 10 to 15 cm segment. This indicates a dilution of radioactivity in the surface sediments that cannot be accounted for by radioactive decay alone. This dilution may be due to sedimentation and bioturbation resulting in the movement of radioactivity to greater depths. The main source of the radioactivity was still the corrosion products released from the reactor coolant at the time of the accident. Subsequent corrosion of activated structural material has not resulted in a significant increase in the radioactivity present in the sediment.

V. SUMMARY

In 1977 and 1979, direct radiation measurements were made of the gamma-emitting radionuclides contained in the upper layers of sediment at the THRESHER and SCORPION debris sites, respectively. In addition, samples of water, sediment, marine life, and debris were collected from the immediate debris areas and analyzed for radioactivity. Similar radiological environmental monitoring operations were repeated at the THRESHER debris site in 1983. None of these samples showed any evidence of release of radioactivity from the reactor fuel elements in either the THRESHER or SCORPION. Cobalt-60 that had been released from both the THRESHER and SCORPION coolant systems, or internal surfaces of piping or components, was detectable at low levels in sediment samples from localized areas that had not previously been sampled. Nickel-63 was detectable at low concentrations in corrosion products magnetically separated from composite sediment samples at each debris site. The Cobalt-60 and Nickel-63 radioactivity present in the sediments is small compared to naturally-occurring radioactivity. Although it would not be possible, if a single person were to consume all the sediment at either site containing detectable radioactivity above background, the resulting total body radiation exposure would be less than that allowed for a worker in one year by the U.S. Nuclear Regulatory Commission. Cobalt-60 and Nickel-63 were not detected in samples of water, marine life, or debris. Thus, neither the THRESHER nor SCORPION have had a significant effect on the radioactivity in the environment.

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APPENDIX E

DESCRIPTION OF OCEAN STUDY AREAS

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APPENDIX E

DESCRIPTION OF OCEAN STUDY AREAS

I. INTRODUCTION

This appendix describes the current state of oceanographic knowledge for three areas in the deep ocean, two in the Atlantic and one in the Pacific, which are thought to be representative of potential disposal sites. In order to develop an analytical model of the effects of any possible disposal, it was necessary to select a typical site so that specific values could be selected for the various physical parameters, such as current speed and direction, horizontal and vertical diffusion terms, and thickness of the bottom mixed layer. These study areas were selected as the result of preliminary screening of a number of possible sites near the 200 nautical mile United States economic zone boundary. The screening (References E.1 and E.2) was performed by oceanographers familiar with the available historical data, primarily relating to an area's water depth, remoteness from human activities, sediment thickness, regularity of the sea floor, absence of geologically significant activity, and the expected general circulation pattern of bottom waters. The criteria used in this screening were derived from those specified by the technical authority for the international convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Reference E.3), and on additional specifications which the oceanographers felt would increase assurance that the sites would be stable and predictable.

Based on the results to date of follow-up studies which have been conducted in the selected areas, as described below, study areas which satisfy all technical criteria have been identified in the Atlantic and Pacific Oceans within a reasonable distance from the United States coastline. The Pacific Ocean study area is within the United States 200 nautical mile economic zone boundary, and a sizable part of one of the Atlantic Ocean study areas is also within 200 nautical miles of the U.S. coast. It is possible that within the latter area a location that satisfies all technical criteria will be found. The study areas identified are expected to be as close to the United States coastline as any site which might eventually be selected, and for this reason they would be likely to produce maximum representative environmental impacts when used in the impact analysis. These areas are not "disposal sites" since approval of a site for actual disposal operations may require qualifying research beyond that performed in support of this statement. However, it was considered an essential part of the environmental evaluation that specific locations be identified to permit a realistic analysis. In this way, specific sea floor corrosion measurements could be made and representative ocean bottom currents and other ocean transport properties could be employed in estimates of the potential downstream transport of radioactive corrosion products. This approach also made it possible to base exposure estimates on an actual population, with realistic data describing the pathways by which individuals might be exposed to radioactive releases. Given the objective that specific locations be identified for realistic analysis, the ocean areas described in this appendix are considered to be typical of areas which are most likely to be acceptable. However, in the event that the sea disposal option is used, actual disposal sites could be selected from many other possible areas.

The two Atlantic Ocean locations (Figure E-1) are approximately 170 to 260 nautical miles east and 200 to 360 nautical miles southeast of Cape Hatteras, North Carolina on the Lower Continental Rise and on the Hatteras Abyssal Plain, respectively. Supporting studies of these areas are being conducted by the University of Rhode Island, Graduate School of Oceanography. The Pacific Ocean location selected for further examination (Figure E-2) is approximately 140 to 200 nautical miles southwest of Cape Mendocino, California. Supporting studies of this area are being conducted by the School of Oceanography, Oregon State University. Each of the specific areas has been subjected to a questioning approach, seeking characteristics that would rule it out as an acceptable disposal site. It is considered essential that any proposed site be approached in a similar questioning way.

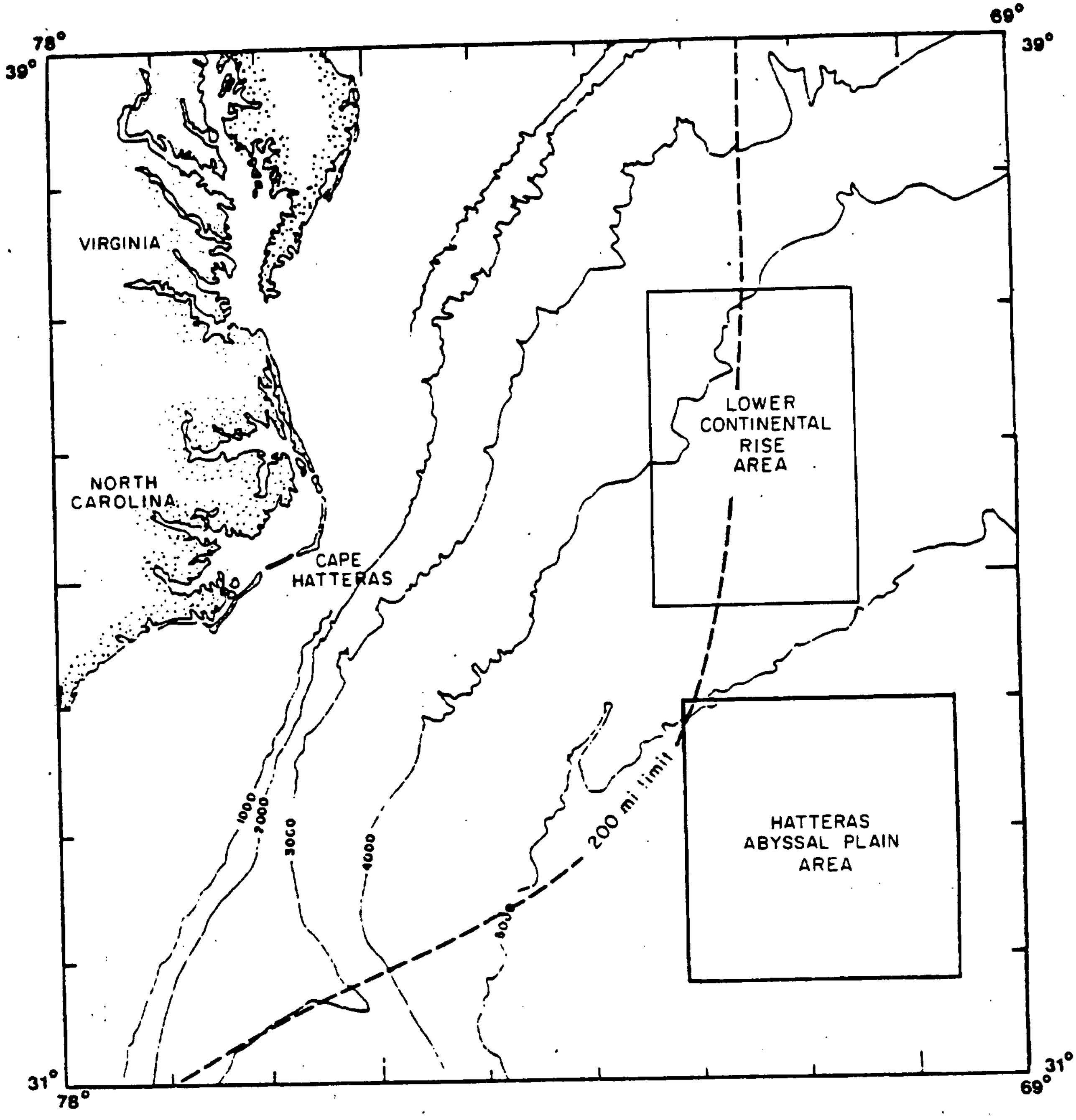


Figure E-1. Atlantic Ocean Study Locations (Depths Shown in Meters)

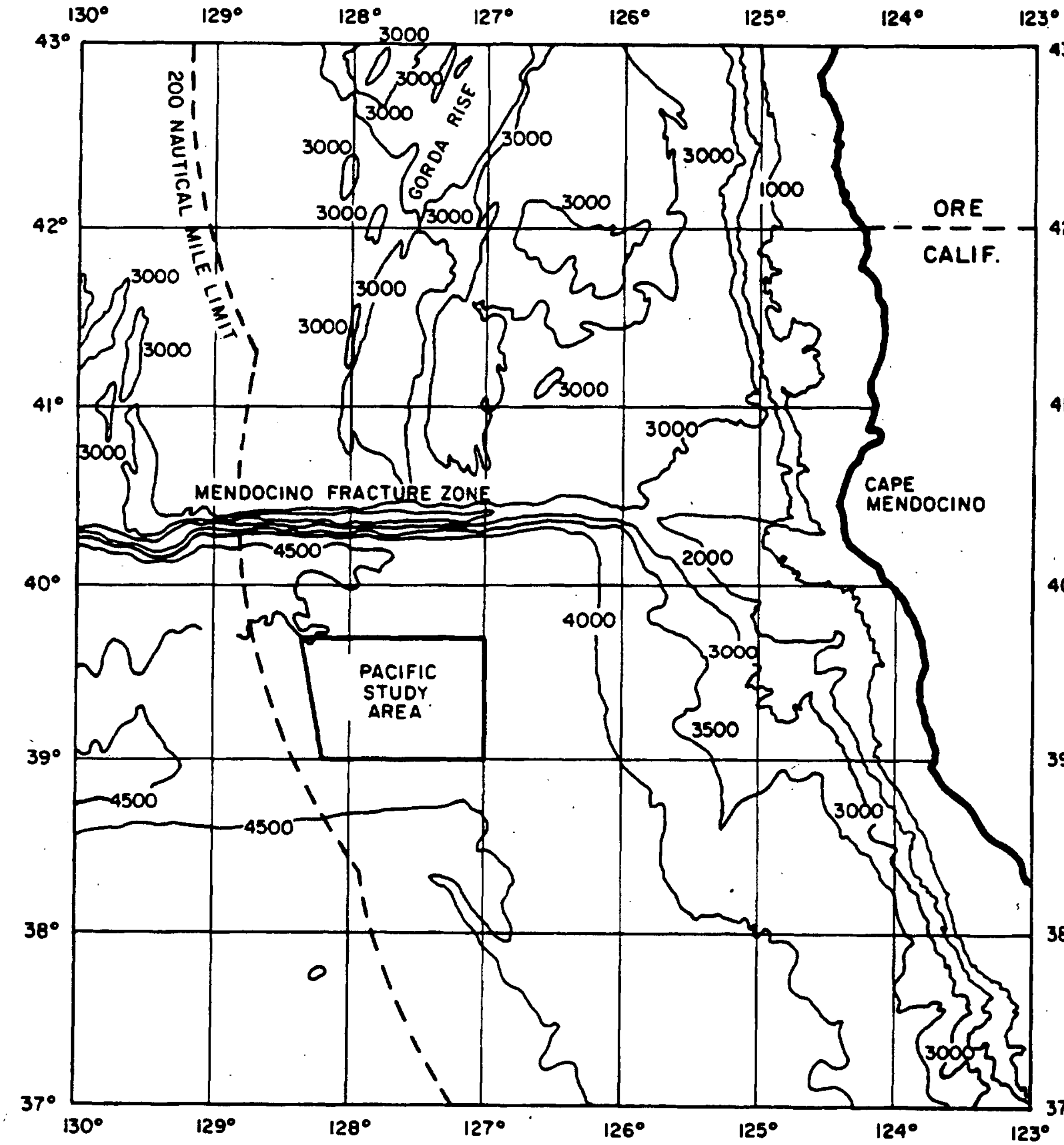


Figure E-2. Pacific Ocean Study Location (Depths Shown in Meters)

II. OCEANOGRAPHIC DATA—BACKGROUND

The total area of the world ocean floor is approximately 139 million square miles, of which more than 80 million square miles have a water depth of at least 4000 meters (Reference E.4). In general, because of this large area and great depth, most remote areas that may be of interest for possible sea disposal would initially be known only in terms of their approximate depth and whether the topography is mountainous or hilly, or resembles a canyon or a plain. Similarly, the very lack of geological and biological activity which might make them suitable disposal sites causes the oceanographic community to have little interest in their study. If a specific area were to become of interest because it satisfied all of the more readily demonstrated selection criteria, it would be possible to concentrate on that area, probing to determine if any of its less obvious characteristics failed to meet requirements. In this way, using a variety of methods that have been developed by the oceanographic community, a more detailed picture can slowly be obtained of the water column, the forms of life on and near the bottom, the sea floor topography, and the underlying sediment. This section describes in general terms some of the methods employed to obtain a more detailed picture of a limited size area of interest. Reference E.4 provides details on the wide variety of underwater equipment and oceanographic instrumentation currently available.

A special-purpose vessel equipped with echo-sounder/recorder and precision navigation equipment repeatedly traverses the area of interest, gradually developing a topographic map of the bottom and searching for indications of irregular topography such as sea mounts, pinnacles, or trenches. The most effective way of performing detailed topographical studies for potential ocean disposal sites involves the use of an array-type survey capability which covers a wide band on either side of the oceanographic survey ship. Towed seismic systems provide an indication of the distance between the sea floor and the basement rock, thus giving a measurement of the sediment thickness along with the bottom profile.

Water temperature, density, oxygen content, and salinity as a function of water depth can be measured and recorded by instruments lowered by the ship from the surface to the ocean floor. Current speed and direction at several different depths are measured and recorded over an extended time period (up to one year) by instruments moored on the ocean floor and kept at fixed depths by flotation devices. Recovery of these current meters and their attached floats is achieved by a sonic signal from a recovery ship that actuates a mechanism which releases the string of floats and instruments from their anchor on the ocean floor, after which they rise to the surface for recovery.

Samples of the sediment, water, and sea life at selected locations within the study area can be obtained for analysis. Long cylindrical corers and relatively shallow box corers are used to remove a vertical tube of sediment, then retain it firmly while returning it to the surface in as undisturbed a condition as possible. The long coring device (3 meters or more in length) is lowered from the ship to the sea floor and its cutting edge is forced into the sediment by a heavy weight at the top of the cylindrical tube. It is then lifted to the surface by a winch. Coring can also be accomplished by free-fall of a weighted tube which penetrates the sediment, collects the sample, and then detaches itself from the weight for return to the surface aided by a hollow float.

Samples of sea life may be obtained by the use of nets and traps similar to commercial fishing gear. For work on the sea floor at very great depths, where the population of animals is likely to be low in abundance, baited traps can be lowered to the bottom to capture specimens. When specimens are brought to the surface, they are not likely to survive the reduced pressure and increased temperature conditions; however, specimens can be collected at pressure and maintained in a high-pressure environment on the recovery ship.

Water sampling at various depths employs specially designed "bottles" which are lowered to the desired depth and then closed to trap a sample for later analysis. Recovery of the water sample must be achieved without contamination being introduced by the sampling equipment or sampling technique.

Confirmation that the physical appearance of the sea floor has been correctly inferred from indirect data can be obtained by deep-sea photography at selected locations, usually black and white 35 millimeters, with the camera operated fixed-focus and the shutter controlled in conjunction with high-intensity strobe lights. Up to several hundred photographs may be taken during one underwater mission, with the pictures taken either at timed intervals or each time a trip weight on the camera-carrying rig contacts the sea floor at a new site. The camera, lights, battery power supply, and associated controls are mounted on a frame that is lowered to the sea floor from the oceanographic vessel.

The techniques described above provide the necessary material for laboratory analyses of sediment lithology and geochemistry, evaluation of sediment physical properties, and for development of estimates of the density of life on the sea floor and in the water column.

The data on current direction and speed for a particular location provide some of the input required for computer-modeling of the transport of dissolved or suspended material from the deep ocean disposal site to the nearest location of human activity. The following sections include descriptions of what has been learned about the Atlantic and Pacific study locations as a result of the concentrated effort to date on these areas of interest. Data derived from historical studies of larger areas are also included, where appropriate, to help provide as complete a description as possible.

III. STUDY AREA IDENTIFICATION

It would be impossible to determine the characteristics and evaluate the environmental effects for all portions of the deep ocean floor; therefore, specific areas had to be identified for study. This made it possible to collect measurements and observations for use in this evaluation where needed information was not already available. It also permitted the calculations of environmental effects to be based on realistic values.

The criteria established under the international convention (Reference E.3), described in Chapter 3, were translated by Dr. C. D. Hollister and Dr. G. R. Heath into guidelines for identifying areas that have a high probability of satisfying all site requirements. These guidelines were intended to assure that the study areas would be representative of the kinds of areas which would reasonably be expected to be selected as disposal sites. However, it is not intended to designate these study locations as ultimate disposal sites or to imply that other locations are not acceptable.

The guidelines, as interpreted and extended by Hollister and Heath, and explained in Reference E.1, are as follows.

1. Sites should be between 50° north and 50° south latitude.

   This criterion is designed to avoid the sources of bottom water and the high biological productivity of the polar regions. Ice rafting of large boulders is also a concern in the polar areas.

2. Depth at the site should be 4000 meters or more.

   This criterion is derived from the facts that the topographical, chemical, and biological gradients tend to flatten below 4000 meters, bottom water circulation may be slower, and organic carbon in the sediment generally is low. This criterion is also motivated by the desire to be clear of continental margins.

3. Sites should be remote from continental margins.

   This criterion is based on avoiding the regions of high biological productivity, increased likelihood of resource exploration and exploitation, and greater unpredictability and instability associated with the continental slope, rise, and associated submarine alluvial fans.

4. Sites should be away from areas of potential seabed resources.

   This criterion is designed to minimize the likelihood of future disturbances which might shorten pathways to man and to avoid possible conflicts in "land" uses.

5. Sites should be away from cables in use.

   This criterion is intended to avoid disturbances and conflicts in use.

6. Sites should be away from areas containing active geologic phenomena such as volcanoes, which would be unsuitable.

   This criterion is designed to reduce the likelihood of unpredicted disturbances which might shorten pathways to man.

7. The area of a site should be defined by precise coordinates, with an area as small as practicable, but no larger than 10^4 km^2.

   This criterion limits the affected area.

8. Sites should preferably be in areas covered by navigational aids.

   This criterion is intended to assist in location of the sites for monitoring and future observation or research.

9. Sites should be away from areas, such as submarine canyons, which have a high rate of exchange of the deep waters with surface layers of any adjacent continental shelf.

   This criterion is intended to avoid shortening pathways to man.

10. Sites should be chosen for convenient conduct of operations and to avoid, as far as possible, the risk of collision with other traffic and undue navigational difficulties.

    This criterion is specified to minimize hazards to navigation and safe operations at the site.

11. Bottom current shear stress should not exceed critical erosional shear stress.

    This criterion is desired to prevent high rates of resuspension of sediments at the site and to prevent rapid movement of material.

12. Sites should be away from areas of intense mesoscale eddy activity.

    This criterion is intended to avoid areas of enhanced eddy diffusivity which could shorten pathways to man.

IV. SITE-SPECIFIC INFORMATION

A. ATLANTIC OCEAN STUDY LOCATION—HATTERAS ABYSSAL PLAIN AREA

1. General Description

This rectangular area (Figure E-1) is centered near 33° north, 71° west and covers approximately 60,000 square kilometers. The area is on the Hatteras Abyssal Plain, centered at approximately 280 nautical miles (520 kilometers) from the closest land point at Cape Hatteras, North Carolina. The sea floor in this study area is almost flat, with water depths of approximately 5300 meters (17,400 feet), and appears not to be swept by strong bottom currents. The only technical reservation about the site was noted in Reference E.5, namely that the area may be intermittently swept by turbidity currents, a phenomenon natural to abyssal plains in which sediment-entrained currents of up to 50 knots are caused by landslides from the continental slope and upper continental rise. However, analysis of core samples taken from this study location suggests that no more than four rather weak turbidity currents have entered the location in the past 11,000 years. Analyses are being performed to estimate the range of velocities and consequent energies associated with these particular events. Reference to the current literature suggests that velocities should not exceed 15 cm per second.

The most recent studies of this area continue to show that the area satisfies all technical guidelines with the possible exception that resuspension of sediments may occasionally be caused by high velocity currents. The significance of this factor is discussed in the summary of this study area (p. E-16).

2. Topography

Figure E-3 (from Reference E.5) shows the topography of the Hatteras Abyssal Plain area, which is identified in the reference as E-N3. Contour lines are shown in meters. The slope of the sea floor in the center of the area is less than 1 foot per 1000 feet, essentially flat.

3. Photographs

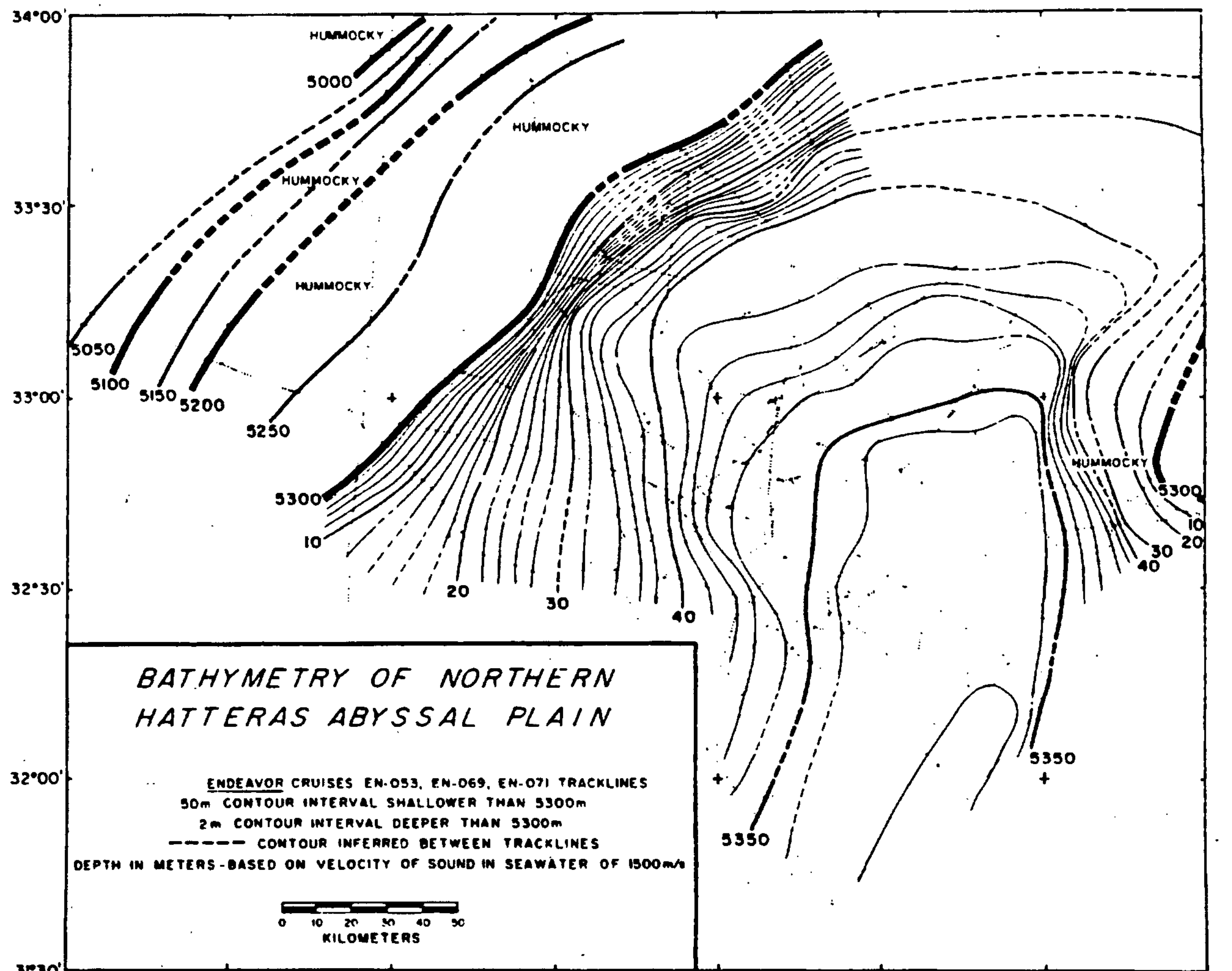
Two representative photographs of the sea floor in the Hatteras Abyssal Plain study area are shown in Figures E-4 and E-5. The former (located 70.5° west, 33° north) shows several scattered small cones and craters and a food can surrounded by sargassum weed. The can gives some indication of the approximate dimensions of the cones and craters. Figure E-5 (located at 70.8° west, 32.8° north), which is on the same scale as the previous photograph, shows numerous small craters and cones. A fairly large mound appears at the right center with an animal and sargassum weed. These and other photographs of the sea floor in this vicinity indicate that some life dwells on the bottom, but it is relatively sparse and its biology is not well known. The animals that have been identified from the photographs as inhabitants of the sea floor in the study area and its near vicinity are limited to starfish, holothurians, crinoids (sea lilies), and sea pens. Various types of crabs and worms are also likely to be inhabitants, based on observed tracks, trails, and mounds as well as information gathered at similar deep ocean sites. A general description of the types of features observed in these photographs is contained in Reference E.6.

The bottom photographs were summarized in Reference E.5 as showing "a relatively tranquil sea floor with the tracks and mounds of benthic organisms well preserved". There is no evidence of erosion by bottom currents and the scarcity of bottom life on the sediment surface is indicated by the photographs.

4. Currents

Bottom currents and their effects on the seabed have been studied with bottom photographs, moored current meters, and sediment cores. Bottom photographs taken in July and August of 1980 show a relatively tranquil seabed with no evidence of significant erosion by bottom currents in the recent past. Current meter measurements at five separate depths have been made near the center of the location at 32°38.61'N, 70°50.75'W, Reference E.14, page 46. The water depth at the mooring is about 5410 meters, and measurements were made about 50 meters, 500 meters, 1350 meters, 2160 meters, and 4340 meters above the bottom. This single mooring recovered in July of 1981 represents 290 days of current measurements and yielded the following results:

Mean Net Current Velocity (Centimeters per second; kilometers per day)	Distance above Bottom (Meters)
3.6; 3.1	50
3.2; 2.8	500
3.3; 2.9	1350
2.7; 2.4	2160
0.8; 0.7	4340



(Contour lines in meters)

Figure E-3. Atlantic Study Location—Topography of Hatteras Abyssal Plain Area

Figure E-4. Photograph of Ocean Floor—Hatteras Abyssal Plain Study Area
(Food can shown left center. Approximate dimensions: 8 inches high, 5 inches in diameter)

Figure E-5. Photograph of Ocean Floor—Hatteras Abyssal Plain Study Area

The current measurements indicate that water movement is moderate and relatively constant throughout the water column with a direction of movement to the northeast. The general northeastward flow is interrupted by a large number of low frequency events, either eddies or meanders in the general flow regime. One noteworthy feature of the current data was the lack of direction values about 220° true. This is the general direction toward the Blake—Outer Ridge, the nearest major submarine feature.

5. Physical Data vs. Depth

The following variables as a function of depth are plotted in Figures E-6 through E-8 respectively: temperature (°C), salinity (parts per thousand) and dissolved oxygen (milliliters per liter). These measurements from Reference E.5 were taken at approximately the center of the Hatteras Abyssal Plain site (70°37′ west, 32°42′ north).

6. Coring Results

The sediment in this area is deposited on the bottom largely as a result of the seaward movement of material washed away from land and deposited on the abyssal plain. Samples of the sediment were obtained by coring techniques which resulted in a total of seven core samples being recovered from the study area to date, five from the floor of the Hatteras Abyssal Plain (center of the area) and one each from the lower continental rise steps (northwest portion of the area) and the Bermuda Rise Hills (southeast portion). All five cores from the abyssal plain have been found to be almost entirely clay and very similar lithologically.

The following description is of the longest core (LGC-11-I, as identified in Reference E.5), which was recovered from a point close to the center of the study area. See Figure E-9 for the oceanographers' "visual core description".

Core LGC-11-I is 116 centimeters in length, with its bottom 22 centimeters composed of silt and its upper 94 centimeters composed of clay. The characteristics of this core suggest that the Holocene/Pleistocene boundary (which occurred approximately 11,000 years ago) lies 94 centimeters below the sea floor. This suggests a Holocene (recent epoch of geological time) sedimentation rate of about 8.5 centimeters per 1000 years. As noted in Section IV.A.1, four rather weak turbidity currents have entered the area during the past 11,000 years.

7. Bottom-Dwelling Life

As shown by numerous photographs of the bottom in Reference E.5, two of which are reproduced as Figures E-4 and E-5, some animal life is present and is believed to be typical of the forms and population density to be found in the deep areas of the Atlantic Ocean (Reference E.1). The most recent studies of this area show that the most common megafauna are "wormlike" organisms. This is based on photographic analysis; marine life specimens have not been collected. The benthic community is not fished because of the depth of the water and the sparse population; one of the bases for its selection was the likelihood that it will never attract commercial or other interest.

8. Characteristics Determined from Surveys of Available Data

The previously-described information on the Hatteras Abyssal Plain area was developed primarily as a result of the concentrated oceanographic work in the area. The following information is based on data that are of general interest and important to a site selection although not originally generated specifically for this study area.

a. **Seismicity.** There are no recorded earthquakes that were centered within the area. The likelihood of future earthquakes is small (Reference E.1).

b. **Volcanic Activity.** The closest active volcanoes are located in the Lesser Antilles Island arc, 900 miles to the southeast. It is highly improbable that the area would be affected directly or indirectly by a volcano (Reference E.1).

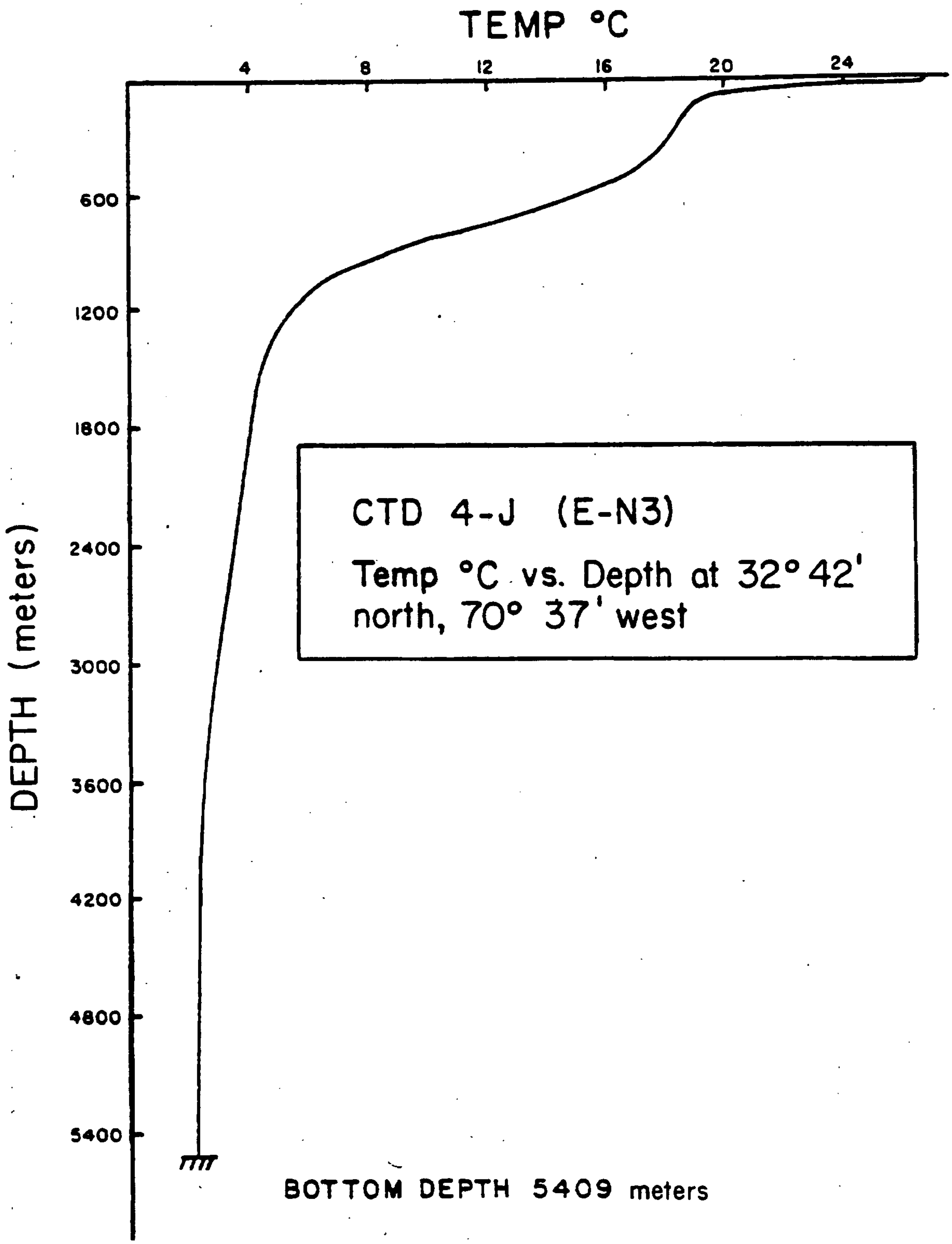


Figure E-6. Temperature vs. Depth (70°37'W, 32°42'N)

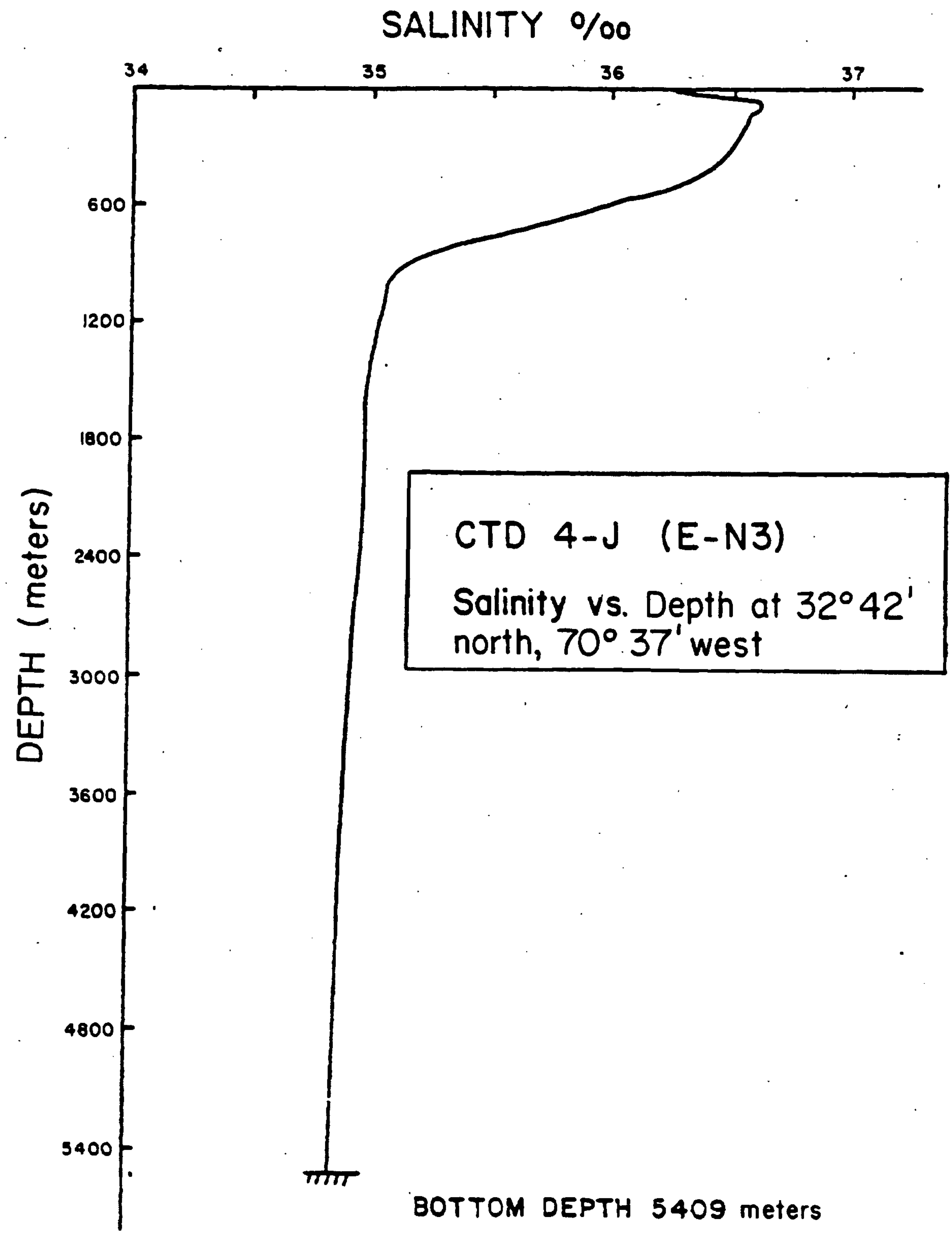


Figure E-7. Salinity vs. Depth (70°37'W, 32°42'N)

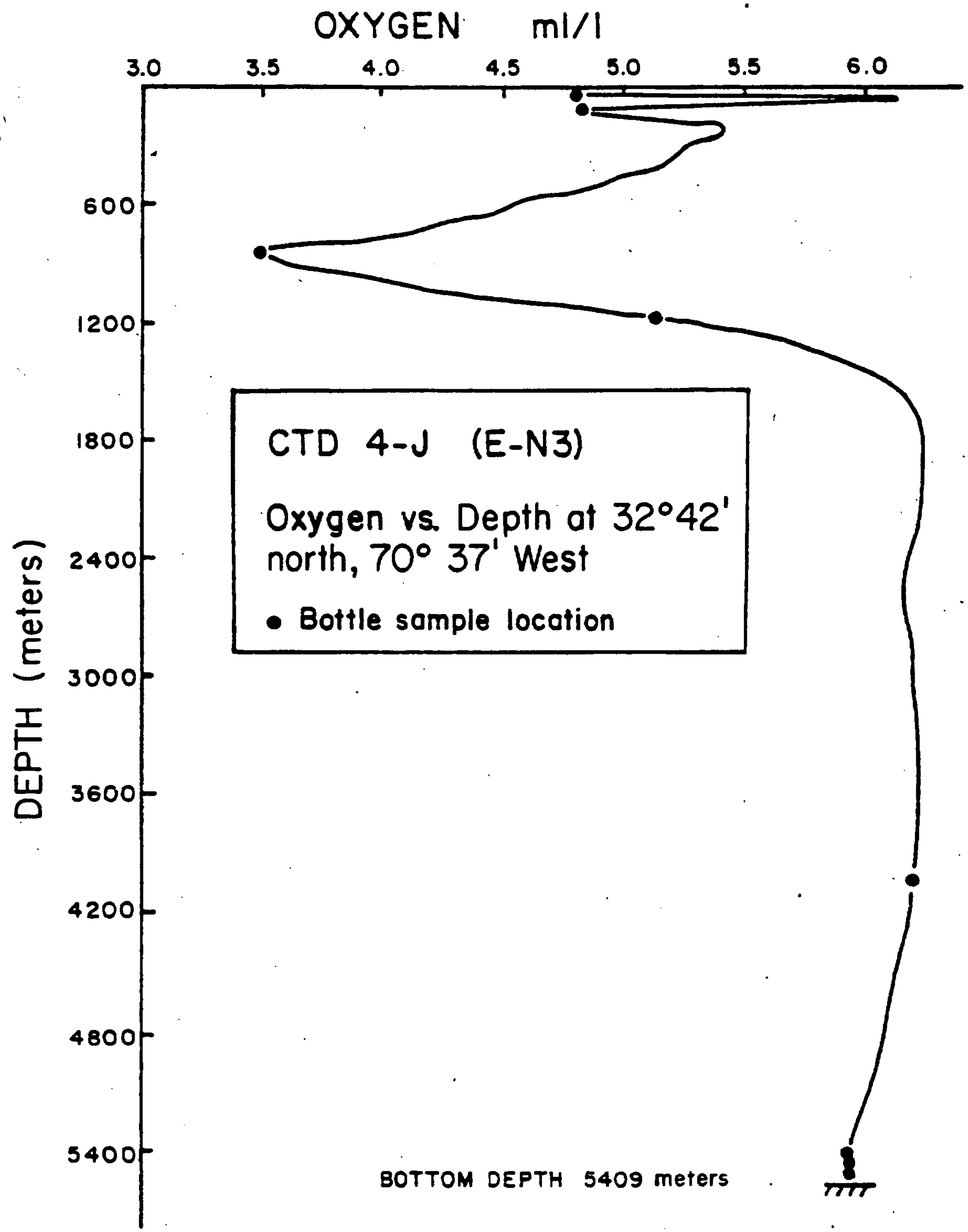


Figure E-8. Dissolved Oxygen Content vs. Depth (70°37'W, 32°42'N)

VISUAL CORE DESCRIPTION

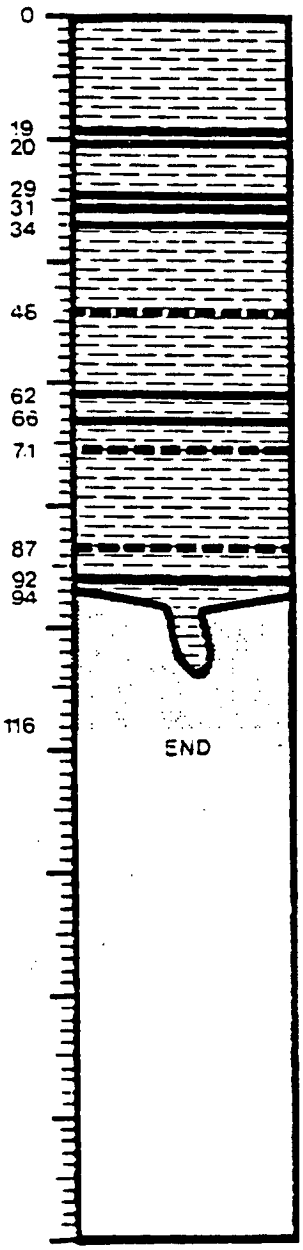
SHIP Endeavor CRUISE EN-053 CORE LGC-11-I LENGTH 116 cm

LATITUDE 32°45.6'N LONGITUDE 70°45.4'W DEPTH 5347 m DATE Aug. 9, 1980

CORE CONDITION Moist DESCRIBED BY Ashraf/Schramm ON Feb. 1981

PHYSIOGRAPHY & LOCATION Abyssal Plain, Western North Atlantic

cm LITHOLOGY



DESCRIPTION

0-19 cm: Clay 10 yr 5/3 brown, very soft, extensively mottled w/10 yr 4/2 dark grayish brown, - mottle 1 cm dia at 6 cm, black fragments of organic matter.
Contact: gradational(?), horizontal

19-20 cm: Void

20-29 cm: Clay 10 yr 5/3 brown, soft, moderately mottled, several 1 mm laminae of alternating 10 yr 5/3 brown, and 10 yr 3/3 dark brown, mottles disrupt laminae.
Contact: sharp, horizontal

29-31 cm: Clay 2.5 y 5/4 light olive brown, soft.
Contact: sharp, horizontal

31-34 cm: Clay 5 y 5/2 olive gray, soft.
Contact: sharp, horizontal

34-48 cm: Clay 2.5 y 4/2 dark grayish brown, soft, extensively mottled w/2.5 y 5/2 grayish brown, at top of unit a 5 mm band of clay 5 y 5/2 olive gray w/sharp irregular bottom contact.
Contact: gradational, horizontal

48-62 cm: Clay 10 yr 5/3 brown, soft.
Contact: sharp, horizontal, irregular.

62-66 cm: Clay 2.5 y 5/2 grayish brown, soft.
Contact: sharp, horizontal

66-71 cm: Clay, 2.5 y 5/2 grayish brown, soft, extensively mottled w/2.5 y 4/2 dark grayish brown.
Contact: gradational, horizontal

71-87 cm: Clay 2.5 y 5/2 grayish brown, soft, extensively mottled w/2.5 y 6/2 light grayish brown - mottle elliptical 2 cm dia.
Contact: gradational, horizontal

87-92*cm: Clay 2.5 y 5/2 grayish brown, soft.
Contact: sharp, concave; *88-90 cm: Fe-rich layer

92-94 cm: Clay 2.5 y 4/2 dark grayish brown, soft.
Contact: sharp, concave

94-116 cm: Silt 2.5 y 3/2 very dark grayish brown, micaceous, w/foram fragments, soft.

SYMBOLS

clay | silty clay | clayey silt | silt | sharp contact | gradational contact

Figure E-9. Visual Core Description of a 116 cm Long Core Recovered from the Center of the Hatteras Abyssal Plain Area (LGC-11-I)

c. **Sediment Thickness.** Sediments in the general area of the Atlantic study areas are expected to be at least 1300 meters thick (Reference E.5).

d. **Cable Routes.** No undersea cables are known to exist in the study area.

e. **Shipping Lanes.** The study area is outside of normal shipping lanes.

9. Summary of Hatteras Abyssal Plain Area

This area is extremely smooth and featureless with no indication of erosive currents. All of the tentatively identified site identification guidelines (Section III) appear to be met. As noted previously, one technical reservation has been identified to date by the oceanographic experts in their search for possible negative aspects of the site. This reservation is based on the observation that abyssal plains are constructed by occasional swift currents (turbidity currents) which sweep the sea floor in the seaward direction as a result of continental slope or continental rise landslides from the landward direction. Although turbidity currents at a disposal site could confound the job of post disposal monitoring, such currents would not result in an unfavorable environmental impact due to sea disposal, and in fact would tend to bury the deposited material and thus reduce disposal effects. Present analyses indicate that no more than four turbidity currents have entered the Hatteras Abyssal Plain study location in the past 11,000 years. Analyses are being designed to determine the speed of these currents and their net effect on the study location.

In general, the Hatteras Abyssal Plain study area would likely prove acceptable as an ocean disposal site, based on the site selection criteria described in Section III of this appendix.

B. ATLANTIC OCEAN STUDY LOCATION—LOWER CONTINENTAL RISE AREA

1. General Description

This rectangular area (Figure E-1) is centered near 36° north, 71°30′ west and covers approximately 45,000 square kilometers. The area is located approximately 180 to 240 nautical miles east of Cape Hatteras. The sea floor is almost flat in the center of the area, with water depths of approximately 4000 to 4200 meters (13,100 to 13,800 feet).

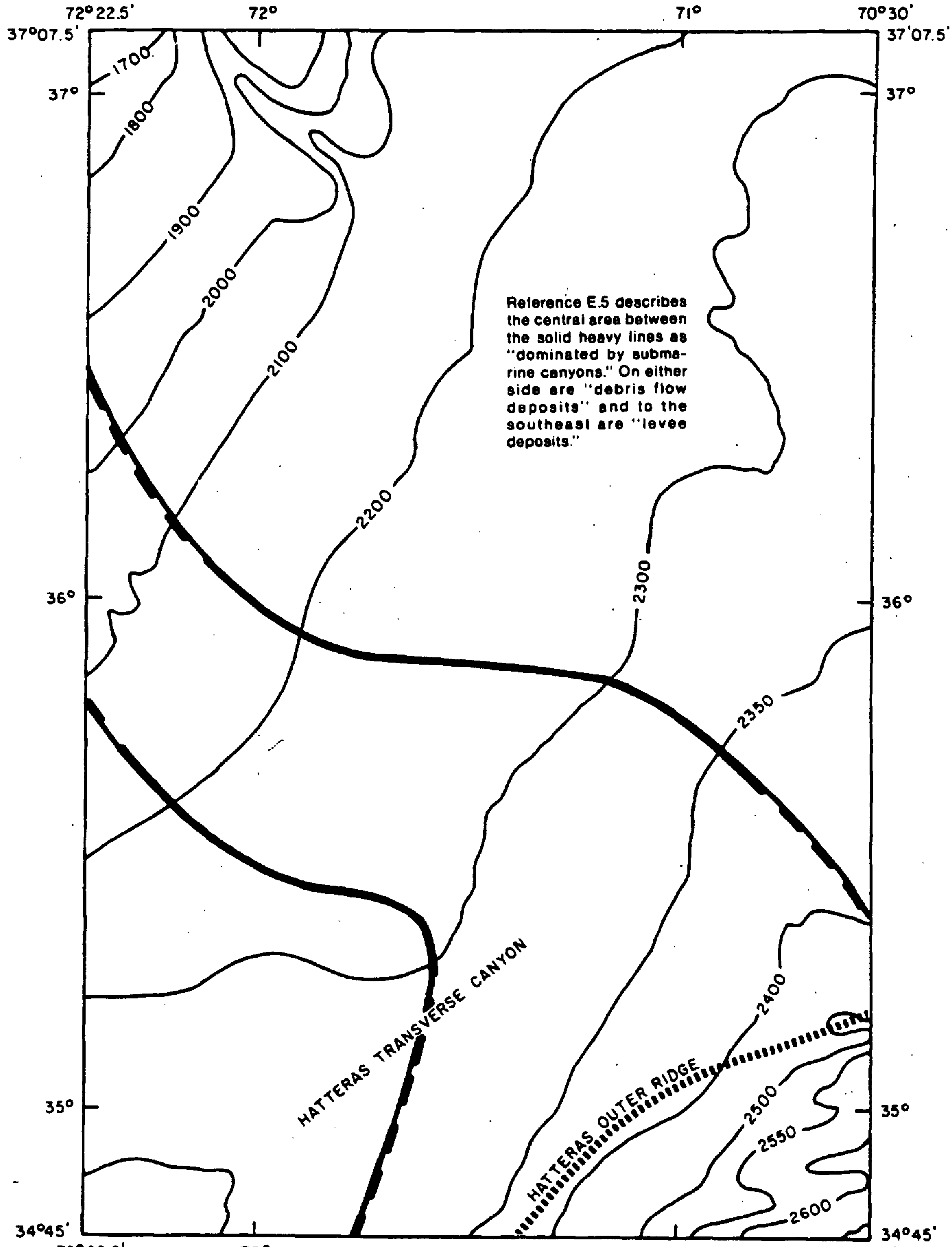
Several locations within this general area and within the 200 nautical mile economic zone boundary have been identified, Reference E.1, but were not initially selected for concentrated study because of the extreme simplicity, both environmentally and topographically, of the Hatteras Abyssal Plain area (Section IV.A) and because of the possibility of stronger bottom currents being encountered closer to the continental slope. Detailed study of a location within this area and within the 200 nautical mile economic zone boundary began in 1982. These studies indicate that only a small area of approximately 1500 km^2 and centered roughly at 36° 30′ north, 71° 30′ west, appears to be suitable for further study. In much of the study area, levee and debris deposits have questionable slope stability; the potential exists for exploitable hydrocarbons; and evidence of sediment resuspension has been observed.

2. Topography

Figure E-10 (from Reference E.5) shows the topography of the Lower Continental Rise study area, which is identified in the reference as E-N2. Contour lines are shown in fathoms, so the 2300 line corresponds to 13,800 feet or about 4200 meters. The slope of the sea floor in the center of the area is about 3 feet per 1000 feet, essentially flat.

3. Photographs

Photographs taken of the sea floor at the center of the Lower Continental Rise study area are very similar to those from the Hatteras Abyssal Plain area (Figures E-4 and E-5). A representative photograph of the former



(Contour lines in fathoms)

Figure E-10. Atlantic Study Location—Topography of Lower Continental Rise Area

Figure E-11. Photograph of Ocean Floor—Lower Continental Rise Study Area

area (taken at 71.6° west, 36.5° north) is shown as Figure E-11. Numerous small cones and craters are visible in the picture, along with a starfish (top center) and scattered tracks and trails. The seabed and the immediately adjacent water column appear relatively tranquil in all photographs, and there is no evidence of erosive currents. Preliminary indications are that the general study area contains locations that are similar to the Hatteras Abyssal Plain study area, and that would meet study area identification guidelines.

4. Currents

Bottom currents and near-bottom currents have been measured at several locations within the general study area.

5. Physical Data vs. Depth

The physical data plotted in Figures E-6 through E-8 for the Hatteras Abyssal Plain study area are also representative of the data measured at the Lower Continental Rise study area.

6. Coring

Many sediment core samples have been taken in the study area.

7. Bottom-Dwelling Life

Marine life specimens have not been taken in this area. As with the Hatteras Abyssal Plain Study Area, the benthic community is not fished because of the depth of the water and the sparse population.

8. Characteristics Determined from Surveys of Available Data

Based on the proximity of the two Atlantic study areas, the general characteristics described in Section IV.A.8 are equally applicable to the Lower Continental Rise study area, except that there is a working telephone cable that crosses the northeastern corner of the Lower Continental Rise area but which does not cross the subregion identified as suitable for further study.

9. Summary of Lower Continental Rise Area

Of the two Atlantic study areas, the Lower Continental Rise area has received relatively less scrutiny to date because of the very favorable conditions at the Hatteras Abyssal Plain location. However, several promising locations within the former area are within the 200 nautical mile economic zone boundary and have been identified as meriting concentrated study. Information gathered to date on the Lower Continental Rise study area indicates that it may be possible to select a relatively small area in the Atlantic on the lower continental rise, within 200 nautical miles of land, and meeting all study area identification guidelines.

C. PACIFIC OCEAN STUDY LOCATION

1. General Description

This nearly-rectangular area (Figure E-2) is centered at 39°20′ north, 127°40′ west and covers approximately 10,000 square kilometers. The area's western boundary is approximately the 200 nautical mile economic zone boundary. The area is seaward of the slope reversal that marks the outer edge of the continental rise in this region. It is west of the northern Delgada Fan, and is a region of rolling topography at the boundary between the abyssal Pacific deposits (pelagic clays) and the distal fan deposits (hemipelagic clays). The closest land point is approximately at Cape Mendocino, California. The area is west of the major west coast fisheries, and a benthic fishery in the area is precluded on the basis of energy requirements. That is, the low population density on and near the bottom, combined with the time and fuel costs for lowering and raising extremely long lengths of cable to 14,000 feet, would make it an extremely inefficient benthic fishing area. No potentially exploitable hard mineral or petroleum resources exist in the area. A second possible area in the eastern North Pacific, centered approximately 200 nautical miles west of San Diego at 32° 30′ north, 123° 30′ west, was also identified (References E.2 and E.11). This second area would probably be acceptable but has not been the subject of concentrated study.

2. Topography

The sea floor in the selected study area is under approximately 4200 to 4450 meters of water (13,800 to 14,600 feet). The topography is gently rolling, with broad irregularities as indicated in the bathymetric map shown in Figure E-12, from Reference E.7. The average slope in the sea floor in the center of the area is about 1 foot per 300 feet, while the maximum slope in several locations appears to be about 1 foot per 10 feet. The entire site is underlain by about 300 meters of silty clay.

3. Photographs

Two photographs of the sea floor in the Pacific study area are shown in Figures E-13 and E-14. As was seen in photographs of the Atlantic sites (Figures E-4, E-5, and E-11), the sea bottom sediment surface population is sparse, with brittle stars, echinoids, and holothurians representing the most abundant visible species. One of the Pacific site photographs (Figure E-13) shows a bathysaurus fish that appears to be approximately 2 to 3 feet long. This photograph is one of only three out of a total of 180 that shows a fish residing near the bottom. Analysis of the photographs by benthic biologists is in progress.

4. Currents

Extensive current measurements at three separate depths have been made near the center of the site, at 39° 27.6′ north, 127° 41.5′ west, Reference E.9. The water depth at the current meter mooring location is about 4250 meters, and the measurements were made about 40 meters, 450 meters, and 1250 meters off the bottom. The three moorings recovered through 1981 represent a recording period of 748 days, and yielded the following results:

Mean Net Current Velocity from Reference E.13, Table 2 (Centimeters per second; kilometers per day)	Distance above Bottom (Meters)
1.13; 0.98	40
1.20; 1.04	450
1.18; 1.02	1250

The current measurements indicate that water movement is slow and relatively constant in at least the bottom 1250 meters, with a direction of movement toward the south-southeast at 29 and 438 meters above bottom, and south-southwest at 1200 meters, with an average speed of about 1.2 centimeters per second, or 1.0 kilometers per day. As shown in Reference E.13, the general southward flow is interrupted at one to two month intervals by mesoscale eddies (oceanic "anticyclones") that produce loops of 10 to 60 kilometers diameter in the progressive current vectors, and that persist for a week to as long as a year. The progressive current vector diagram is drawn by connecting in "tail-to-head" sequence each current measurement, each having a length proportional to the current speed, and a direction corresponding to that actually measured. Surface velocities (long term monthly averages) are in the range 0.04 to 0.5 knot, and trend generally to the south (Reference E.11).

5. Physical Data vs. Depth

Measurements of temperature and salinity as a function of depth at 39°32.2′N, 127°39.6′W are shown in Figures E-15 and E-16. Figure E-17 shows a northeast Pacific profile of dissolved oxygen, with bottom values from the Pacific study area.

6. Coring

Initial data of importance in establishing the composition of the sediment in the study area were obtained from the Deep Sea Drilling Project, Reference E.10. As part of the project, two holes, one 295 meters deep, the second 384 meters deep, were drilled in the sea floor in an area that became the northeast quadrant of the

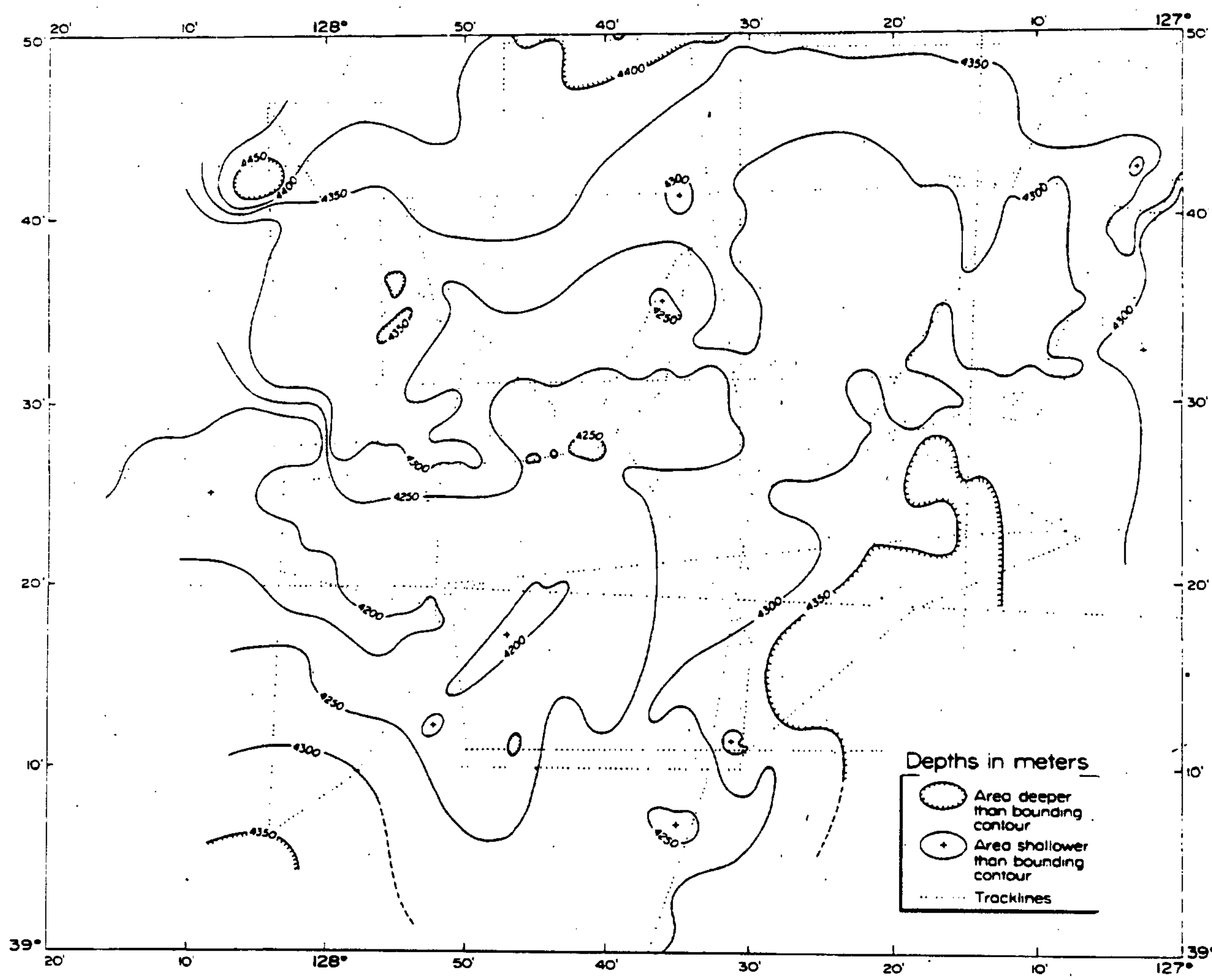


Figure E-12. Pacific Study Location—Topography

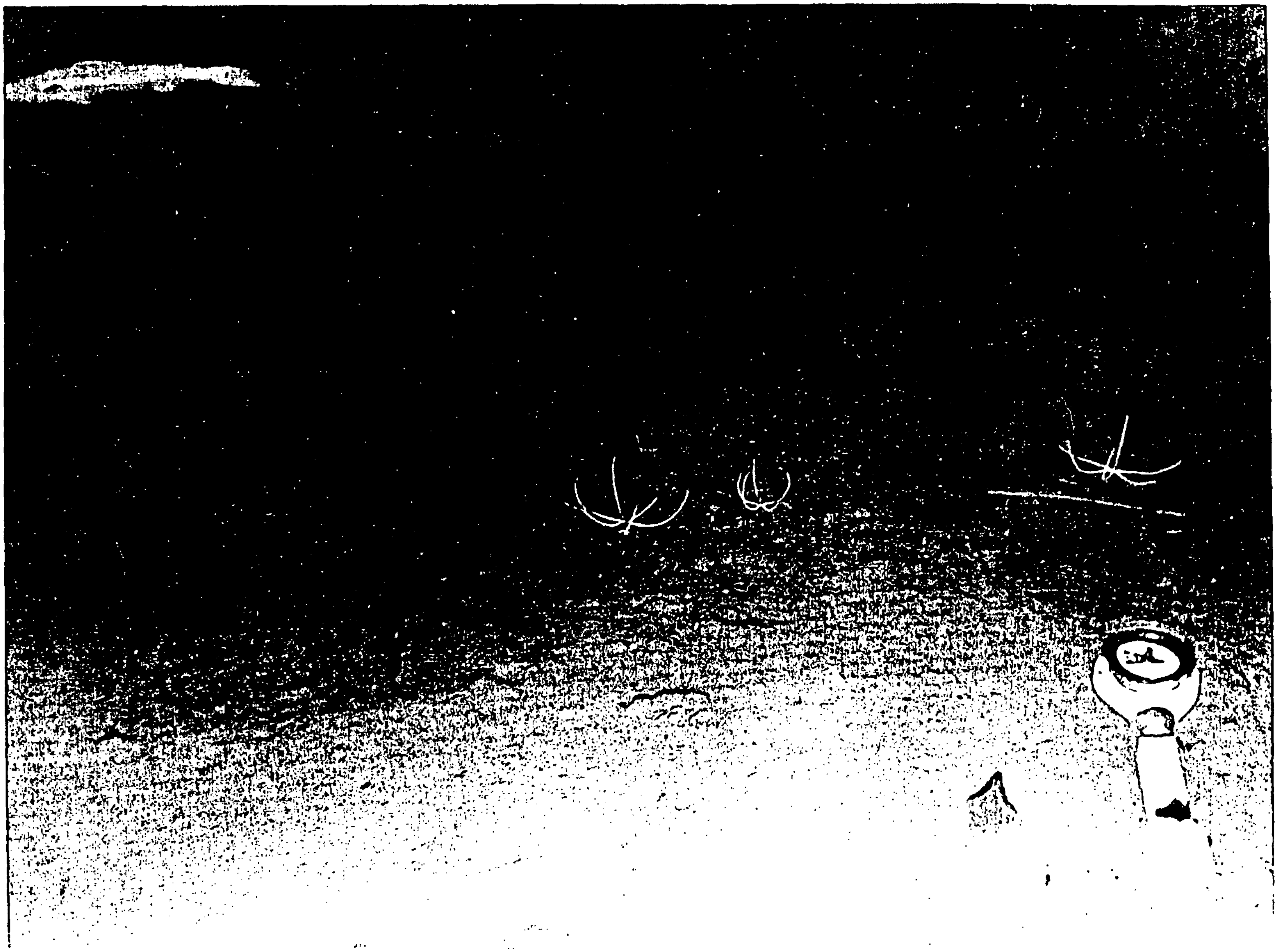


Figure E-13. Photograph of Ocean Floor—Pacific Study Area

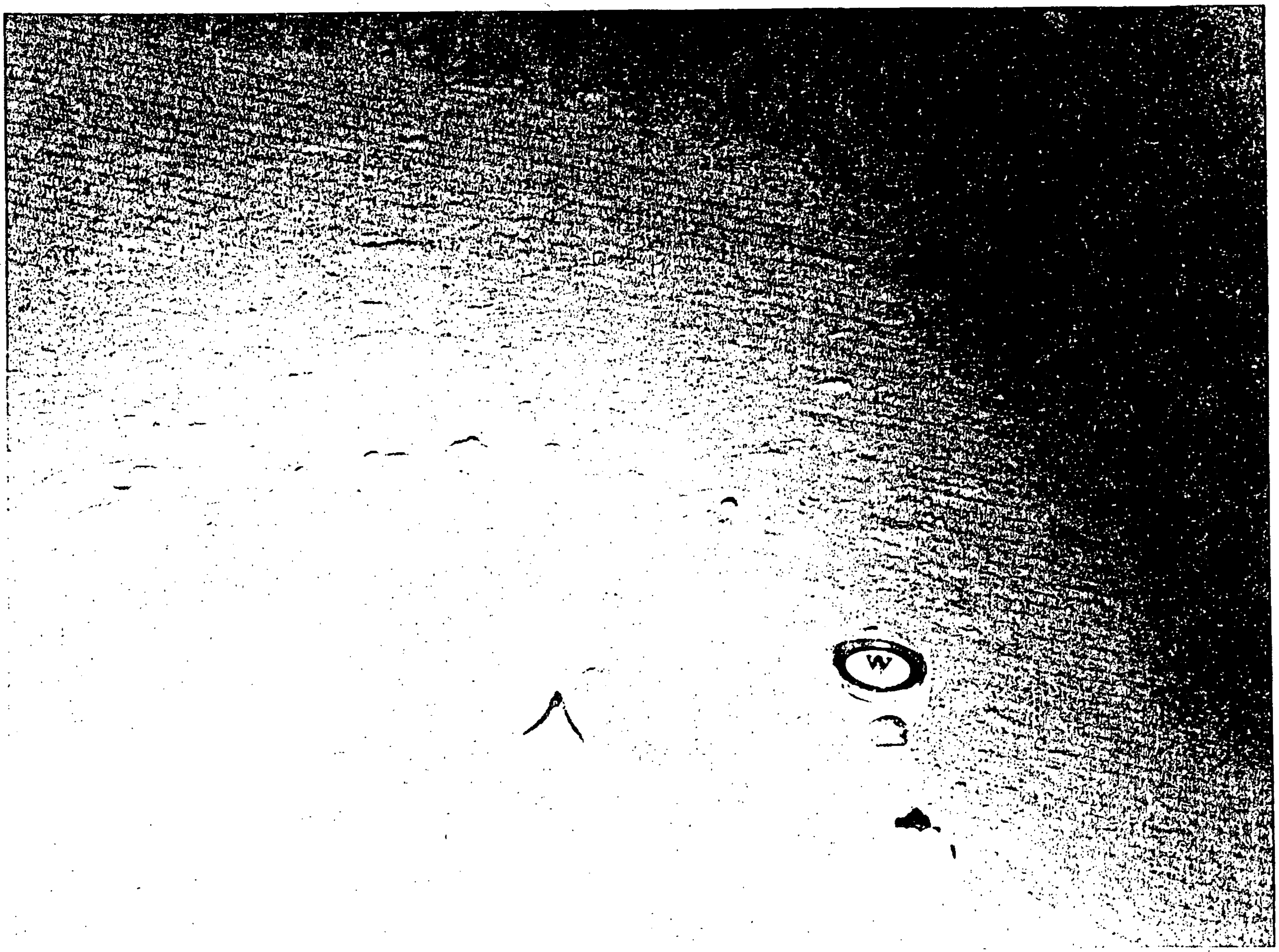


Figure E-14. Photograph of Ocean Floor—Pacific Study Area

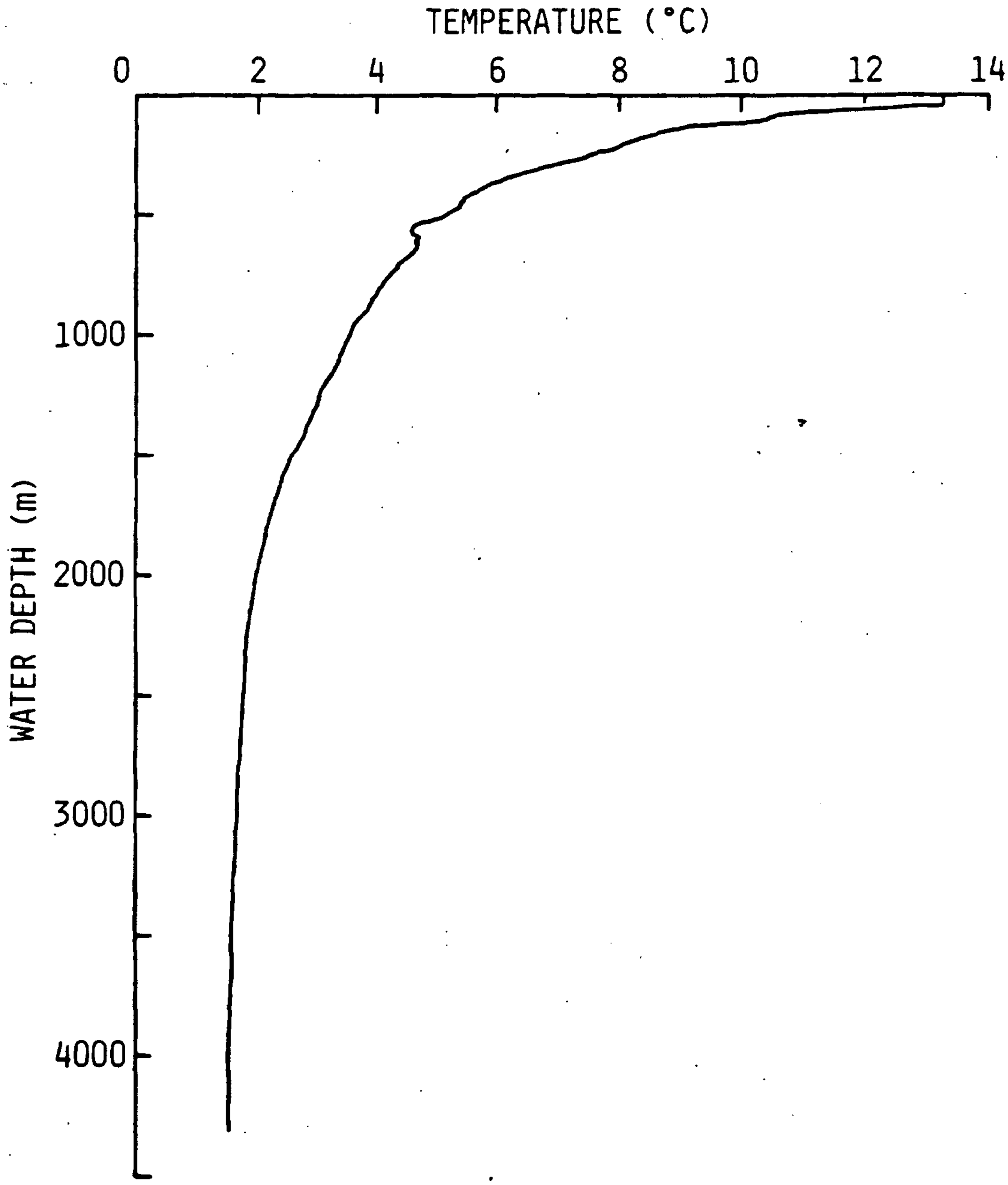


Figure E-15. Temperature vs. Depth (127°39.6'W, 39°32.2'N)

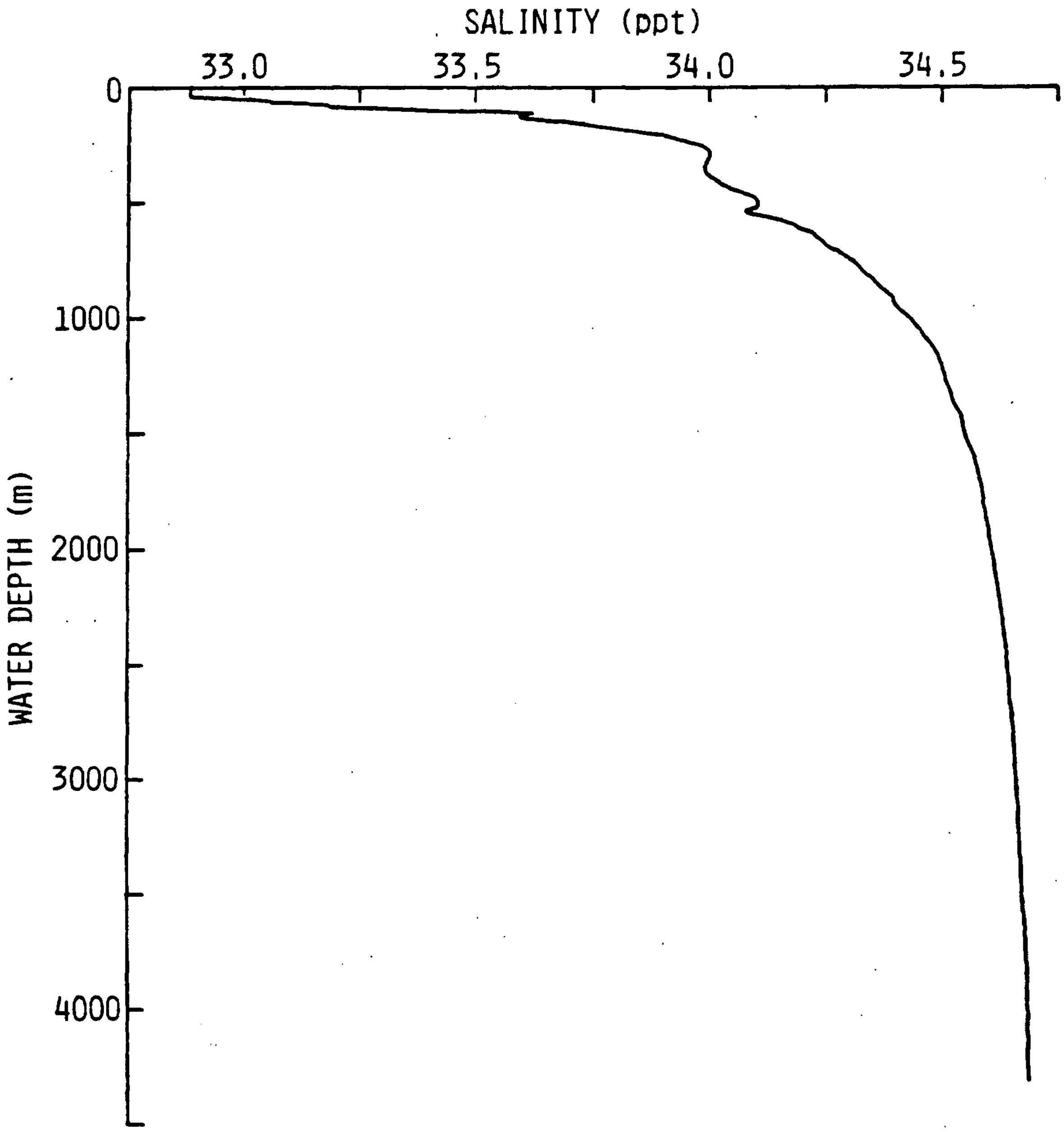


Figure E-16. Salinity vs. Depth (127°39.6'W, 39°32.2'N)

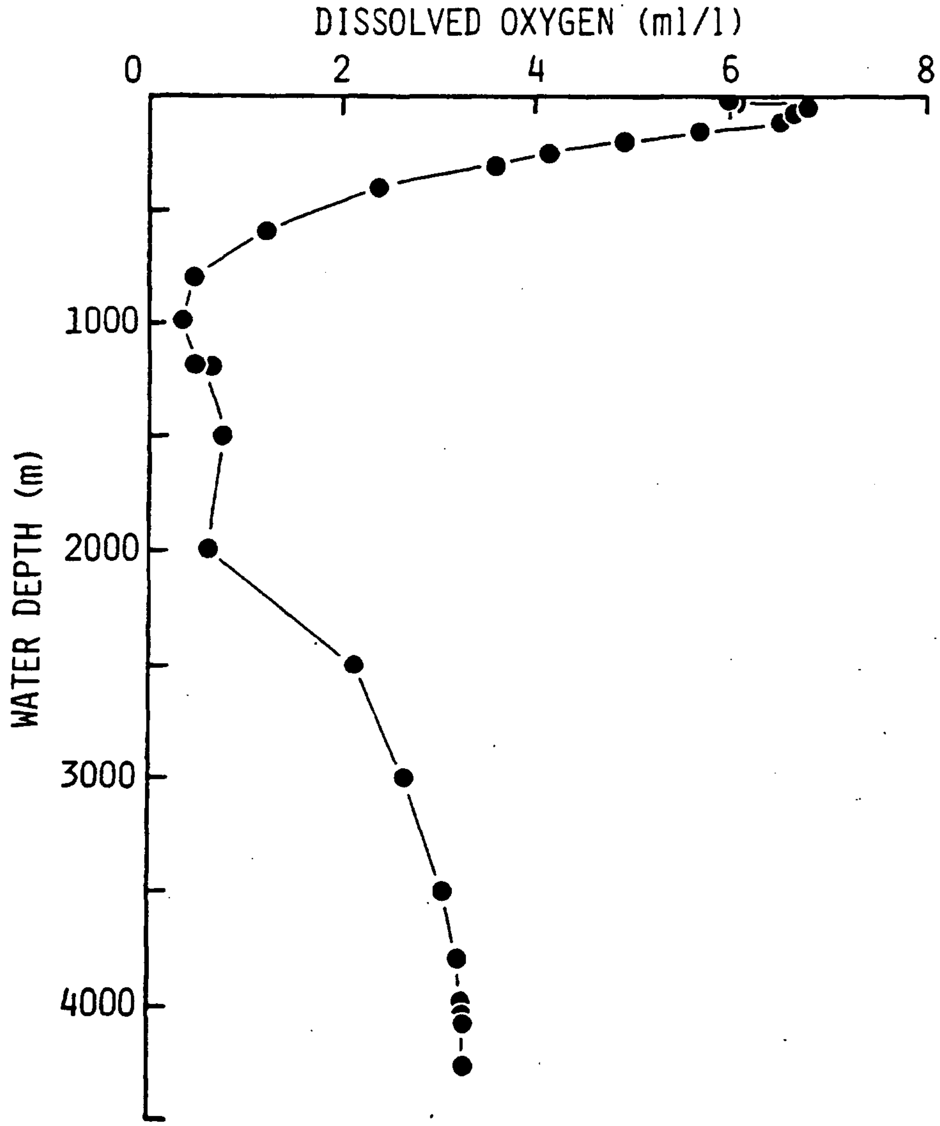
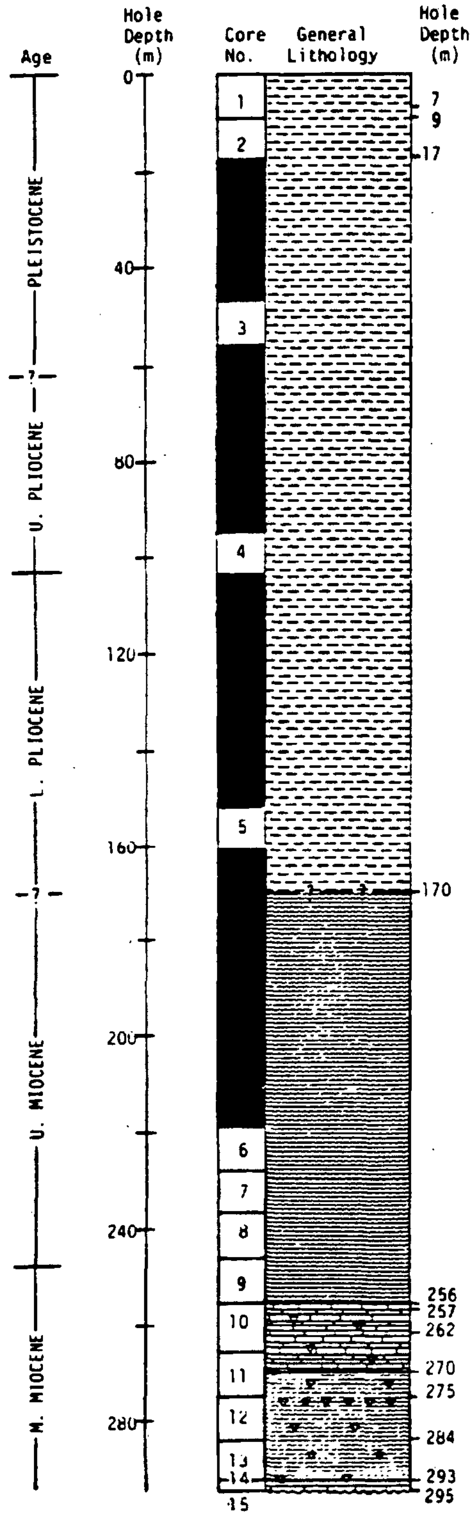


Figure E-17. Dissolved Oxygen Content vs. Depth



DSDP SITE 33

Summary of Lithology

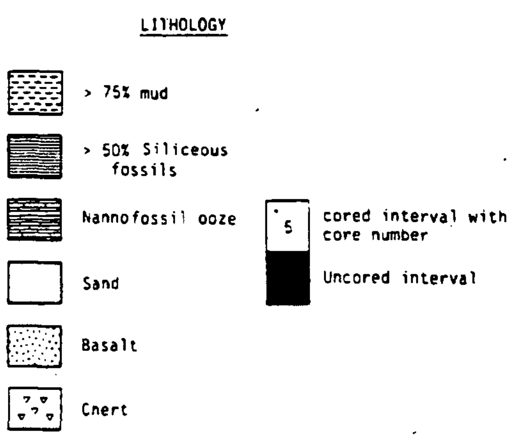
0-∿170 meters, cores 1-5, Pleistocene to Lower Pliocene in age. Dark green-gray dominantly clayey mud. Some siliceous fossil mud occurs in cores 3 and 5. Minor amounts of siliceous fossils and nannofossils occur throughout the interval. Silty mud layer from 7-9 meters. Fresh glass volcanic ash layer at 8.5 meters. Manganese clay pellet (?) at 17 meters. Pyrite spheres scattered throughout core 2. Black mottling in core 4. Cores 3, 4, and 5 have traces of zeolite, pyrite spherules, and silt-size fresh feldspar.

∿170-256 meters, cores 6-9, Upper Miocene-Middle Miocene in age. Dark greenish-gray beds. Mostly siliceous fossil ooze with thin nannofossil-siliceous ooze at bottom of cores 6 and 9. Some pyritized diatoms at base of core 6. Mottled in the lower part of core 8 and volcanic glass content increases down core 8.

256-270 meters, core 10 and top of core 11, Middle Miocene in age. Thin beds of greenish-gray nannofossil ooze. Round dark green cherty mudstone concretion with minor slightly pyritized and recrystalized fossil remains at 257 meters. Mottling at base of core 10. Approximately 262 meters represents the first reflection (.375 seconds) in the seismic profile. This closely corresponds to the top of the chert bearing sediments.

270-293 meters, bottom of core 11 to core 14, Middle Miocene in age. Dominantly siliceous fossil mud with significant quantities of dark green cherty fragments. Decrease in coring rate along with increased chert fragments between cores 11 and 12 suggest top of main cherty formation at 275 meters. Cherty layers alternating with softer sediments to the base of this section. Glassy ash layer at 284 meters and ash fragments in core catcher at 293 meters.

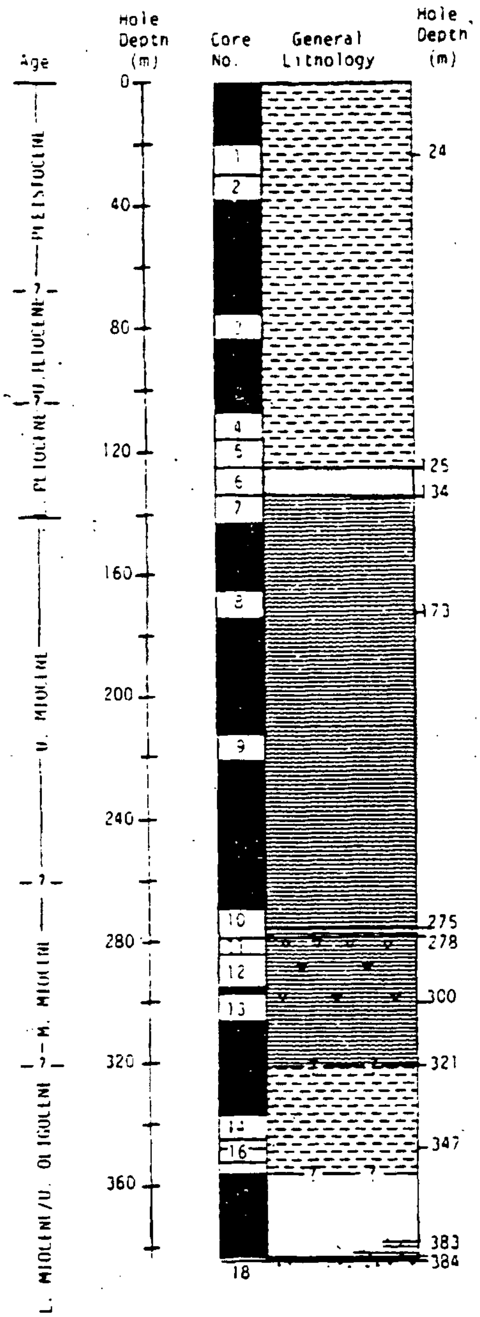
293-295 meters, core 15, Middle Miocene in age. Dark green to light green-gray nanno-siliceous fossil ooze interbedded with mud siliceous fossil ooze. Some chert chips. Hole terminated by hard horizon, lithology unknown. Basement not reached. Estimated that .475 second seismic reflection representing 350 meter depth is basement contact.



Lithologic summary of DSDP Drill Site 33. (latitude 39° 28.48'N, longitude 127° 29.81'W). Water depth of 4284 meters and hole depth of 295 meters. The basement was not reached at this site.

Figure E-18. Lithology of Deep Sea Drilling Project Site 33

DSDP SITE 34



Summary of Lithology

0-125 meters, cores 1-5, Pleistocene to Lower Pliocene in age. Greenish-gray mud with some siliceous fossils. Prominant nannofossils mud and muddy nannofossils ooze interbedded with gray mud in core 3 and top of core 4. Ashy bed at 24 meters. Rare sand pods and pyrite replacement of siliceous fossils in core 2. Slight to moderate mottling in core 3. Volcanic ash pods with some pyrite nodules and worm tubes in core 5. Increasing amounts of siliceous fossils in lower portion of core 5.

125-134 meters, core 6, Lower Pliocene in age. Mostly alternating greenish-gray and green-black silty siliceous fossil ooze. 5 to 25 centimeter beds of well sorted, fine-medium silty sand. Sandy beds are graded and have sharp upper and lower boundaries. The 0.18 second seismic reflection may correspond to this sand section.

134-275 meters, core 7 to top of core 10. Lower Pliocene to Middle Miocene in age. Greenish-gray siliceous fossil mud and non-fossiliferous clay. Thin bed of nannofossil mud near base of core 7. Graded 7 centimeter ash bed at 173 meters. First appearance of siliceous mudstone pebbles in core 9 and scattered olive black silicified mudstone pebbles in upper part of core 10.

275-278 meters, bottom of core 10. Middle Miocene in age. Thin greenish-gray and bluish-gray nannofossils siliceous clayey ooze.

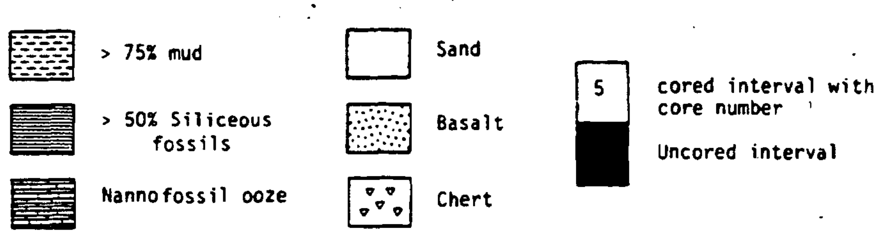
278-321 meters, cores 11-13, Middle Miocene in age. Greenish-gray and bluish-gray siliceous-fossil ooze and siliceous fossil mud. The main cherty sequence starting at the top of core 11 may correspond to the 0.39 second seismic reflection at 278 meters. Significant chert found in cores 11, 12, and 13 with slow penetration and poor recovery. Mottling in cores 12 and 13 with pyritic replacement of siliceous fossils in core 13. Two volcanic ash horizons near 300 meters.

321-356 meters, cores 14-17, Lower Miocene to Oligocene in age. Dark greenish-gray to greenish-gray mud and zeolitic mud with nannofossils ooze near base of interval. Local dolomite rhombs and rare burrow mottling in core 14. Scattered whitish zeolite pods throughout interval, especially concentrated at 347 meters. Thin beds with slump structures and mottling in core 16. Semi-lithified rock fragments in core 17 show extensive mottling.

383 meters, top of core 18, the age of core 18 is questionable. Contact between the sediments and basement not well preserved because of coring. Sediments are dark gray, yellow, orange and green; fine grained and contain calcite with some chlorite. No fossils noted.

384 meters, bottom of core 18, basement rock. Dark gray altered glassy basalt containing microamygdules of chlorite and fractures filled with carbonate and chlorite minerals.

LITHOLOGY



Lithologic summary of DSDP Drill Site 34. (latitude 39° 28.21'N, longitude 127° 16.59'W). Water depth of 4322 meters and hole depth of 384 meters to top of basaltic basement.

Figure E-19. Lithology of Deep Sea Drilling Project Site 34

study area. The latter hole reached the basement basaltic rock. Figures E-18 and E-19 provide summary descriptions of the lithology of these two sites. As stated in Reference E.11, the absence of significant lithologic breaks or coarse grained sediments in samples from the upper 200 meters of these holes suggests that depositional conditions have been very stable for millions of years.

Nine gravity cores of up to 3 meters in length, along with seven box cores between 19 and 34 centimeters in length were taken from the sea floor throughout the study area during August 1979. The following is a summary of the observations made in Reference E.12 regarding the lithologic properties of the area as shown by visual and microscopic examination of these cores.

The descriptions fall into three main groups:

a. Sediments from the eastern one-third of the study area (five core samples) are somewhat coarser than the more westerly sites, and contain thin beds of fine sand (1 to 11 centimeters thick) that were laid down at the seaward end of the Delgada Fan which is marked by the valley running southwest from 39°45' north, 127° west to 39° north, 127°25' west. All the cores are strongly mottled due to burrowers in the upper 10-30 centimeters. Based on the colors of the core materials, manganese is reduced at 4 to 25 centimeters below the sea floor. Thus, pore waters below this depth range do not contain dissolved oxygen. Conditions become strongly reducing at 2 to 3 meters, as indicated by the presence of fine sulphides in the deepest core.

b. Sediments from the low rise in the western two-thirds of the area (five core samples) are finer and firmer than those in the eastern one-third. (The two "3-meter gravity cores" penetrated only 79 and 81 centimeters.) Manganese reduction is indicated at 5 to 20 centimeters beneath the sediment surface, but no sulphides were evident. As in the core samples from the eastern one-third of the area, burrowing is indicated by mottling of the depositional structures in one of the core samples.

c. Sediments from the depressions to the north and south of the "4250 meter high" (six cores) are fine-grained and softer than the sediments sampled elsewhere in the area. (Three of the "3-meter gravity cores" over-penetrated to depths in excess of 350 centimeters.) All of the cores are strongly burrow-mottled. Manganese reduction is indicated at 5 to 35 centimeters and fine sulphides are visible in two of the longer cores, indicative of sulphate reduction (strong reducing conditions).

In summarizing the results of the Pacific site core sample examinations, Reference E.12 states that the "cores confirm that (the site) is a transitional pelagic-hemipelagic area dominated by the deposition of fine-grained terrestrial clays." The gradual downcore increase in shear strength is "typical of pelagic rather than turbidite deposits, suggesting that abrupt vertical or horizontal variations in properties are unlikely." Based on the appearance of the core material, Reference E.12 concludes that the "supply of organic debris from the sea surface is sufficient to consume the dissolved porewater oxygen" and, at greater depths, to reduce "first solid manganese oxyhydroxides, then porewater sulphate." Thus, the undersurface of any large object on the sea floor would be subject to anoxic chemical conditions, whereas the portions exposed to seawater would be subject to oxic reactions.

Three successful doppler penetrometer deployments have been made in the Pacific study area, one drop near the center and two in the northwestern portion, Reference E.8. The sediment shear strength, as determined from the penetrometer data, is higher than the shear strength deduced from recovered core samples by a factor of two. This difference is not considered to be exceptional when in-situ shear strength measurements are compared with those from recovered samples that are analyzed either onboard ship or in the shore laboratory. Therefore the shear strength of sediments at other locations can be deduced from recovered core samples without the need for penetrometer measurements, so long as adequate allowances for uncertainty are made.

The absence of thick sediments and reservoir beds guarantees that commercial hydrocarbon deposits are absent, and the absence of ferromanganese nodules ensures that the region will not be of interest to deep-sea miners.

7. Bottom-Dwelling Life

Research currently in progress includes biological sampling carried out to characterize the benthic invertebrate community and to identify the foodweb connections of this seafloor ecosystem. Benthic samples were collected using large "otter trawls" and box corers at 8 locations and 9 locations, respectively. Additional information on population numbers per unit area was obtained using bottom photographs at 10 locations. Although the characterization work is still in progress, the developing benthic picture appears to be similar to other deep sea benthic communities. The epibenthic megafauna is dominated by echinoderms both with respect to the number of species and organisms. The dominant benthic species are benthic rat tails (coryphaenoides armatus and coryphaenoides yaquinae).

Fish abundances at midwater depths are low, based on relatively shallow trawling at 2090-2525 meter depths, amounting to about one fish per 100,000 m^3, and 2 grams per 1000 m^3. The dominant pelagic species is another rat tail (coryphaenoides filifer). It was not found close to the bottom.

The sea floor in this area is not exploited by commercial fisheries, and one of the bases for its selection was the likelihood that it will never attract such fisheries.

8. Commercial Fishing

Commercial fishing in the surface waters of the Pacific Study Area occurs with low productivity (Reference E.11). The annual albacore catch by the U.S. fishing fleet off the west coast is sampled by the National Marine Fisheries Service (NMFS), a branch of the National Oceanographic and Atmospheric Administration, in La Jolla, California. Annual average albacore catch by the sampled portion of the U.S. fishing fleet (approximately 15 percent of the total) is as shown in Figure E-20, based on NMFS unpublished data for the entire 22-year period of available data (1961-1982). For the general location of the Pacific Study Area (a one degree by one degree rectangle), the annual average albacore catch is about 0.02 percent of the total. The values in Figure E-20 can be made representative of the entire U.S. fishing fleet by multiplying each entry by 1/0.15 or about 7. Whether or not this scale-up is performed, it is apparent that the average annual catch in the general location of the Pacific Study Area is a small fraction (0.5 percent) of the average annual catch in the most productive area of the same size. If the NMFS data were selected to cover shorter time intervals than the entire 22-year available period, the relative catches in the Pacific Study Area location would be 0.2 percent (1961-1970), 1.1 percent (1971-1980), and 0.5 percent (1981-1982) of those in the most productive area of the same size.

9. Characteristics Determined from Surveys of Available Data

The previously-described information on the Pacific Ocean site was developed primarily as a result of the concentrated oceanographic work in the area, exceptions being the Deep Sea Drilling Project results and the commercial fish catch data. The following information is based on data that ara of general interest and important to a site selection although not originally generated specifically for the study area.

a. **Seismicity.** Earthquake records (since 1853) indicate that no earthquakes of magnitude 3.5 or greater were centered within the area (Reference E.11).

Recent research shows the oceanic basement beneath the sediments to be the result of a simple sea floor spreading along a straight north-south section of rise crests between what were the Mendocino and Pioneer transform faults. This indicates that the (Pacific Study) area has not been tectonically disturbed by either the Mendocino or Pioneer fracture zones or the Delgado Fan.

b. **Volcanic Activity.** There is no known recent volcanic activity in the study area. The nearest active tectonic feature is the Mendocino Fracture zone, some 40 to 80 nautical miles (70-150 kilometers) to the north. This fracture zone, which forms the boundary between the Gorda-Juan de Fuca and Pacific lithospheric plates, is well defined seismically and topographically. Its associated seismicity does not extend into the study area.

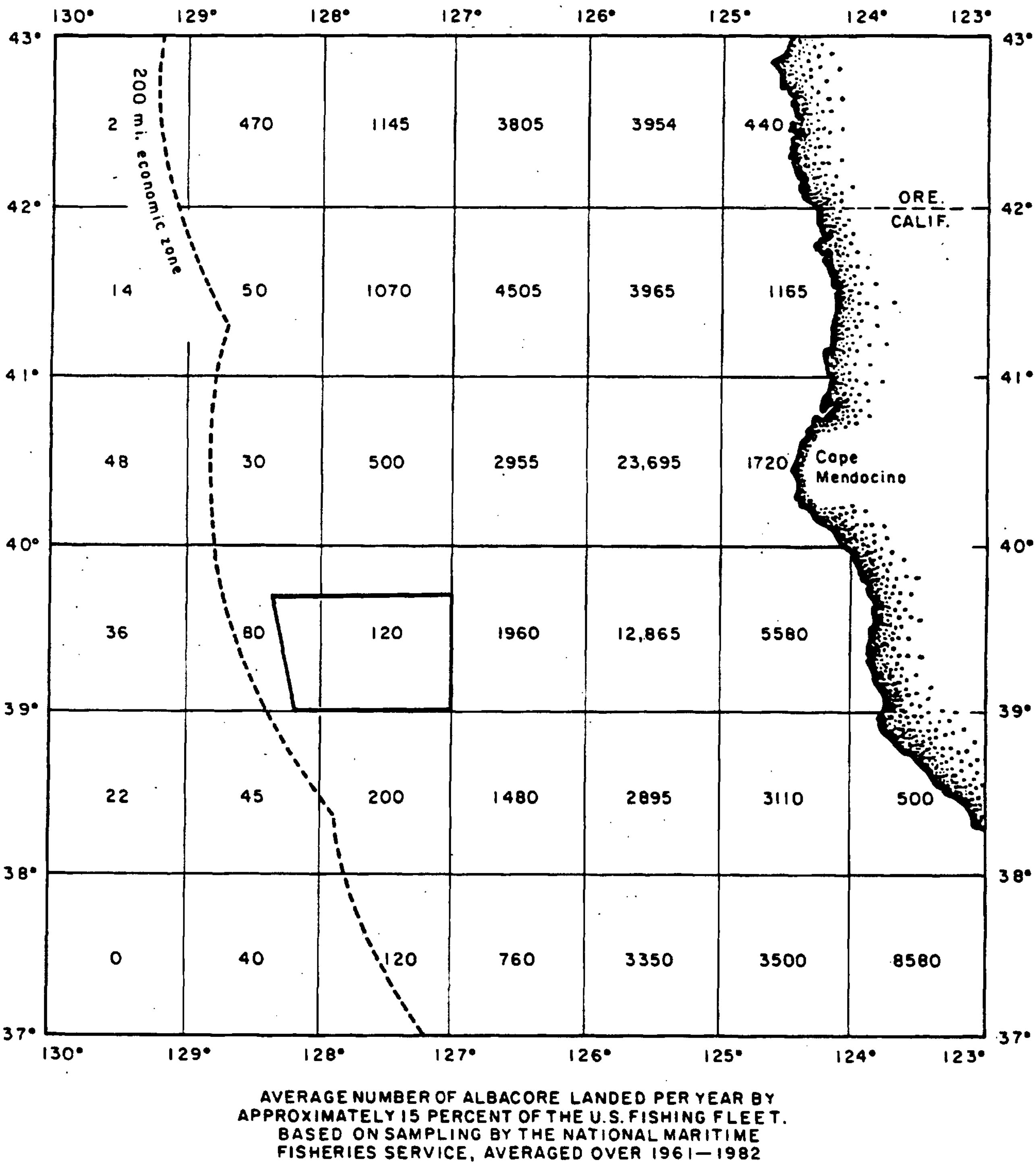


Figure E-20. Average Annual Albacore Landings by Approximately 15 Percent of U.S. Fishing Fleet (1961-1982)

c. **Sediment Thickness.** Historical data show a fairly uniform sediment thickness of about 300 meters, in agreement with Deep Sea Drilling Project results (Reference E.7). This relatively thin sediment column precludes the accumulation of and future exploration for oil or gas.

d. **Cable Routes.** There are no known cable routes in the area.

e. **Shipping Lanes.** The area is well clear of major U. S. shipping routes, although it does lie on the northern route from Vladivostok to Panama (Reference E.11).

10. Upwelling

Recent research on the subject of upwelling has employed infrared images of the coastal and off-shore ocean along Oregon and California. These images, obtained from satellite photographs, show near-shore upwelling events that take place within 25 kilometers of shore. Cold water "filaments," rich in nutrients, are frequently caught between near-shore eddies and appear to trail out on the surface from the coast to 400 kilometers or more as they are stirred. This phenomenon does not represent a "shortcut" between the sea floor at the study area and the waters at or near the surface. The upwelled water originates from relatively shallow depths on the continental shelf and has not circulated from the bottom waters of the study area, where there is very little vertical mixing of waters and where the direction of bottom water circulation is to the south.

11. Summary of Pacific Ocean Location

All information compiled to date on the Pacific site shows it to be an isolated, tranquil, and predictable area compatible with the tentative study site identification guidelines of Section III of this appendix. The area would be likely to prove acceptable as an ocean disposal site, based on the site selection criteria used to identify study areas.

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APPENDIX F

CORROSION OF STRUCTURAL ALLOYS

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APPENDIX F

CORROSION OF STRUCTURAL ALLOYS

I. INTRODUCTION

Corrosion is the natural process which eats away the exposed surfaces of metals and alloys, and changes strong structural alloys from solid objects into unrecognizable forms of flakes and powder and soluble substances. This appendix describes the need for quantitative corrosion information, the actions that were taken to acquire it, and the results that were obtained for use in this environmental assessment. Background information on some closely-related topics is included.

Practically all of the radioactivity involved in this environmental assessment is "induced" activity wherein the originally-inactive structural alloys in the new reactor plant were exposed to neutrons during normal operation of the reactor plant. These neutrons penetrated these alloys and reacted with the various nonradioactive atoms in them to form some radioactive atoms. These radioactive atoms exist throughout the mass of the alloys, not just on the surfaces. Since the radioactivity has been induced throughout the structures, it will continue to decay in place until it is exposed by corrosion. The longer the alloy can resist the corrosive action of its local environment, the more time there would be for harmless decay to occur. The rate at which the remaining undecayed radioactivity would be released to the environment depends on the corrosion rate of the alloy in its surroundings.

II. SUMMARY

Natural corrosion processes would eventually penetrate the containment barriers and degrade the structure of the radioactive alloys until the remains would be dispersed into the environment by diffusion and other natural processes. During the time that would be required for corrosion to reduce these massive structures to dispersible forms, radioactive decay would be decreasing the amount of radioactivity remaining to be dispersed. Those alloys that are more corrosion resistant would survive longer, and their radioactivity would decay further before being released to the environment.

The structural alloys used in the submarine and in the reactor plants have been assessed for their corrosion rates in seawater and in soil based on data from the literature and from supporting ocean and laboratory seawater corrosion tests. The long-term results indicate that the alloys have either of two characteristic rates:

1. The larger rate (up to 5 mils per year) is characteristic of low alloy steels. Exposed surfaces tend to corrode uniformly with some irregularity, but no significant pitting. For convenience, carbon steels are included with the low alloy steels.

2. The smaller rate (up to 0.5 mil per year) is characteristic of corrosion resistant alloys that exhibit most of their weight loss by pitting. Observed weight changes are expressed for convenience as the amount of thickness that would have been lost by the exposed surface if the loss were uniform, by dividing the weight change by the corresponding density and surface area. Such thicknesses are expressed here in mils (0.001 of an inch); one mil is also equal to 25.4 micrometers (μm).

The rates in seawater were determined from the maximum and average values for long-term corrosion testing based on published data for these materials in the ocean, as illustrated in Figure F-1. The values from the enveloping lines are listed in Table F-1. The one-year values account for the faster corrosion rates that occur during the first few years of exposure. Published values for corrosion of these materials in soil tend to be somewhat lower.

Supporting tests were planned and executed, to confirm the adequacy of the limiting values from the literature and to examine the effects of additional variables. Ocean-bottom experiments, laboratory tests, and their results are all described in detail.

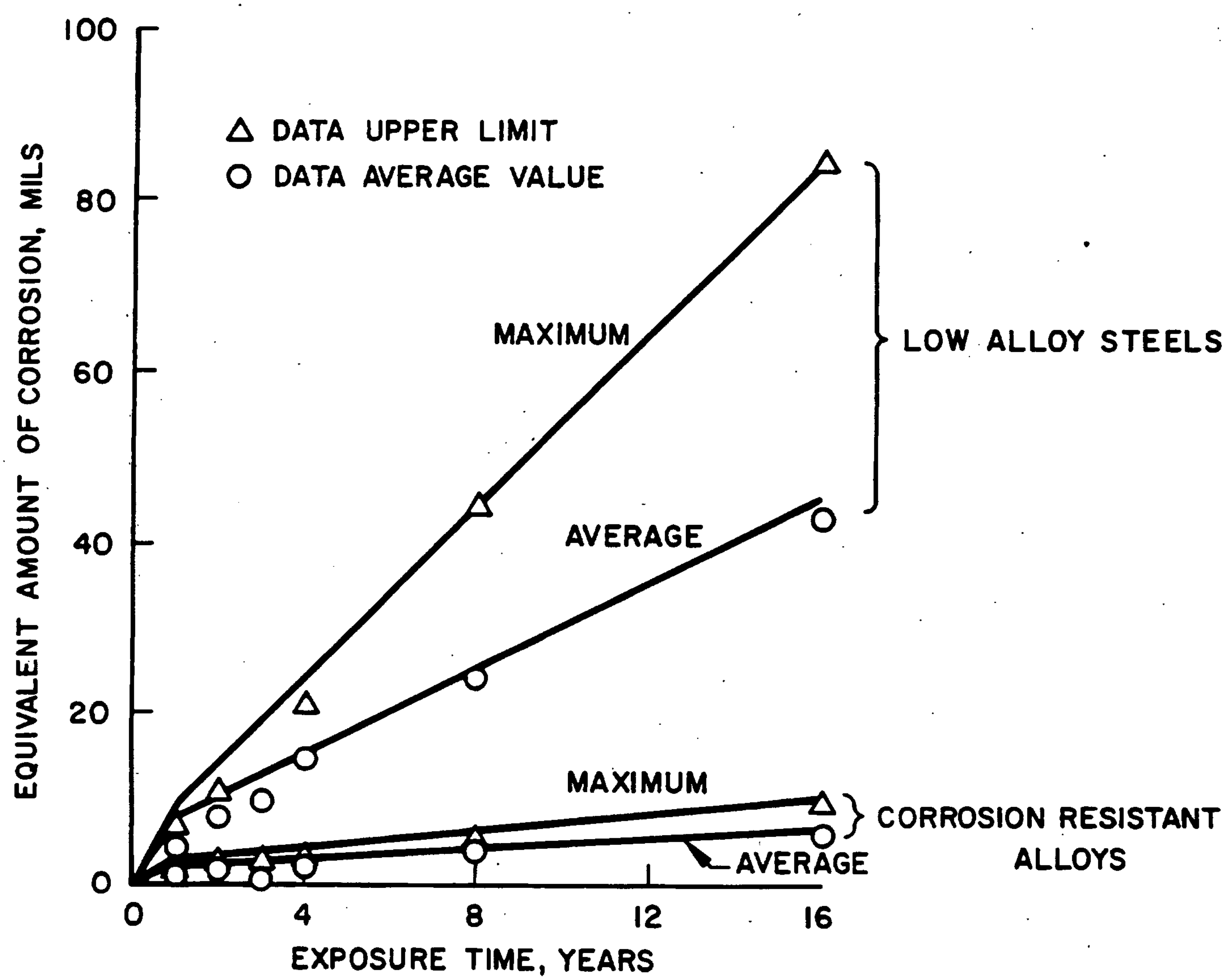

Figure F-1. Amount of Corrosion in Seawater for Low Alloy Steels and Corrosion Resistant Alloys

III. DISCUSSION

Conservative values for the corrosion release rates were determined from published values for applicable tests and were confirmed by specific ocean and laboratory seawater corrosion tests. This effort is described in detail below.

A. REQUIREMENTS FOR CORROSION INFORMATION

Corrosion rates for the structural alloys determine the rates at which they would be penetrated as containment barriers and the rates at which their induced radioactivity would be released to the surrounding environment. These rates depend upon two different characteristics of corrosion: pitting and average corrosion. The average corrosion rate is the rate at which the mass of the alloy is changed from the metallic form to the various corrosion products. The release of induced radioactivity would be proportional to the amount of corroded alloy, and the average corrosion rate would be the appropriate measure of this effect.

TABLE F-1. CORROSION RATES FOR LOW ALLOY STEELS AND CORROSION RESISTANT ALLOYS IN SEAWATER

	Material	
Long-Term Rates	**Low Alloy Steels**	**Corrosion Resistant Alloys**
Maximum(1)	5 mils/year	0.5 mil/year
Average(2)	2.5 mils/year	0.3 mil/year
One-Year Values		
Maximum	9 mils	3 mils
Average	8 mils	2.2 mils

NOTES: (1) Maximum values from envelope of highest values in published data discussed in text.
(2) Average values from envelope of highest averages in published data discussed in text.

The pitting rate is the rate at which the thickness of the alloy is penetrated by corrosion in localized regions of an exposed surface. The pitting rate always exceeds the average rate. The time it would take to penetrate a containment barrier would depend on its thickness and its pitting rate. Pitting rates are conveniently expressed as a factor applied to the average corrosion rate to express the ratio by which the pitting rate exceeds the average rate.

Corrosion of lead in the disposal environment would occur eventually when lead shielding in the reactor compartment would be exposed by corrosion and begin to corrode due to exposure to soil moisture or to seawater. Subsequent release of lead corrosion products into the surrounding environment would allow some lead to be transported away from the disposal site by groundwater flow or by seawater flow. As described in Chapter 4, the maximum concentrations of lead in the groundwater and seawater at locations downstream from the disposal site would be less than the EPA criteria. Corrosion data were required to estimate the dispersibility of the lead corrosion products in groundwater, and to estimate the corrosion release rate in seawater.

There is a characteristic difference between the amount of corrosion that occurs in a structural alloy and the amount of alloy material that is released to its environment because some of the alloy material is retained as corrosion products that adhere to the corroding surface in the form of a film or scale, as shown in Figure F-2. This difference is significant early in the corrosion process when the scale or film is being established, but while the thickness of the corrosion scale increases to achieve its steady-state value, the corrosion release rate increases to become equal to the corrosion rate. For estimating the effects of the corrosion release processes, it would be conservative to use the long-term corrosion rate as the corrosion release rate.

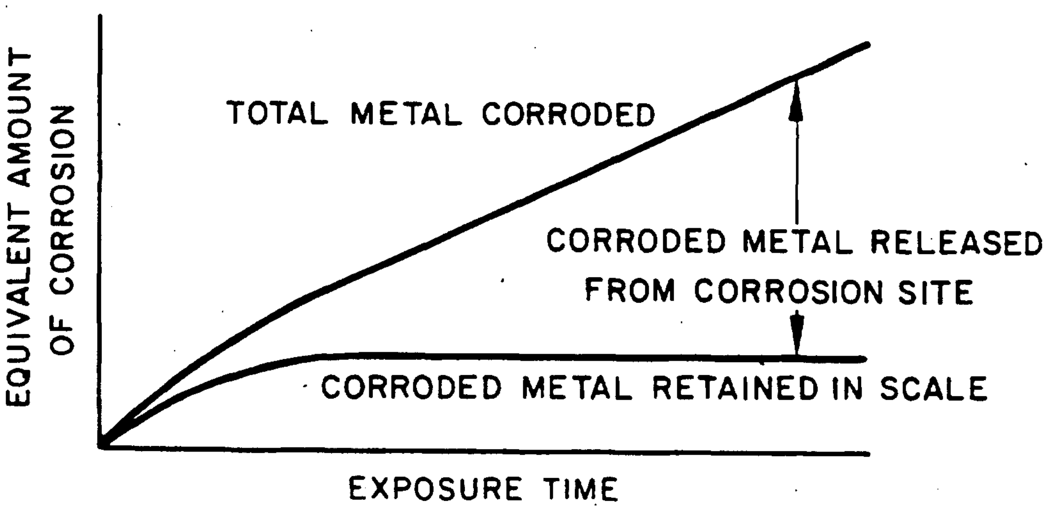

Figure F-2. Difference Between Corrosion and Corrosion Release

Not all of the released corrosion products are equally dispersible in the environment. A very small fraction of the corrosion products is soluble and would be dispersed readily in seawater or in groundwater, but the corrosion products from typical structural alloys are not very soluble in either seawater or freshwater. So, the bulk of the released corrosion products would be insoluble and would tend to precipitate in the immediate vicinity of the corroding structure. Some of these corrosion products would be sizeable flakes that would settle rather rapidly and others would be in a small enough size range that they could disperse for some distance before they would be expected to be deposited on a solid surface. Ultimately, all of the corrosion products would be dispersed to a degree that would depend on the time scale considered. However, during the time when the large flakes or piles of powder would be retained nearby, their radioactivity would be continuing to decay and to become progressively lower.

Maximum and average values of the corrosion release rates for the structural alloys were estimated as follows:

1. The highest measured long-term corrosion rates were used to estimate the maximum corrosion release rates.

2. The average values of measured long-term corrosion rates were used to estimate the average corrosion release rates.

All of these needs were satisfied by information acquired from published data. Maximum and average limits for long-term corrosion rates, short-term corrosion allowances, and pitting ratios have been determined. In addition, laboratory and ocean-bottom seawater corrosion tests were conducted to clarify some specific corrosion effects, as described below.

B. PLAN OF ACQUISITION

Corrosion information is acquired experimentally. As planned, the bulk of the needed information was obtained from published results of appropriate tests. Additional experiments were conducted to confirm the adequacy of using the published data and to clarify the effects of certain variables such as stress, temperature, and oxygen concentration.

C. ACTIONS TAKEN

A literature search for applicable corrosion data was conducted, and corrosion experiments were performed in the oceans and in the laboratory.

The literature search was conducted in three parts. A computer-aided search of abstracts by key words was conducted using the remote-access retrieval system operated by the Department of Energy (DOE) Technical Information Center at Oak Ridge, Tennessee. Over 10,000 abstracts on corrosion and related topics were searched for pertinent information. In addition, available secondary sources were searched for applicable data and for references to primary sources of such data. References F.1 and F.2 were found to be useful. Finally, personal communications provided useful leads to primary sources of such data. The results are discussed below.

In-situ ocean corrosion experiments were conducted in both the Atlantic and Pacific Oceans. Corrosion experiments were conducted at two locations at the bottom of the Atlantic Ocean (at depths of 3200 meters and 3700 meters) to obtain data from specimens of structural materials exposed to the Western Boundary Undercurrent on the western North Atlantic continental rise. Data was obtained for exposures ranging from nine months to three years. The alloys tested are listed in Table F-2, and the results of this testing are discussed below.

A one-year experiment was conducted at the bottom of the Pacific Ocean (at a depth of 5860 meters) to obtain preliminary data from exposure of structural alloys and to test experimental methods. The alloys are

TABLE F-2. ALLOYS TESTED IN OCEAN CORROSION EXPERIMENTS

Low Alloy Steels	Typical Applications
AISI 4340[a] ASTM A302 Grade B ASTM A516[b] Carbon Steel[b] HY-80	Submarine and reactor plant structures
Corrosion Resistant Alloys	
Nickel-Chromium-Iron (NiCrFe) Alloy 600 Stainless Steel, CRES 304 Stainless Steel, CRES 304L[b] Stainless Steel, CRES 308[b] Stainless Steel, CRES 347[b]	Reactor plant structures

Note: (a) Tested in Pacific Ocean only.
(b) Tested in Atlantic Ocean only.

listed in Table F-2. This was followed by a three-year experiment to obtain longer-term data from structural alloys at the bottom of the Pacific Ocean at another site (at a depth of 4245 meters). The results of this testing are discussed below.

A one-year laboratory corrosion tests of 24 specimens were conducted as discussed below to determine the effects of three different temperatures and two oxygen concentrations on the corrosion and release of corrosion products from corrosion resistant alloys (CRES 304 and NiCrFe Alloy 600) in seawater.

D. RESULTS

Results are provided from the literature survey, the ocean corrosion experiments, and laboratory seawater corrosion testing.

1. Literature Survey

Of the many references examined for applicable corrosion data, reports published by the U.S. Naval Civil Engineering Laboratory (NCEL) and by the Naval Research Laboratory (NRL) were found to be most useful for seawater corrosion. The most applicable ones are listed in Table F-3. The summaries reported by K. H. Logan of the National Bureau of Standards in Reference F.7 provided the soil corrosion values listed in Table F-3. Most of the other sources examined were found to be not applicable either because they reported unique experiments of limited applicability or they did not address the topics of concern. The quantity and quality of the data from these Naval Laboratories were found to be adequate to define the corrosion characteristics of the structural alloys for environmental assessment.

The Naval Civil Engineering Laboratory has conducted extensive corrosion tests in the Pacific Ocean at two deep ocean sites that are approximately 80 miles from Port Hueneme, California. Test Site I has a nominal depth of 1800 meters; Test Site II is approximately 700 meters. Their tests consist of many test specimens attached to submersible test units that are lowered to the ocean floor for periods of exposure that ranged from nine months to three years, then retrieved.

The Naval Research Laboratory has conducted extensive immersion corrosion tests in the Pacific Ocean at a shallow water site at Naos Island in Panama, as a part of a larger program that involved exposure of many specimens to five different environments in Panama for periods of time up to 16 years. All specimens were exposed simultaneously. Each set of specimens consisted of 10 replicates so that duplicate specimens could be removed after exposures of 1, 2, 4, 8, and 16 years. Further details are available in Reference F.8.

TABLE F-3. CORROSION DATA FROM THE LITERATURE

a. Seawater Exposure

Material	Exposure Time	Equivalent Amount of Corrosion(1): Range of Values (mils)	Average (mils)	Adjusted Average(2) (mils)	Source
Low Alloy Steels	0.34 year	0.5-1.9	1.0	1.7	NCEL, Ref F.3
	0.54	0.5-1.0	0.8	2.6	NCEL, Ref F.3
	1	0.3-6.9	5.5	4.4	NRL, Ref F.4
	2	8.5-11	10.0	7.9	NRL, Ref F.4
	2.91	0.7-7.4	2.8	9.8	NCEL, Ref F.3
	4	15-21	19.0	14.8	NRL, Ref F.4
	8	25-44	32.4	24.0	NRL, Ref F.4
	16	45-84	60.2	43.3	NRL, Ref F.4
Corrosion Resistant Alloys	0.34	<0.03-0.3	0.08		NCEL, Ref F.5
	0.54	<0.05-0.3	0.07		NCEL, Ref F.5
	1	0.6-1.5	1.1		NRL, Ref F.6
	1.10	<0.1-1.8	0.3		NCEL, Ref F.5
	2	0.3-2.2	1.4		NRL, Ref F.6
	2.06	<0.2-3.5	1.1		NCEL, Ref F.5
	2.91	<0.3-2.9	0.6		NCEL, Ref F.5
	4	0.3-3.5	2.4		NRL, Ref F.6
	8	2.1-5.5	4.2		NRL, Ref F.6
	16	0.8-9.5	5.9		NRL, Ref F.6

b. Soil Exposure

Material	Exposure Time	Penetration Rates(3): Range	Average	Source
Low Alloy Steels	4-12 years	6-25 mils/yr	14 mils/yr	Ref F.7
Corrosion Resistant Alloys	5-14	0.4-4.3	1.3	Ref F.7

NOTES: (1) Equivalent to observed weight loss during corresponding exposure time.

(2) Averages for low alloy steels only were adjusted for differences between the seawater temperatures and oxygen concentrations at the testing site versus those at the Pacific study area, in accordance with the formula developed by NCEL and published in Reference F.9.

(3) Equivalent rates for weight loss are considerably less: 1.1 mils/yr with a penetration rate of 25 mils/yr for black iron in four years; and 0.00017 mil/yr for stainless steel in nine years after which the surface was visually "unaffected".

The applicable data from these tests is summarized in Table F-3. It includes data from specimens exposed to seawater alone and to the sediments at the bottom of the ocean. Tabulated values are averages of results from duplicate specimens. The amounts of corrosion for the low alloy steels are characteristically greater than those of the corrosion resistant alloys. The averages for the low alloy steels were adjusted to account for the effects of different temperatures and different oxygen concentrations between the testing sites and the Pacific study area. The adjustment was calculated from a formula developed by NCEL and reported in Reference F.9. The magnitude of the adjustment of the averages depended mostly upon the differences in the oxygen concentration which accounted for between 65 and nearly 100 percent of the adjustment in each case. No adjustment was available for the average amounts of corrosion on corrosion resistant alloys in seawater, but the unadjusted values are considered to define suitable values for use in the environmental assessment.

Adjusted values for the NRL average data for low alloy steels and the corresponding NCEL data are in good agreement over the range of common periods of exposure. The data on corrosion resistant alloys shows that the NRL data from Panama are consistently greater than the NCEL data, most likely due to the higher temperature at the Panama test site. Oxygen in the range of 1 to 10 parts per million by weight (ppm) was found in laboratory corrosion tests to not have a large effect on corrosion of corrosion resistant alloys. Since no formula has been established to correct the possible effects on corrosion resistant alloys due to the differences in temperature and oxygen concentration between the test sites and the study area, no adjustment was made. The maximum values and the average values for the corrosion resistant alloys selected for assessing environmental effects are considered to be conservatively high due to the effect of these differences in oxygen and temperature values.

The results of the naval experiments listed in Table F-3 are plotted on the graphs in Figure F-3 for comparison with the limiting lines developed from these data. The lines were devised to provide conservative representations of these data for use in the environmental assessment. The corrosion rates listed in Table F-1 were obtained from the slopes of these lines.

Conservative representations of the corrosion data were used in the environmental assessment so that the assessment would be suitable even if new corrosion data were to include some results that might exceed the reference lines by small amounts. It is expected that new corrosion data would agree in general with the range and trend of these data, but the natural variability of corrosion data might result in some small exceptions in new corrosion data.

An historic example of long-term corrosion behavior of metals on the ocean bottom was obtained from the USS MONITOR which was lost at sea in a storm off North Carolina in 1862. In 1977, a section of wrought iron hull plate was recovered from the wreck and examined for mechanical properties and metallurgical characteristics. The tests showed that sound metal approximately 1/4 inch thick remained from an original thickness thought to have been approximately 3/8 inch, indicating that the plate had corroded at an average rate of approximately 0.5 mil per year from each side during the 115 years that it was exposed on the ocean floor under 200 feet of seawater. Further details are available in References F.10 and F.11.

Pitting data for corrosion resistant alloys in seawater are reported in References F.5 and F.8. Reference F.5 reports the maximum pit depth in each specimen, and Reference F.8 reports both the maximum pit depth and a 20-pit average. The 20-pit average was determined from the five deepest pits on each of the two major surfaces (9 × 9 inches each) of each of the two duplicate specimens. For assessing the environmental effects, the 20-pit average was used for the average case and instant penetration was used for the maximum case, to ensure adequate conservatism.

For corrosion resistant alloys in Reference F.8, the average value for the 20-pit average over a 16-year period is 46 times the average penetration based on weight loss. The factor of 46 indicates that the average of the 20 deepest pits in 2.25 square feet of surface is 46 times deeper than the thickness calculated by dividing the corrosion weight loss by the product of the density and the surface area. The pitting ratio is used in this assessment to estimate when a containment barrier would be penetrated by corrosion processes, and it reflects the fact that penetration occurs at a faster rate than weight loss alone would account for. The penetration time is estimated by dividing the material thickness by the product of pitting ratio and the average rate of corrosion loss.

Data on the corrosion of lead in land burial were obtained from Reference F.12 in which the National Bureau of Standards reported the results of field tests in 38 different types of soil with exposures that ranged

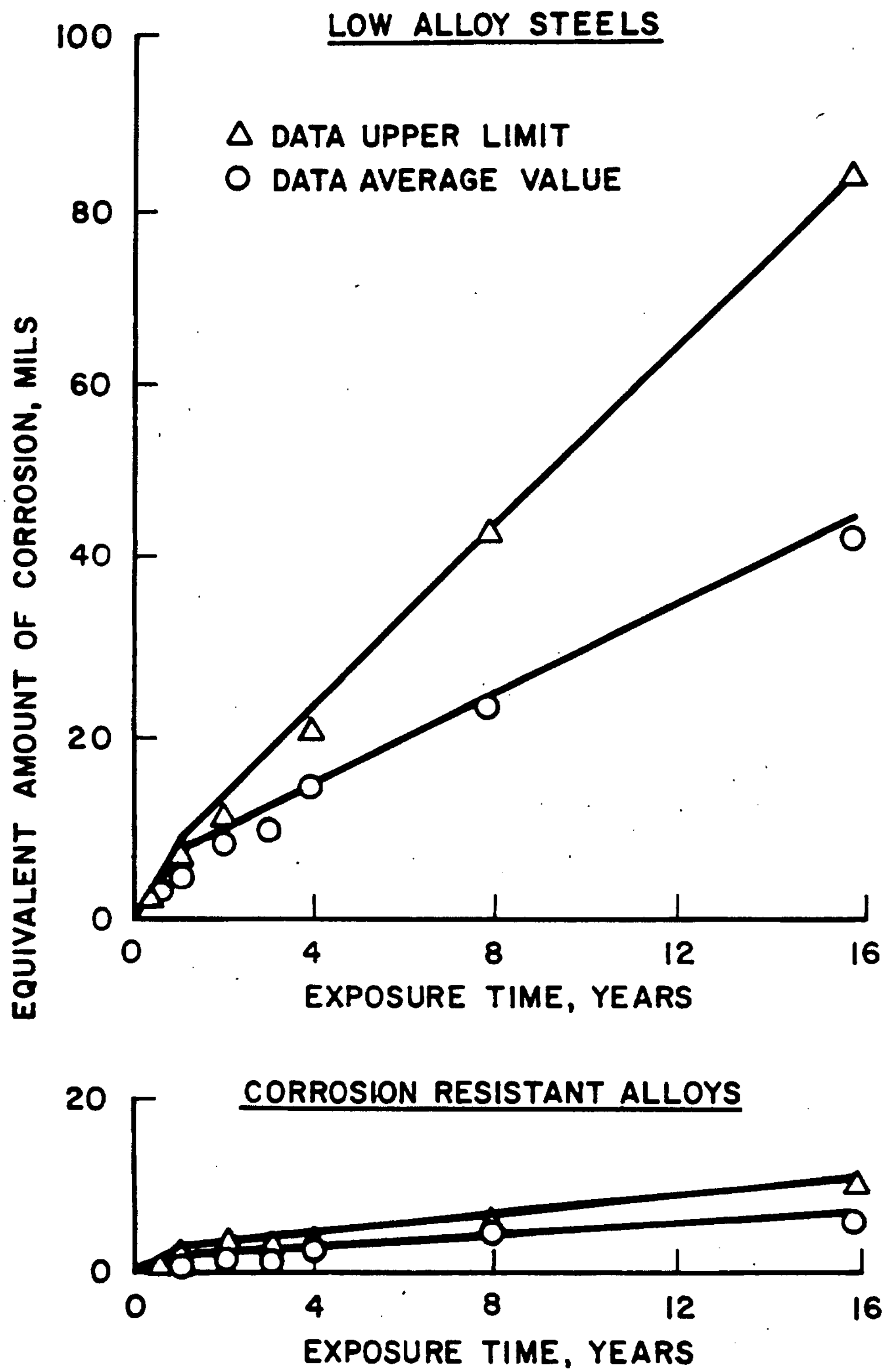

Figure F-3. Time-Corrosion Plots for Published Data up to 17 years. From tests in Cecil clay loam, which is similar to the soil in the Savannah River burial ground, the amount of corrosion did not exceed 0.8 mil (weight-loss basis) in 10 years of exposure, an average corrosion rate of not more than 0.08 mil per year. Lower corrosion rates would be expected at Hanford because the rainfall is less and the ground at the burial site is drier.

In seawater, data from the naval experiments reported in References F.8 and F.9 indicated that the amount of corrosion did not exceed 4.9 mils in 16 years of exposure, an average corrosion rate of approximately 0.3 mil per year. One-year exposures resulted in amounts of corrosion in the range of 0.3 to 0.6 mil.

Due to its corrosion resistance, lead pipes installed and used in ancient Rome have endured in place and were dug up in modern times from the ruins of Pompeii and Rome. Many of these lead pipes were in an almost perfect state of preservation after 1900 years of exposure.

2. Ocean Corrosion Experiments

The first Pacific Ocean experiment has been completed and the second one is in progress. The Atlantic Ocean experiments are also continuing.

The data from these experiments indicate that actual corrosion at these sites is typically less than that inferred from the literature survey. The amounts of corrosion suffered by the corrosion resistant alloys are characteristically lower than those of the low alloy steels. The results of these experiments are plotted on the graphs in Figure F-4. For comparison, the limiting lines developed from the literature survey are also shown. The data include results from specimens exposed to seawater alone and to the sediments at the bottom of the ocean, and represent averages of results from duplicate specimens. The data from the ocean corrosion experiments are within the limits of the literature values, and the average values tend to be somewhat lower than the literature values. This appears to be characteristic of corrosion in the deep ocean, where corrosion rates tend to be low because of the low temperature and relatively quiescent conditions. Details of the Atlantic Ocean corrosion experiments and results of evaluations of the data that has been acquired are reported in Reference F.13. Details of the first Pacific Ocean corrosion experiment and evaluation of the acquired data are reported in Reference F 14.

3. Laboratory Seawater Corrosion Testing

Laboratory corrosion tests were conducted to examine the effects of temperature and oxygen concentration on corrosion and release of corrosion products. Twenty-four specimens representing two corrosion resistant alloys were exposed for one year of cumulative-exposure.

The data from the tests show the effects of three different seawater temperatures and two different oxygen concentrations on the amount of corrosion suffered by two different corrosion resistant alloys during the first three months of exposure and after one year of cumulative exposure. The amounts of corrosion increase with temperature, but are relatively insensitive to different oxygen concentrations in the range of 1 to 10 ppm and to the two different alloys: CRES 304 and NiCrFe.

The amount of corrosion products released from the specimens during 12 months of exposure to seawater at 2°C increased from 0.3 percent of the amount of corrosion to 2.2 percent. At 36°C, the maximum was 2.4 percent, and at 80°C, the maximum was 4.0 percent. The unreleased corrosion products formed the corrosion-resistant film on the metal surfaces. On the basis of these tests, it would be reasonable to expect that the release rate for corrosion resistant alloys in the cold seawater of the deep ocean during the first year would not exceed five percent of the amount of corrosion. Details of this experiment and evaluation of the data are reported in Reference F.15.

Corrosion theory predicts that the corrosion release rate will approach but not exceed the long-term corrosion rate, as described in Section IV.A (Corrosion Theory, Corrosion Model), below. The long-term corrosion rate for corrosion resistant alloys is 14 percent of the one-year value, using the average values from Table F-1. Since this value exceeds the values obtained from laboratory testing, it would be conservative to use the long-term corrosion rate as the corrosion release rate for the short-term exposures as well as for the long-term ones.

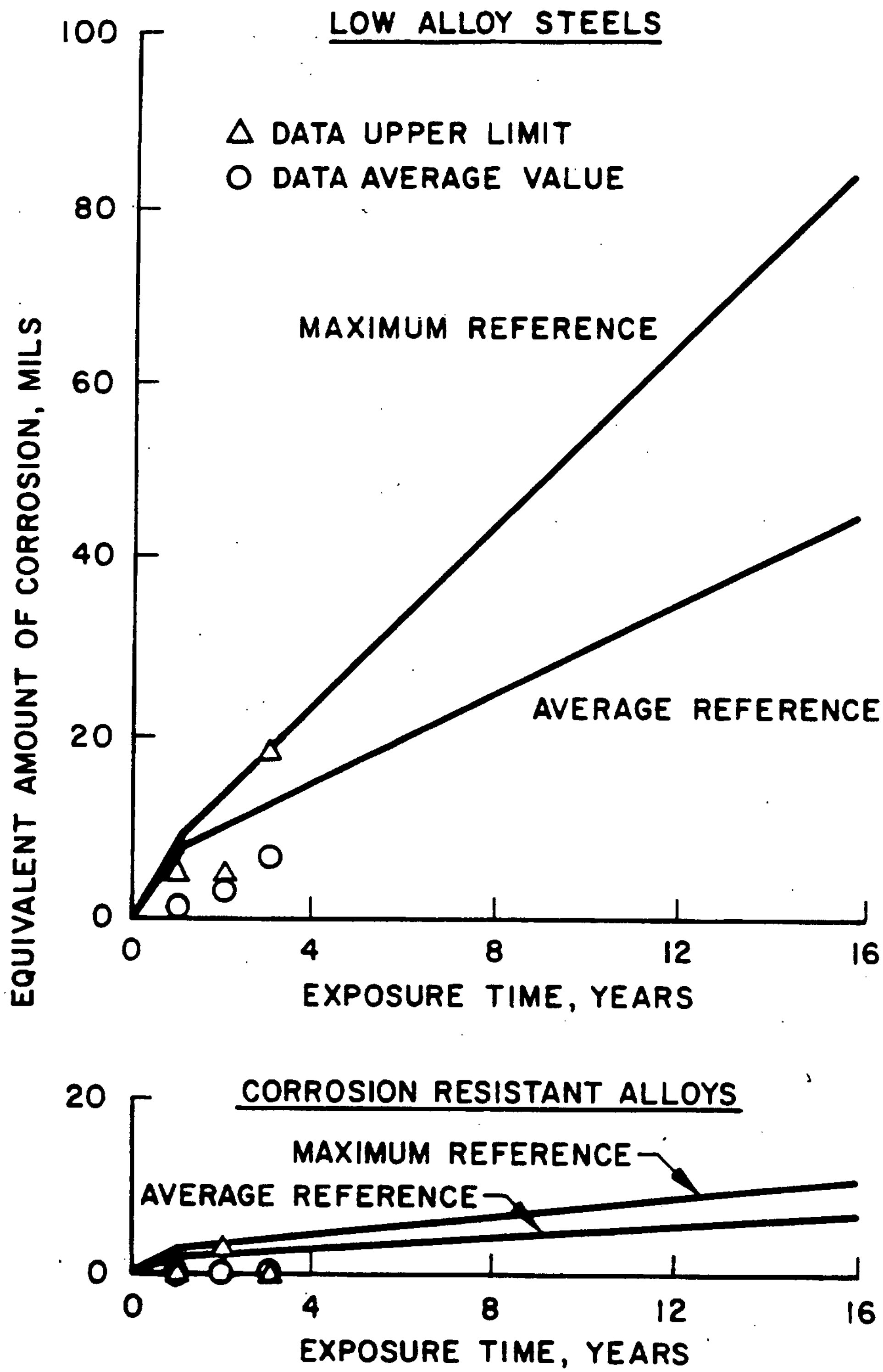

Figure F-4. Time-Corrosion Plots for Ocean Corrosion Experiments

IV. BACKGROUND

This section summarizes some corrosion-related details that may not be readily available.

A. CORROSION THEORY

The main features of corrosion theory are summarized in this section. For simplicity and brevity, many of the fine points that are very significant to the science and technology of corrosion are omitted. The emphasis is on the fundamental concepts that relate to the specific topics discussed here.

Structural alloys immersed in seawater corrode because the atoms of the metallic elements at the surface of these alloys have a natural tendency to escape from the surface of the alloy and pass into the seawater as ions. When these ions escape from the metal, the electrons that they leave behind also escape to a nearby surface where they react with other ions or molecules in the seawater. These reactions are the main processes in general corrosion, as illustrated in Figure F-5, where iron (Fe) is used as an example. While the iron is escaping as ferrous ions (Fe^{++}), the electrons are reacting with hydrogen ions (H^+), with dissolved oxygen molecules (O_2), or with both, depending upon their availability in the local region. These reactions are written as electro-chemical reactions, as follows:

$$Fe \rightarrow Fe^{++} + 2e^-$$

$$2e^- + 2H^+ \rightarrow H_2$$

$$\text{or, } 2e^- + \frac{1}{2}O_2 + H_2O \rightarrow 2(OH)^-$$

Since ocean waters normally contain both hydrogen ions and dissolved oxygen, these reactions can proceed without difficulty, producing the relatively rapid corrosion rates experienced by structural alloys with clean, uncorroded surfaces.

As the corrosion reactions continue, there is a natural accumulation of ferrous ions and hydroxyl (OH^-) ions in proximity to the corroding surface. This creates an alkaline condition at the surface, and tends to reduce the corrosion rate by reducing the local concentration of hydrogen ions and by increasing the local concentration of ferrous ions.

As the local concentration of oxygen tends to be consumed by the corrosion reaction, additional oxygen diffuses into the local region from the surrounding seawater and supports the corrosion process. The rate of corrosion is limited by the rate at which oxygen diffuses through the local region. While diffusing through this region, some of the oxygen is consumed in a reaction with the ferrous ions, converting them to ferric ions and making more hydroxyl ions:

$$2Fe^{++} + \frac{1}{2}O_2 + H_2O \rightarrow 2Fe^{+3} + 2(OH)^-$$

Since ferric hydroxide is much less soluble than ferrous hydroxide, some of the iron in solution precipitates as ferric hydroxide either locally or at some downstream location—creating at first the familiar rusty stain. During this process, the ferric hydroxide ages and partially dehydrates to form a hydrous ferric oxide:

$$Fe(OH)_3 \rightarrow FeO(OH) + H_2O$$

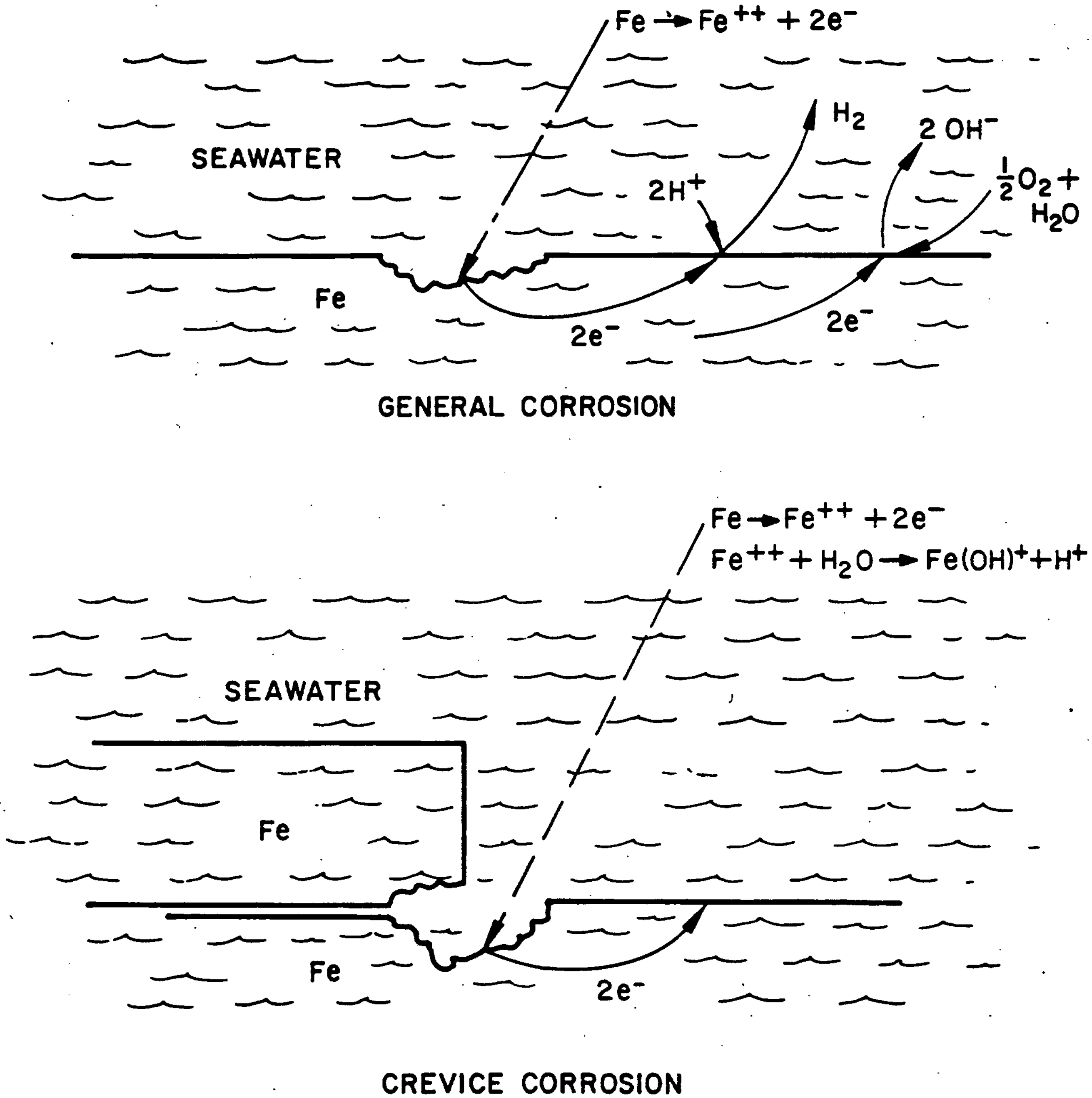

Figure F-5. Corrosion Processes

Ordinary rust is the result of further aging and dehydration, to produce ferric oxide:

$$2\,FeO(OH) \rightarrow Fe_2O_3 + H_2O$$

As the corrosion process continues, the corrosion products (iron hydroxides and oxides) accumulate and tend to interfere with the diffusion of hydrogen away from the local corrosion site and of oxygen to the local corrosion site. The result is that the part of the local corrosion site closest to the surface of the corroding metal acts as a protective barrier and tends to slow the corrosion process. Also, the lack of sufficient oxygen prevents the ready oxidation of the ferrous ions. In this environment of limited oxygen, a mixture of ferrous ions and ferric ions exists and tends to react with the local concentration of hydroxyl ions to form the black corrosion product, magnetite:

$$Fe^{++} + 2\,Fe^{+3} + 8(OH)^- \rightarrow Fe_3O_4 + 4\,H_2O$$

On low alloy steels exposed to seawater, the usual rusty-colored corrosion product was found to have such a layer of black material under it.

By the actions of these processes, the corrosion processes proceed, with relative rapidity on bare metals at first, but slowing down as the accumulation of corrosion products on the surface of the metal slows the diffusion of reactants to the local corrosion region and the diffusion of the soluble portion of the reaction products from the local corrosion region. The soluble portions that are able to diffuse away are a small fraction of the total, but they are "released" to the environment in this way. In addition, some of the insoluble portions of the corrosion products are also released if they are not bound tightly to the surface.

In this regard, there is a large difference between low alloy steels and corrosion resistant alloys. The corrosion products of corrosion resistant alloys are naturally bound to the alloy surface very strongly—thus providing the necessary diffusion barrier to make the alloy corrosion resistant. On low alloy steels, the corrosion products are less strongly bound and are less protective. Hence, the low alloy steels corrode faster than the corrosion resistant alloys and tend to release more of their solid corrosion products because they are not strongly bound together. Ultimately, either type of alloy achieves a dynamic steady state where corrosion products are being released at the same rate that new ones are being formed at the metal surface. After this point, the amount of retained corrosion products tends to remain constant, providing a constant resistance to further corrosion, and limiting the corrosion rate of the metal to its lowest and constant long-term rate.

Corrosion products are released in two ways by these processes. A small fraction is released directly as a result of the corrosion process. This fraction consists of the soluble portion of the corrosion products that diffuses through the existing layer of corrosion and escapes to the surrounding seawater. Some small particles (diameter less than approximately 0.45 μm, for example) escape at the same time and are considered to be released directly. The results of laboratory seawater corrosion testing showed that not more than five percent of the corrosion products formed from corrosion resistant alloys during the first year were released directly and could be considered to be readily transportable.

The larger fraction is released later on, after residing with the adherent corrosion products for a while, when the old corrosion products are displaced by new ones and the old ones are lost by mechanical processes associated with the development of stresses built up in the corrosion products as they get thicker. These corrosion products are released as large particles or flakes that tend to fall to the surface below. In the ocean, this would typically be to the sediment at the ocean bottom. Eventually, even this material would be slowly dissolved and would diffuse away and be released to water in the environment, but it would take thousands of years.

The external processes whereby corrosion products are released to the environment are illustrated in Figure F-6. Overall, the mass of metal (M) is reduced by its corrosion rate (C) to produce corrosion products that form an adherent scale (S) or film, and subsequently form a local residue (R) of undistributed corrosion products. A fraction (r) of the corrosion products formed is released directly into the environment (E). The scale formed is released gradually (αS) to form the local residue, and the local residue is transported gradually (βR) by various mechanisms into the surrounding environment (E). The corrosion model is discussed further in sections below.

In addition to general corrosion, where the metal surface and its corrosion products are freely exposed to the seawater, there are seven other corrosion processes that are significant:

1. Crevice Corrosion

When two surfaces of the same kind of structural alloy are in close proximity, as in a bolted joint, for example, the narrow gap between them creates a unique corrosion situation. Dissolved oxygen can diffuse to the exposed region outside the crevice, where it reacts to form hydroxyl ions (OH^-). Inside the crevice, iron corrodes and goes into solution as ferrous ions (Fe^{++}). Since diffusion of ferrous ions out of the crevice and hydroxyl ions into the crevice is slow, acidic conditions can be created by hydrolysis according to the equation:

$$Fe^{++} + H_2O \rightarrow H^+ + Fe(OH)^+$$

These conditions are illustrated in Figure F-5. In addition, chloride ions (Cl^-) can migrate into the crevice to balance the charge of the positively charged ions (Fe^{++}, $Fe(OH)^+$ and H^+). Higher chloride concentrations can also contribute to corrosive conditions. This effect was quite evident in the specimens from the ocean corrosion experiment, where the low alloy steel couples exhibited the grooving effect of crevice corrosion around the boundary of the crevice region associated with the strip bolted to the plate. A similar effect was found in specimens of low alloy steel that were bolted to the nylon support; there was a groove around the boundary. The crevice formed between the steel specimen and the essentially-inert nylon. Specimens of corrosion resistant alloys also exhibited crevice corrosion effects, which were typically deeper than those in the low alloy steel couples.

2. Galvanic Corrosion

When two different metals are in contact with each other and immersed in seawater, a galvanic cell is formed. By their nature, one of the metals will be more "noble" than the other one and it will corrode <u>less</u> than it would by itself, possibly not at all. The more "active" metal in the cell will corrode <u>more</u> than it would by itself. This was demonstrated in an ocean corrosion experiment, where plates of A302B low alloy steel were coupled with smaller strips of CRES 304. The average amount of corrosion of the more noble CRES 304 was reduced by a factor of 47 (range: 5 to 1200). The average amount of corrosion of the more active A302B was not increased significantly (range: 0.11 to 1.5) because its surface area was greater by a factor of approximately four. The larger area reduces the electrical current density (amperes per square meter) and reduces the intensity of the corrosion damage to the larger surface. Conversely, if a <u>smaller</u> piece of low alloy steel were coupled to a large piece of corrosion resistant alloy, the low alloy steel would be corroded at a large rate for two reasons:

a. Low alloy steel is more active than corrosion resistant alloys by approximately one-half volt. This is almost as great as the potential difference between zinc and low alloy steels, and zinc is used as a sacrificial anode to protect steels against excessive corrosion.

b. The smaller area would increase the current density and would increase the intensity of the corrosion damage.

Because of this effect, fasteners exposed to a corrosive environment are usually made of a material that is more noble than the materials being fastened.

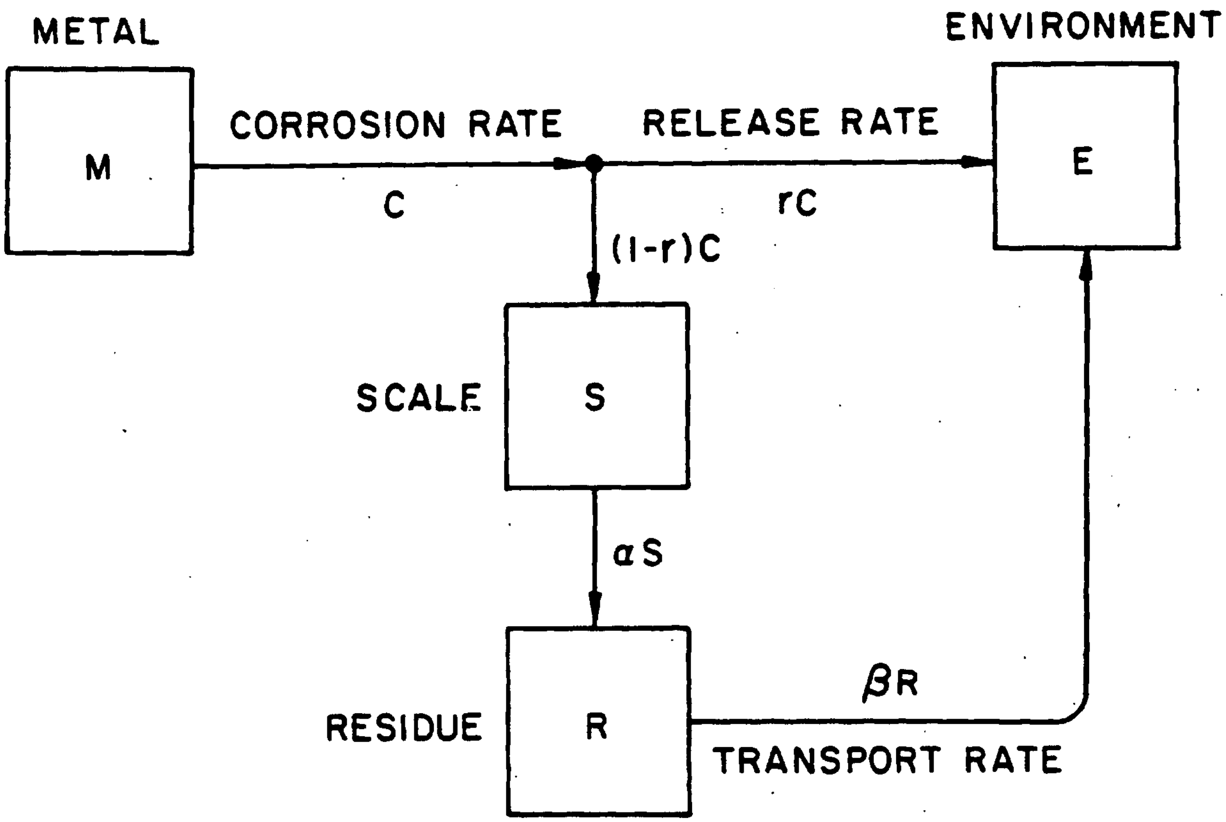

Figure F-6. Corrosion Release Model

Where two materials of the same size and thickness but of galvanically different metals have been welded together and exposed to seawater, the exposed areas of the two metals are essentially the same, but galvanic corrosion would occur. Normally, the more-active metal would be expected to corrode through at an earlier time, but when the more-noble metal is a corrosion resistant alloy, pitting usually occurs and may cause earlier penetration because the pitting corrosion effect is aggressive and localized. The term "pitting" is used here in the broad sense of localized penetration, as discussed below in Section IV.A.3.

If low alloy steel and corrosion resistant alloy were welded and exposed to seawater, galvanic effects would cause the low alloy steel in the vicinity of the bimetallic weld to corrode at an accelerated rate. Correspondingly, the corrosion resistant alloy in the vicinity of the bimetallic weld would corrode at a diminished rate. Away from the weld, the two metals would corrode locally at nearly their normal (non-galvanic) rates, as though they were not connected. This difference in nearby corrosion rates is caused by the different resistance to the flow of the galvanic current at different distances from the weld. The bulk of the current and the bulk of the corresponding corrosion effects are localized near the weld. At remote distances, the galvanic current and the corresponding galvanic effects are reduced, and the normal corrosion phenomena prevail.

For the environmental assessment, it was estimated that the containment represented by such a region would be penetrated earliest by the pitting action of seawater on the corrosion resistant alloy remote from the weld rather than by galvanic corrosion of the low alloy steel near the bimetallic weld. The basis for this is that the pitting rate in the corrosion resistant alloy away from the weld was calculated from corrosion data to be faster than the galvanically-enhanced corrosion rate in the low alloy steel near the weld. The calculations given below indicate that exposure of at least one hundred years would be required for either of these penetrations to occur.

The penetration rates for the low alloy steel that is remote from the weld and for the corrosion resistant alloy that is near the weld would be less than either of the two rates cited above. The low rate for the remote low alloy steel is due to it being relatively distant from the site of the galvanic acceleration, and the low rate for the corrosion resistant alloy near the weld is due to it being galvanically protected.

For the environmental assessment, the depth of pitting in corrosion resistant alloys after the first year was expressed as

$$D = 46\,(2.2 + 0.3\,(t - 1))$$

where D is the depth in mils and t is the time in years. The factor of 46 is the average pitting factor from the literature study (Section III.D.1). A typical value for the maximum pitting factor in corrosion resistant alloys is approximately 200, more than a factor of four larger than the average pitting factor of 46. The other values are the averages based on weight-change data obtained from the literature (Table F-1).

The depth of galvanic corrosion in low alloy steel was expressed as

$$D_1 = 2.4\,(8 + 2.5\,(t - 1))$$

where D_1 is the depth in mils. The factor of 2.4 is the average galvanic corrosion factor for low alloy steel from data in Reference F.8. A typical value for the maximum galvanic corrosion factor for low alloy steel is approximately 10, more than a factor of four larger than the average galvanic corrosion factor of 2.4. The other values are from Table F-1.

Comparing the two equations, the depth of pitting in the corrosion resistant alloy (D) is always greater than the depth of galvanic corrosion in low alloy steel (D_1) by a factor of at least 2.3; pitting would penetrate faster than galvanic corrosion by at least this factor. For example, a one-inch thickness of corrosion resistant alloy would be penetrated by pitting in seawater in approximately 66 years, but an equal thickness of low alloy steel would require approximately 160 years to be penetrated by galvanic corrosion.

To predict that the low alloy steel would be penetrated by galvanic corrosion sooner than pitting would penetrate an equal thickness of an equal area of corrosion resistant alloy, the amount of corrosion in the low alloy steel near the bimetallic weld would have to be predicted to exceed the amount of pitting corrosion in corrosion resistant alloy given by the expression above for the depth (D) as a function of time. Thus, at one year the predicted amount of such corrosion in low alloy steel would have to exceed 101 mils; two years, 115 mils; three years, 129 mils; etc., increasing by almost 14 mils each year. Observed penetrations have not been as large as these values.

These values were obtained from the average values used in the environmental assessment to calculate the best estimates of the effects of such corrosion. For assessments of worst-case conditions, it was assumed that all containment barriers failed instantly at the time of disposal. Since this assumption is more conservative in terms of earlier penetration of containment than any realistic estimates of maximum pitting and galvanic corrosion rates, the actual maximum rates from the literature were not used for environmental assessment.

3. Pitting Corrosion

Corrosion resistant alloys corrode in seawater and in soils and lose weight primarily by concentration-cell corrosion and by under-deposit corrosion. For simplicity in discussion and in estimating penetration rates in corrosion resistant alloys, data from these types of corrosion and simple pitting corrosion were combined under the common term of pitting. Pitting in the combined sense is used to refer to corrosion which is localized in one or more spots over the affected surface. In some cases, the local corrosion will be aggravated by an electrochemical cell caused by a difference in concentration of a reactant in the corrosion process: concentration-cell corrosion. In other cases, a deposit of some material (living or not) on the surface will enable crevice corrosion to occur where the structure itself has no crevice: under-deposit corrosion. In simple pitting, the natural surface of the material is such that it tends to corrode in local spots distributed over the affected surface rather than corrode uniformly. Since all of these represent corrosion situations where the rate of penetration significantly exceeds the average rate based on weight change alone, the common term of pitting is applied to them all even though corrosion specialists distinguish among them.

Although there is some general corrosion, it is typically quite low, for the film of corrosion products is quite adherent and quite resistant to corrosion attack. Pits begin by a failure of the film at a defect in the film. At the pit, the exposed metal surface is more active than the surrounding protected surfaces, so an electrolytic cell is established (similar to the galvanic cell described above) with a smaller area for the active surface. As in the galvanic cell, a small-area active surface is attacked rapidly. In corrosion resistant alloys, the cell potential is approximately one-half volt.

Pitting in seawater is aggravated by the chemical nature of the corrosion products. With the available chloride ions from the seawater, the confining geometry of a pit allows ferrous and ferric chloride to accumulate and aggravate the local corrosion process and cause more rapid penetration. These solutions may become quite acidic (pH of approximately 1.0) and are effective in attacking the corrosion resistant film and causing additional pitting or an elongated pit where the higher-density solution is exuded by the pit onto an adjacent surface where attack continues in the downward direction.

There are two main aspects of pitting that are modeled for computational purposes. Both are simple, conservative estimates of complicated situations. First, the time is estimated when pitting would penetrate the barrier wall; then, the time is estimated when pitting would progress so far that the barrier is no longer significant to retard outward diffusion or hydraulic transport of radioactivity in comparison with other restrictions that are connected with it in series. The latter would occur, for example, when a pipewall would be penetrated by pitting corrosion to such an extent that the total open area due to pitting exceeded the cross-sectional area of the pipe.

In this assessment, the average penetration time is estimated as described below; the maximum case is based on instant penetration rather than maximum pitting rates because pitting is not the maximum means for penetration, compared to mechanical failure, for example. At the time of penetration, consistent with the 20-pit average, the wall thickness (Θ) is equal to the product of the pitting ratio (P) and the amount of corrosion (A) equivalent to the weight loss per unit surface and,

$$\Theta = P \cdot A$$

After the first few years,

$$A = a + bt_l$$

where t_1 is the average time when penetration would occur. From these,

$$t_1 = \frac{(\Theta/P) - a}{b}$$

For example, if

$\Theta = 1.125$ inches

$P = 46$

$a = 0.0019$ inch

$b = 0.0003$ inch/year

then, $t_1 = 75$ years.

After penetration would occur, pitting would continue and the barrier would become more and more penetrated by increasing pitting. If all of the pitting attack were effective in penetrating the wall, although some of it is not, the volume of corroded metal (V) would be equal to the product of the open flow area (F) and the wall thickness (Θ),

$$V = F \cdot \Theta$$

The volume of corroded metal (V) is also equal to the product of the surface area (S) and the amount of corrosion (A) equivalent to the weight loss per unit surface area,

$$V = S \cdot A$$

From these two,

$$\frac{F}{S} = \frac{A}{\Theta} = \frac{a + bt}{\Theta}$$

where t is the time since exposure to seawater began. This indicates that the relative amount of open area (F/S) would increase linearly with time. If the open flow area (F) has a restricted flow area (F') in series with it, the flow rate would be limited by F' even after F became larger than F'. The time when the amount of open area would equal the value (F') would be

$$t_2 = \frac{\Theta(F'/S) - a}{b}$$

For example if

$\Theta = 1.125$ inches

$F' = 5$ square feet

$S = 54$ square feet

$a = 0.0019$ inch

$b = 0.0003$ inch/year

then $t_2 = 340$ years.

Extrapolation to values of (F/S) approaching unity may not provide realistic estimates of the time because of the simplifying assumptions used to construct the model in contrast to the complicated situation that would exist with extremely extensive pitting, but the results are considered to be conservative because the calculated times would be less than the actual times when the actual amount of remaining metal is grossly less than the initial amount.

4. Sediment Corrosion

Although the preliminary ocean corrosion experiments disclosed no significant difference between specimens exposed to water only and specimens exposed to the sediment on the bottom, other experiments reported in the literature indicate that aggravated corrosion can occur in metals exposed to ocean-bottom sediments. In some cases the aggravated-corrosion effect is due to a differential-oxygen cell, where part of the metal is immersed in the sediment and part of it is exposed to the water above. In other cases the aggravated-corrosion effect is related to hydrogen sulfide produced by microorganisms that can thrive in anaerobic conditions and produce hydrogen sulfide by reducing naturally-occurring sulfate ions. If the sediment were aerated by adequate diffusion from the water above or by bioturbation, anaerobic conditions would be precluded and hydrogen sulfide could not be produced. Furthermore, if the oxygen concentration in the pore water was nearly zero and the metal was uniformly exposed to it, corrosion would be retarded by the low oxygen concentration.

A differential-oxygen cell could exist if the oxygen concentration in the pore water of the sediment were different from (typically, less than) that in the water above. Such a difference might occur if oxygen dissolved in the pore water was being consumed by corrosion or biological processes in the sediment. Metal exposed to such different oxygen concentrations would suffer aggravated corrosion in the region of lower oxygen concentration, especially in that part of the region closer to the sediment-water interface; the more remote parts of the region would be somewhat less corroded because they would be exposed to somewhat more uniform conditions. In many respects, this type of corrosion is similar to crevice corrosion, as described above, where the greatest damage is done in the vicinity of the interface between the free-water region and the confines of the crevice region, and much of the damage is attributable to the electrochemical cell created by the two different concentrations of dissolved oxygen acting on the same metal.

This is important to this environmental impact statement in the case of the estimate of how long the external containment (the reactor compartment) could resist penetration by corrosion. Since the containment boundary consists of different thicknesses of low alloy steel exposed to environments with possibly different corrosion rates (water or sediment), the penetration time for each one was estimated to identify the one which would be penetrated soonest. The bulkhead would be expected to be penetrated by seawater corrosion before the hull would be penetrated by aggravated sediment corrosion because the hull is so much thicker than the bulkhead that it could resist aggravated sediment corrosion for a longer time than the bulkhead could resist seawater corrosion.

The most important organisms affecting corrosion in seawater are the sulfate-reducing bacteria. Where anaerobic conditions can exist, such as under thick corrosion products on low alloy steels or in sediments that contain decomposing organic material, the presence of such organisms may be sufficient to support a corrosion rate of 4 mils per year. In "Marine Corrosion" (Reference F.16), LaQue states, "The steel specimens on which a high population of sulfate reducing bacteria were present were found to be corroding at what must be considered to be a normal rate of corrosion of steel in quiet seawater — about 25 mg/(dm^2)(day) or 0.004 in./year." In such a case, the organisms appear to act in lieu of the oxygen to support the cathode reaction and may even consume hydrogen formed at the cathodes to permit the corrosion processes to occur at near-normal rates. These organisms participate in the cathodic reaction by enabling the reduction of normally-occurring sulfate ions to the sulfide form to accommodate the electrons provided by the anodic reaction, where metallic iron becomes ferrous ions.

Sulfide ions (more frequently, H_2S or HS^- ions) are produced by the sulfate-reducing bacteria, and, in the presence of sufficient ferrous ions, iron disulfide forms and precipitates, according to the reaction

$$Fe^{++} + 2H_2S \rightarrow FeS_2 + 4H^+ + 2e^-$$

This reaction produces the characteristic sulfide forms of the various corrosion products that develop in the presence of the sulfate-reducing bacteria.

If the sulfide environment were somehow removed, the precipitated iron disulfide would subsequently dissolve, but the concentration of soluble iron ions would be limited by the precipitation of ferrous hydroxide, and if sufficient oxygen were to become available the ferrous iron would be oxidized and would be precipitated, as described at the beginning of this section. The precipitation of iron (and other corrosion products) as the sulfide or hydroxide or oxide acts to retard the free release of such corrosion products and cause them to remain longer at or near the corrosion site rather than disperse freely in the environment.

5. Soil Corrosion

Corrosion of structural alloys in soil follows the same general principles as in seawater provided there is sufficient moisture present to allow ionization to occur. Test data published in the literature for exposures of 4 to 14 years are summarized in Reference F.7. Low alloy steels exhibit some pitting-type penetration rates of up to 25 mils per year (average: 14 mpy) and weight losses equivalent to as much as 1.1 mils per year. Corrosion resistant alloys are much less affected: pitting-type penetration rates range from "unaffected" in nine years to 4.3 mils per year (average: 1.3 mpy) and a weight loss in one case equivalent to 0.00017 mil per year. These values are approximately equivalent to the corresponding values for seawater exposure, and are tabulated above in Table F-3. On this basis, the values for seawater corrosion, listed in Table F-3, were also applied to assessments of corrosion and corrosion release in the land burial scenarios.

6. Stress Corrosion Cracking

Susceptible alloys that have a surface in tension that is exposed to certain corrosive agents can fail prematurely due to the formation and growth of characteristic cracks. Many corrosion resistant alloys such as stainless steel are susceptible to stress corrosion cracking (SCC) when exposed to seawater, tensile stress, and elevated temperatures. Austenitic stainless steels seldom exhibit SCC in seawater below approximately 50°C, as reported in Reference F.17. Low alloy steels stress-relieved above approximately 1100°F are not susceptible to SCC in seawater. It is expected that SCC would not be a failure mode for the containment boundary because the low alloy steel forming the reactor compartment is not a susceptible alloy.

7. Corrosion Release

To establish characteristic rates for environment assessments, a corrosion model correlating corrosion data with time was used. The amount of corrosion was plotted as a function of time and characteristic growth patterns were observed. Typically, there is a general increase in the amount of corrosion as time progresses, as shown on Figure F-7. During the first few years, the typical corrosion curve is steeper and the corrosion rate is larger than it is later on, due to incomplete development of the corrosion film (or scale) which acts to

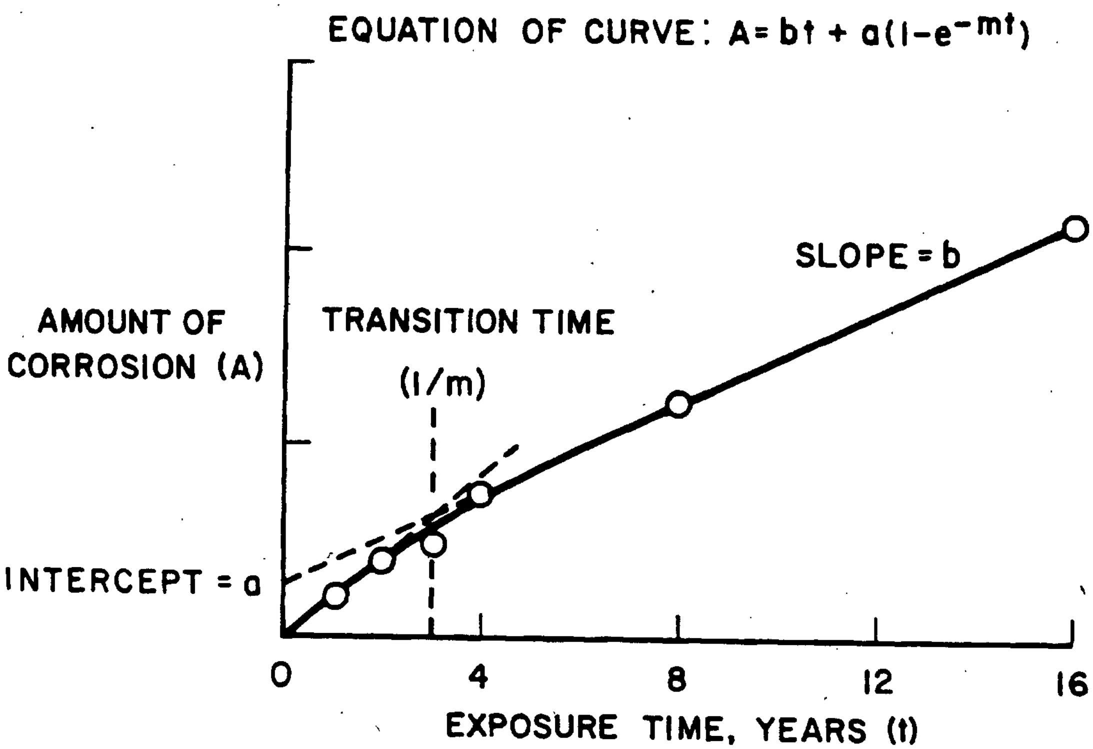

Figure F-7. Typical Time-Corrosion Curve

retard faster corrosion. After the film or scale achieves its steady state thickness, corrosion continues at the minimum rate and the corrosion curve continues upward with a constant slope. After the characteristic slopes were established from the data in the literature, the long-term rate (slope = b) was calculated from the slope. The time at which the two straight lines intersect is the mean lifetime for the development of the long-term slope, and leads to the equation,

$$A = bt + a(1 - e^{-mt})$$

where

A = the amount of corrosion at time, t

b = long-term rate of corrosion

a = intercept for line through the long-term data

m = reciprocal of time at intersection of two lines.

This equation is consistent with the kinetic model which assumes that the corrosion rate decreases with time at a rate that is directly proportional to the difference between the corrosion rate and its long-term constant value.

This model of the corrosion process was applied to the corrosion release model illustrated in Figure F-6 to explore the implications for the total release rate represented by the sum

$$\frac{dE}{dt} = rC + \alpha S$$

where

E = the amount of corrosion products released to the environment

C = corrosion rate

r = fraction of corrosion products released to the environment

S = the amount of corrosion products retained as scale

α = fractional rate at which corrosion products in the scale are released from the scale.

This sum represents the total release to the environment when the delay-effect of the residue is eliminated from consideration by setting βR equal to αS, as though the residue did not exist. This was assumed for simplicity and to conservatively maximize the calculated release rate.

The differential equation for the amount of scale,

$$\frac{dS}{dt} + \alpha S = (1 - r)\, C .$$

where the corrosion rate, $C = b + ame^{-mt}$. Integration provided

$$S = (1 - r)\left[\frac{b}{\alpha}(1 - e^{-\alpha t}) + \frac{am}{m - \alpha}\,(e^{-\alpha t} - e^{-mt})\right]$$

for the case where $\alpha \neq m$ and the initial value of S = 0. From this, the total release rate,

$$\frac{dE}{dt} = r\,(b + ame^{-mt}) + \alpha(1 - r)\left[\frac{b}{\alpha}(1 - e^{-\alpha t}) + \frac{am}{m - \alpha}\,(e^{-\alpha t} - e^{-mt})\right]$$

The data from the laboratory corrosion release testing were used to estimate values for the parameters r and α for corrosion resistant alloys. The results indicated that direct release (r) amounts to approximately 0.2 percent of the amount of corrosion and that the release rate from the scale (α) amounts to approximately one percent per year of the amount of scale present. At steady-state, the total release rate calculated by this equation would be equal to the parameter, b, the long-term corrosion rate. At earlier times, the total release rate would be calculated to be less than b. On this basis, it would be conservative to assume that the release rate is equal to the long-term corrosion rate. This is consistent with the results of the laboratory corrosion release testing described above and in Reference F.15.

The corrosion release model, illustrated in Figure F-6, includes provision for a residue that would exist where the corrosion scale would flake off and deposit particles on the surface below. This would be expected for low alloy steels, which rust more freely than corrosion resistant alloys do, but for the latter the residue would be expected to consist of very small particles of scale and precipitated corrosion products that might be small enough to be carried readily by the stream and might be transported a considerable distance before they would be deposited on the bottom sediment. An estimate of this effect indicated that particles with a diameter of 0.1 micron (typical of particles of fine clay, tobacco smoke, or atmospheric dust) could be transported for a distance of 200 miles in a stream moving at one centimeter per second before gravity would cause them to settle from an initial height of 10 meters. Similarly, particles as large as 10 microns would be transported a distance of approximately one mile. Since these estimates suggest that corrosion products might also be transported for a considerable distance from the corrosion site, the conservative assumption would be that all corrosion products are readily transported by ocean currents even though some of them would not travel such great distances, but would be found within the sediments in the local vicinity of the source.

B. CORROSION-RELATED ASPECTS OF THE OCEAN-BOTTOM ENVIRONMENT

Corrosion theory and experience indicate that the temperature and the oxygen concentration of the seawater are the prime variables that determine the corrosion rate of a particular structural alloy. Values for these two parameters are listed in Table F-4 for the sites where significant data were obtained. In general, the oxygen concentration is a few ppm and the temperature is a few degrees Celsius.

Data from the ocean corrosion experiments indicate that the corrosion of specimens exposed to the sediment on the bottom is approximately the same and typically less than it is for those exposed to water only. This indicates that the surface layer of the bottom sediment is well oxygenated, probably in equilibrium with the oxygenated water at the bottom. Oceanographic data indicate that anoxic conditions are found deeper into the sediment, beginning at approximately one meter or so.

Limited evidence indicates that there is little or no biofouling effect on corrosion in the ocean at depths below 1200-2100 meters. The corrosion and corrosion release rates used in this assessment make no explicit allowance for such effects, but the data from the ocean corrosion experiments and that selected from the literature would naturally reflect any effect of biofouling to the extent that it exists.

TABLE F-4. CHARACTERISTICS OF OCEAN-BOTTOM ENVIRONMENTS

Location	Oxygen Concentration	Temperature	Depth
Pacific Ocean Corrosion Experiment Site No. 1 (MPG-1)	5.3 ppm	1.6°C	5860 m
Pacific Ocean Corrosion Experiment Site No. 2 (W-N)	4.7	1.5	4245
Atlantic Ocean Corrosion Experiment Site No. 1 (Test Stand)	10.0	2.8	3000
Atlantic Ocean Corrosion Experiment Site No. 2 (W.H. Station 2)	10.0	2.8	3700
NCEL Exposure Site No. I-1	1.7	2.6	1615
NCEL Exposure Site No. I-2	1.9	2.3	1719
NCEL Exposure Site No. I-3	1.9	2.3	1719
NCEL Exposure Site No. I-4	2.3	2.2	2066
NCEL Exposure Site No. I-5	2.3	2.3	1798
NCEL Exposure Site No. II-1	0.6	5.0	713
NCEL Exposure Site No. II-2	0.6	5.0	722
NCEL Exposure Site No. V	8.2	12-19	1.5
NRL Test Site (Fort Amador)	6.2	16-32	4.3

Accelerated corrosion may occur with biofouling, and this has been allowed for in the assessment. A dead-water pocket may exist between certain organisms and the metallic surface, and the local metal surface may become anodic and corrode if anaerobic bacteria are prevalent because they may lower the pH of the water and cause pitting corrosion. Since the data from the literature and from the supplemental ocean corrosion testing include the effects of natural conditions such as biofouling, and since pitting corrosion rates are uniformly applied to the corrosion resistant alloys, which tend to pit, no further allowance needed to be made for the effects of biofouling on either low alloy steels or on corrosion resistant alloys. In addition, the data from the literature were interpreted conservatively in selecting maximum values and conservative average values for the corrosion rates of low alloy steels and corrosion resistant alloys, as listed in Table F-1.

On the basis of all of the available information, the corrosion and corrosion release rates used in these assessments are considered to be suitable for estimating the times when containment barriers would be penetrated and the rates at which radioactive material would be released to the environment.

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APPENDIX G

ESTIMATED RADIOACTIVE RELEASES FOLLOWING DISPOSAL AT SEA

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APPENDIX G

ESTIMATED RADIOACTIVE RELEASES FOLLOWING DISPOSAL AT SEA

I. INTRODUCTION

This appendix describes the methods used to estimate the rates at which radioactive material might be released from defueled and decommissioned nuclear submarines should the ocean disposal alternative be selected.

During the operation of a nuclear submarine, radioactive nuclides are created within the metal matrix of components exposed to neutrons from the reactor core. These components include the structural supports for the core (inside the reactor pressure vessel), the reactor pressure vessel and, to a much smaller extent, the metal structures outside the reactor pressure vessel (see Figure G-1). If a decommissioned submarine were placed on the ocean floor, the radionuclides would become available for release to the environment only as the metal components corrode and their containment is penetrated.

Two conditions of containment are evaluated in this appendix. The first case considers three levels of containment which are the metal matrix, the reactor vessel, and the reactor compartment. In this case the radioactive corrosion products in the reactor vessel could not be released to the environment until both the reactor vessel containment and the reactor compartment were penetrated by corrosion. This condition corresponds to the expected condition of the submarines after emplacement and is referred to as expected containment. The second case examines the release rates where the metal matrix represents the only containment. In this case all metal surfaces are assumed to be exposed directly to the ocean waters immediately upon disposal and the radioactive corrosion products are available for transport by the ocean as the corrosion occurs. This case is called minimum containment and conservatively models the results of accidents in transit to the disposal site or a mishap during disposal at the disposal location.

In the expected containment condition two sets of assumptions were considered. The first set of assumptions is the "best estimate" and was established to provide a conservative yet reasonably realistic release rate to the environment. The second set of assumptions is very conservative and was designed to provide a significant overestimate of the release rate to the environment. The very conservative release rates are used to evaluate the effects on the environment with release rates significantly larger than realistically expected.

The corrosion rates used in estimating the release rates are taken from Appendix F and the initial inventories of radioactive nuclides are those given in Table 1-1 (Chapter 1). The calculations assumed that the submarines would be placed on the ocean bottom six months after their final reactor operations, which is a shorter time than expected to be required for completion of shipyard preparations. The shorter time tends to maximize the release since it minimizes radioactive decay before disposal.

The release rates calculated by the equations described in this appendix are used as the source of radioactivity in the transport calculations (Appendix H) that examine physical ocean transport and biological transport.

Section II below describes the approach used to evaluate the release rates, Section III summarizes the results of the evaluation, and Section IV provides the equations used to perform the calculations.

II. DESCRIPTION OF THE RELEASE MECHANISMS

A. EXPECTED CONTAINMENT

1. General

Tests have demonstrated (Appendix D) that decommissioned nuclear submarines would remain intact when emplaced on the deep ocean bottom. With the submarine intact, three levels of containment would exist for most of the radioactive material. The containment barriers are the metal matrix, the reactor pressure vessel and associated piping, and the reactor compartment (shown schematically in Figure G-1). The effectiveness of each barrier is illustrated by examining where the radioactive material is located relative to the barriers. A summary of the distribution of the radioactive material (six months after final reactor shutdown) is given in Table G-1. From this table it can be seen that approximately 97.8 percent of the total activity would be located within the structural components inside the reactor pressure vessel and another 0.1 percent would be inside the reactor vessel and plant piping in the form of an adherent corrosion product film containing some radioactive particles called "crud*." Another 1.8 percent of the radioactivity would be in the metal structure of the very thick reactor pressure vessel wall. Essentially 0.3 percent of the activity is part of the metal which makes up the structural components outside the pressure vessel but inside the reactor compartment volume defined by the compartment bulkheads and hull. A minute fraction of the radioactive inventory (0.00006 percent) is contained within the metals of the compartment bulkheads and hull. This radioactive material is treated as being uniformly distributed in the metals of the submarine hull and reactor compartment bulkheads and is assumed to be released to the environment as these metals corrode. Hence, the initial release of an extremely small amount of radioactivity to the environment is calculated to begin when the corrosion of the hull begins.

TABLE G-1. DISTRIBUTION OF RADIOACTIVE MATERIAL SIX MONTHS AFTER LAST REACTOR OPERATIONS

	Percent of Total Curies
Structural Components (corrosion resistant alloys) inside the reactor vessel.	97.8
Crud—corrosion products from reactor operation. Present as a film on surfaces inside reactor vessel and piping of the plant.	0.1
Reactor Pressure Vessel Wall	1.8
Structural Components outside the reactor vessel and inside the reactor compartment.	0.3
Compartment Bulkheads and Hull	0.00006

The basic factors that affect the release rates of radioactive material from the containment are the corrosion rates, the radioactive decay, and the corrosion product transport and settling. The discussion below describes how each of these factors is handled for the "best estimate" and the "conservative estimate" (unrealistically high) conditions.

2. Expected Containment—Best Estimate

a. Corrosion Rates

The corrosion rates are the average rates taken from Table F-1 of Appendix F. The corrosion rates are highest in the first year and thereafter they are constant with time. The appropriate corrosion rates are applied to individual components and each component is assigned its thickness. Corrosion is assumed to continue on each individual component until that component is completely consumed.

*Crud is used here to denote the corrosion product film on the internal reactor vessel and piping surfaces left from reactor operations and the activation products trapped within this film. The adherent corrosion film is indistinguishable from any other corrosion on these materials and behaves in the same manner.

SCHEMATIC OF NUCLEAR PROPULSION PLANT

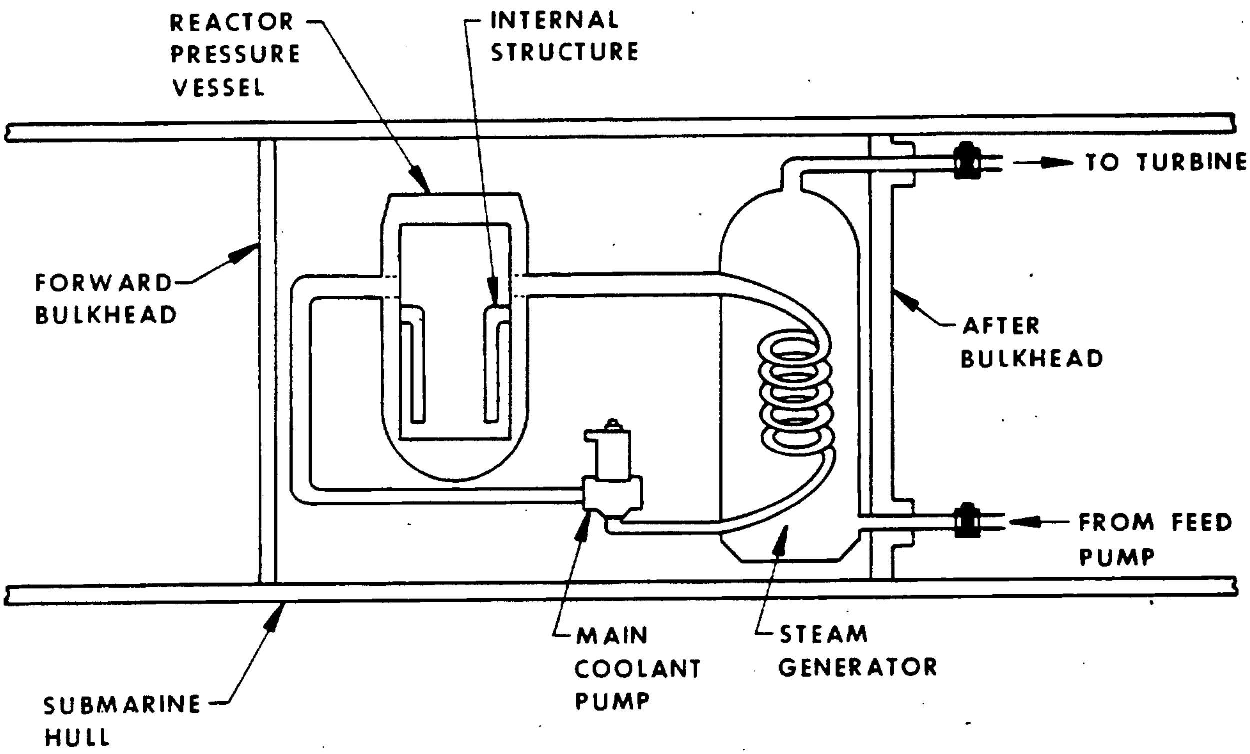

Figure G-1. Submarine Reactor Compartment

The corrosion rates of individual components are also used to establish the times when penetration of the containment barriers could occur. Examples of the individual components that are analyzed in this manner are the reactor compartment bulkheads, the reactor vessel, reactor plant piping, and the various core support structures in the reactor vessel (see Figure G-1).

The low alloy components are assumed to corrode uniformly over their surface. However, the components made of corrosion resistant alloys, such as stainless steel, corrode at localized points in a manner that causes pitting. Therefore, a pitting acceleration factor was applied to the corrosion rates of these alloys to account for localized holes through those components. These holes are then assumed to be a pathway through which radioactive corrosion products might move well before general surface corrosion would penetrate the containment.

Based on the corrosion rates of individual components, it was determined that on the average the inlet and outlet piping to the reactor vessel would pit through in approximately 75 years and the reactor compartment bulkhead would be penetrated in approximately 100 years. General surface penetration of the reactor vessel would not occur until approximately 1300 years; however, it was assumed that a flow through the reactor vessel would be established approximately 400 years after disposal, as discussed in Section II.A.2.b below.

b. **Transport and Settling of Corrosion Products**

As the metal corrodes, some of the corrosion products will be soluble, some will be very small particles that are easily transportable, some will be large particles that will settle to the bottom of the reactor vessel or reactor compartment, and some material will form a solid oxide film attached to the metal. However in the release rate calculations, it was assumed that all corrosion products were released from the metal in a soluble form or as very small particles that are transportable. Based on the expected corrosion particle size distribution, the settling time half-life is 40 days. This settling is assumed to continue until a flow is established in the reactor vessel by the effects of the ocean current passing through openings corroded in the reactor piping. At that time, resuspension in the reactor vessel would become dominant and settling is assumed to be discontinued. In the release calculations outside the reactor vessel, all corrosion products are considered to be transportable and no credit is taken for settling.

In approximately the year 100 the reactor compartment bulkheads could be penetrated, and it is assumed that all transportable material in the reactor compartment would be released to the environment during the first year following penetration. In the following years all transportable corrosion products in the reactor compartment are considered to be released to the environment as they become available.

Between the time pitting holes first occur in the piping leading to the reactor vessel (year 75) and the time a current is established through the reactor vessel (about 400 years), the transport of material out of the reactor vessel into the reactor compartment is accounted for by a diffusion-type process. Because of the small size of the pitting penetrations and the large size of the vessel, a current through the vessel is not possible through the pits. In fact, a substantial current through the reactor vessel would not be expected until general surface penetration of the reactor vessel occurs about 1300 years following disposal. However, to be conservative, a substantial current through the reactor vessel was assumed to begin in approximately 400 years. When the current is initiated through the reactor vessel, all transportable material in the reactor vessel is assumed to be released to the environment. In the following years, the newly-formed transportable material in the reactor vessel is assumed to be released to the environment as it becomes available.

c. Decay

As discussed in Section II.A.2.a, the corrosion process is evaluated for individual components. Hence by knowing the concentration of the radionuclide in individual components, it is possible to calculate the release rate for each isotope. This tracking of isotopes makes it possible to accurately account for radioactive decay prior to release. The decay constants used in the calculation correspond to the half-lives presented in Chapter 1 (Table 1-1).

3. Expected Containment—Conservative Estimate

The release rates calculated with this scenario were used for the conservative dose estimates (unrealistically high). In this treatment the corrosion and decay are identical to that used in the best estimate of the expected containment. However the transport and settling of the corrosion products are significantly different. The treatment of these factors is discussed below.

As with the best estimate calculation, the conservative release rates assumed that all corrosion products would be released from the metal in a transportable form. However, in the very conservative approach, the settling time for the corrosion products was increased by a factor of approximately 30 which has the effect of significantly increasing the concentration of radioactive material suspended in the reactor vessel. Then the leakage coefficient between the reactor vessel and the reactor compartment (between years 75 and 100) was increased by a factor of 45. Both of these changes have the effect of significantly increasing the concentration of radioactive material in the reactor compartment at the time the reactor compartment is penetrated (approximately year 100).

At the time the reactor compartment would be penetrated (approximately year 100), a flow was assumed to occur through the reactor compartment and the reactor vessel. This flow rate has the effect of sweeping out the suspended radioactive material. The assumption of a flow rate through the reactor vessel in approximately the 100th year is particularly conservative since at that time the only penetration into the reactor vessel volume is the small pitting holes in the corrosion resistant alloy piping.

The effect of these very conservative assumptions is to maximize the amount of radioactive material suspended in the reactor compartment and the reactor vessel at the time the reactor compartment is penetrated. This amount of radioactive material is then released to the environment over a short period of time immediately after the bulkhead penetration has occurred. Since the dose to man is based on the maximum ocean water concentration (see Appendix H), this treatment maximizes the calculated dose.

B. MINIMUM CONTAINMENT—BEST ESTIMATE AND CONSERVATIVE ESTIMATE

The minimum containment condition assumes that the surfaces of all radioactive components will be exposed directly to the free ocean water as soon as the submarine reaches the ocean floor. In this case, the metal matrix would provide the only containment and the radioactive corrosion products would be available to the environment as the corrosion occurs. Because the containment provided by the reactor vessel and reactor compartment are not considered, transport and settling within the submarine are not considered and all corrosion products are released directly to the environment.

The basic factors in evaluating the radioactive material release rates are the corrosion rates and radioactive decay. In the minimum containment case, the only difference between the best estimate and the conservative estimate is the corrosion rates. The best estimate-minimum containment calculations used the highest average corrosion rates presented in Appendix F, Table F-1. The conservative estimate-minimum containment calculations used the maximum values presented in Appendix F, Table F-1. The corrosion rates are applied to individual components and each component is assigned its individual thickness. Corrosion of each component is assumed to continue until it would be completely consumed. By knowing the radionuclide content of each component, it is possible to calculate the independent release rate for each isotope. This tracking process also allows the radioactive nuclide concentration to be adjusted for radioactive decay.

All radioactivity is assumed to be released in a transportable form directly to the environment. The crud is assumed to be uniformly released to the environment during the first year after disposal and corrosion products are assumed to be released to the environment as the corrosion occurs. The transport and settling characteristics of the corrosion products once in the ocean waters are discussed in Appendix H.

III. SUMMARY OF RESULTS

A. EXPECTED CONTAINMENT

1. Best Estimate

The best estimate of the release rates to the environment are summarized in Figure G-2 for the disposal of 100 submarines with expected containment. It is assumed that the 100 submarines would be disposed of at a rate of three per year. Most of the radioactivity released is Nickel-63 and Nickel-59 because the other nuclides originally present in larger quantities would have decayed to small quantities before the containment would be penetrated. An appreciation for the relative release rates of the 16 radioactive nuclides is found in Table G-2 which lists by nuclide the maximum annual release to the environment from all 100 submarines. For information, the year of the maximum release of each nuclide is identified. From this table it is seen that with the exception of Nickel-63 and Nickel-59, the maximum annual release rates of all other nuclides combined is less than 0.1 curie per year.

It is informative to compare the release to the environment shown in Figure G-2 to the ocean disposal release of 10^7 curies/year for mixed beta and gamma emitters permitted by the IAEA (INFCIRC/205/Add.1/Rev. 1, August 1978). The maximum annual release from the disposal of 100 submarines would be only 0.0004 percent of the release permitted by the IAEA. It should be pointed out that the IAEA assumed in the analysis supporting the development of the limit that all material dumped is immediately released to the ocean, and that the dumping would continue at that rate for approximately 40,000 years. Even if one assumed that all of the radioactivity in the submarine were released immediately upon disposal, the disposal of three submarines per year would still be less than 2 percent of that rate permitted by the IAEA. These comparisons are not used in evaluating the environmental impact on the dose to man; however, they do provide a perspective on the magnitude of the releases.

For information, the release rates as a function of time are displayed for Nickel-63, Nickel-59, Carbon-14, Iron-55, Cobalt-60, and Niobium-94 in Tables G-3 through G-8.

2. Conservative Estimate (Unrealistically High)

The release rates to the environment obtained using the conservative assumptions are summarized in Figure G-3 for the disposal of 100 submarines. It is assumed that the 100 submarines would be disposed of at a rate of three per year. Most of the radioactivity released is Nickel-63 and Nickel-59 because the other nuclides originally present in large quantities would have decayed to small quantities before the containment would be penetrated. The relative release rates of the various nuclides are found in Table G-9 that presents the maximum annual release for each nuclide.

Comparing the maximum annual release rates from Table G-9 to the IAEA limits shows that even with the unrealistically high estimate of the release, it is only 0.008 percent of the release rate allowed by the IAEA.

For information, the annual release rates as a function of time are displayed for Nickel-63, Nickel-59, Carbon-14, Iron-55, Cobalt-60, and Niobium-94 in Tables G-10 through G-15.

B. MINIMUM CONTAINMENT

1. Best Estimate

The best estimate release rates for the case of minimum containment are summarized in Figure G-4 for the one submarine accident condition. As seen in the figure, the highest release rate occurs in the first year. Most of the activity release in that year is due to Iron-55 and Cobalt-60. This can be seen in Table G-16 which displays the maximum annual release rate for each nuclide. The maximum annual release rate in the minimum containment case occurs in the first year primarily because all of the "crud" is assumed to be released to the environment during that year. This treatment is very conservative since it releases short-lived radioactive material directly and quickly to the environment. The extent of the conservatism can be seen by examining the monitoring data obtained in the vicinity of the THRESHER and the SCORPION which were lost at sea. Surveys conducted in the vicinity of these submarines (Annex to Appendix D) have shown no significant release of activity.

Comparing this maximum release rate to the IAEA limit shows that even the maximum accident would result in a release rate that is only 0.001 percent of the general limit established by the IAEA. For information, the release rates over time are displayed for Iron-55, Cobalt-60, Nickel-63, Cobalt-58, Manganese-54, and Zirconium-95 in Tables G-17 through G-22.

2. Conservative Estimate (Unrealistically High)

The release rates for the one submarine accident with minimum containment and conservative corrosion rates are summarized in Figure G-5 and Table G-23, which lists the maximum annual release for each nuclide. The behavior of these releases is essentially the same as the minimum containment best estimate presented above. The increased magnitude in the conservative case comes from the higher corrosion rates used, leading to higher releases by corrosion. Once again, the "crud" release of the first year dominates the early times after disposal. The nuclide specific release functions are provided for the individual nuclides Iron-55, Cobalt-60, Nickel-63, Cobalt-58, Manganese-54, and Zirconium-95 in Tables G-24 through G-29.

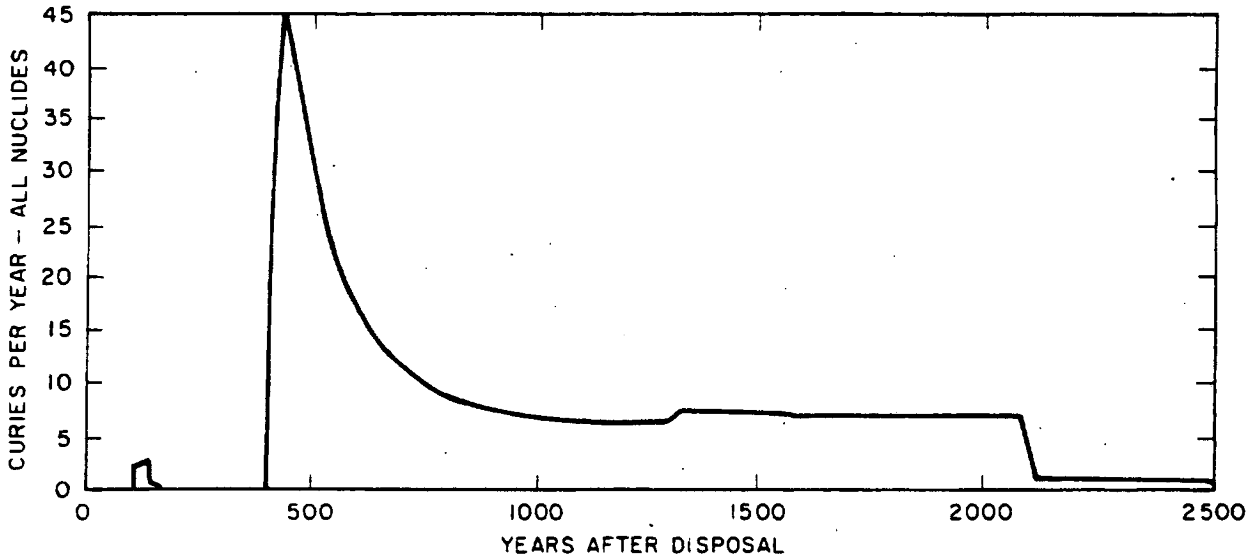

Figure G-2. Total Release to the Environment — 100 Submarines Disposed of at a Rate of 3 Per Year — Expected Containment — Best Estimate

TABLE G-2. MAXIMUM ANNUAL RELEASE EXPECTED CONTAINMENT—BEST ESTIMATE 100 SUBMARINES DISPOSED OF AT A RATE OF 3 PER YEAR

Nuclide	Approximate Time when Maximum Occurs (Year)	Maximum Release In Any One Year (Ci)
Ni-63	420	39.0
Ni-59	1300	7.0
C-14	1300	0.053
Nb-94	1300	0.0052
Fe-55	30	0.0041
Mo-93	130	0.0028
Co-60	30	0.0011
Tc-99	130	0.00083
Mn-54	30	4.0×10^{-5}
Co-58	30	2.4×10^{-6}
Fe-59	30	1.6×10^{-6}
Cr-51	30	9.2×10^{-7}
S-35	30	6.5×10^{-9}
Sc-46	30	7.5×10^{-10}
Zr-95	*	0.0
Hf-181	*	0.0

*Nuclide had fully decayed into a stable form before the containing barriers were penetrated.

TABLE G-3. NICKEL-63 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—BEST ESTIMATE 100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	2.3×10^{-5}	800	3.0
25	2.7×10^{-4}	920	1.1
95	2.7×10^{-4}	1025	0.54
98	2.1	1130	0.26
100	2.3	1250	0.11
130	1.1	1320	0.049
135	0.4	1400	0.021
150	0.1	1500	0.011
380	0.017	1615	5.2×10^{-3}
390	1.8	1725	2.5×10^{-3}
400	16.8	1835	1.1×10^{-3}
420	39.0	1945	5.0×10^{-4}
500	22	2290	4.0×10^{-6}
600	8.3	2610	4.0×10^{-7}
700	5.0	2855	4.0×10^{-8}

TABLE G-4. NICKEL-59 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—BEST ESTIMATE 100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	1.8×10^{-7}	392	0.56
20	2.0×10^{-6}	395	1.1
30	2.9×10^{-6}	400	2.2
96	2.9×10^{-6}	420	5.9
98	0.025	1250	5.8
120	0.030	1300	7.0
130	0.014	2080	5.5
132	5.8×10^{-3}	2100	2.3
145	2.7×10^{-3}	2110	1.0
155	8.7×10^{-4}	3100	0.50
385	8.7×10^{-4}	4650	0.21
390	0.21		

TABLE G-5. CARBON-14 RELEASE RATES vs. TIME AFTER DISPOSAL
EXPECTED CONTAINMENT—BEST ESTIMATE
100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	0.0	400	0.014
98	4.7×10^{-4}	420	0.046
120	5.8×10^{-4}	1300	0.053
132	1.5×10^{-4}	1500	0.023
385	1.5×10^{-4}	2500	0.011
390	1.8×10^{-3}	2525	5.9×10^{-3}
394	7.7×10^{-3}	5000	2.2×10^{-3}

TABLE G-6. IRON-55 RELEASE RATES vs. TIME AFTER DISPOSAL
EXPECTED CONTAINMENT—BEST ESTIMATE
100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	1.4×10^{-3}	50	4.0×10^{-5}
7	3.3×10^{-3}	60	2.9×10^{-6}
24	3.8×10^{-3}	70	2.4×10^{-7}
30	4.1×10^{-3}	98	4.3×10^{-9}
38	9.5×10^{-4}	130	1.5×10^{-9}

TABLE G-7. COBALT-60 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—BEST ESTIMATE

100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	2.2×10^{-4}	95	2.8×10^{-7}
7	6.8×10^{-4}	100	3.2×10^{-4}
24	1.0×10^{-3}	130	3.4×10^{-4}
30	1.1×10^{-3}	135	1.4×10^{-5}
40	3.9×10^{-4}	140	7.4×10^{-6}
50	1.2×10^{-4}	150	1.6×10^{-6}
60	2.9×10^{-5}	200	1.5×10^{-9}
70	8.4×10^{-6}		

TABLE G-8. NIOBIUM-94 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—BEST ESTIMATE

100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	0.0	395	8.2×10^{-4}
97	0.0	410	2.9×10^{-3}
98	4.2×10^{-5}	1300	5.2×10^{-3}
130	2.6×10^{-5}	1475	2.7×10^{-3}
132	1.3×10^{-5}	1500	1.8×10^{-3}
385	1.3×10^{-5}	2100	1.6×10^{-3}
390	1.7×10^{-4}	2500	7.3×10^{-4}
392	4.3×10^{-4}	4500	3.0×10^{-4}

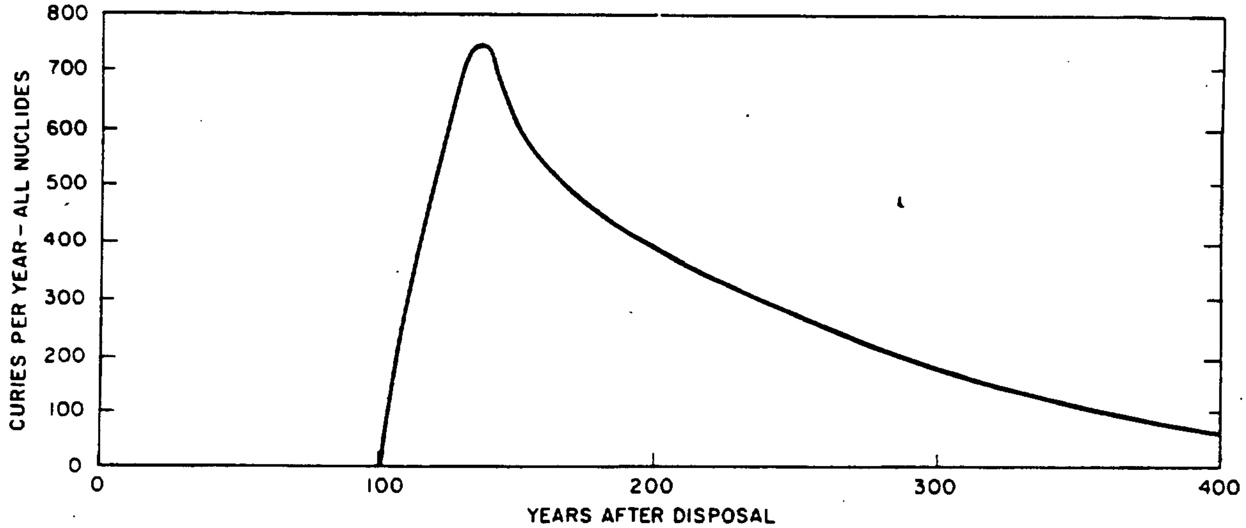

Figure G-3. Total Release to the Environment — 100 Submarines Disposed of at a Rate of 3 Per Year — Expected Containment — Conservative Estimate

TABLE G-9. MAXIMUM ANNUAL RELEASE EXPECTED CONTAINMENT — CONSERVATIVE ESTIMATE 100 SUBMARINES DISPOSED OF AT A RATE OF 3 PER YEAR

Nuclide	Approximate Time When Maximum Occurs (Year)	Maximum Release In Any One Year (Ci)
Ni-63	133	700
Ni-59	133	10.6
C-14	133	0.092
Nb-94	133	0.0082
Fe-55	30	0.0041
Mo-93	133	0.0032
Co-60	133	0.0017
Tc-99	133	0.00095
Mn-54	30	4.0×10^{-5}
Co-58	30	2.4×10^{-6}
Fe-59	30	1.6×10^{-6}
Cr-51	30	9.2×10^{-7}
S-35	30	6.5×10^{-9}
Sc-46	30	7.5×10^{-10}
Zr-95	*	0.0
Hf-181	*	0.0

*Nuclide had fully decayed into a stable form before the containing barriers were penetrated.

TABLE G-10. NICKEL-63 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE
100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	1.7×10^{-5}	133	700
32	3.4×10^{-4}	141	550
95	2.3×10^{-4}	200	320
100	65	320	100
102	130	620	10
104	170	800	2.6
106	210	1000	0.51
108	250	1300	0.059
112	340	1500	0.011
118	460	2000	2.7×10^{-4}
125	600		

TABLE G-11. NICKEL-59 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE
100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	1.1×10^{-7}	133	11.0
32	2.8×10^{-6}	550	5.9
95	2.7×10^{-6}	1320	5.8
100	0.80	2100	2.7
107	3.4	2115	0.28
115	6.0	2500	0.060

TABLE G-12. CARBON-14 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE
100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	0.0	133	0.092
99	0.0	144	0.071
100	8.8×10^{-3}	520	0.057
103	0.020	1315	0.044
110	0.040	1470	0.031
120	0.068	2100	0.010
		2500	9.5×10^{-3}

TABLE A-2. ESTIMATED COSTS FOR SEA DISPOSAL ALTERNATIVES

Condition	Configuration (2)	Disposal Costs (1) Capital	Recurring	Unit Disposal (3)
Flooded Free Fall (4)	A	$0.7 M	$1.0 M	$1.1 M
Buoyancy-Assisted Lowering	A	30.9	1.7	4.8
Glomar Explorer	B	3.0	4.2	4.5
	3C	3.0	4.7	5.0
	A	37.5	2.5	6.3
Launch Barge	C	4.2	5.1	5.5
Buoyancy-Assisted Lowering	2B	30.9	3.4	6.5
	C	19.0	4.3	6.2
	3C	30.9	4.3	7.4
Buoyant Transporter	C	35.6	4.4	8.0
	B	119.2	3.5	15.4
	A	203.1	1.8	22.1

NOTES: (1) Disposal costs include only those costs associated with the pre-disposal preparations; the relatively constant costs of inactivation and reactor compartment work are excluded.

(2) A = Entire submarine
B = Reactor compartment attached to the spaces aft
C = Reactor compartment only
2B or 3C = Multiple units transported to site

(3) Unit disposal costs are based on ten disposals at approximately three disposals per year.
Unit Disposal Cost = (Capital Cost)/10 + (Recurring Cost)
Costs expressed in millions of dollars.

(4) Controlled sinking by modification of ship's control surfaces.

The Glomar Explorer would be the lowest-cost method of very accurate placement without large development costs and associated risk. It would be applicable to either the reactor compartment alone (up to three in one trip) or attached to the spaces aft. There are three considerations of major concern for this application:

a. To be cost effective, the Glomar Explorer must be time-shared with other projects. Recent estimates of operating cost ($44,500 per day) are based on full utilization of the ship. If the ship were to be used only 15 percent of the time, as it would be for disposal alone, the cost per day would be much greater to account for the loss of revenue during the idle time.

b. Modifications to the Glomar Explorer must be compatible with the needs of other users. The Glomar Explorer may be used in the Ocean Margin Drilling Program when the Glomar Challenger is retired. If this plan were implemented, the heavy lift system might be removed and the well made smaller. Either of these actions would render Glomar Explorer unusable for the disposal actions considered here.

c. The Glomar Explorer is essentially a one-ocean vessel for repetitive tasks. Its beam is 115 feet 8 inches and the locks in the Panama Canal are only 110 feet in width. Additional cost would be involved to travel around Cape Horn.

Overall evaluation of the alternatives within the sea disposal option considered technical feasibility, operational feasibility, and estimated cost with equal emphasis. Recommendations for further consideration or conclusions against further consideration were based on these factors. Environmental effects would be involved in two ways:

a. The accuracy of placement would affect the amount of area required for disposal of multiple numbers of reactor compartments, as discussed above.

b. The type of placement may affect the integrity of the containment if an excessively fast descent were to occur onto a rocky bottom, but this would not be expected to occur. Evaluation of expected landing conditions has shown that the reactor compartment would be intact after landing at the expected velocity on a bottom having the expected condition because the design is compatible with predicted impacts. Three methods have been identified that could be developed to reduce the impact loads further, if this were necessary:

(1) A deformable structure could be attached to the unit to absorb on impact part of the energy of the falling unit.

(2) Appendages could be attached to the unit to increase the drag forces and limit the terminal velocity to a smaller value.

(3) Buoyancy could be added to the unit to offset part of the gravitational force.

These methods would require further development to mitigate the landing impact associated with a free-fall disposal, but none of these methods is considered to be necessary for intact emplacement on the sea floor.

D. COSTS OF DISPOSAL

The costs of disposal consist of three main categories:

1. Radiation doses that would be received by the general population and by the shipyard workers.

2. Economic costs that would be required to accomplish the disposals.

3. Other environmental impacts that would be anticipated to occur.

As discussed in Appendices C and J, the estimated radiation doses that would be received by the general population and the hypothetical maximum exposed individual would be quite small compared to natural background radiation. For comparable situations between land and sea disposal, such as normal disposals or credible accidents, the numerical results for estimated doses differ by small amounts since the estimated doses are small, even though their ratios may be quite large in some instances. Large ratios are considered to be due mostly to the uncertainties involved in the calculations rather than real differences in expected doses. Since the calculated differences are so small, the indicated differences are not considered to be significant; rather, the real difference is overwhelmed by the magnitudes of the uncertainties in the calculations. Under these conditions, the estimated doses are not considered to be an efficient basis for choosing between the land and sea methods of disposal. The estimated doses indicate that either of the options is safe and environmentally acceptable regarding its radiological consequences.

In contrast, the estimated economic costs have been found to be quite large, ranging from $5.2 million to $16.2 million per ship for the six cases given detailed evaluation. These estimates are considered to be reliable within ±15 percent of the estimated cost. Since the costs were all estimated on a consistent basis and the totals were arrived at by summing estimated costs for each main element of cost, differences of much less than 15 percent of the estimated total cost are considered to be realistic. On this basis, the estimated costs are considered to be an efficient basis for comparing the desirability of disposal methods.

1. Radiation Doses

The small radiation doses that would be committed by these disposals would be justified by the lack of a suitable alternative that would involve no dose commitment at all. There does not appear to be a practical alternative that would commit a smaller dose, even at much greater economic cost, as discussed below.

The estimated radiation doses that would be received by the shipyard workers during disposal activities are essentially independent of the disposal method because their work is essentially the same for each of the practical alternatives. The estimated values for these doses are listed in Table A-3. These values are based on measurements made during deactivation of the nuclear submarine HALIBUT in 1976. The doses would be incurred during the deactivation of reactor plant systems and preparations that would be required for disposal or storage in a safe and environmentally acceptable manner. Shipyard experience in doing work on radioactive reactor plant systems has evolved methods and procedures that would be applied to minimize the actual doses.

Similarly, the radiation doses that would be eventually received by the general population would differ slightly between land and sea disposal, but would be essentially independent of the alternatives within these options because the sources and release rates would be essentially the same for each of the alternatives within the land and sea disposal options. Details are provided in Appendices C and J.

If disposal were to be deferred and the ship and reactor compartment were to be stored instead of being disposed of promptly, the radiation doses that would be received by the shipyard workers would be essentially the same. Although much of the short-lived radioactivity would decay while the ship was in storage, and final preparations for disposal would be performed in much lower radiation fields than would prevail during prompt disposal, the amount of reduction of the workers' doses would be a small fraction of the total because the bulk of the exposure would occur during the initial deactivation of the systems: 17 man-rem in a total of 20 man-rem, as shown in Table A-3. In addition, there would be some unavoidable duplication of effort and radiological surveys would be required during storage. As a result, the total worker dose for deferred disposal would be approximately 20 man-rem per ship.

Population dose commitments are estimated for the maximum year to be not more than 2.1 man-rem per year for land disposal and not more than 6 man-rem per year for sea disposal, for a total of 100 ships. Estimates of the actual doses as well as conservative estimates of maximum population doses are given in Chapter 4 and are detailed in Appendices C and J. Since these estimates were obtained by conservative procedures, the actual doses would be expected to be considerably smaller than these conservative estimates indicate. This has two effects:

a. The actual doses and their difference for land and sea disposal are expected to be quite small in comparison with unacceptable doses since they would be a small fraction of the dose from natural background.

b. The actual doses and their difference would be expected to be quite small in comparison with the ranges of uncertainty in the estimates.

TABLE A-3. ESTIMATED WORKER DOSES FOR SELECTED DISPOSAL OPTIONS

Activity(1)	Estimated Dose(2)
Installation of temporary shielding	3 man-rem per ship
Installation and removal of radiological containments	1
Radiological control personnel	1.5
Engineering personnel	1
Nuclear inspection personnel	1
Other operations	9.5
WORKER DOSE, Active Disposal(3)	17 man-rem per ship
Radiological surveys(4)	2
Preparations for disposal(5)	1
WORKER DOSE, Inactive Disposal(6)	20 man-rem per ship

NOTES:
(1) Certain activities have been excluded from the disposal category, such as: establishing the proper plant conditions for defueling; and the defueling activities up to and including welding the closure penetrations; they are included in the defueling category.
(2) Based on measured values obtained from deactivation of HALIBUT in 1976.
(3) For disposal of ships decommissioned from active service without interim storage.
(4) Based on 20 years of interim storage.
(5) Based on 20 years of decay during interim storage.
(6) For disposal of ships after 20 years of interim storage.

The results of these two effects are that the doses can be judged to be safe and environmentally acceptable, but their difference cannot be used efficiently to choose between land and sea disposal.

In addition, since the estimated population dose is exceeded by the estimated worker dose, it is not considered to be beneficial to incur more worker dose to further mitigate the population dose unless some relatively greater benefit could be obtained for some very small increase in worker dose. The current plan for each alternative appears to provide as much benefit, in terms of providing long-term containment, as can be obtained with reasonable accrual of worker doses: to ensure that the reactor vessel is securely closed and sealed using minimum worker exposure, and to ensure that the reactor compartment is securely closed and sealed using minimum worker exposure. The worker exposures are considered to be as low as is reasonably achievable consistent with providing this level of containment for the protection of the public because the shipyard work practices are based on their experience in minimizing worker doses associated with normal maintenance and repair of nuclear submarines prior to disposal.

2. Economic Costs

The estimated costs for selected disposal options are listed in Table A-4. Six disposal options are summarized in this table: sea, land with sea disposal of the rest of the ship, and land with the rest of the ship disposed of as scrap, for active ships and inactive ships. The lowest estimated cost is for sea disposal of active ships, and the highest estimated cost is for land/scrap disposal of inactive ships. These six options are the ones

TABLE A-4. ESTIMATED COSTS FOR SELECTED DISPOSAL OPTIONS

Activity	Estimated Total Costs(1) Sea(2) Active(10)	Sea(2) Inactive(10)	Land/Sea(3) Active(10)	Land/Sea(3) Inactive(10)	Land/Scrap(4) Active(10)	Land/Scrap(4) Inactive(10)
Inactivation(5)(6)	$2.2 M	$4.0 M	$2.6 M	$ 4.0 M	$ 2.1 M	$ 4.0 M
Storage(7)	0	1.8	0	1.8	0	1.8
Preparation(6)	2.8	2.4	3.7	3.5	10.4	9.6
Operations(8)	0.1	0.1	0.9	0.9	0.8	0.8
Monitoring(9)	0.1	0.1	0	0	0	0
TOTAL COST	$5.2 M	$8.4 M	$7.2 M	$10.2 M	$13.3 M	$16.2 M

NOTES: (1) Millions of dollars per ship, 1981 dollars.
(2) Reactor compartment and ship's hull together would be sunk at sea.
(3) Reactor compartment would be buried on land and ship's hull would be sunk at sea.
(4) Reactor compartment would be buried on land and ship's hull would be cut up for scrap.
(5) Excludes defueling ($3.9 M) and removal of missile compartment if applicable ($0.4 M).
(6) Inactivation and preparation for disposal differ and include the following items that tend to make land disposal more costly than sea disposal: removal of reactor compartment and its transport to the burial site, and rejoining the hull for sea disposal or demilitarizing it and cutting it up for scrap.
(7) Includes estimated costs of materials and services required for minimal maintenance and periodic radiological surveys for 20 years. Possible additional costs for construction of additional storage facilities have not been included.
(8) Includes, as appropriate, $0.8 million per ship for land disposal of the reactor compartment (including amortization of capitalized costs for jacks and rollers and certain barge equipment) and $0.1 million per ship for towing the ship to sea for disposal. The recurring operational costs for land disposal include: barge, tugboat and transporter usage, jacking operations, overland transport, prorated burial pit preparation, engineering, and minor equipment rental.
(9) Includes estimated costs for qualifying a sea disposal site and for monitoring it. If two sea disposal sites would be used, the estimated cost would be nearly $0.3 million per ship. Refer to Appendix K.
(10) Active refers to a ship that would be disposed of following completion of active service without protective storage. Inactive refers to a ship that would be disposed of after inactivation and protective storage.

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selected for detailed considerations; others not listed that were considered here have higher unit costs for the disposal operations, as shown in Table A-2. The main differences among these costs are in the shipyard activities required for preparation of disposal, as detailed in Note (6) of Table A-4.

In each option, the major costs would be for inactivation and preparations, and the costs of the actual disposal operations would be the smaller part. Disposal of active ships without storage would be less costly by approximately $3.0 million per ship because of the costs associated with preparation for storage, storage, and removal from storage. Land disposal of both the reactor compartment and the hull would be the most expensive option because of the large costs associated with demilitarization, removing major equipment from the hull, and cutting the hull for scrap. Preliminary estimates indicated that the scrap value of the hull material would be essentially offset by the cost to "demilitarize" the material and protect strategic information.

Land disposal at the Savannah River Plant would require construction of a barge slip to off-load the reactor compartment from the transport barge to the crawler-transporter for the overland trip to the burial site. The existing barge slip at the Port of Benton, near the Hanford Site, would be adequate for off-loading the reactor compartment. The proposed barge slip at Savannah River would cost approximately $1.3 million. This would include pre-construction surveys and environmental assessments, materials and labor for construction, and overhead and administrative costs.

The costs associated with preparation for and removal from a naval inactive ship maintenance facility are based on the minimum work required to store the ship and reactor plant in such a way that it would be safe and environmentally acceptable. Utilities and necessary maintenance services are included, but there is no allowance for periodic docking for hull inspection and repair. The future availability of sites for mooring inactive ships has not been addressed.

The differences among these costs and their principal elements of cost are illustrated in Figure A-2. The main differences are apparent in the costs of non-nuclear preparation for disposal; these are the costs associated with effort applied outside the reactor compartment.

The main elements of the costs of disposal are illustrated in a logic-flow diagram in Figure A-3. This figure shows what the costs are which are associated with the various components of the disposal process. At each decision point, the associated costs are separately identified in the boxes.

The preliminary steps which are common to all of these disposal options are defueling, decommissioning, and missile compartment removal (if applicable).

Before shipyard work can start to inactivate the ship and prepare it for disposal, three decisions would need to be made:

1. **Whether to store or not store the ship before disposal.** In Figure A-3, the minimum costs associated with these alternatives are shown as $4.9 million (active disposal) and $8.2 million (storage for inactive disposal) per ship, as a part of subsequent preparations for disposal.

2. **Whether to dispose of the ship by land or by sea.** The decision for sea disposal or for land disposal determines whether the reactor compartment would be left in the ship for sea disposal or would be removed ($0.4 million per ship) for land disposal.

3. **Whether the rest of the ship would be welded together and prepared for sea disposal or cut apart for scrap.** These additional costs to inactivate and prepare for disposal would differ slightly between active and inactive disposals but are mainly dependent upon the chosen disposal option.

Disposal operations are shown in Figure A-3 for moving either the ship or the separated hull and reactor compartment from the shipyard to the disposal site. A credit is shown for the scrap value of the hull in the land/scrap option. The total estimated costs are shown at the bottom of the tabulation.

In addition to the direct costs of disposal, i.e., processing the ship and disposing of its parts, an indirect cost is associated with qualifying the disposal site and monitoring the radioactivity in the environment in the vicinity of the disposal sites to provide assurance that unacceptable amounts of radioactivity have not accumulated. Details on monitoring are provided in Appendix K. In Figure A-3, these costs are included in the costs of preparation.

The estimated cost of monitoring a sea disposal site would include the initial cost to qualify the site. It is estimated that the qualification of a site would require an expenditure of approximately $6 million during the period of two to three years prior to the first sea disposal. After disposal started, there would be an ongoing program to verify satisfactory emplacement and to monitor the environment. It is estimated that the ongoing monitoring program for a sea disposal site would have a present-value cost of nearly $9 million. The total cost for qualifying and monitoring a site would amount to approximately $0.1 million per ship.

The land disposal sites being considered at Hanford and Savannah River are currently active and are being monitored on a continuing basis. These monitoring programs would continue and would be adequate to provide suitable monitoring for disposal of reactor compartments. No additional cost would be required.

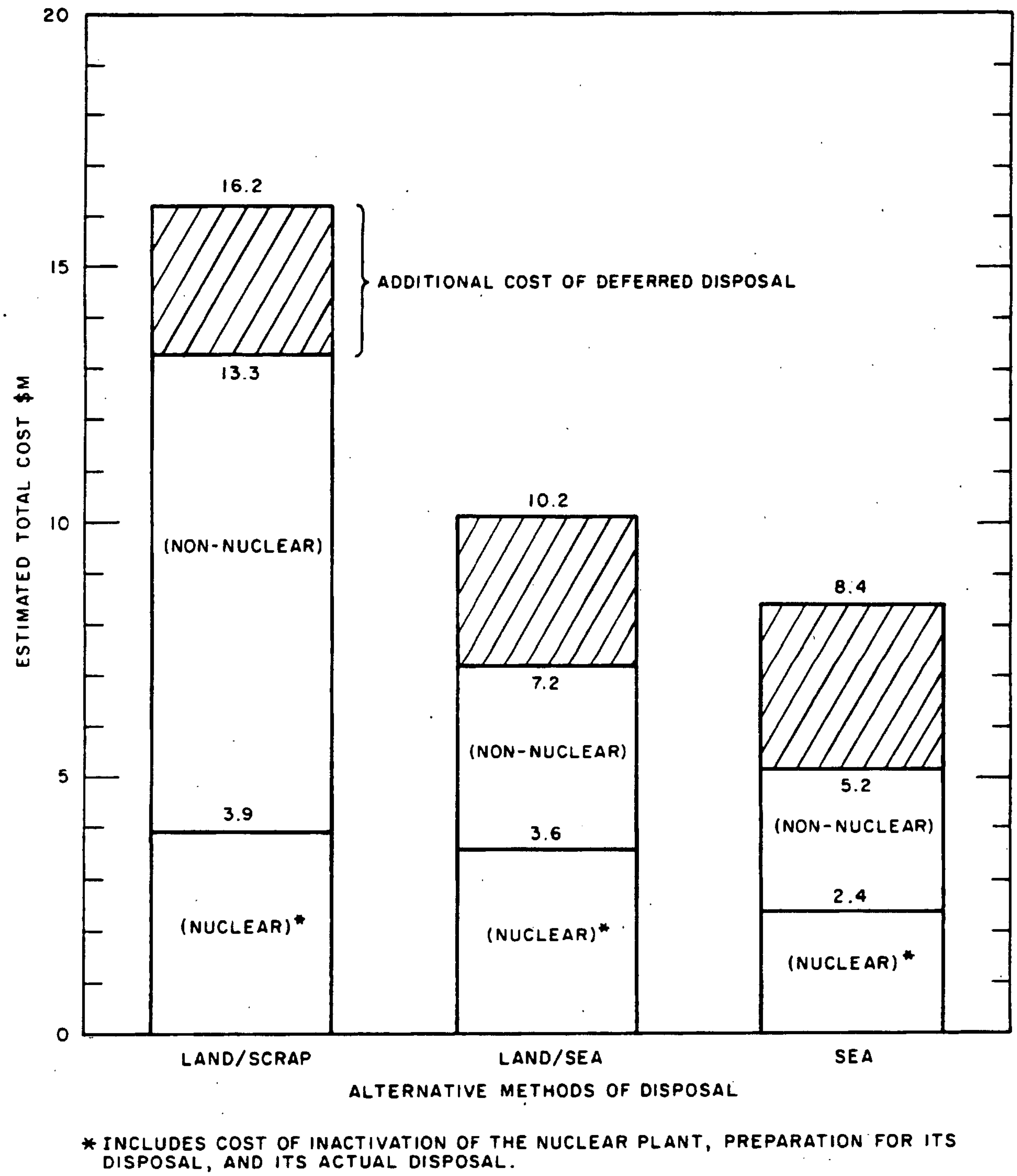

Figure A-2. Estimated Total Costs of Disposal

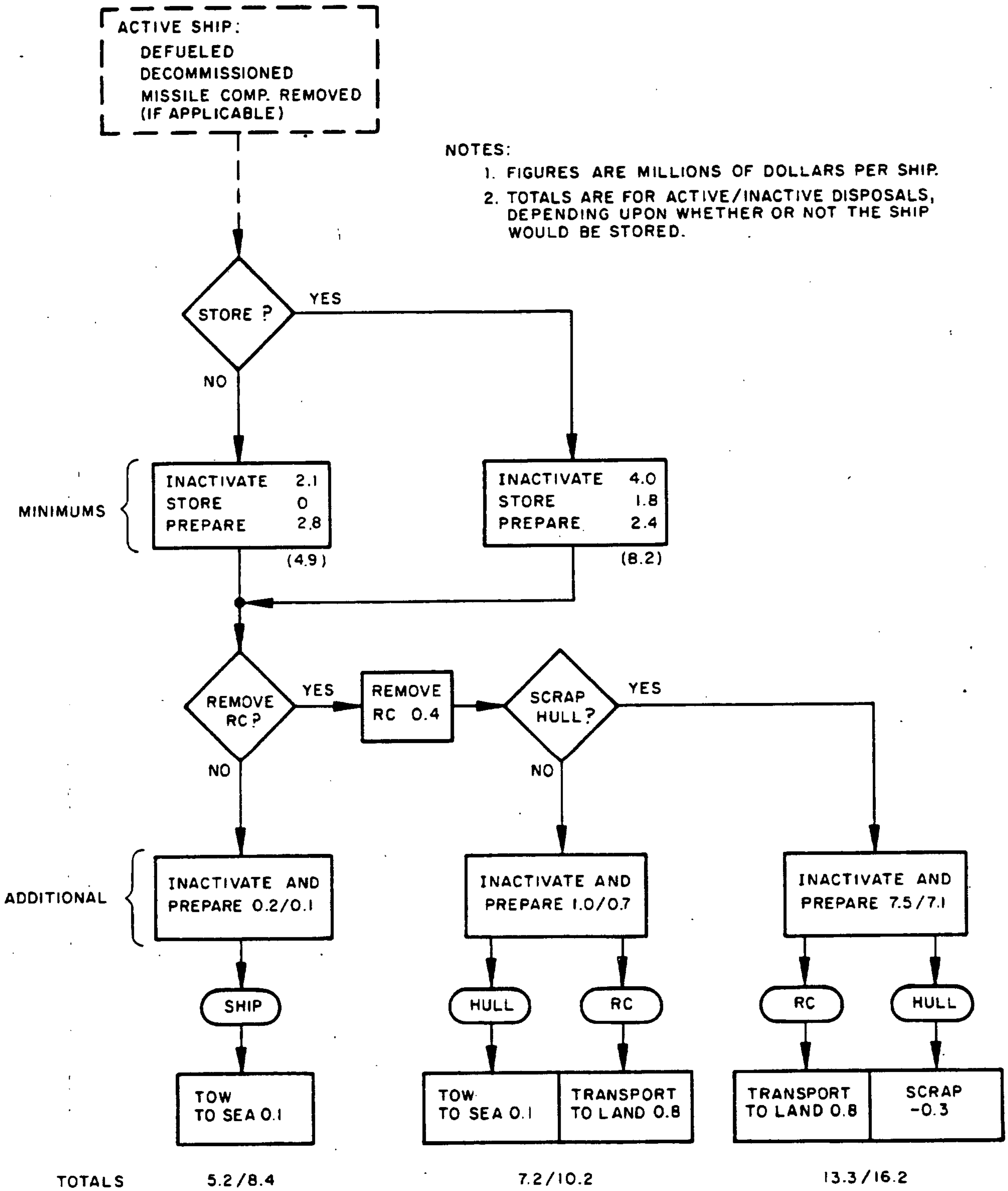

Figure A-3. Estimated Total Costs of Disposal

3. Other Environmental Impacts

Other environmental impacts were identified and examined for cost impacts.

Four other environmental impacts have been identified and have not been found to be unacceptable:

a. Normal transport and potential accidents during transport of the disposal unit would create additional risk of exposure to the workers and the general population. The extent of this risk was found to be small and would not have any significant impact on the choice of disposal method. Details are provided in Chapter 4.

b. Loss of land use (including the ocean bottom area if sea disposal would be used) is inherent in the contemplated disposal actions. At both land disposal sites, the land has already been withdrawn from other use for storage and disposal purposes. A total of approximately 10 acres of land would be required for the burial sites for 100 reactor compartments, and this land would not be expected to be returned to public use in the foreseeable future. This area is a small fraction of the areas of the Hanford Site and the Savannah River Plant which together occupy over 500,000 acres. For sea disposal, a larger area would be required. To allow for the uncertainties of placement locations on the bottom, a total of less than 100 square miles of ocean bottom would be required for the sea disposal sites. At potential sea disposal sites, the tentative site-selection criteria exclude sites that may have economic potential, such as resources or other unique utility. It does not appear that loss of land use would be a significant impact. Refer to Chapter 4 for details.

c. Change in the natural environment due to disposal actions may affect the local flora and fauna; however, this effect is considered to be a small one having highly localized significance. For land disposal, the disposal units would be covered with local earth and the disturbance would be expected to be a temporary one with no significant long-term or wide-spread effect that would place any species at risk. For sea disposal, experience in similar circumstances suggests that the presence of the disposal unit on the ocean bottom would change the local environment such that small species would be attracted to it for shelter from predators and large species would be attracted to it because of the increased concentrations of prey, but this effect would be highly localized to the area within a kilometer or so of the units. No change in species or overall abundance of species would be expected. In no event is it considered likely that any species would be exposed to a significant risk. See Chapter 4.

d. Methods for removal or containment of the radioactive material after disposal at sea, and their estimated costs have been assessed and are described in Appendix M. Since there is no technical basis for expecting that either removal or containment would ever become necessary, there is no expected economic cost and the costs identified in Appendix M have been excluded from the estimated costs for the sea and the land/sea disposal options.

On the basis of these results, no further cost impact is evident, and the assessment of the disposal options has been concentrated on estimating the potential radiation dose commitments and comparing the costs of the six options, as described above.

APPENDIX B

LAND DISPOSAL

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APPENDIX B

LAND DISPOSAL

I. INTRODUCTION

This appendix provides information on the details of the land disposal option for the disposal of reactor plants upon deactivation of naval nuclear submarines. It is based on engineering studies that were performed to identify and evaluate the tasks that would be required to accomplish land disposal in a safe and environmentally acceptable way. These studies indicated that land disposal would be technically feasible and within the capabilities of present-day equipment. It would involve removing the entire reactor compartment from a submarine and transporting it by water and land routes to a suitable burial site. The sequence of anticipated events and the expected operations are described.

II. SUMMARY

After the reactor has been defueled, land disposal of the reactor compartment would involve only low-level radioactive waste, and would be accomplished by the following sequence of principal events:

1. The reactor plant systems and mechanical equipment would be prepared for disposal. This would include removal of reactor coolant and ion exchange resin.

2. The reactor compartment would be cut from the submarine.

3. The reactor compartment would be closed and sealed.

4. The reactor compartment would be transported by barge and by crawler transporter to the burial site.

5. The reactor compartment would be buried at the disposal site.

6. The site would be monitored for radioactivity, and the results of this monitoring would be used to determine if regulatory requirements were being met.

The details of each of these steps are discussed in the sections which follow, with particular references to the approved U.S. Department of Energy land burial sites: Hanford Site, located on the Columbia River near Richland, Washington, and the Savannah River Plant, located on the Savannah River near Aiken, South Carolina.

III. DISCUSSION

A. CONCEPTS OF LAND DISPOSAL

Several different concepts of land disposal were considered before burial of the entire reactor compartment was selected to be the preferred concept for land disposal.

The general concept of land disposal is based on four main steps:

1. **Preparation of the items to be buried.** These preparations are intended to make as low as is practicable the following items: the rate at which the radioactivity would be released from the items to the environment, the amount of radiation exposure that would be received by those who prepare the reactor compartment and by the general public, and the economic costs that would be involved in these actions.

2. **Burial of the items.** Burial involves choosing a site and associated burial techniques that would minimize the rate at which radioactivity would be released to the environment and subsequently the possible dose to persons who may be exposed to such releases, and which would minimize the impact due to using the chosen site for this purpose.

3. **Monitoring the environment.** Monitoring involves measurement of the radioactivity in the environment around the burial site to determine the extent and magnitude of actual releases, if any, and whether the releases are within acceptable limits.

4. **Disposal of the remainder of the ship.** Two alternatives were evaluated for disposing of the greater, non-radioactive portion of the submarine:

   a. Sea disposal, by welding together the sections that would have been forward and aft of the reactor compartment and towing them to a suitable sea-disposal site.

   b. Scrapping, by cutting the remaining sections into suitably-sized pieces and selling them for scrap.

Three general concepts of land disposal were considered, varying mainly in the degree of preparation that would be required:

1. Dismantle the reactor plant and cut the radioactive components into pieces that could be packaged in steel drums with concrete. Burial of such packages would be consistent with current practice, but the extensive preparations would require specialized facilities and much manpower. A great deal of manpower would be required to dismantle the plant, and this would involve substantial exposure of radiation to workers during dismantling, even if temporary shielding were used. Specialized facilities would be required to cut and package the components and to limit the spread of radioactivity. Additional manpower would be required to operate the facility.

2. Dismantle the reactor plant and package whole components in specially-built containers. Burial of such packages would be a limited extension of current practice because it would be based on existing technology; however, less manpower and less radiation exposure would be expected, and less-specialized facilities would be required than in the above type because the components would not be cut into pieces.

3. Remove the entire reactor compartment from the submarine and bury it intact after sealing all openings, using the surrounding hull and bulkheads as a package. The reactor vessel itself would be sealed to contain the radioactivity within the reactor vessel and internal structures. The transport of such a package over the anticipated sea and land routes is feasible with currently available equipment. Less manpower and less radiation exposure to the workers would be expected in this case because less work would be done in the radiation area. No specialized facility would be required for dismantling or packaging. This is the preferred method for land disposal.

Among these concepts, the preferred method would be burying the entire reactor compartment because there would be less radiation exposure to the workers and no specialized facility would be required. Costs would also be less for this concept than for the others. On this basis, engineering studies were conducted on this concept to identify the necessary tasks and the potential problems. The results indicated that it would be feasible, as discussed below.

B. SITES CONSIDERED

Existing burial sites were considered and two were found to be suitable for burying entire reactor compartments: Hanford Site in Washington and Savannah River Plant in South Carolina. Others were dropped from further consideration because either they were remote from the shipyards or they were not government-owned. Access by waterway would be necessary to accommodate a barge carrying the reactor compartment and to minimize the need to transport the compartment overland by crawler transporter to the burial site. On this basis, the potential burial site at the Idaho National Engineering Laboratory in Idaho was eliminated, and the Oak Ridge National Laboratory site in Tennessee was considered to be too remote since the inland waterway is approximately 1600 miles long.

1. Hanford Site

The Hanford Site occupies approximately 570 square miles of semiarid land in the southeastern part of Washington. Waste management and reactor fuel processing facilities are located in what are known as the 200 Areas, on a plateau approximately seven miles from the Columbia River. Reactor facilities are located along the river in the 100 Areas, and reactor fuel manufacturing and the research and development laboratories are located downstream just north of Richland in the 300 Area. The Hanford Site begins at approximately 345 river miles from the mouth of the Columbia River.

The potential burial site lies along the west boundary of the 200W Separations Area. The specific area of consideration is currently in use as a burial ground, although, depending on long term needs, it may have to be expanded. The contemplated disposal of activated metal components is within the scope of existing disposals at Hanford, as described in the Final Environmental Statement for Waste Management Operations, Reference B.1.

The burial area (as well as the entire reservation) is underlain by a vast field of flood lavas of the Columbia River Basalt group. The basalt formations are estimated to be 10,000 to 12,000 feet thick and are overlain by approximately 500 feet of coarse to fine grained sediments deposited by glacial flooding. These sediments formed the soils now found on site.

The burial area lies at an elevation of approximately 700 feet above sea level. The topography is basically level with slopes of less than 2 percent. The primary soil type is classified as "Rupert Sand", which is a coarse grained sand overlain by fine-grained windblown sand. The relief characteristics consist of hummocky terraces and dune-like ridges. The natural vegetation of the site consists of sagebrush with cheat grass and sandberg bluegrass.

The water table under the burial site is constrained on the bottom by the basalt basement rock at an elevation of approximately 100 feet above sea level. Saturated soils exist to an elevation of approximately 450-475 feet above sea level. Thus, there is approximately 250 feet of unsaturated sandy-gravelly soils beneath the proposed burial site. Tests have shown that these soils are very dry in nature since the rainfall which is received (average 6.25 inches per year) does not penetrate to the groundwater table, but rather penetrates only to a shallow depth and is subsequently given off from the ground surface by evaporation.

The site is in a region of low to moderate seismicity. On the basis of the damage that has been experienced since 1840, the U. S. Coast and Geodetic Survey designated the area a Zone 2 seismic probability, implying the potential for moderate damage from earthquakes. The underlying sands and gravels at the site provide excellent protection against damage. Earthquake intensities greater than four on the Modified Mercalli Scale (MM-IV) have not occurred in the immediate Hanford area.

The National Research Council's Panel on Land Burial found that no measurable harm to human health has resulted from the past practices in the land burial of solid low-level radioactive waste at Hanford. This was reported in the results of a long study by the Panel of the problems associated with shallow land burial of solid low-level radioactive waste, Reference B.2.

Further details are available in References B.1 and B.2.

2. Savannah River Plant

The Savannah River Plant occupies approximately 300 square miles of mostly-forested land on the South Carolina side of the Savannah River, approximately 150 river miles from the river's mouth at Savannah, Georgia. The burial ground for solid waste storage and two tank farms for high-level liquid waste storage are located in what is known as the 200 Areas on the Aiken Plateau, approximately nine miles from the Savannah River. Reactor facilities are located centrally in the 100 Areas, reactor fuel and target fabrication (300 Area) and the Savannah River Laboratory and Administration (700 Area) are located in the northwestern part, and the Heavy Water Production and Recovery (400 Area) are located in the southwestern part of the plant site.

The potential burial site lies between two tank farms, just north of the central part of the plant site. The specific area of consideration is currently in use for solid waste storage, although, depending on long-term needs, it may have to be expanded. The contemplated disposal of activated metal components is within the scope of existing disposals at Savannah River, as described in the Final Environmental Statement for Waste Management Operations, Reference B.3.

The burial area and the entire plant site is underlain by bedrock over which are approximately 1000 feet of unconsolidated and semiconsolidated sediments. Five formations are identified, and these are interspersed with horizontal layers of clay. Immediately over the bedrock is the Tuscaloosa Formation, 500 to 600 feet of sand and clay which contains several prolific water-bearing beds. Water pressure measurements in the Tuscaloosa Formation indicate that the water in this major aquifer flows from off-site locations in the Aiken plateau, flows under the plant site, and discharges off-site in the Savannah River valley upstream from the Savannah River Plant.

Overlying the Tuscaloosa Formation are several formations: Ellenton, Congaree, McBean, and Barnwell, totalling approximately 350 feet, consisting predominantly of compact clayey sand and sandy clay. Any contamination from the burial area above them entering the groundwater in these formations would be transported both downward and laterally, principally laterally at each of several clay barriers. Because the water heads in the underlying Tuscaloosa and Ellenton Formations are higher than in the Congaree Formation approximately 200 feet below the surface, such contamination would be discharged into a surface stream (Upper Three Runs) before it could enter the Tuscaloosa aquifer. Further details on the hydrology of the region are available in Reference B.3.

The burial area lies at an elevation of approximately 300 feet above sea level. The topography is basically level with slopes of less than one percent. The natural vegetation of the dry sandy areas of the site consists of a scrub oak community dominated by various oaks and longleaf pine, with ground cover of three awn grass and huckleberry.

The site is in a region of moderate seismicity. On the basis of the damage that has been experienced since 1754, the U.S. Coast and Geodetic Survey designated the area a Zone 2 seismic probability, implying the potential for moderate damage from earthquakes. During the past 100 years, the area within 100 miles of the plant has experienced 16 shocks greater than IV (Modified Mercalli Scale): 1 shock of intensity X, 1 of intensity VIII, 2 of intensity VII, and 12 of intensity V. Seismic monitors, installed in the plant's reactor buildings between 1952 and 1955 have never indicated a shock in excess of 0.002 g (intensity II). The design basis earthquake acceleration for the plant is 0.2 g.

The National Research Council's Panel on Land Burial found that no measurable harm to human health has resulted from the past practices in the land burial of solid low-level radioactive waste at Savannah River. Although contaminants are slowly moving from the waste in the subsurface, the data indicate that the contaminants are well adsorbed in the soils or are adequately diluted by natural processes. These results were reported in Reference B.2.

Further details on the character of the plant site and its environmental impacts are available in References B.2 and B.3.

3. Other Potential Sites

Oak Ridge Reservation occupies approximately 58 square miles in east central Tennessee, approximately 25 miles west of Knoxville, Tennessee. It is approximately 1600 miles from the Gulf of Mexico, by the Mississippi, Ohio, Tennessee, and Clinch Rivers. It has a potential burial site at the Oak Ridge National Laboratory (X-10 area), located approximately eight miles from the K-25 area dock on the Clinch River. The water table at X-10 is relatively shallow and can be as little as 14 feet below the surface, so that a reactor compartment would have to be buried in soil that is partly saturated with groundwater. This limitation and the great distance required for transport from the ocean would put this site at a disadvantage relative to Hanford and Savannah River.

Further information is available in References B.2 and B.4.

Idaho National Engineering Laboratory occupies approximately 894 square miles of a desert plain in southeastern Idaho. The water table lies 200 to 900 feet below the surface, and radioactive solid wastes are currently stored and buried there. However, the lack of a suitable river for barge transportation of the reactor compartment makes this site less desirable.

Further information is available in References B.2 and B.5.

Los Alamos Scientific Laboratory Site occupies approximately 43 square miles in north central New Mexico, approximately 35 miles northwest of Santa Fe. It is situated on the Pajarito Plateau between the Jemez Mountains to the west and the Rio Grande Valley to the east. The Laboratory land area includes building sites, test area, waste disposal locations, and large buffer zones for safety and security. Since there is no suitable river for barge transportation, this potential site was not considered further.

Further information is available in References B.2 and B.6.

C. PREPARATION FOR TRANSPORT

After completion of defueling operations, the reactor vessel closure head would be sealed by welding, preparations for transport would start and would include the following sequence of primary steps:

1. Prerequisite operations and salvage.
2. Cutting and sealing piping systems.
3. Cutting the reactor compartment from the rest of the ship.
4. Closing and securing the reactor compartment.
5. Moving the reactor compartment to the barge and welding it to the barge.

These steps are discussed in the following sections.

1. Prerequisite Operations

The technical operations are discussed in these sections. Background information on regulations relating to shipper and carrier requirements are provided below in Sections IV.C.3 and IV.C.4.

a. **Primary Systems.** Radioactive liquids, toxic liquids, and ion exchange resin in the purification system would be removed from the reactor plant systems to the maximum extent practical prior to transport for burial. The operating manuals for the reactor plant contains procedures for blowing down and draining primary systems. These operations are a part of normal shipyard operations associated with the maintenance and repair of such systems. The environmental effects of these operations are within the scope of current practices at the shipyards.

b. **Reactor Vessel Pumpdown.** Water can be drained from the reactor vessel only to the bottom of the reactor vessel nozzles. To remove water from the reactor vessel, a pumpdown system would be used.

c. **Primary Shield Water Tank.** The shield tank would be pumped down to remove chromate-treated water. The water pumped from the tank would be processed by evaporation in the shipyard's radioactive liquid waste processing system, and the sludge from the evaporator would be solidified and disposed of as solid radioactive waste.

d. **Special Nuclear Material.** Some components in the reactor compartment contain special nuclear material and require special handling. This special nuclear material would be removed from the reactor compartment and disposed of separately.

e. **Salvage of Reactor Plant Components.** It is not considered to be cost effective to attempt to salvage any radioactively-contaminated component from the reactor compartment unless the component is of high value or in critically short supply. Items that would be considered for removal because of known shortages or high value include some instruments, pumps, and copper bus bars.

2. Cutting and Sealing Contaminated Piping

Contaminated piping and components external to the reactor compartment would be removed, capped securely, and stowed in the reactor compartment for disposal. Cut piping and small components located adjacent to the outside of the reactor compartment bulkheads would be left in place and would be capped where necessary. The lower portion of the aft bulkhead would be covered with a new watertight bulkhead because this would be more cost effective and would involve less radiation exposure than removing the numerous items located there. These operations are similar to normal shipyard operations associated with the maintenance and repair of such systems. The environmental effects of these operations are consistent with current practices at the shipyards.

3. Cutting the Reactor Compartment from the Rest of the Ship

After the reactor compartment has been prepared and contaminated systems external to the reactor compartment have been removed or covered, the entire reactor compartment and its components would be removed from the remainder of the submarine.

a. Hull cuts for removing the reactor compartment would consist of cutting and removing two 18-inch long hull sections forward and aft of the respective fore and aft reactor compartment bulkheads. The hull-cutting operations are a part of normal shipyard operations associated with the construction and overhaul of such ships. The environmental effects of the cutting are within the scope of current practices at the shipyards. The removed hull sections would provide clearances during removal and transfer to the barge. The location of the hull cut sections would provide for the following:

(1) The cutting work would be outside existing compartment shielding, therefore minimizing radiation exposure to personnel performing the cut-out and removal operations.

(2) The cuts would maintain the forward and aft reactor compartment bulkhead horizontal stiffener integrity. They also would keep the outermost frame members to maintain hull strength of the end sections for subsequent transfer to the barge and transit to the disposal site.

(3) A significant portion of contaminated piping outside the aft reactor compartment bulkhead would remain and would be removed intact with the reactor compartment.

b. In preparation for the hull cuts, the following would have to be accomplished:

(1) Piping and electrical cables passing through the reactor compartment bulkheads to the remaining fore and aft sections would be cut and capped.

(2) All piping, components, cables, and structure in the hull cut sections would be removed to provide clearance.

(3) Between the hull cut sections and their respective bulkheads, all piping and components except for those contaminated items that would remain intact for disposal with the reactor-compartment and structure not contributing to the strength of the bulkhead or hull would be removed.

(4) The outer shell or superstructure in way of the hull cut would generally be cut and removed from the pressure hull.

After the hull cuts were made, a new watertight bulkhead would be added at the aft cut to seal the lower half of the area outside the reactor compartment. The new bulkhead would provide a secondary boundary for contaminated piping that would remain intact on the aft bulkhead. The new bulkhead would meet the design strength of the reactor compartment bulkheads.

4. Closing and Securing the Reactor Compartment

a. **Reactor Compartment Integrity Requirements.** The existing strength of the reactor compartment envelope is considered adequate for transporting the reactor compartment by barge. The weakest portions of the reactor compartment envelope are the forward and aft compartment bulkheads. The strength requirements for closure of all reactor compartment cuts and penetrations would, as a minimum, meet the design strength of the reactor compartment bulkheads.

b. **Bulkhead Penetration Closures.** The environmental assessment for transporting the reactor compartment to a burial site was based in part on the fact that radioactive contamination in the reactor plant would be contained by at least two metal boundaries, the first being the all welded primary piping systems or components and the second being the pressure hull and the reactor compartment bulkheads. More than 99.8 percent of the radioactivity in the package would be present in the form of activity induced in the structural metals and therefore is further contained. To be consistent with these levels of containment, the piping, electrical and ventilation penetrations through the reactor compartment bulkheads and pressure hull would be sealed.

c. **Hull Penetration Closures.** There are two discharge valves that would be plugged and seal welded to provide a primary boundary. The secondary boundary would be a plate covering the plugged penetration and welded to the hull. The hull and backup valves would also be shut to provide additional isolation from system internals.

d. **Security.** It has been determined that the Department of Energy burial sites would have no requirement for entrance into the reactor compartments before or after burial. No requirement has been identified for personnel entrance into the reactor compartment during transportation from the shipyard to the burial site. Therefore, prior to leaving the shipyard, personnel accesses to the reactor compartment envelope would be welded shut or covered with a weldment to prevent entrance during transportation and at the burial site. This would assure that the reactor compartment would be completely sealed before leaving the shipyard, with no access possible other than by use of hull cutting equipment. Special security precautions are not required at the burial site because the existing burial site security for buried radioactive material is considered to be adequate.

e. **Reactor Compartment Tests.** Prior to shipping the reactor compartment to the burial site, a test would be conducted to verify the integrity of the reactor compartment envelope. The testing would be accomplished after all penetrations and openings into the reactor compartment envelope including the shielded tunnel, with the exception of the personnel access doors and test entry points, have been permanently closed and sealed.

5. Transferring and Securing the Reactor Compartment to the Barge

Several alternative methods were considered for movement of the reactor compartment to the barge after being cut free from the submarine. This section discusses the most practical one.

During the transfer, the load would be supported by at least eight chain-type rollers. Hardened steel rollers reduce the friction forces to the double-rolling-action of the chain and eliminate the need for a conventional axle. High capacity rollers such as Hillman Equipment Model 5XTDW (200-ton capacity) or 6X (300-ton capacity) are routinely used in multiples to move loads in the over-1000-ton range. The rollers require only 35 to 50 pounds of force to move one ton of load. They are conservatively designed to withstand twice their rated load without damage. The type "R" configuration has guide rollers and would be well adapted to transferring the reactor compartment along the load beams which would be used to transfer the compartment to the barge.

The reactor compartment would be transferred from its hull location to the deck of the barge by first raising it with jacks and blocks, not more than an inch at a time, to the level of the deck of the barge. With the roller assemblies in place, the reactor compartment would then be pulled along the load beams with chain falls to the deck of the barge. Finally, the reactor compartment would be lowered onto the deck of the barge with jacks and blocks, and would be welded securely to the barge.

a. **Preparations.** The submarine and a barge would be docked side-by-side in the drydock. The ship would be docked normally with the exception that four prefabricated support fixtures (described below) would be in place beneath the reactor compartment. The barge would be docked as low in the dock as possible and aligned such that the final stowage location on the barge deck would be directly opposite the compartment. After docking, the support fixtures would be raised, fitted, and welded to the ship's hull. These fixtures would then provide support for the compartment during all subsequent jacking, rolling, stowage, and transportation. Blocks would be installed under the fixtures and partially loaded so that as the hull cutting operation proceeds, the compartment's weight would be fully supported.

At a convenient time, four structural pads would be welded to the bottom of the compartment for use at the unloading site, to allow securing to the crawler which would transport the compartment from the barge slip at the unloading site to the burial site.

Prior to transferring the compartment to the barge, load distribution beams would be installed on the barge, if necessary, to distribute the weight of the compartment over sufficient area to meet the deck load rating of the barge. The beams would have a wear plate attached to their top surface which would bear the pressure of the rollers during the transfer operation to prevent scuffing and gouging. The rollers would have outrigger guide rollers which would bear on the load beam flanges. Attachment of the rollers to the support fixtures would include a rubber pad which would allow small vertical roller movements while maintaining uniform roller loading.

b. **Jacking.** Jacking and blocking would be used to raise the compartment. Four, 600-ton hydraulic jacks with 12- or 24-inch strokes would be operated from a control console. The console would allow operation of individual jacks from a common hydraulic power supply and would provide an indication of the load on each jack. The jacks would be tested in accordance with lifting standard requirements prior to use.

The compartment would be jacked so that the bottom of the support fixtures would be at an elevation approximately 12 to 18 inches above the elevation of the load beams on the barge deck. The compartment would then be securely blocked. Blocking for additional load beam sections would then be installed under the reactor compartment, and load beams would be placed on the blocking. Rollers would be attached to the bottom of the support fixtures and the reactor compartment lowered to allow the rollers to support the weight of the compartment on the load beams. At this time, the jacks would be removed to allow installation of the remaining blocking and load beam sections to allow transfer of the compartment to the barge.

c. **Moving the Reactor Compartment onto the Barge.** Rigging would be installed between the compartment and fixed points to provide the estimated 40 tons (maximum) horizontal pull required to move the compartment onto the barge. Suitable restraints would be provided to ensure positive control of the load at all times.

After the compartment would be moved onto the barge, the jacks would be repositioned under the support fixtures, the compartment jacked to allow removal of the rollers, and then lowered to allow the support fixtures to support the weight of the reactor compartment on the load beams. The support fixtures would be welded to the load beams and the load beam extensions removed to complete the transfer.

The primary advantage of this method is that one-time investment costs would be minimized. The investment cost of plant equipment for this method would be approximately $320,000. This would provide the load beam system, the rollers, and the keel blocks for use as beam supports and jack supports.

d. **Securing the Reactor Compartment to the Barge.** Prior to transferring the reactor compartment to the barge, load distribution beams would be installed on the barge deck, if necessary. These load distribution beams would be designed to distribute the weight of the reactor compartment over sufficient deck area to meet the deck-load rating.

Movement of the reactor compartment to the barge would require that four support fixtures be fitted and welded to the compartment's hull. These fixtures would then provide for support and attachment to the deck plates or the load distribution beams installed on the barge. The fixtures would be welded to the deck plates or the load distribution beams. The attachment to the compartment hull would be designed to withstand the maximum forces associated with the wind loading, list, trim, pitch, roll, yaw specified in MIL-STD-1399, Section 301, and any postulated credible accidents. Overall height of a typical reactor compartment above the barge deck following loading would be approximately 35 feet as shown in Figure B-1.

e. **Estimated Cost of Disposal Operations.** Unit costs for the land disposal operations alone are estimated to be approximately $0.8 million per reactor compartment. This amount is due mostly to recurring costs that would be required to move the reactor compartment from the ship to the burial site, and it includes the associated expendable materials, labor costs, and equipment rental costs. Unit costs were computed by averaging the estimated capital costs for reusable structures and materials over 10 ships and adding the ratio to the recurring costs. Estimated costs are listed in Table B-1. Further details on the costs of disposal are provided in Appendix A.

D. TRANSPORT TO THE DISPOSAL SITE

The Hanford Site would be the closest disposal site for submarine reactor compartments that would be deactivated in Honolulu or West Coast shipyards, such as the Puget Sound Naval Shipyard. Similarly, the Savannah River Plant would be the closest disposal site for submarine reactor compartments that would be deactivated in East Coast shipyards, such as the Charleston Naval Shipyard. At an additional cost, the reactor compartments could be transported from the shipyards to a disposal site on the opposite coast. The sections below describe the routes to these sites and the anticipated problems that were identified in developing plans for transporting the reactor compartments to these sites.

1. Transit Routes

The normal commercial shipping lanes would be used to transport the reactor compartments from the shipyards to the two potential disposal sites. Where appropriate, this would include the use of inland waterways. The shipyards that might be involved are listed in Table B-2.

The shortest routes are from Puget Sound to Hanford on the West Coast and from Charleston to Savannah River on the East Coast. The longest routes would involve those through the Panama Canal to the disposal site on the opposite coast, and from Pearl Harbor to Hanford or Savannah River. On the West Coast, the longest route to Hanford is from Mare Island. On the East Coast, the longest route to Savannah River is from Portsmouth Naval Shipyard.

a. **Route from Puget Sound Naval Shipyard to Hanford Site.** The normal commercial shipping lanes from Puget Sound Naval Shipyard would be used, via Rich Passage, past Restoration Point, northerly through Puget Sound, westerly through the Straits of Juan de Fuca, past Cape Flattery, and southerly down the Washington Coast to the mouth of the Columbia River.

After reaching the Columbia River, the remainder of the trip to the Port of Benton near the Hanford Site would be approximately 342 miles. Because of the number of dams on the Columbia River, the navigation will be through essentially slack waters until just prior to reaching the unloading site. Additional information on river limitations is given in Section III.D.2.a.

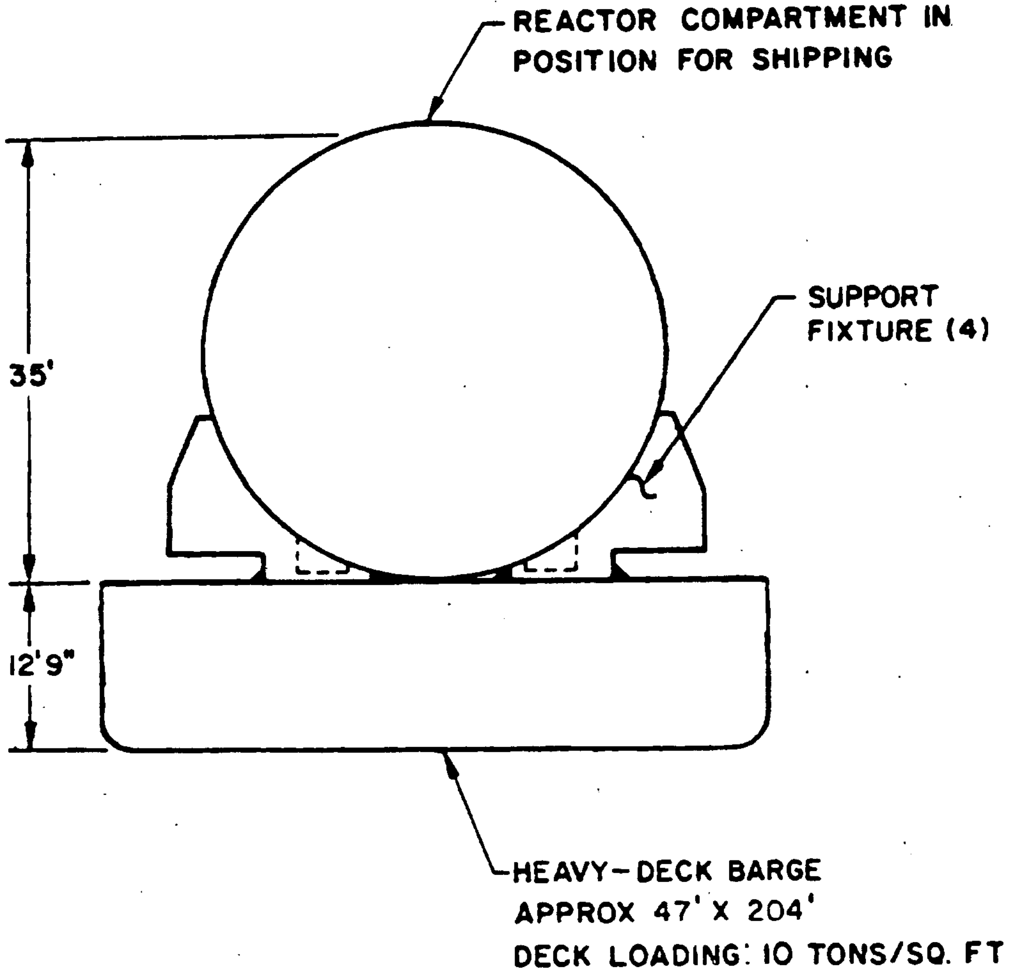

Figure B-1. Reactor Compartment on Barge

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b. **Route to Savannah River Plant.** The normal commercial shipping lanes to the Savannah River Plant would be used from whichever shipyards would prepare reactor compartments for disposal. Navigation up the Savannah River to the Savannah River Plant would be more difficult than navigation up the Columbia River because of the water depth and limiting vertical clearances. Additional information on the Savannah River is given in Section III.D.2.b. Preliminary discussions with an experienced operator of barges and tugs indicate that a reactor compartment could be barged up the Savannah River without insurmountable problems. This operator has frequently moved barges up this river.

c. **Route from Hawaii.** The routes from Hawaii to either of the potential disposal sites would include considerable distances over waters that are very much deeper than the design depth of the reactor compartment bulkhead. If the barge were to sink in those waters, the bulkheads would be crushed by the pressure of the deep water until there was sufficient failure to allow leakage flow to equalize the pressure on the hull structures. The reactor plant would then be subjected to the increased pressure and would subsequently be crushed and the pressure boundaries would be expected to fail. Crushing would be expected to occur because there would be no water to support the structures against deep-sea pressure, as there would be in sea disposals.

TABLE B-1. ESTIMATED COSTS OF DISPOSAL OPERATIONS

Initial Costs		
Plant Equipment	$	320,000
Transportation Route[(1)]		830,000
Transport Barge[(2)]		5,700,000
Total Initial Cost	$	6,850,000
Recurring Costs (per ship)		
Barge Operations	$	60,000
Jacking		160,000
Land Operations[(3)]		210,000
Total Recurring Cost	$	430,000
Prorata Initial Cost[(4)]		400,000
Total Cost of Disposal Operations[(5)]	$	830,000 per ship.

Notes: (1) Includes utilities relocation and engineering.
(2) Sized to transport two reactor compartments per trip.
(3) Includes crawler rental and transport, prorata burial pit preparation, and engineering.
(4) Basis: 10 disposals except 20 for specially-built barge (two disposals per trip).
(5) The estimated total cost of disposal operations for the alternative of using a leased barge modified to meet technical requirements is $820,000 per ship.

TABLE B-2. SHIPYARD LOCATIONS

California	Mare Island Naval Shipyard, Vallejo
Connecticut	Electric Boat Company, Groton
Hawaii	Pearl Harbor Naval Shipyard, Honolulu
Maine	Portsmouth Naval Shipyard, Kittery*
New Hampshire	Portsmouth Naval Shipyard, Portsmouth*
South Carolina	Charleston Naval Shipyard, Charleston
Virginia	Newport News Shipbuilding and Drydock Company, Newport News Norfolk Naval Shipyard, Portsmouth
Washington	Puget Sound Naval Shipyard, Bremerton

***Portsmouth Naval Shipyard is located in two adjoining states: Maine and New Hampshire.**

The consequences of such an accident would be less severe than those of the sea-disposal accident in which it was assumed that all containment would fail. This accident has been evaluated in Appendix J (Dose Commitment Estimates, Sea Disposal), and the results of the analysis are discussed in Chapter 4. The results indicate that the consequences of such an accident are not sufficient to preclude using Pearl Harbor to process decommissioned submarines for land disposal at Hanford or Savannah River.

2. River Limitations

a. **Columbia River.** The off-loading site on the Columbia River at Port of Benton is located at River Mile 342.8. A navigation channel is maintained up the Columbia River by the Corps of Engineers to River Mile 335 which ends approximately at the mouth of the Yakima River. The minimum dimensions of this channel are 14 feet deep by 250 feet wide at the channel bottom. Soundings of the remaining 8 miles to the Port of Benton indicate that adequate channel depth (14 feet) exists. However, since this stretch of the river is not maintained by the Corps of Engineers, the channel depth would need to be verified prior to use.

Starting at the mouth of the Columbia River, the Port of Benton is reached through a series of four locks at the Bonneville, Dalles, John Day and McNary Dams. Lock sizes are as follows:

Bonneville—76 feet wide, 500 feet long, 24.2 feet deep

Dalles—86 feet wide, 675 feet long, 18.0 feet deep

John Day—86 feet wide, 675 feet long, 15.0 feet deep

McNary—86 feet wide, 675 feet long, 22.0 feet deep

The limiting horizontal clearance is the lock system at Bonneville Dam. The limiting vertical clearance is a highway bridge at River Mile 328.4, (Pasco-Kennewick Highway Bridge) that is 52.3 feet above the 340 foot normal pool elevation of the McNary Dam impound. These limits are not expected to be restrictive.

b. **Savannah River.** The proposed off-loading site on the Savannah River is presently an abandoned small-boat basin near an abandoned barge wharf both at River Mile 157. The authorized project depth of the river channel to this point is 9 feet deep and 90 feet wide at the channel bottom. This project depth, however, is not routinely maintained. The normal depth is a minimum of 7.5 feet at low water. The limiting horizontal clearance for the river is the 90 foot width of the project channel. The limiting vertical clearances on the river are two fixed bridges, one at River Mile 61.5 (vertical clearance of 38 feet at low water) and the second at River Mile 119 (vertical clearance of 40 feet at low water). The water depth under both these bridges is 13 feet at low water (based on National Oceanic and Atmospheric Administration Nautical Charts 11514 and 11515). The Corps of Engineers can control water level by regulating flow from a dam upstream of the Savannah River Plant. There is no dam downstream of the Savannah River Plant and therefore river level cannot be controlled by water impoundment. The low water levels of the river occur during the months of May through October.

A 33-foot diameter reactor compartment could be barged up the Savannah River under the two fixed bridges by adjusting barge ballast to provide one to two feet of free board when passing under the bridges with an overall barge depth not to exceed 13 feet. Low profile reactor compartment support fixtures would allow the bottom of the reactor compartment to remain within two feet of the barge deck. The river level could be controlled at the low level and the shipments could be scheduled to occur during the months of May through October. (During the months of November through April, the river depth at River Mile 157 fluctuates 13 feet between flood high (EL 96 feet) and low water (EL 83 feet).)

Following the above precautions, a clearance of about 1 1/2 feet could be maintained between the lowest bridge and load and between the barge and river bottom. The low water river depth would need to be verified under the bridges at River Miles 61.5 and 119 prior to shipment.

3. Barge Operations

There would be some environmental impact due to barge operations because of the size of the reactor compartment and the number of compartments (approximately 100) to be transported. Both of these factors are a matter of degree since barge traffic is a current practice on both the Columbia River and the Savannah River, but land disposal would add to the total traffic approximately three trips per year for approximately 35 years. Background information on transport barges is provided below in Sections IV.A. and IV.C.4.c.

a. **Tug Boat Criteria.** There is no known requirement or regulation on the size or number of tugs required when making a tow of such material. For safety and reliability considerations, the use of a twin screw twin engine tug would be desirable.

Traffic that is classified as hazardous may be given special consideration by the U.S.C.G. Captain of the Port. The Captain of the Port may require special handling procedures which could define the number of tugs, time of tow, control of traffic, and any other factors that he would consider necessary to assure a safe shipment.

Whatever size or number of tugs would be used, they would have appropriate navigational and communication devices that would assure adequate control of the tow. For instance, a depth finder would be considered mandatory since the tow will transit close to the shoreline and the depth should be monitored continuously during that phase of the transit. For transit through closely controlled waters, the tow would be required to have a continuous radio watch and channel guard with the U.S.C.G. Vessel Traffic Control System. Also, transit in ocean waters would probably require communication with the respective Captain of the Port.

b. **Barge Ballasting.** During the off-loading sequence at either the Hanford Site or the Savannah River Plant, the barge would be ballasted with water to sink the barge onto the grounding pad. Also, transit to the Savannah River site would require the barge tank system to be partially filled to reduce the freeboard to clear two of the fixed bridges on the river. Once these bridges have been passed, the barge tank system would again be emptied to regain maximum stability and to reduce draft for the remaining transit to the off-loading site.

A portable ballast system consisting of individual submersible pumps and plastic piping would be adequate instead of a built-in system, since only selected tanks would have to be ballasted and deballasted. Since the stability of the barge is reduced by the free-surface effect of a partially-filled tank, no more than one tank at a time would be ballasted or deballasted. The centerline tanks would be used to reduce the freeboard when the load would pass under the Savannah River bridges. These tanks, because of their central location, would have less effect on stability than the set of cross-connected port and starboard tanks.

c. **Permits and Regulations.** A reactor plant prepared for disposal would meet Department of Transportation (DOT) regulations regarding marking, labeling, and packaging prior to shipment. For shipping purposes, the reactor compartment enclosing the reactor plant would be considered a single package composed of its radioactive contents and packaging. The ship's hull and the forward and after bulkheads would provide the packaging. The shipper would provide shipping papers and a certification to the carrier that the package is in accordance with the regulatory requirements regarding marking, labeling, and packaging. The package would meet the safety standards set forth in 10CFR71 (Subpart C), "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," Reference B.7, for normal conditions of transport and for hypothetical accident conditions. The package integrity and operational controls would be adequate to assure the safety of the shipment. Background information on applicable regulations is provided below in Section IV.C.

The major portion of the shipping route would be by water with the final portion being overland. Commercial carriers would have to comply with certain DOT regulations for transport of radioactive materials. These include not accepting a package for transport unless a shipper's certification is received that the package is in accordance with regulatory requirements, possession of shipping papers, preparation of a dangerous cargo manifest, reporting of incidents, and in the case of the overland portion of the route, application of placards to the vehicle. If a public vessel (Navy tug) were to be used, the DOT regulations would not apply to the water portion of the route.

The proposed water route to the Hanford Site, for example, falls under the jurisdiction of the Thirteenth Coast Guard District, and the Corps of Engineers has jurisdiction over the navigation locks that would be encountered. No regulation was found that would preclude the shipment of the subject package through the waterways, drawbridges, and navigation locks encountered in the proposed route. However, the various Captains of the Port would have to be notified 24 hours prior to arrival of the subject shipment in their respective areas.

Washington and Oregon, by virtue of a formal agreement with the NRC, have adopted regulations pertaining to intrastate shipment of radioactive material consistent with requirements of the DOT. Therefore, a shipment of radioactive material that would meet DOT requirements would also comply with regulations of Washington and Oregon.

No requirement for special licenses or permits was found for the proposed route and method of transport by virtue of the shipment being radioactive. This does not preclude licenses or permits required by the carriers to engage in commerce. It is concluded that the subject shipment could be made over the route and via the mode of transport proposed within the framework of existing federal and state regulations governing the transport of radioactive materials.

4. Off-Loading Sites

a. **Hanford Site—Port of Benton.** The optimum unloading place on the Columbia River for transporting a reactor compartment to the Hanford Site would be an existing barge slip in the Port of Benton Industrial Park located on the northern edge of Richland, Washington. Commercial nuclear power plant components weighing as much as 1,000 tons have been unloaded at this barge slip. In discussions with the contractor who unloaded the components, Neil F. Lampson Inc., Kennewick, Washington, it was determined that the barge slip is adequate for this type of operation.

The existing barge slip was constructed in 1972 for use by Westinghouse at the Port of Benton Industrial Park located on the northern edge of Richland. The industrial park consists of a 12 acre tract and a 280 acre tract. This land was deeded to the Port of Benton by the Government on a Quit Claim Deed in 1969. The deed stipulates that the 12 acre tract adjacent to the Hanford Site may be used for construction of public port facilities only and the 280 acre tract is restricted to industrial use only. The barge slip was constructed on the 12 acre tract under terms of a 1972 contract between Westinghouse Hanford Company and the Port of Benton.

The barge slip is approximately 1/4 mile south of the Hanford Site at River Mile 342.8. The slip has cellular sheet pile bulkheads on the upstream and landward sides and a riprapped bulkhead on the downstream side. (See Figure B-2.) The slip has a 60 × 150 foot gravel grounding pad at an elevation of 330 feet (based on Corps of Engineers Sea Level Datum 1947) which provides 8 to 10 feet of water at normal water conditions of 338 to 340 feet elevation. Gravel is added to or removed from the grounding pad as required to place the deck of the specific barge being used level with the top of the bulkheads. The 1972 Westinghouse contract with the Port of Benton requires that the user is responsible for preparation of the slip bottom to accommodate particular barges and must leave the slip bottom height between 10 to 14 feet below the height of the dock after each use. The landward bulkhead is capped by an 8-inch thick reinforced concrete slab, 8 feet in width. The remaining bulkhead areas have gravel surfacing. Existing mooring hardware is minimal and consists of 3 cleats. The maximum size barge which can be fully grounded at the existing facility is 60 × 150 feet; however, by using special grounding techniques a longer barge could be accommodated. The existing slip could also be modified to accommodate a wider barge with a mimimum of effort and expense (not more than approximately $50,000). However, present studies indicate that a barge wider than 60 feet would not be required for transporting a submarine reactor compartment.

There would be some relatively small environmental impacts associated with the use of the barge slip because the barge would need to be grounded each time, to unload the reactor compartment, and this would probably require that gravel in the grounding pad be adjusted. This would involve some relatively small cost and would disturb any accumulated sediment and marine life in the grounding pad. Additional cost and environmental disturbance would be involved if the slip needed to be modified, but this is not expected to be necessary.

b. **Savannah River Plant.** At the present time, no facility exists on the Savannah River that would be suitable for off-loading a reactor compartment to be buried at the Department of Energy's Savannah River Plant in South Carolina. An abandoned sheet pile barge landing wharf, an abandoned small boat basin, and a surfaced boat ramp are located at River Mile 157 at the Savannah River Plant. The small boat basin is adjacent to the wharf on the upstream side. The boat ramp, located approximately 50 feet upstream of the small boat basin, has a 21-foot wide black topped surface and exits the water at about 7 percent grade. Farther upstream, about 1/4 mile, is a dredged inlet canal used as a cooling water supply for the site. The canal is 500 yards long and approximately 50 yards wide. Upstream of the canal approximately 200 yards is the mouth of Upper Three Runs Creek. Downstream, the remaining shore bordering the river at the Savannah River Plant is extensive swamp land.

The concept for unloading facilities for the Savannah River Plant consists of a barge slip and grounding pad constructed in the small boat basin, as shown in Figure B-3. The alternative would be to use a crane at the abandoned wharf. Of these two options, the construction of the barge slip and grounding pad would be more feasible for the following reasons:

(1) A suitable access road exists to the area of the wharf, the small basin, and the boat ramp.

(2) The existing abandoned wharf would require the use of a crane for off-loading the reactor compartment due to the height difference between the nominal land level and the river surface. It is possible to install a stiff leg derrick or other crane at this site. An installed stiff leg derrick would cost approximately $3 million. The sheet pile bulkhead of the wharf appeared to be in satisfactory condition, however, the condition of the buried tie rods and piling anchors has not been verified. The timber fender piles would possibly require upgrading or replacement.

(3) The existing boat ramp site could possibly be used as a barge slip site but would have to be modified extensively by widening and contouring to facilitate off-loading. The ramp itself would have to be removed to make room for a barge grounding pad and a sheet pile slip constructed for unloading with a crawler. The barge would also extend farther into the river during unloading than if a barge slip were constructed in the small boat basin.

(4) The cooling water intake canal is considered unsuitable for use as an unloading site. The canal contains several subsurface pipes used to relieve pressure from subterranean water sources. It is possible to off-load just upstream of the entrance to the canal, however, river flow and soggy land would present major problems in construction of a barge slip and access road.

(5) The use of Upper Three Runs Creek for an unloading site would be undesirable because of its use for environmental studies, heavy timber along the shore, and extensive marsh lands adjacent to the creek.

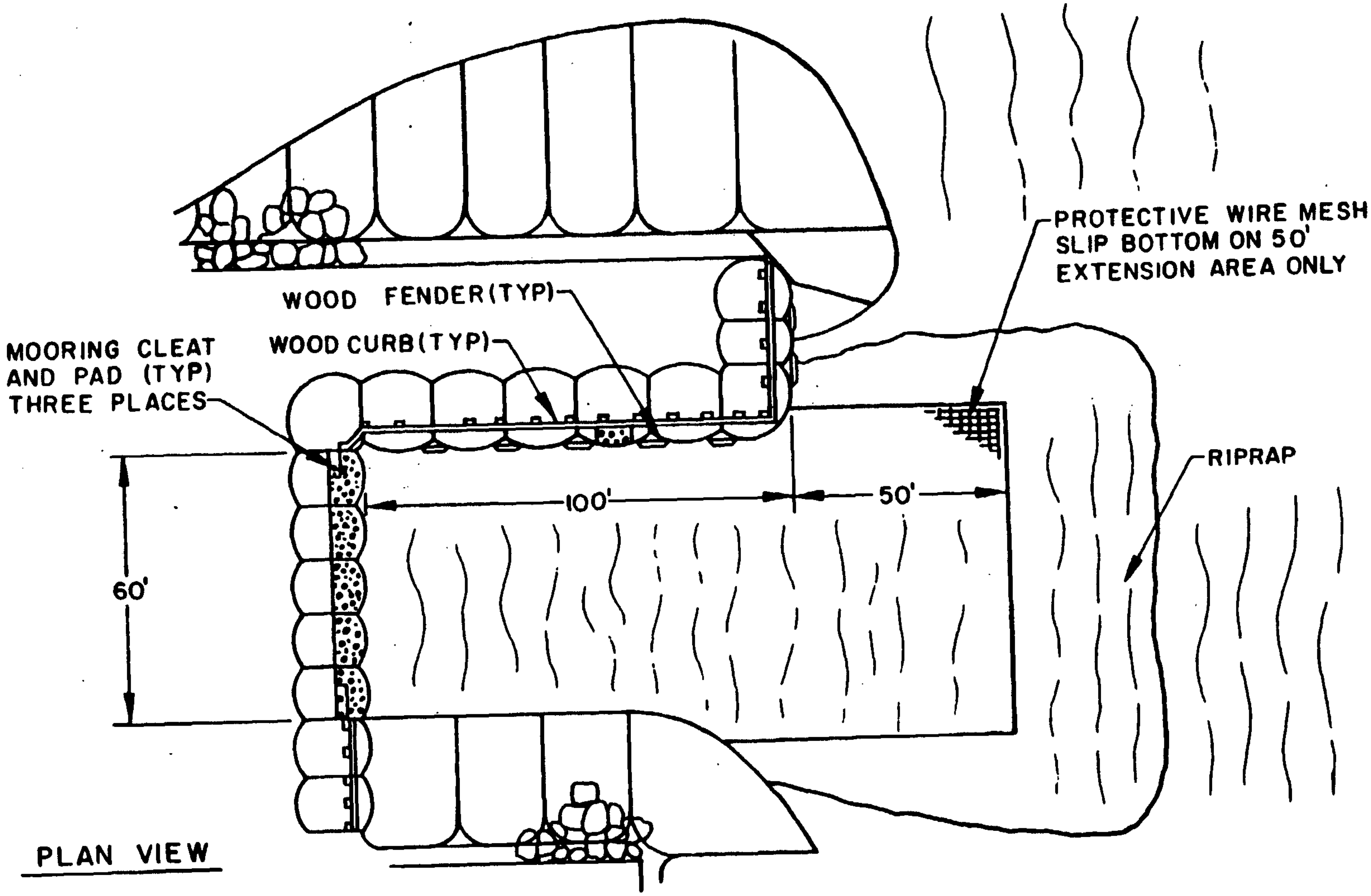
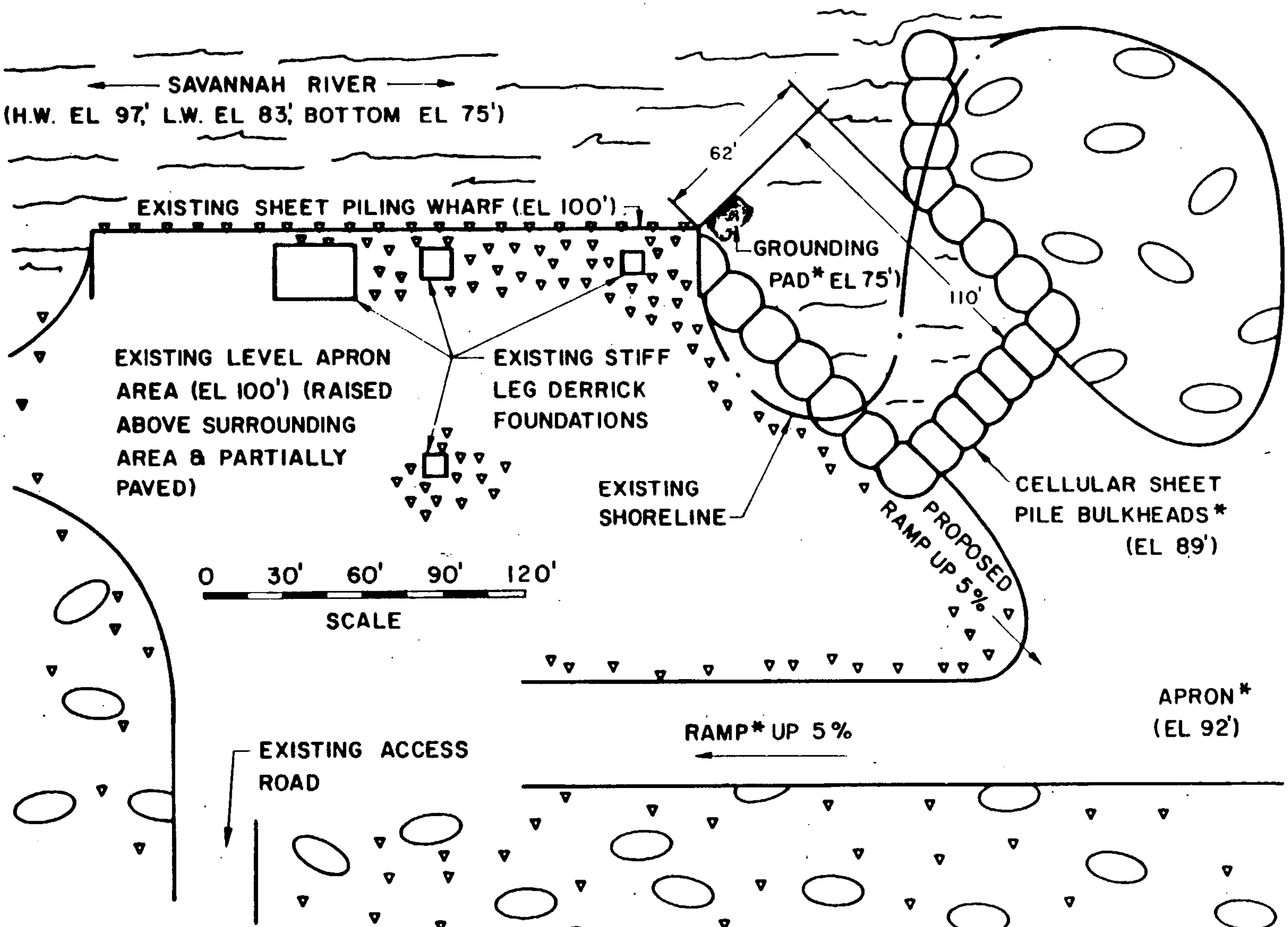


Figure B-2. Barge Slip at Port of Benton near Hanford Site



* ITEMS MARKED ARE PART OF THE CONCEPTUAL DESIGN AND DO NOT EXIST AT THIS TIME.

Figure B-3. Conceptual Design of the Potential Barge Slip at Savannah River Plant

(6) The remaining shore bordering the river at the Savannah River Plant is extensive swamp land.

(7) The use of a barge slip and grounding pad on the Savannah River would be limited to those months of the year with low water flow (May through October). During the months of November through April, the river fluctuates and may be too high to allow transporting the reactor compartment under fixed bridges that cross the river.

The estimated cost for construction of a barge slip such as that illustrated in Figure B-3 is approximately $1,300,000. This would include: pre-construction surveys, design, and assessment of environmental impacts; materials and labor for construction; and associated overhead and administrative costs.

There would be some environmental impacts associated with the construction and use of the barge slip due to disturbing the river bank and the local habitat and to the costs of construction and subsequent use. Additional impacts associated with silting and habitat disturbance would be involved due to the dredging of the river to open the channel to obtain sufficient clearance near the unloading site. These impacts are similar to other impacts that are a part of existing barge usage along the Savannah River. Details on the assessment of impacts on the floodplain and wetlands associated with the selection of the unloading site are provided in Appendix L.

5. Barge Unloading

The Port of Benton barge slip near the Hanford Site or the one proposed for the Savannah River Plant (see Figures B-3 and B-4) would be utilized to off-load the reactor compartment from the barge. In order to accomplish this, the elevation of the grounding pad at the slip would have to be adjusted prior to barge arrival so that upon grounding the barge, the deck would be approximately level with the top of the quay wall (within 4 or 5 inches). After the barge was grounded, timber mats would be used to construct a transition between the barge deck and the haul road, with gravel used to build up the road as required. If the barge were to extend past the end of the grounding pad at the slip, special grounding techniques are available which could be used to ensure that the barge would remain stable and level.

The unloading procedure would be applicable to either the Port of Benton or Savannah River unloading sites. Jacking is required to raise the compartment above the barge deck to allow loading onto the crawler. This would be accomplished as follows: A timber mat would be installed on the barge deck level with the top of the load beams and a road transition constructed dockside to match the timber mat. Jacks and cribbing would be installed at the jacking points. The welds securing the support fixtures would be cut and the reactor compartment jacked and cribbed to allow a crawler to be positioned under the support fixtures. The unit would then be lowered with the jacks until the previously attached pads on the reactor compartment would rest on the crawler. The compartment would be secured to the crawler and the unit would then be ready for the overland trip to the burial site. Background information on the use of the crawler is provided below in Section IV.B. In order to support jacking operations, temporary services would be required to support weight handling operations. Submersible pumps and piping, and a power supply for the pumps would be required to ballast and deballast the barge.

6. Overland Route from Unloading Site to Burial Site

a. **Hanford Site.** There are currently existing road facilities from the barge slip to the proposed burial site. The total overland distance is approximately 31 miles. At a transporter speed of 1 mph, the overland haul would take approximately one and one-half days.

There would be some relatively small environmental impacts resulting from using the anticipated route. Costs would be involved in raising or moving overhead utility lines (electric power and telephone, for example), in providing load-distribution or reinforcing structures, in having an architect engineer evaluate the load-carrying capacity of existing unloading docks and roadways, and, if necessary, modifying them. Traffic along the public part of the route would be affected temporarily, but this impact could be minimized by scheduling the moves to avoid the periods of peak traffic. These impacts are similar to the corresponding impacts that occurred when large components for the Hanford reactors were moved by barge and roadway to their present locations at the Hanford Site.

The first one-quarter mile is off the Hanford Site. The slip access road is a 28-foot-wide gravel road which includes a 6 percent grade. (See Figure B-4.) The remaining distance to the reservation is one block along "C" Avenue, a little-used two-lane road. Both of these roads lie within the industrial park operated by the Port of Benton. A map of the Hanford Site is located in Chapter 3, Figure 3-2.

The Hanford Site is encountered upon crossing Horn Rapids Road. A one-mile-long unimproved transporter route has already been cut diagonally across country to connect with Hanford Route 4 South, a four-lane road leading toward the burial areas. Approximately the first nine miles of this route have been used to transport loads in excess of 1,000 tons with no apparent problem. Previous experience indicates that the use of one lane in addition to the shoulder or median strip provides an adequate haul surface for a crawler when using the four-lane roads while still allowing near-normal traffic flows. After approximately nine miles, Route 4 branches to the left of the Wye barricade and becomes a two-lane highway. The original four-lane road continues straight ahead as Hanford Route 2 South. Both roads connect to Hanford Route 11A which leads directly to the 200W area burial site. Either of these routes would be sufficiently wide and are properly sloped and graded to accommodate a crawler transporter. Although Hanford Route 2 may be preferred because it is wider and less traveled, the final selection would probably be Hanford Route 4 based on the cost of raising Route 2 overhead electric power lines, as discussed below. If Hanford Route 4 were to be selected, scheduling of the move would be arranged to avoid blocking the two-lane roadway during morning and evening peak traffic, as this is the main route for workers from N Reactor and the 200E and 200W areas.

A third route was also investigated. The unimproved telephone right-of-way, leading from the 300 area near the Port of Benton, connects with the Army Loop Road which leads directly to the burial area via Route 3. It appears that the telephone right-of-way could be extended to the burial ground, but there is an extensive radiologically controlled area between the loop road and the 200W area which cannot be traversed. Although there are few overhead utilities on this route, the 13 mile unimproved road would have to be extensively widened, cut and filled, and the 14 mile paved Army Loop Road is only 20 feet wide which would not accommodate a 28 foot transporter. Therefore, this route was not considered further.

Several overhead utilities would need to be relocated to clear the approximately 42 foot height of the loaded crawler.

The Bonneville Power Administration, in a letter to D.O.E., Richland on 27 June 1978, indicated that the minimum safe clearance to an energized line is 6 feet for a 115 KV line, 7 feet for a 230 KV line, and 13 feet for a 500 KV line.

Travel to the burial site via Hanford Route 4 would require raising one 115 KV and seven 13.8 KV or smaller power lines at an estimated total cost of $158,000. If Hanford Route 2 were selected, it would be necessary to raise four 115 KV and eight 13.8 KV or smaller power lines at an estimated total cost of $225,000.

In addition, approximately five telephone lines, approximately five guy wires, and at least one set of traffic signals would have to be raised or removed for either route.

Route 4 crosses a set of underground radioactive waste transfer lines and an export water line. Route 2 crosses two export water lines. These crossings may require load distributing timber or other strengthening to bear the weight of a loaded crawler. An architect engineer would have to evaluate the need and specify requirements.

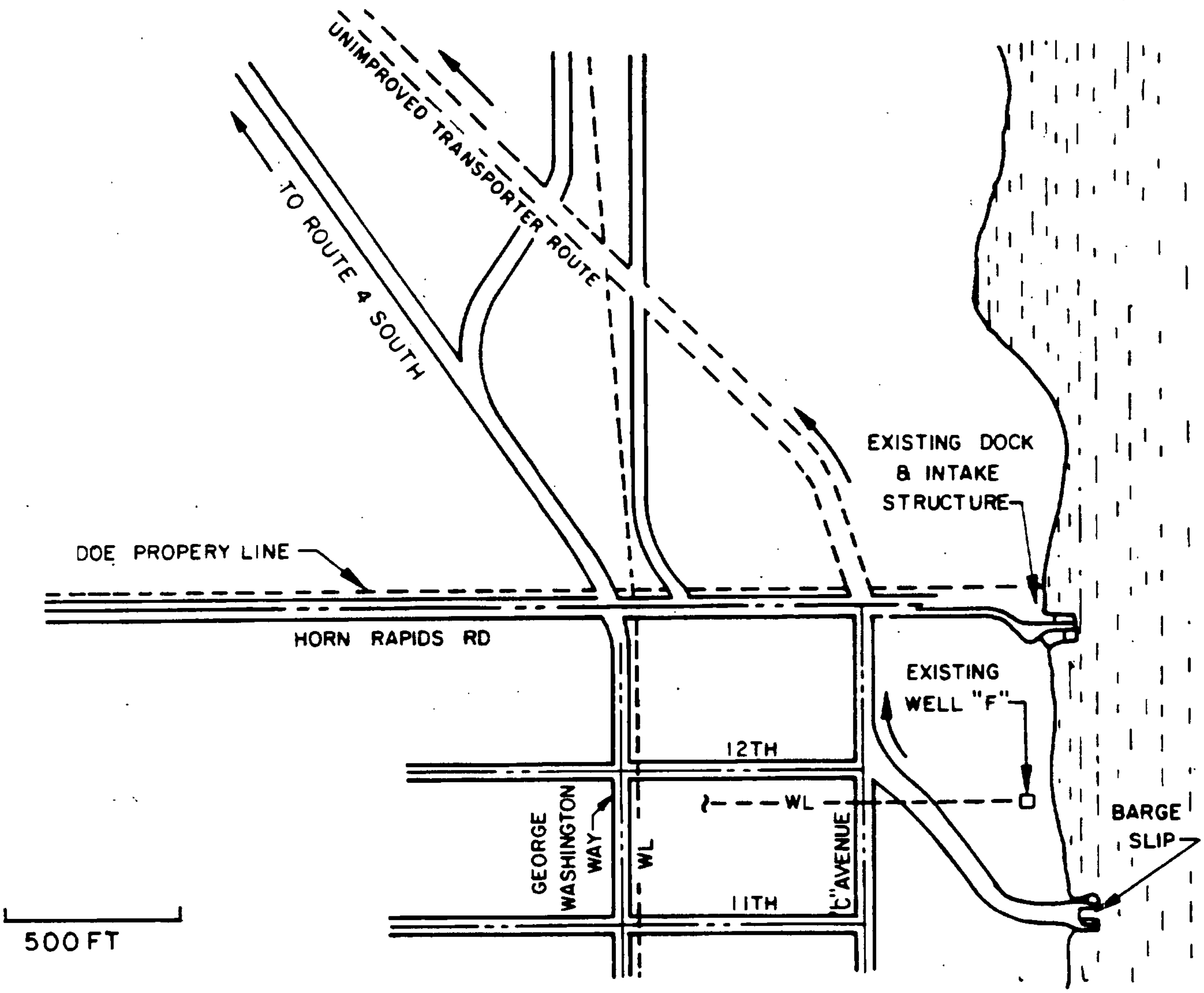


Figure B-4. Debarkation Area at Port of Benton

Several railroad tracks would be crossed on either route. These would pose no problem except three of the crossings have signals on arms cantilevered over the roadway. It appears that the crawler could be maneuvered around these obstructions, although it may be more appropriate to arrange to loosen four clamp bolts and swing the arms out of the way.

The load carrying capacity of the unloading dock and all roadways would need to be evaluated prior to accomplishing the haul to the burial site. A preliminary road investigation has been conducted by the Department of Energy, Hanford. However, a final evaluation would need to be made by an architect engineer, similar to the Road Evaluation Study made in 1973 for transferring Fast Flux Text Facility components from the Port of Benton to the site.

Based on the cost of revising overhead utilities and provided the load bearing capacity of the road is adequate, the two lane Route 4 would be more appropriate for the crawler route to the burial site.

b. **Savannah River Plant.** The route from the proposed off-loading site, near the abandoned barge landing wharf area on the river, to the burial ground is approximately 9.3 miles long. (See Figure B-5.) The criteria used in selecting the route were to make maximum use of existing roads or right-of-ways and to keep the distance as short as practical.

There would be some environmental impacts resulting from using the anticipated route. Costs would be involved in raising or moving overhead utility lines, in improving some of the road surfaces, and in providing load distribution or reinforcing structures where the route crosses over underground piping. The land route would be entirely within the site which is a closed government site except for controlled through-traffic on South Carolina Highway 125 and the Seaboard Coastline Railroad, both of which would be crossed. The crossings would be scheduled to avoid periods of peak traffic and would be controlled to assure the safety of the parties involved. These impacts are similar to previous ones which occurred when large components for the Savannah River reactors were moved by barge and roadway to their present locations at the site. Details on the assessment of impacts on the floodplain and wetlands associated with the selection of the overland route are provided in Appendix L.

Starting at the proposed off-loading site on the river, the route would be as follows:

(1) Northeast along the dock access road for 0.3 mile to River Road. This road has a 21-foot wide pavement and is 33 feet wide shoulder-to-shoulder.

(2) Southeast on River Road for 0.6 mile to Road 3. River Road has a 21-foot wide pavement and is 33 feet wide shoulder-to-shoulder.

(3) Northeast on Road 3 for 2.3 miles to a 115 KV power line right-of-way. The width is adequate for the crawler.

(4) North on the 115 KV power line right-of-way for 0.4 mile to the start of Burma Road. There would not be a problem with interference of the power line along the right-of-way. The right-of-way would need to be bladed and widened at some points for the crawler.

(5) Northeast on Burma Road for 4.5 miles to four-lane Highway "C". The first 0.3 mile of Burma Road is paved. The next 1.1 miles is an abandoned dirt road that would need blading to permit crawler passage. The last 3.1 miles on the Burma Road is a recently improved dirt road and would be satisfactory. Large trucks have used this last portion of the road with no difficulty. The width is adequate for the crawler.

(6) Southeast on Highway "C" for 0.4 mile to a two-lane paved road, Highway "E". The width is adequate for the crawler.

(7) East on Highway "E" for 0.8 mile to the burial ground entrance. Highway "E" is a good paved two-lane road with a 21-foot wide pavement and is 33 feet wide shoulder-to-shoulder.

The personnel at the Savannah River Plant have stated that there would be no difficulty with blockage of two-lane paved roads for the time required for passage of the crawler.

To obtain the estimated 42-foot vertical clearance required for the loaded crawler, three 115 KV power lines may have to be raised, one on Road 3 and two on the Burma Road. Some guy wires for power poles along the 115 KV power line right-of-way would also have to be relocated or temporarily disconnected.

The tentative haul route crosses two cooling water supply lines, a 72-inch diameter line on River Road, and a cooling water lateral along the 115 KV power line right-of-way. A liquid transfer line in the burial ground would also be crossed. Additional investigation would be needed to determine the amount and method of bridging or strengthening that these underground lines would require.

Two sets of railroad tracks, one on Road 3 and the second in the burial ground, would need to be crossed.

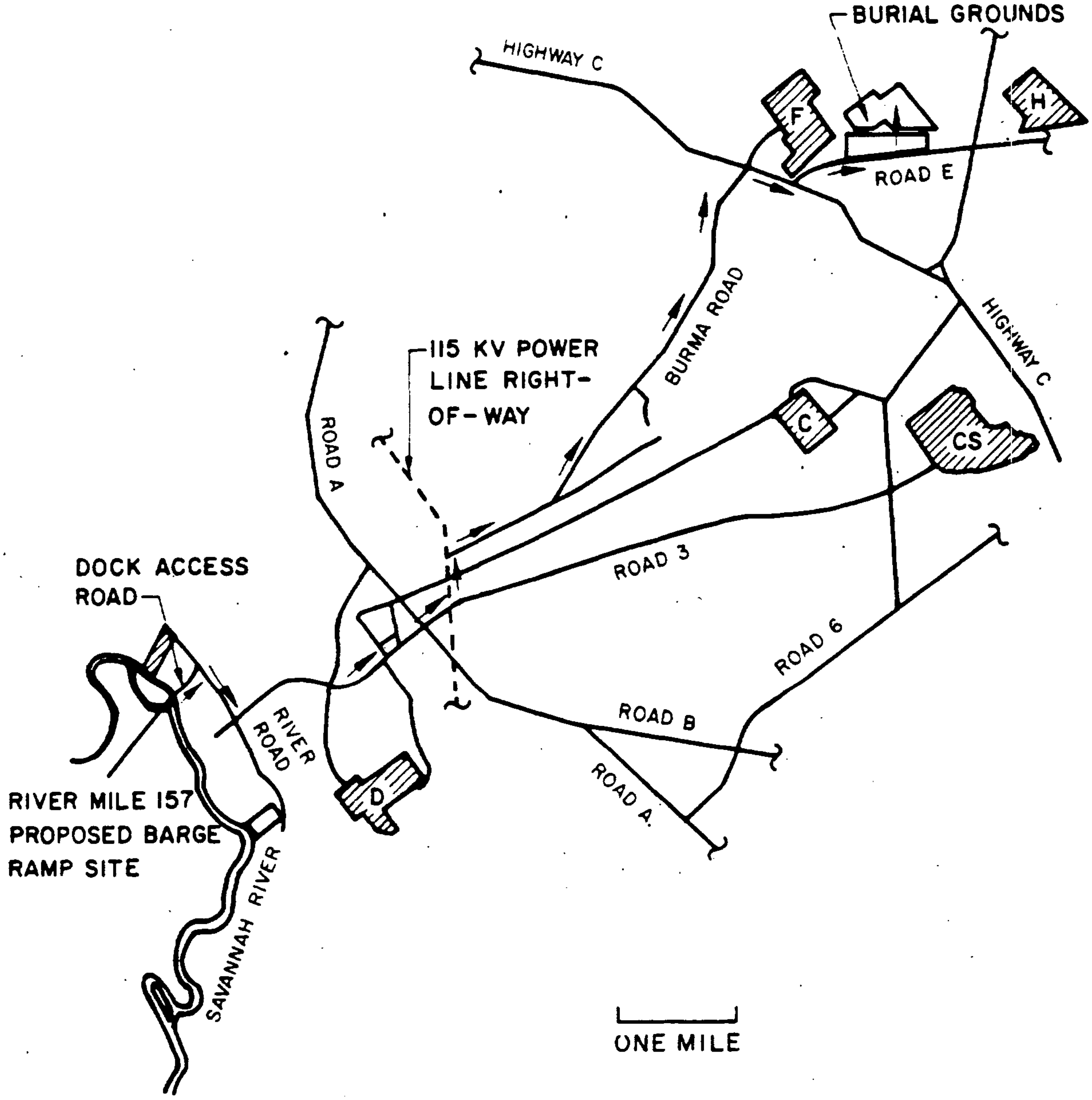


Figure B-5. Crawler Route at Savannah River Plant

E. BURIAL SITE OPERATIONS

1. Burial Site Soils

The proposed burial location for the Hanford Site lies along the west boundary of the 200W Separations Area. The site soil is sandy—gravelly having a water table level 250 feet below grade. This soil is very dry since the average rainfall (6.25 inches per year) does not penetrate to the groundwater table, but rather penetrates only to a shallow depth, and is subsequently given off from the ground surface by evaporation. The reactor compartment would be buried with a minimum cover of eight feet of soil to meet technical standards at the Hanford Site.

At the Savannah River Plant, technical standards require that all solid radioactive waste be stored with a cover of at least four feet of soil and with at least ten feet of undisturbed soil between the permanent groundwater table and the stored waste. An annual rainfall of 47 inches results in some perched water tables in the burial area. Excess surface water is controlled at the Savannah River Plant burial ground by the use of trenches dug around the burial areas.

2. Size of Pit

To allow maximum utilization of the burial ground, it is planned that a long trench would be dug to allow placement of a number of reactor compartments in a row. The bottom of the trench would be flat and approximately 42 feet wide. Entry to the trench would be via a ramp with a 5 to 6 percent grade. For the most economical use of the burial ground, additional rows of reactor compartments would be buried adjacent to the first row. If this scheme were used, the first row would only be partially backfilled initially to allow access to the adjacent second row. It is estimated that approximately 12 reactor compartments could be buried adequately in one acre of ground, and that eight to ten acres would be sufficient to bury 100 compartments.

At Hanford, concrete blocks would be placed to support the reactor compartment when the load is transferred from the crawler by jacking. Due to the nature of the soil, the trench sides would slope outward at 45° Excavation would be accomplished using the Hanford Site's dragline equipment.

At the Savannah River Plant, the reactor compartments would be jacked down to pier supports at the bottom of the trench after the load was transferred from the crawler to temporary blocks and the crawler was removed. The sides of the trench could be almost vertical because of soil conditions in the area. Other considerations of the trench would be similar to those for the Hanford Site. The trench would be prepared using local grading equipment.

3. Unloading Compartment from Crawler

Burial would be accomplished by driving the crawler, with attached reactor compartment, down a dug ramp and into the trench between preplaced pier supports. When in position, jacks would be used with blocking and cribbing to raise the compartment to allow removal of the crawler from the trench. The compartment would then be lowered and secured to the pier supports.

The trench would be backfilled to bury the reactor compartment with the required amount of soil coverage using equipment available at the site.

F. SAFETY OF TRANSPORT

Detailed engineering studies have been performed to assess the safety of shipping a deactivated submarine reactor compartment to a land burial site. The packaging and transportation would be governed by the requirements specified by Title 10, Code of Federal Regulations, Part 71 (10CFR71), Reference B.7. The results of the engineering studies indicate that the shipment would comply with all specified requirements. If the land disposal option is employed, the Navy would satisfy all requirements of the Nuclear Regulatory Commission Transportation Certification Branch to obtain approval for the use of the reactor compartment package for shipment of radioactive material. Specific information from the engineering studies is summarized below.

The reactor compartment was analyzed for use as its own shipping and disposal package. The cylindrical pressure hull together with the forward and aft bulkheads would be the containment boundaries for the reactor compartment. Requirements for the containment of radioactive material being transported under normal and accident conditions are specified by 10CFR71. Both normal and accident transport conditions are discussed below.

1. Normal Transport

The shipment would comply with the requirements for normal transport conditions as specified by 10CFR71. The requirements involve evaluating the reactor compartment under free drop, puncture, heat, cold, pressure, water spray, and vibration conditions and then comparing the results with specific requirements for normal transport.

If the reactor compartment were to fall 1 foot, the hull would be deformed locally approximately 2 3/8 inches, and the contents of the reactor compartment would experience an impact deceleration of 11 g. There would be no significant damage because the local deformation would not affect the integrity of the containment, and the calculated deceleration would be much lower than the design shock load for submarines. Additionally, it would be expected that the reactor compartment would not be able to drop a distance of 1 foot. During disposal operations which involve raising or lowering the reactor compartment, jacking and blocking would be such that no more than a 1-inch free drop could occur.

Reactor compartment integrity was also assessed by evaluating the effect of various impact conditions which might cause the reactor compartment to be punctured. One hypothetical impact condition involved striking the exposed bulkhead with a 150-pound bar, 6 inches in diameter, having the energy equivalent to a 15-foot free drop. The results indicated that the energy of the bar would be approximately 30 percent of the minimum energy required to puncture the bulkhead and no puncture would occur. A second impact condition involved striking the area which would be most vulnerable to penetration with a 13-pound steel cylinder, 1 1/4 inches in diameter, dropping from a height of 40 inches. The area most vulnerable to penetration is the bulkhead, and the results indicate that the energy of the steel cylinder would be approximately three percent of the minimum energy required to puncture the bulkhead and no puncture would occur.

If the reactor compartment were subjected to an ambient temperature of 130°F in direct sunlight, the structures in the reactor compartment would achieve a temperature of less than 187°F. Structures inside the reactor vessel would be heated further by the energy released by the normal processes of radioactive decay. The heat produced would be mostly due to the decay of Cobalt-60 and would produce a temperature of less than 530°F in the hottest part of these structures. These temperatures are less than normal service temperatures and would cause no damage to the reactor compartment. The associated pressure increase would be less than 27 psia, would be well within the design capability of the reactor compartment, and no damage would occur.

If the reactor compartment were subjected to an ambient temperature of −40°F, differential thermal contraction may cause local yielding, but it is not expected to affect the integrity of the reactor compartment. Additionally, the steels which make up the hull and bulkheads have good material properties at temperatures lower than −40°F; therefore, no brittle fracture failures would occur.

If pressure equal to 0.5 standard atmospheric pressure (7.4 psi), were applied either on the outside or on the inside of the reactor compartment, there would be no damage to the reactor compartment.

If the reactor compartment were subjected to water spray sufficiently heavy to keep the entire exposed surface continuously wet for 30 minutes, no water would be able to enter the reactor compartment because it would have been closed and sealed at the shipyard. Additionally, the reactor compartment would be tested for leaks prior to shipment.

During normal transport, the reactor compartment would be subjected to vibrations over a broad spectrum of frequencies. Conservative calculations were made to determine what frequencies would occur during shipment for disposal, and those frequencies were compared to the design limits for the reactor compartment. The results showed that the vibrations incurred in transporting the reactor compartment would occur at frequencies that would be less than one-fourth of the design frequencies of the reactor compartment and reactor compartment components. Therefore, there would be no resonance and no damage to the reactor compartment would occur due to vibration.

Radiation levels outside the reactor compartment during normal transport conditions would not exceed the criteria specified in Title 49, Code of Federal Regulations Part 173 (49CFR173), Reference B.8, which require that the radiation levels not exceed 10 mrem per hour at 6 feet from the hull or 200 mrem per hour on contact with the package surface. Conservative shielding calculations demonstrated that these requirements would be satisfied. Additionally, a detailed radiation survey at the shipyard would be performed before transport to confirm that the radiation levels would be within the requirements.

2. Accidents

The engineering studies also showed that the shipment would comply with the requirements for hypothetical accidents specified in Appendix B of 10CFR71, Reference B.7. The requirements involve evaluating the reactor compartment under free drop, puncture, and thermal accident conditions and then comparing the results with specific requirements.

If the reactor compartment were to fall 30 feet onto an unyielding surface, the maximum dynamic impact force would occur on the aft bulkhead in an end drop orientation. This would do the most damage to the internal components and some of the components might break free of their foundations. These internal components would not break through the pressure hull or the bulkheads due to the bluntness of the components and the strengths of the hull and bulkhead materials. The reactor vessel would not be damaged and would remain in its normal position. As a result, the reactor compartment containment would not be ruptured.

If the reactor compartment were to fall 40 inches onto a 6-inch diameter mild steel bar mounted vertically on an unyielding horizontal surface, the hull would probably be punctured. The bar would not penetrate the reactor vessel but it might puncture the shell of the steam generator and some of the heat-exchanger tubes might be ruptured, depending on the orientation of the drop.

Since the reactor compartment containment could be penetrated by the accident conditions identified above, a conservative estimate of the radioactivity which might be released under these accident conditions was made. The results of this analysis were then compared to the allowable limits specified in 10CFR71 and are presented below.

More than 99.8 percent of the radioactive material in the reactor compartment is due to neutron activation of the structural materials within the reactor compartment. This radioactive material cannot become loose and be released from the reactor compartment under accident conditions. Only the surface-deposited activated corrosion products could potentially become available for release.

The activated corrosion products amount to a total of approximately 66 curies of radioactive material. This material consists of normal corrosion and wear products, originally carried by the reactor coolant, which had adhered to all wetted surfaces inside the reactor vessel, pipe walls, and steam generators. Most of this material is tightly adherent and only a small fraction would be released if a severe shock to the reactor compartment were to occur. In developing an estimate of the activity to be released, it has been conservatively assumed that 33 percent of the deposited activity is "loose" and would be available for potential release under accident conditions. The amount of loose activity assumed represents an upper limit based on shock tests, and the actual amount of loose material present would be expected to be less than 33 percent.

Because of the complex geometry of the primary coolant system, only a small fraction of the loose material could be released under accident conditions. It was conservatively assumed that 100 percent of the loose activity in the steam generators, and 20 percent of the loose activity in the reactor vessel, purification system, and main coolant piping could enter the reactor compartment.

Only a small fraction of the radioactivity that could enter the reactor compartment could be released to the environment because the release paths would be blocked by shut valves, welded closures, and similar barriers. Since the majority of the time in transport would be over water, it was conservatively assumed that the reactor compartment would be immersed in water during this accident. This could allow approximately 50 percent of the radioactivity loose in the reactor compartment to be released to the environment.

Based on the conservative assumptions presented above, a maximum total of approximately 3.5 curies could be released to the environment due to these hypothetical accidents. This amount would be less than 10 percent of the limit specified by 10CFR71. Additionally, the requirements in 10CFR71 specify that of the total number of curies released, only certain amounts of specifically grouped radionuclides can be released. The total was broken down into the radionuclide groups specified and the results showed that the amount of grouped radionuclides released would be less than 25 percent of the limits specified by 10CFR71.

If the reactor compartment were subjected to a 1475°F fire during an accident, there could be some melting of the lead shielding in the reactor compartment. The remainder of the reactor compartment would not be materially altered by the fire. Since some of the lead shielding could be melted and the containment of the reactor compartment could be penetrated as a result of the other hypothetical accidents identified above, a shielding evaluation was performed to determine external radiation levels.

The requirements in 10CFR71 specify that, under hypothetical accident conditions, the maximum radiation level at 3 feet from the hull must not exceed 1000 mrem per hour. It was conservatively assumed in the shielding calculations that no lead shielding would remain in place in the reactor compartment. The analysis showed that a maximum radiation level of 988 mrem per hour at 3 feet from the hull could occur; therefore, the requirements of 10CFR71 would be met. The actual presence of some of the lead shielding would lower the actual radiation levels compared to the calculated levels.

The potential structural damage to the reactor compartment and its contents is concluded to cause no condition which would exceed specified limits for normal transportation and hypothetical accident conditions. All analyses were done conservatively to ensure that the conclusions based on them would be safe ones.

G. MONITORING

Both Hanford Site and Savannah River Plant monitor their areas for potential releases of radioactivity to the environment, and they periodically report the results of their environmental monitoring in several series of reports:

1. Hanford Site

a. Groundwater data and evaluations are reported in the series, "Radiological Status of the Groundwater Beneath Hanford Project for . . . (the specified period)."

b. Data from locations within the plant boundaries are presented in the annual "Environmental Status of the Hanford Reservation for . . . (the specified period)."

c. Data from offsite locations are presented in the annual "Environmental Surveillance at Hanford for . . . (the specified period)."

d. Summary information is available in Reference B.1.

2. Savannah River Plant

a. Offsite data and evaluations are reported in the annual "Environmental Monitoring in the Vicinity of the Savannah River Plant. Annual Report for (the specified year)."

b. Summary information is available in Reference B.3.

The results of these evaluations are summarized in Table B-3 which lists the population doses for the areas surrounding the two sites due to their total operations. References B.1 and B.3 should be consulted for details regarding the calculation of these results. Further information on monitoring the disposal sites is provided in Appendix K (Monitoring Program).

TABLE B-3. SUMMARY OF POPULATION DOSES AT HANFORD AND AT SAVANNAH RIVER

Site:	Hanford	Savannah River
Natural Background, man-rem/yr	27,000	86,000
Maximum Due to Operations:		
Whole Body, man-rem/yr	2.5	131
Thyroid, man-rem/yr	12	73
Lung, man-rem/yr	2.5	0.004

IV. BACKGROUND

This section provides background information that would be useful to most readers, but might not be readily available.

A. TRANSPORT BARGE

A flat deck ocean barge would be used to transport the reactor compartments to the burial site. This barge would be required to have a deck load rating of approximately 20,000 pounds per square foot, and to be capable of remaining stable after sustaining damage that would flood two of its watertight compartments if it were in an accident. The maximum sized barge which could be fully grounded at the existing barge slip at the Port of Benton and the proposed Savannah River unloading sites is 60 feet by 150 feet. However, by using special grounding techniques, a longer barge could be accommodated. The maximum barge height which could be used for Savannah River transports would be limited to 13 feet because of the minimum bridge clearance of 38 feet at low water at River Mile 61.5. A similar barge height restriction does not exist for barge transport on the Columbia River.

Demurrage rates for a 204 foot × 47 foot × 12.75 foot barge, for example, would be about $700 a day based on a 60-day use. Transportation of such a barge from the East Coast to Bremerton, Washington would take approximately 25 days and cost about $210,000 (this includes barge demurrage for the 25 days). If the barge were needed at Puget Sound for 60 days to load the reactor compartment, transport the reactor compartment to Hanford and unload, the cost would be approximately $250,000 for the 60-day period.

Over a period of 20 years, assuming that 1 1/2 ships per year would have the reactor compartment removed and disposed of, and that the barge would be available locally after the first usage, the total cost of renting the barge is estimated to have a present value of $6.3 million.

The cost of constructing a barge for the purpose of transporting reactor compartments has also been investigated. The barge would be designed for a 20,000 pounds per square foot deck loading and would be constructed with two longitudinal watertight bulkheads and transverse watertight bulkheads every 30 feet of barge length. The outboard compartments would be cross-connected with 6-inch diameter piping to prevent listing in the event of rupture of an outboard compartment. The proposed barge would have the basic dimensions of 150 feet × 48 feet × 12.75 feet and would displace 360 tons. The barge with a 1000-ton load would have a draft of about 7 feet-6 inches, leaving a freeboard of 5 feet-3 inches. The barge materials would be mild steel.

The cost for constructing the 150 foot × 48 foot × 12.75 foot barge was estimated to be $2.9 million in 1981 dollars. Maintenance was estimated at $8,800 per year. Over a 20-year period, the total cost of building and maintaining a barge would have a present value of approximately $3.0 million. The cost of constructing a larger barge, one that would be capable of carrying two reactor compartments, would be approximately $5.7 million, and would be advantageous in reducing the associated costs of towing and transporting each reactor compartment.

B. USE OF CRAWLER FOR MOVEMENT OF HEAVY LOADS

Wheeled vehicles were initially used to transport heavy loads such as reactor vessels. These vehicles were very complex, required extensive road preparation, and reached a practical load limit at about 600 tons.

The introduction of crawlers in the early 1970's has allowed the overland transportation of loads in excess of 1000 tons. The crawlers used to transport 1000-plus-ton loads are fairly compact and simple. Figure B-6 shows the basic configuration and dimensions of a 1000-ton crawler. After an evaluation of the crawlers design specifications, reviewing the history of previous loads moved by crawlers, and observing crawlers at work moving 1000-plus-ton prefab modules onto barges for shipment to Prudhoe Bay, Alaska, the crawler method was selected for compartment transportation. The Lampson 1200-ton transporter from Neil F. Lampson Inc., Kennewick, Washington, was selected as the reference compartment transport vehicle (other firms' equipment would be considered if and when it becomes available). The 1000-ton crawler is illustrated in Figure B-6.

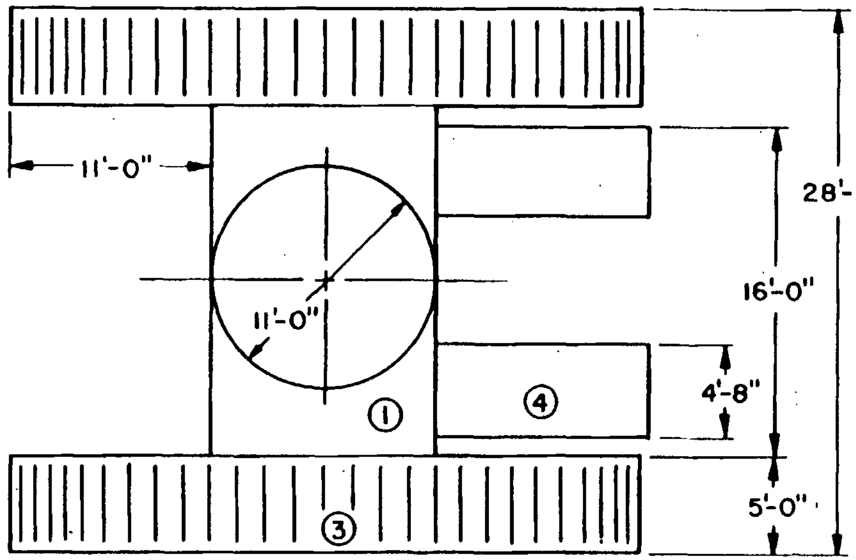
Features of these vehicles are as follows:

Each track is individually powered allowing positive steering by counter rotation of tracks. Due to the transmission used, steering through turns is continuous, smooth and gradual using torque and throttle without brake application.

The final drives produce over a million pound-feet of torque—the crawlers are not limited by power, only by traction, on very steep inclines.

The crawlers are very stable, due to their large track area, and are capable of operating on grades up to 12 percent with full load, although 5 or 6 percent grades would be the maximum recommended when transporting the compartment.

Track loading of the road surface would be approximately 60 pounds per square inch; this is comparable to that of commercial trucks and is compatible with most road surfaces. Some scuffing of the road surface would be experienced due to the steel treads, however, protective measures, such as placement of strips of rubber conveyor belting under the treads, would be employed where scuffing is unacceptable. Steel plate turning mats would be employed where scuffing damage must be avoided when steering the crawlers through tight turns.



SUBASSEMBLIES

		WT, LB	QTY
(1)	CAR BODY	62,000	1
(2)	SIDEFRAME	65,000	2
(3)	TRACK	35,000	2
(4)	POWER UNIT	18,000	2

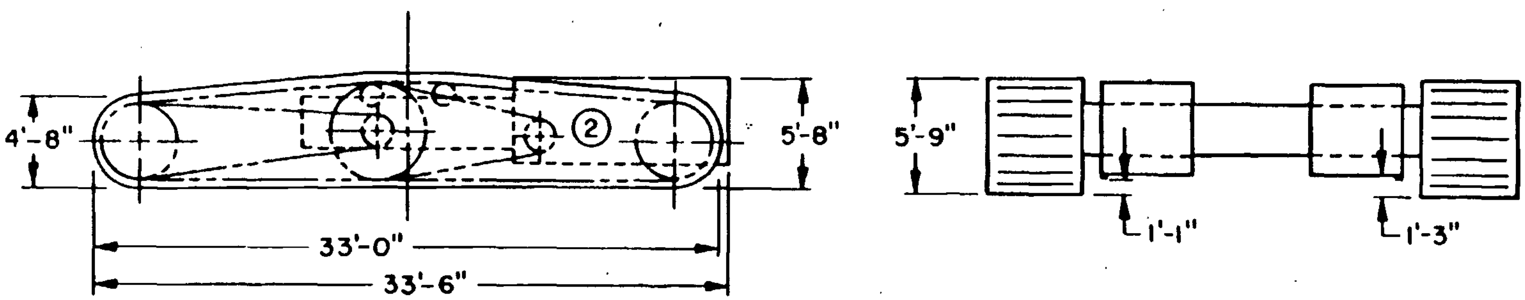


Figure B-6. Crawler Transporter (1000-Ton Capacity)

The 1000-ton crawler weighs about 150 tons and is composed of five pin-connected sections and the two steel tracks. The heaviest section is the side frame which weighs 33 tons each. The sections are shipped by truck (four truck loads) and can be assembled in about eight hours.

The 1200-ton crawler has a tested capacity of 1320 short tons and would meet the nuclear requirement that the maximum loading not exceed 80 percent of tested capacity. The expected weight of the reactor compartment is 964 short tons; 80 percent of the tested capacity of the crawler is 1056 short tons, a margin of 10 percent above the nuclear requirement.

The cost of renting a 1200-ton transporter would be approximately $30,000 per month and the purchase price would be approximately $800,000.

C. REGULATIONS APPLICABLE TO SHIPMENT OF REACTOR PLANTS FOR DISPOSAL

1. Introduction

This section reviews the applicable Federal and State regulations which would have to be met in transporting a decommissioned reactor plant to the disposal site, using a shipment from Puget Sound Naval Shipyard to the Hanford Site as an example. For the purposes of this review, it was assumed that a reactor compartment, when mounted on a barge, would be moved via tugs from the shipyard through Puget Sound, the Straits of Juan de Fuca, down along the Washington Coast and up the Columbia River to the Port of Benton dock just north of Richland, Washington. The reactor compartment would then be transported via a crawler type transporter from the Port of Benton to the burial site at Hanford.

2. Applicable Regulations

The U. S. Department of Transportation has regulatory responsibility for safety in the transportation of hazardous materials (except postal shipments) by all modes of transport in interstate or foreign commerce (rail, road, air, water) and by all means (truck, auto, ocean vessel, airplane, river barge, rail car, etc.). These regulations are promulgated by Reference B.8.

Part 172 of Reference B.8 designates radioactive material as a hazardous material for the purposes of transportation in commerce. Regulations of this part also cover the preparation of shipping papers, marking, labeling, and placarding requirements. Part 173 of Reference B.8 specifies packaging requirements that must be met by the shipper when preparing hazardous material for shipment. In the case of the subject shipment, the U. S. Navy, Naval Sea Systems Command would have responsibility as the shipper. The shipyard would transfer legal custody for a radioactive waste shipment to the organization responsible for disposal prior to departure of the shipment from the shipyard. It is also indicated in Part 173 of Reference B.8 that shipments of hazardous materials by the Department of Defense (DOD) must be packaged in accordance with these regulations or in containers of equal or greater strength and efficiency as required by DOD regulations. Additionally, the Navy requires that radioactive material shipped from shipyards be in accordance with Reference B.8.

Parts 176 and 177 of Reference B.8 prescribe requirements that must be observed by commercial carriers with respect to the transportation of hazardous material by vessel or motor vehicle, respectively. It is noted that Part 176 does not apply to public vessels (e.g., U.S. Navy vessels) not engaged in commercial service. The applicability of Part 176 will depend on whether the subject shipment is made using Navy vessels or is contracted to a commercial tug company.

The U.S. Nuclear Regulatory Commission (NRC) has responsibility for safety in the possession and use, including transport, of by-product, source, and special nuclear materials. In Reference B.7, the NRC has established requirements which must be met for its licensees to transport or deliver to a carrier quantities of licensed materials in excess of Type A quantities. One of these requirements is that the licensee shall not transport or deliver any licensed materials to a carrier except as authorized in a general or specific license issued by the NRC. Although the U.S. Navy is not a licensee of the NRC by virtue of the Atomic Energy Act of 1954 as amended, in certain instances Reference B.8 requires the use of packaging which meets the pertinent requirements of Reference B.7.

The states of Oregon and Washington have entered into formal agreements with the NRC by virtue of the Atomic Energy Act of 1954 as amended, whereby the regulatory authority over by-product, source, and less than critical quantities of special nuclear material has been transferred to the states from the NRC. These "Agreement States" have adopted uniform regulations pertaining to intrastate transportation of radioactive materials which require the shipper to conform to the packaging, labeling, and marking requirements of the DOT (i.e., Reference B.8) to the same extent as if the transportation were subject to the rules and regulations of that agency. The only exception is that any notification of incidents referred to in Reference B.8 are also to be filed with the cognizant state agency. In the state of Washington, these regulations are contained in the Washington Administrative Code ("Radiation Control Agency"). In Oregon the regulations are published by the Oregon State Health Division.

The U.S. Coast Guard has responsibility for enforcement of the regulations governing the water shipment of hazardous materials in accordance with Part 176 of Reference B.8. The shipping route of the cited example would fall under the jurisdiction of the Thirteenth Coast Guard District for shipments that would originate at Puget Sound Naval Shipyard, for example, as indicated in Reference B.11. The portion of the cited shipping route from Puget Sound Naval Shipyard to the 47°32'N latitude off the Washington Coast is within the Seattle Marine Inspection Zone and the Seattle Captain of the Port Area. The remainder of the route falls within the Portland Marine Inspection Zone and the Portland Captain of the Port Area.

The U.S. Coast Guard also has the authority to issue rules and regulations pertaining to the operation of drawbridges. The rules governing the operation of drawbridges on the Columbia River are provided in Part 117 of Reference B.11. These rules specify call signals, the requirements for advance notification, and the hours of drawbridge operation.

The Corps of Engineers has jurisdiction over the navigation locks on the Columbia River. In Part 207 of Reference B.12, rules are provided for navigating each of the locks on the Columbia River.

3. Shipper Requirements

Part 173 of Reference B.8 prescribes certain requirements to be observed by shippers in preparing radioactive materials for shipment. The steps involved include identifying the type of radionuclides that are to be shipped, the quantity of radionuclides, and whether the material is "special form" or "normal form." From this information a determination would be made as to the packaging requirements.

a. **Radionuclides.** The radionuclide content of a typical submarine reactor plant at six months after final operation is presented in Table 1-1 of Chapter 1.

b. **The Form of the Radioactive Material.** The radioactive material in a deactivated reactor plant would be classed as "normal form" since it is not considered that it would qualify as "special form" as defined in paragraph 173.389(g) of Reference B.8. Normal form radioactive materials are classified into seven "transport groups" according to their radiotoxicity and their relative hazard in transportation. As indicated by paragraph 173.390 of Reference B.8, the radionuclides in a deactivated reactor plant fall into transport group IV, with the exception of Cobalt-60 which because of its higher radiotoxicity falls into transport group III. Package quantity limits are a function of the transport group for normal form radioactive material (i.e., the lower the transport group the lower the limit).

c. **Packaging Requirements.** For shipping purposes, the complete deactivated reactor compartment is considered to be a single package composed of its radioactive contents and packaging. The radioactive contents would include the entire reactor plant system which is radioactive as the result of neutron activation. The ship's hull and the forward and after reactor compartment bulkheads when suitably sealed would provide the packaging. Since the quantity of radioactivity (i.e., transport groups III and IV) exceeds 200 curies, the package contents would be classed as a "large quantity of radioactive material in normal form." Such material must be packaged in accordance with the requirements of paragraphs 173.393, 173.395, and 173.398 of Reference B.8. These include general packaging and shipping requirements, special packaging test requirements, and the requirement that the packaging meet the pertinent requirements of Reference B.7. These include general packaging standards, structural standards, and evaluation of the package against standards for normal conditions of transport and hypothetical accident conditions.

d. **Compliance with Packaging Requirements.** The previous section defined the applicable package requirements for the type, quantity, and form of radioactive material to be shipped when disposing of a decommissioned reactor plant. In normal situations, packaging designers would design the packaging around these requirements. However, in the case of a decommissioned reactor plant where the hull and reactor compartment bulkheads would be utilized as the packaging, an assessment was made to determine that this approach would meet the applicable packaging requirements, as described above in Section III.F. The reactor compartment package would meet the established burial ground packaging requirements.

e. **Labeling and Marking Requirements.** As required by paragraph 172.300 of Reference B.8, the subject package must be plainly and durably marked on the outside of the package to indicate the following information:

(1) The proper shipping name (i.e., Radioactive Material, n.o.s.).

(2) The name and address of the consignee or consignor.

(3) The gross weight of the package.

As required by paragraph 172.400 of Reference B.8, the subject package would require a "Radioactive Yellow—III" label affixed to opposite sides of the package near the marked proper shipping name. The following information is to be entered on the label: (1) the names of the radionuclides, (2) the number of curies, and (3) the transportation index.

f. **Shipping Papers and Shipper's Certification.** As required by paragraph 172.200 of Reference B.8, each person who offers radioactive material for transportation shall describe the material on the shipping papers. For shipment by water, the shipping papers are to include the following information:

(1) The proper shipping name (i.e., Radioactive Material, n.o.s.).

(2) The total quantity (by weight, volume, or as otherwise appropriate) of the hazardous material.

(3) The name of each radionuclide in the radioactive material (e.g., see Table 1-1 of Chapter 1).

(4) A description of the physical and chemical form of the material (e.g., activated reactor components and metal corrosion and wear products).

(5) The activity content of the package.

(6) The category of label applied to the package (i.e., "Radioactive Yellow—III").

(7) The transport index assigned to the package.

(8) A notation of the package identification marking as prescribed in the applicable NRC approval.

(9) The type and gross weight of the package.

(10) The shipper's signed certification that the material is properly classified, described, packaged, marked, and labeled and is in proper condition for transportation.

(11) The name of the shipper.

g. **Notifications.** Page 124 of Reference B.11 requires that a vessel carrying radioactive material on board notify the applicable Coast Guard Captain of the Port at least 24 hours in advance of arrival in the area. This notification is to include the amount and stowage of the material. It would be expected that this notification would be made to the appropriate Captains of the Port Areas prior to the subject shipment leaving the shipyard.

4. Carrier Requirements

a. **Methods of Transport.** The disposal of a decommissioned reactor plant would involve two methods of transport. For example, during a transport from Puget Sound Naval Shipyard to Hanford, the major portion of the trip would be via barge from the shipyard to the Port of Benton and the remainder of the trip would be overland via crawler from the Port of Benton to the burial site. The requirements applicable to commercial carriers for the transport of radioactive material by vessel are contained in Part 176 of Reference B.8. The overland portion of the trip would start just outside the boundaries of the Hanford Site and the requirements for carriage of radioactive materials on the public highways contained in Part 177 of Reference B.8 would be applicable.

b. **Acceptance Requirements.** The carrier may not transport a hazardous material unless the material is properly described on the shipping papers and the shipper's certification has been provided that the material is properly classified, described, packaged, marked, and labeled. The shipper would provide this information to the carrier at the shipyard assuming the services of a commercial tug company were utilized. If Navy tugs were used, this information would be provided to the company providing the crawler service when the package was off-loaded at the destination site.

c. **Barge Requirements.** Subpart F of Part 176 of Reference B.8 specifies classes of barges which are authorized for the transportation of hazardous materials and prescribes certain applicable conditions. The barge proposed for transport of a decommissioned reactor plant would be classified as Class "A" with "AA" hull. This type of barge is authorized for transport of radioactive materials with the condition that outside containers vulnerable to damage by water may not be used. Since the outside of the subject package is of all metal construction with all closures seal welded, this condition would be satisfied.

d. **Inspection Requirements.** Part 176 of Reference B.8 requires that an inspection of the cargo on an unmanned vessel must be made after stowage has been completed to ensure this stowage has been accomplished properly and that there is no visible sign of damage to the packages or evidence of heating, leaking, or sifting. This is to be made by the individual who is responsible to the carrier and who is in charge of loading the cargo. Although for this particular situation the carrier would not be in charge of the loading (i.e., assuming the Navy does not take on the role of the carrier), it is expected that the carrier would inspect the load prior to departure from the shipyard.

e. **Placarding.** In accordance with subpart F of Part 172 of Reference B.8, the barge would not require placarding. The crawler would have to be placarded on each side and each end with "Radioactive" placards. The shipper would have to provide the necessary placards.

f. **Dangerous Cargo Manifest.** Part 176 of Reference B.8 requires that the master of a vessel transporting radioactive material prepare a dangerous cargo manifest. The carrier must keep the manifest on the vessel during transport and retain a copy of it for inspection one year thereafter. The information required on the manifest is in general similar to that provided on the shipping papers.

g. **Emergencies, Accidents, and the Reporting of Incidents.** Part 176 of Reference B.8 indicates that when an accident occurs on board a vessel involving hazardous material, the master is to adopt such procedures as will, in his judgment, provide maximum safety for the vessel and its crew. Also, hazardous material may be jettisoned only if the master believes this action to be necessary to prevent or substantially reduce a hazard to human life or reduce a substantial hazard to property. When a hazardous condition exists on a vessel transporting hazardous material, the master is to notify the nearest Captain of the Port as soon as possible and shall comply with his instructions.

For highway shipments, the carrier must notify the shipper at the earliest practicable moment following any incident in which there has been breakage, spillage, or suspected radioactive contamination involving radioactive material shipments. If radiological advice or assistance is needed, the Department of Energy Regional Office for Radiological Assistance is to be notified.

The carrier is to notify the DOT as soon as possible after each incident that occurs during the course of transportation in which, as a direct result of hazardous materials, (1) a person is killed or hospitalized, (2) property damage exceeds $50,000, and (3) fire, breakage, spillage, or suspected contamination occurs involving radioactive material. Each carrier is to submit a detailed hazardous materials incident report to the DOT within 15 days of such an incident. State authorities may also need to be notified.

V. REFERENCES

B.1 Final Environmental Statement. Waste Management Operations. Hanford Reservation. Richland, Washington. U.S. Energy Research and Development Administration. ERDA-1538 (December 1975).

B.2 The Shallow Land Burial of Low-Level Radioactively-Contaminated Solid Waste. National Research Council, Washington, D. C. (1976) (621.4838 Na).

B.3 Final Environmental Impact Statement. Waste Management Operations. Savannah River Plant, Aiken, South Carolina. U.S. Energy Research and Development Administration. ERDA-1537 (September 1977).

B.4 Final Environmental Impact Statement. Management of Intermediate Level Radioactive Waste. Oak Ridge National Laboratory. Oak Ridge, Tennessee. U.S. Energy Research and Development Administration. ERDA-1553 (September 1977) (ERA-3-324).

B.5 Final Environmental Impact Statement. Waste Management Operations. Idaho National Engineering Laboratory. Idaho. U.S. Energy Research and Development Administration. ERDA-1536 (September 1977) (ERA-3-323).

B.6 Final Environmental Impact Statement. Los Alamos Scientific Laboratory Site, Los Alamos, New Mexico. U.S. Department of Energy. DOE/EIS-0018 (December 1979) (ERA-5-12547).

B.7 Title 10 Code of Federal Regulations—Energy, Chapter I—Nuclear Regulatory Commission, Part 71—Packaging of Radioactive Material for Transport and Transportation of Radioactive Material under Certain Conditions.

B.8 Title 49 Code of Federal Regulations—Transportation, Chapter I—Materials Transportation Bureau Department of Transportation (Parts 100-199).

B.9 Not used in Final Environmental Impact Statement.

B.10 Not used in Final Environmental Impact Statement.

B.11 Title 33 Code of Federal Regulations—Navigation and Navigable Waters, Chapter I—Coast Guard, Department of Transportation (Parts 1-199).

B.12 Title 33 Code of Federal Regulations—Navigation and Navigable Waters, Chapter II—Corps of Engineers, Department of the Army (Parts 200-399).

APPENDIX C

DOSE COMMITMENT ESTIMATES, LAND DISPOSAL

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APPENDIX C

DOSE COMMITMENT ESTIMATES, LAND DISPOSAL

I. INTRODUCTION

This appendix describes the estimation of possible long-term dose commitments that might occur as a result of land disposal of the reactor compartments of defueled and decommissioned nuclear submarines. The appendix also describes the transportation-related public exposure and the method used to estimate possible immediate effects of surface-deposited radioactive material (crud) that might be released to the environment as a result of a postulated extreme accident during land disposal operations.

For the radionuclides contained within the buried reactor compartment to reach man, the following events would have to occur. First, the reactor compartment outer boundary (pressure hull and bulkheads) would have to be penetrated by corrosion. This outer barrier is estimated to remain intact for at least 200 years, based on a thickness loss rate of 0.0025 inch per year, as described in Appendix F. Normal expectation is for the buried compartment to remain unpenetrated for an indefinite time, probably many centuries.

Second, water would have to flow through the corroded outer boundary and then corrode the components within the compartment. Small quantities of radioactive material might then be released, but over 98 percent of the initial radioactivity would be untouched for more than 2000 years after the outer barrier is penetrated because it is contained within the several-inch-thick reactor vessel. The result of this long delay before significant exposure of radioactive components to groundwater would be that almost all of the radioactive material, except the long-lived Nickel-59 and small amounts of Carbon-14, Nickel-63, and Niobium-94 would have decayed to stable form prior to release. (See Table C-1.)

Third, the groundwater would have to carry the radioactive corrosion products, most of which would be insoluble, away from the immediate disposal site to water supplies available to man. In estimating the effect on average individuals, it has been assumed that all of the radioactive material released by the corrosion process would reach a nearby river (Savannah River or Columbia River, depending on the disposal site) which would then be the major pathway to the general population. An alternate pathway is also assumed in order to determine the dose commitment to maximum-exposed individuals. This alternate pathway has been assumed to be either a well or a local stream passing through the burial site and entraining all of the radioactive material released from as many as ten of the buried reactor compartments. (See Section V.)

It has been assumed that all of the radioactive corrosion products would be dissolved or suspended uniformly in the groundwater and that this water would flow into the river, local stream, or well where it might become available for consumption and use by individual users. No credit is taken for retardation and diminution of the radionuclides by such mechanisms as absorption by soil particles, deposition in stream or river beds, and removal of radioactive material by water treatment systems that may be employed by downstream users. The resulting estimates of radiation exposure are shown to be conservative when compared (see Section VIII) with similar exposure estimates based on methods provided in the U.S. Nuclear Regulatory Commission generalized Environmental Impact Statement on Land Disposal (Reference C.1).

The exposure estimates are conservative (i.e., high) due to simplifications that do not take into account various factors that would actually lead to reduced exposure.

II. RADIOACTIVE MATERIAL RELEASE ASSOCIATED WITH NORMAL LAND DISPOSAL OPERATIONS

Table C-1 lists both the maximum annual radioactive material release estimates by individual nuclide, and the total release estimated to occur over all time. The tabulated values were calculated with the corrosion release model employed for sea disposal release estimates (Appendix G) with the following differences. The

TABLE C-1. RADIOACTIVE MATERIAL RELEASE ATTRIBUTABLE TO LAND DISPOSAL (ONE REACTOR COMPARTMENT BURIAL)

Nuclide	Maximum Annual Release (Curies Per Year)	Total Release Over All Time (Curies)
Ni-59	0.57×10^{-1}, year 2800	1.2×10^{2}
C-14	0.36×10^{-3}, year 2800	0.60
Ni-63	0.26×10^{-2}, year 200	0.25
Nb-94	0.39×10^{-4}, year 2800	0.70×10^{-1}
Mo-93	0.51×10^{-5}, year 200	0.83×10^{-2}
Tc-99	0.16×10^{-5}, year 200	0.36×10^{-2}
Fe-55	0.14×10^{-3}, year 1*	0.63×10^{-3}
Co-60	0.22×10^{-4}, year 1*	0.17×10^{-3}
Mn-54	0.32×10^{-5}, year 1*	0.57×10^{-5}
Co-58	0.18×10^{-6}, year 1*	0.18×10^{-6}
Fe-59	0.79×10^{-7}, year 1*	0.79×10^{-7}
Cr-51	0.28×10^{-7}, year 1*	0.28×10^{-7}
S-35	0.58×10^{-9}, year 1*	0.58×10^{-9}
Sc-46	0.64×10^{-10}, year 1*	0.64×10^{-10}

Corrosion rates: Low-alloy steel: 0.0025 inch per year per exposed surface
Corrosion resistant alloy: 0.0003 inch per year per exposed surface

*These early releases are based on the radioactive material contained in the metal of the exterior boundary (hull and bulkheads), and the assumption that this activity would be uniformly distributed in the metal.

corrosion of the outer containment barrier (bulkhead) was assumed to occur only from the outside, and during the period of 200 years in which the outer containment remains unpenetrated, none of the interior components would be significantly affected by corrosion because water would not have entered the compartment. After outer barrier penetration, components within the reactor compartment but outside the reactor vessel were assumed to corrode on both inner and outer exposed surfaces, while the sealed reactor vessel was assumed to experience only exterior surface corrosion. At this time, radionuclides present in the reactor vessel wall or in plant components outside the reactor vessel could begin to be released. After the reactor vessel is penetrated, components within the vessel were assumed to corrode on both inner and outer surfaces. Only the longest-lived radionuclides would remain after the reactor vessel is penetrated. Corrosion of the corrosion-resistant alloys was represented by general surface corrosion only because the addition of further releases by way of escape through pitting penetrations was considered to be an unnecessarily conservative assumption in the analysis of land disposal effects. This analysis is already conservative in view of the assumption of a continuously flowing supply of water to keep all of the affected surfaces wet and to carry away radioactive corrosion products.

As may be seen from Table C-1, all of the long-lived Nickel-59 (120 curies) has been assumed to be released over all time, along with a major part of the Carbon-14 (0.6 curie of the initial inventory of 1 curie). Release over all time of all other nuclides is estimated to be small, with Nickel-63 (0.25 curie) the only other nuclide which would amount to more than 0.1 curie. The maximum annual release would occur approximately 2800 years after disposal when penetration of the reactor vessel would initiate the release to the disposal site of the long-lived nuclides, primarily Nickel-59, which would amount to an estimated 0.057 curie per year.

The release of a small quantity of radioactive material is shown for early years, beginning as soon as disposal occurs. These releases are based on the minute quantities of radioactive material contained in the metal of the exterior boundary (hull and bulkheads), and the conservative assumption that this activity is uniformly distributed throughout that metal so that initial corrosion of the exterior boundary would begin the release of some radioactive material.

The maximum annual release rates of all radionuclides have been considered in estimating the highest possible annual exposure rate to the public, even though the maximum releases would not occur in the same period in some cases. In effect, however, as shown by the relative magnitudes of the annual releases shown in Table C-1, only the Nickel-59 release would have any significant effect on the exposure estimates. This not only simplifies the internal exposure calculations of Section IV, but also makes it practical to show the step-by-step dose calculations. For these calculations, the Nickel-59 maximum annual release has been increased to 0.07 curie per year, per reactor compartment, so that this activity release can conservatively represent all of the radionuclides.*

III. EXPOSURE PATHWAYS

A. AVERAGE INDIVIDUAL EXPOSURE PATHWAY

The approach used in this appendix to estimate the long-term consequences of reactor compartment burial was obtained using established methods and site-specific information for the Savannah River Laboratory (for the water consumption pathway), and was supplemented by the multiple exposure pathways analysis of Reference C.2. With this combination, the exposure is estimated for drinking water, fish, crops, milk, and meat consumption.

As described in the introduction to this appendix, the primary exposure pathway would most likely be through the groundwater to a nearby river that supplies water to major populations downstream, as well as supplying water for animals and irrigation and supporting food fish. For this analysis a major river such as the Savannah River was assumed to receive all released radioactive material.

The individual exposure analysis is also conservatively applicable to reactor compartment burial at the Hanford Site, where long-term releases might be received by the Columbia River. The minimum flow rate of the Columbia River is approximately five times as great as the minimum annual average Savannah River flow rate. The larger flow rate would reduce the estimated radioactivity concentration in the river water, and

***When external exposure hazard is also considered, as in the alternate approach shown in Section VIII.A, Table C-2, Niobium-94 is treated explicitly along with Nickel-59 and Carbon-14.**

would cause lower individual dose commitment estimates for users of Columbia River water, based on any given radioactive material release from the buried reactor compartments. The lower annual precipitation rate and greater depth of the water table at Hanford also imply that the analysis is conservatively applicable to both burial locations.

B. MAXIMUM INDIVIDUAL EXPOSURE PATHWAY

To allow for the possibility in the distant future that some individuals would receive radiation exposure as a result of living near the disposal site, a maximum exposure estimate has been calculated (see Section V) by assuming that all water consumed and used by such maximum-exposed individuals could come from a small local stream that passes through the site and picks up all of the released radioactivity from as many as ten of the reactor compartments. This approach would also represent water consumption and usage from a well hypothetically contaminated by all of the released radioactive material from ten reactor compartments. This number of reactor compartments would be in the path of a stream moving across a roughly square disposal pattern.

C. INHALATION AND DIRECT RADIATION PATHWAYS*

Transport of radionuclides to the population by the inhalation pathway is considered to be small in comparison to transport by surface streams or wells, since transfer of any corrosion product to the atmosphere would be hindered by the presence of the soil cover during at least the initial period after disposal, and since later, when corrosion release of radioactive material is occurring, the size of the corrosion particles would generally prevent transport through the air.

The effects of the direct radiation or intrusion pathway during the first 100 years after disposal would also be small because of the small number of people that would be involved, the low rate of external irradiation from the hull section (less than 0.1 mrem per hour), and the massive size and difficulty in penetrating the sealed reactor compartment. After the first 100 years, the direct radiation levels at any location within or near the disposal package would be virtually zero because of the radioactive decay of the nuclides (principally Cobalt-60) that produce the direct radiation.

IV. ESTIMATED 70 YEAR DOSE COMMITMENT TO AVERAGE INDIVIDUALS

Analyses of the effects of exposure to radiation or radioactive materials are based on the estimated dose commitments. A dose commitment is the total dose received by an individual during the entire remainder of his life following some specified period of exposure to radiation or radioactive materials. (This concept is described more fully in Appendix J, pages J-1 and J-2.) In this statement, the dose commitments are computed over the 70 years following a one year exposure, unless otherwise stated.

The estimates developed in this section are conservatively applicable to either possible disposal site for an average individual whose exposure is assumed to be due to the presence of Nickel-59 in water. The maximum annual release rate of Nickel-59 would be much larger than those of all other radionuclides, as shown in Table C-1, and has been rounded up to 0.07 curie per year per reactor compartment, so that the analysis is applicable not only for Nickel-59 but also for the sum of all available nuclides.

The various water-related pathways and associated maximum consumption rates for any age group are as follows.

1. water consumption (730 liters per year, Table J-2, Appendix J);

2. freshwater fish consumption (6.9 Kg per year, Table E-4, Reference C.2);

***The inhalation and direct radiation pathways are included in an alternate calculation method. See Section VIII.A (Agricultural Intruder).**

3. consumption of crops grown on irrigated soil (24 Kg per year. Thus, 10 percent of the total 240 Kg per year maximum of Table E-4, Reference C.2, is assumed to be taken from an area affected by contamination);

4. consumption of milk from cows that hypothetically consume contaminated water and crops (20 liters per year. Thus, 10 percent of the total 200 liters per year maximum of Table E-4, Reference C.2, is assumed to be from an area affected by contamination); and

5. consumption of meat from animals that hypothetically consume contaminated water and crops (9.5 Kg per year. Thus, 10 percent of the total 95 Kg per year maximum of Table E-4, Reference C.2, is assumed to be from an area affected by contamination).

The concentration of Nickel-59 in water was estimated to be 1×10^{-9} μCi/ml, based on the maximum estimated annual release (0.07 curie/yr per reactor compartment, as explained on page C-3), diluted by the minimum annual average flow of the Savannah River (7500 cubic feet per second). That is,

$$1 \times 10^{-9} \frac{\mu Ci}{ml} = \frac{(0.07\ Ci/yr)(100)(10^6 \mu Ci/Ci)}{(7500\ ft^3/second)(3.15 \times 10^7\ sec/yr)(28.32\ liters/ft^3)(1000\ ml\ per\ liter)}$$

This concentration is lower than the Reference C.3 unrestricted area limit for Nickel-59 (2×10^{-4} μCi/ml) by a factor of 200,000. On this basis, it might be expected that individual total body exposures would not exceed about 2.5×10^{-3} mrem per year, since the limits of Reference C.3 prevent annual total body exposures from exceeding approximately 500 mrem (i.e., 500 mrem/year ÷ 200,000 = 2.5×10^{-3} mrem/yr). However, each exposure pathway is evaluated separately in the following discussion and the sum of all such pathways yields the conservative estimate of 6.0×10^{-3} mrem per year for the total body exposure of an average individual. The following discussion also calculates the exposure to bone (bone is the organ that would receive the maximum exposure) for an average individual. If the actual annual average flow of 10,420 cubic feet per second were used, the calculated exposures would be approximately 28% lower.

A. WATER CONSUMPTION PATHWAY

i—Annual hypothetical intake of Nickel-59

$$= (730\ liters/yr)\left(\frac{1000\ ml}{liter}\right)\left(1 \times 10^{-9} \frac{\mu Ci}{ml}\right)$$

$$= 7.3 \times 10^{-4}\ \mu Ci/yr$$

ii—Annual exposure, total body

$$= (7.3 \times 10^{-4}\ \mu Ci/yr)(1.63 \times 10^{-3}\ rem/\mu Ci^*)(10^3\ mrem/rem)$$

$$= 1.2 \times 10^{-3}\ mrem/yr$$

iii—Annual exposure, bone

$$= (7.3 \times 10^{-4}\ \mu Ci/yr)(9.76 \times 10^{-3}\ rem/\mu Ci^*)(10^3\ mrem/rem)$$

$$= 7.1 \times 10^{-3}\ mrem/yr$$

*These dose commitment factors are from Table I-4, Appendix I, expressed in rem per μCi. The same factors are used throughout this section.

B. FRESHWATER FISH CONSUMPTION PATHWAY

i—Average hypothetical concentration of Nickel-59 in freshwater fish

$$= \left(1 \times 10^{-9} \frac{\mu Ci}{ml}\right)\left(100 \frac{Ci/g}{Ci/ml}\right)^{*} \left(\frac{1000\ g}{Kg}\right)$$

$$= 1 \times 10^{-4}\ \mu Ci/Kg$$

ii—Annual intake of Nickel-59

$$= \left(6.9 \frac{Kg}{yr}\ \text{fish}\right)\left(1 \times 10^{-4} \frac{\mu Ci}{Kg}\right)$$

$$= 6.9 \times 10^{-4}\ \mu Ci/yr$$

iii—Annual exposure, total body

$$= \left(6.9 \times 10^{-4} \frac{\mu Ci}{yr}\right)(1.63 \times 10^{-3}\ rem/\mu Ci)(10^{3}\ mrem/rem)$$

$$= 1.1 \times 10^{-3}\ mrem/yr$$

iv—Annual exposure, bone

$$= (6.9 \times 10^{-4}\ \mu Ci/yr)(9.76 \times 10^{-3}\ rem/\mu Ci)(10^{3}\ mrem/rem)$$

$$= 6.7 \times 10^{-3}\ mrem/yr$$

C. PATHWAY DUE TO CONSUMPTION OF CROPS GROWN ON IRRIGATED SOIL

The method of calculation follows that of Equation (4), page 1.109-3 of Reference C.2.

i—Irrigation rate

= 50 inches per year, inferred from Page II 3-7, Reference C.4

= 8.3 inches per month for a six month irrigation period

= 0.29 liter/m^2 per hour, during six months of irrigation

ii—Assumed period of long-term buildup of soil contamination

= 15 years, Table E-15, Reference C.2

iii—Hypothetical concentration in soil after 15 years, based on a surface density of 240 Kg per square meter of soil (Table E-15, Reference C.2)

$$= \frac{(0.29\ liter/m^2\ hr)(4380\ hrs/yr)(15\ yrs)(1 \times 10^{-9}\ \mu Ci/ml)\ (1000\ ml/liter)}{240\ Kg/m^2}$$

$$= 7.9 \times 10^{-5}\ \mu Ci/Kg$$

*Concentration factor of 100 for nickel in freshwater fish, from Table A-1 of Reference C.2.

iv—Hypothetical concentration in crops grown in this soil; considering uptake via roots, and a concentration factor of 0.019 for nickel (Table E-1, Reference C.2)

$$= (7.9 \times 10^{-5}\ \mu\text{Ci/Kg})(0.019)$$

$$= 1.5 \times 10^{-6}\ \mu\text{Ci/Kg}$$

v—Hypothetical activity of Nickel-59 on plant surfaces, based on 25 percent of the deposited activity being retained on the crops, and a rate constant of 0.0021 per hour (14 day half-life) for removal of activity on plant or leaf surfaces by weathering (Table E-15, Reference C.2)

$$= \left(1 \times 10^{-9}\ \frac{\mu\text{Ci}}{\text{ml}}\right)\left(\frac{0.29\ \text{liter}}{\text{m}^2\text{-hr}}\right)\left(\frac{1000\ \text{ml}}{\text{liter}}\right)(0.25)\left(\frac{1}{0.0021/\text{hr}}\right)$$

$$= 3.5 \times 10^{-5}\ \mu\text{Ci/m}^2$$

vi—Hypothetical activity of Nickel-59 per Kg of crops, based on an agricultural productivity of 2 Kg/m^2 (Table E-15, Reference C.2) (not including uptake via roots)

$$= (3.5 \times 10^{-5}\ \mu\text{Ci/m}^2) \div (2\ \text{Kg/m}^2)$$

$$= 1.8 \times 10^{-5}\ \mu\text{Ci/Kg}$$

vii—Total hypothetical activity of Nickel-59 per Kg of crops (= iv + vi)

$$= (1.5 \times 10^{-6} + 1.8 \times 10^{-5})\ \mu\text{Ci/Kg}$$

$$= 2.0 \times 10^{-5}\ \mu\text{Ci/Kg}$$

viii—Annual hypothetical uptake of Nickel-59

$$= (24\ \text{Kg/yr})(2.0 \times 10^{-5}\ \mu\text{Ci/Kg})$$

$$= 4.8 \times 10^{-4}\ \mu\text{Ci/yr}$$

ix—Annual hypothetical exposure, total body

$$= (4.8 \times 10^{-4}\ \mu\text{Ci/yr})(1.63 \times 10^{-3}\ \text{rem}/\mu\text{Ci})(10^3\ \text{mrem/rem})$$

$$= 7.8 \times 10^{-4}\ \text{mrem/yr}$$

x—Annual exposure, bone

$$= (4.8 \times 10^{-4}\ \mu\text{Ci/yr})(9.76 \times 10^{-3}\ \text{rem}/\mu\text{Ci})(10^3\ \text{mrem/rem})$$

$$= 4.7 \times 10^{-3}\ \text{mrem/yr}$$

D. MILK CONSUMPTION PATHWAY

i—cow's daily intake of crop (Table E-3, Reference C.2)

= 50 Kg/day

ii—cow's daily intake of water (Table E-3, Reference C.2)

= 60 liters/day

iii — cow's daily hypothetical intake of Nickel-59

$$= (50\ \text{Kg/day})(2.0 \times 10^{-5}\ \mu\text{Ci/Kg})(2.9^{*}) + (60\ \text{liters/day})\left(1 \times 10^{-9}\ \frac{\mu\text{Ci}}{\text{ml}} \times \frac{1000\ \text{ml}}{\text{liter}}\right)$$

$$= 2.9 \times 10^{-3}\ \mu\text{Ci/day}$$

iv — Nickel activity transfer coefficient to milk, per Table E-1, Reference C.2

$$= 0.0067\ \mu\text{Ci/liter per}\ \mu\text{Ci/day}$$

v — Hypothetical Nickel-59 activity in milk

$$= \left(\frac{0.0067\ \mu\text{Ci/liter}}{\mu\text{Ci/day}}\right)(2.9 \times 10^{-3}\ \mu\text{Ci/day})$$

$$= 1.9 \times 10^{-5}\ \mu\text{Ci/liter}$$

vi — Individual's hypothetical annual uptake of Nickel-59 via milk consumption

$$= (20\ \text{liters/yr})(1.9 \times 10^{-5}\ \mu\text{Ci/liter}) = 3.8 \times 10^{-4}\ \mu\text{Ci/yr}$$

vii — Annual hypothetical exposure, total body

$$= (3.8 \times 10^{-4}\ \mu\text{Ci/yr})(1.63 \times 10^{-3}\ \text{rem}/\mu\text{Ci})(10^{3}\ \text{mrem/rem})$$

$$= 6.2 \times 10^{-4}\ \text{mrem/yr}$$

viii — Annual hypothetical exposure, bone

$$= (3.8 \times 10^{-4}\ \mu\text{Ci/yr})(9.76 \times 10^{-3}\ \text{rem}/\mu\text{Ci})(10^{3}\ \text{mrem/rem})$$

$$= 3.7 \times 10^{-3}\ \text{mrem/yr}$$

E. MEAT CONSUMPTION PATHWAY

The Nickel-59 activity in all meat consumed is assumed to be equal to that of beef cattle.

i — Animal's daily intake of crop (Table E-3, Reference C.2)

$$= 50\ \text{Kg/day}$$

ii — Animal's daily intake of water (Table E-3, Reference C.2)

$$= 50\ \text{liters/day}$$

iii — Animal's hypothetical daily intake of Nickel-59 (same as calculated for milk in previous section)

$$= 2.9 \times 10^{-3}\ \mu\text{Ci/day}$$

iv — Nickel activity transfer coefficient to meat (Table E-1, Reference C.2)

$$= 0.053\ \mu\text{Ci/Kg per}\ \mu\text{Ci/day}$$

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*The factor of 2.9 accounts for the lower agricultural productivity of crops per unit area when the grass-cow-milk-man pathway is considered (0.7 Kg/m^2 vs. 2.0 Kg/m^2, per Table E-15, Reference C.2).

v—Hypothetical Nickel-59 activity in meat

$$= \left(\frac{0.053\ \mu Ci/Kg}{\mu Ci/day} \right) \left(2.9 \times 10^{-3}\ \frac{\mu Ci}{day} \right)$$

$$= 1.5 \times 10^{-4}\ \mu Ci/Kg$$

vi—Annual hypothetical uptake of Nickel-59 via consumption of meat

$$= (1.5 \times 10^{-4}\ \mu Ci/Kg)(9.5\ Kg/yr)$$

$$= 1.4 \times 10^{-3}\ \mu Ci/yr$$

vii—Hypothetical annual exposure, total body

$$= (1.4 \times 10^{-3}\ \mu Ci/yr)(1.63 \times 10^{-3}\ rem/\mu Ci)(10^3\ mrem/rem)$$

$$= 2.3 \times 10^{-3}\ mrem/yr$$

viii—Hypothetical annual exposure, bone

$$= (1.4 \times 10^{-3}\ \mu Ci/yr)(9.76 \times 10^{-3}\ rem/\mu Ci)(10^3\ mrem/rem)$$

$$= 1.4 \times 10^{-2}\ mrem/yr$$

F. SUM OF EXPOSURES VIA ALL PATHWAYS

i—Sum of hypothetical exposures, total body

$$= 1.2 \times 10^{-3}\ mrem/yr\ (water) + 1.1 \times 10^{-3}\ mrem/yr\ (fish)$$

$$+ 7.8 \times 10^{-4}\ mrem/yr\ (crops) + 6.2 \times 10^{-4}\ mrem/yr\ (milk)$$

$$+ 2.3 \times 10^{-3}\ mrem/yr\ (meat)$$

$$= 6.0 \times 10^{-3}\ mrem/yr$$

ii—Sum of hypothetical exposures, bone

$$= 7.1 \times 10^{-3}\ mrem/yr\ (water) + 6.7 \times 10^{-3}\ mrem/yr\ (fish)$$

$$+ 4.7 \times 10^{-3}\ mrem/yr\ (crops) + 3.7 \times 10^{-3}\ mrem/yr\ (milk)$$

$$+ 1.4 \times 10^{-2}\ mrem/yr\ (meat)$$

$$= 3.6 \times 10^{-2}\ mrem/yr$$

These hypothetical total exposures are considered to be very conservative because all of the released radioactive material is assumed to be carried in the river water. Based on the observation discussed earlier in this section that the conservatively estimated Nickel-59 water concentration would be lower than the Reference C.3 limit by a factor of 200,000 to 1, the annual average individual total body exposure estimate of 6.0×10^{-3} mrem/yr is seen to be reasonable (i.e.,

$$\frac{500\ mrem/yr}{200{,}000} = 2.5 \times 10^{-3}\ mrem/yr\ ,$$

as compared with 6.0×10^{-3} mrem/yr).

V. ESTIMATED 70 YEAR DOSE COMMITMENT TO MAXIMUM-EXPOSED INDIVIDUALS

The maximum-exposed individuals are assumed to be exposed as a result of living near the disposal site in the distant future (several thousand years from the present) when the release of radioactive material at the maximum rate might occur, and when the site's identity as a radioactive waste disposal area is no longer recognized. The 70 year dose commitments are estimated in the same way as those for average-exposed individuals (see Section IV) except that the water flow rate is assumed to be much reduced, accounting for much higher concentrations in the water that is ingested, and all food consumed is assumed to be affected by the contamination, in contrast to the previous assumption that 10 percent of crops, milk, and meat consumed by average-exposed individuals is affected.

The source of hypothetical contamination for the limited number of maximum-exposed individuals is assumed to be a local stream flowing at 20 cubic feet per second* instead of the value used in the previous section (7500 cubic feet per second). This flow could represent a 15 foot wide stream one foot deep, moving at approximately one mile per hour. It has been assumed that all of the annually released material from up to ten of the compartments, which would be the approximate number of compartments in the path of a stream moving across a roughly square disposal pattern, could be taken up by this water. This approach increases the hypothetical Nickel-59 concentration in water from 1×10^{-9} μCi/ml, as used in the previous section, to 3.8×10^{-8} μCi/ml. Thus the maximum-exposed individuals are assumed to be exposed to water that has a hypothetical concentration of Nickel-59 about 38 times as high as the calculated average river concentration. This difference, and the added assumption that all food consumed would be affected by the Nickel-59 release, results in increased exposures in direct proportion to the higher concentration and consumption fraction.

Total body exposure is obtained by summing the individual contributions from Section IV.F. The contributions from crops, milk, and meat must be multiplied by a factor of 10 to adjust for the greater usage.

This total is:

$$38\,(1.2 \times 10^{-3}\ \text{mrem/yr}),\ \text{water} + 38\,(1.1 \times 10^{-3}\ \text{mrem/yr}),\ \text{fish}$$

$$+ (38)(10)(7.8 \times 10^{-4}\ \text{mrem/yr}),\ \text{crops} + (38)(10)(6.2 \times 10^{-4}\ \text{mrem/yr}),\ \text{milk}$$

$$+ (38)(10)(2.3 \times 10^{-3}\ \text{mrem/yr}),\ \text{meat}$$

$$= 1.5\ \text{mrem/yr, all pathways}$$

A similar approach yields a maximum organ (bone) exposure of 8.9 mrem/yr.

VI. MAXIMUM ANNUAL POPULATION DOSE COMMITMENT

The hypothetical population dose commitment estimate is obtained by multiplying the average individual total body dose commitment from one year of exposure (6.0×10^{-3} mrem per year, from Section IV) by the appropriate affected population. As noted previously, the exposure would not occur for several thousand years, so the estimate must be regarded as only a rough approximation, but one that is biased to be conservative.

*See page C-13 for an estimate of dose based on a minimum diluting flow rate of 3.84 gallons per minute (representing a well) combined with an annual radioactive material source that is estimated according to the method of NUREG-0782 (Reference C.1).

Downstream of the Savannah River Plant, the present population of water users is approximately 70,000 persons (Reference C.5). Based on internal studies by the Savannah River Laboratory, this population is assumed to increase over the next century and a half, reaching a level five times the present population, or 350,000, after which it remains constant. This value can be assumed to be appropriate for the Savannah River Plant, so the corresponding population total body dose commitment would be

$$(6.0 \times 10^{-3} \text{ mrem/yr})(350{,}000 \text{ persons})(10^{-3} \text{ rem/mrem}) = 2.1 \text{ man-rem/yr.}$$

The population downstream of the Hanford Site along the Columbia River is approximately four times as large as the downstream population along the Savannah River, based on information in Reference C.6, which includes 1979 census data for cities above 25,000 and 1970 census data for other cities and towns. It would be reasonable, therefore, to base the population dose commitment on a future population of 1.4 million rather than 350,000. If this approach were taken, the population dose commitment would be about 8.4 man-rem/year. The latter figure is **not** used, however, because it would be unnecessarily conservative inasmuch as the individual dose commitment estimate is based on a water concentration associated with the minimum flow of the Savannah River. When the five-fold larger flow of the Columbia River is used, the population dose commitment would be 1.7 man-rem per year. Therefore, the larger value, 2.1 man-rem per year total body, is considered appropriate. The corresponding population exposure to bone would be 12.6 man-rem per year.

If specific assumptions for the Hanford Site were used, including dietary assumptions, the population dose commitments for the Hanford area would be reduced, probably to a level near 0.2 man-rem/year, total body, and 1.3 man-rem/year, to bone.

VII. EXPECTED HEALTH EFFECTS OF LAND DISPOSAL

The maximum total body population dose commitment of 2.1 man-rem per year, combined with a conservatively estimated relationship between low-level dose and population health effects (0.45×10^{-3} additional cancer cases per man-rem, cited in Appendix D of Reference C.7), implies a total expected number of additional health effects of 0.001 per year, several thousand years in the future. That is,

$$\left(\frac{2.1 \text{ man-rem}}{\text{year}}\right)\left(0.45 \times 10^{-3} \frac{\text{additional cancer cases}}{\text{man-rem}}\right) = 0.001 \text{ per year}$$

The interpretation of this result is that it would be very unlikely that even one person would be affected in any year in the distant future as a result of radiation exposure attributable to the land disposal of the reactor compartments from defueled and decommissioned submarines. Consideration of the effects of various conservative assumptions used in this analysis suggest that the estimate of 0.001 health effects per year is conservative by several factors of 10, since most of the radioactive corrosion products eventually released to the disposal site would actually be expected to remain at the site, and most of the corrosion products that would be transported away from the immediate area would be expected to be either absorbed within a short distance by soil particles, deposited in stream or river beds, or removed by water treatment systems.

VIII. COMPARISON OF INDIVIDUAL DOSE COMMITMENT ESTIMATES WITH RELATED ESTIMATES

A. ALTERNATE ESTIMATES BASED ON NUREG-0782 (NRC LAND DISPOSAL ENVIRONMENTAL IMPACT STATEMENT)

General procedures for estimating the radiation exposure attributable to land disposal are presented in Reference C.1 (NUREG-0782) for a variety of different forms of low-level radioactive waste. As a check on the exposure estimates of Section IV, alternate estimates based on Reference C.1 for well users and surface water users are shown below.

Reference C.1 does not treat disposals that have the unique form of the sealed, high-integrity ship's compartment. However, its methods have been applied as directly as possible, as detailed below, to estimate exposure via drinking water and crop irrigation to the users of a well located on or near the disposal site, or a surface stream.* The results indicate that the average individual exposure calculated in Section IV of this appendix is conservative.

The separate components of the type of analysis described in Appendix G of Reference C.1, as applied to reactor compartment burial, are as follows for the predominant nuclide, Nickel-59.

1. Concentration of Nickel-59 in the waste form (C_w), where a reactor compartment has a volume of 400 cubic meters.

$$C_w = \frac{120 \text{ curies}}{400 \text{ m}^3} = 0.3 \text{ Ci/m}^3$$

2. T = source duration factor, representing the number of years during which the total curie content could be released at the maximum annual rate, i.e.

$$T = \frac{120 \text{ curies}}{\sim 0.06 \text{ curie/yr}} = 2000 \text{ years}$$

3. V_w = annual volume of water that percolates through the disposal ground

V_w = (180 mm/yr, from Reference C.1) × (Disposal Site Surface Area)

$V_w = (0.18 \text{ m/yr})(10 \text{ acres}) = 7.3 \times 10^3 \text{ m}^3/\text{yr}$

4. f_c = fraction of the radionuclides that could be transferred from the waste to the leachate, i.e., to the water volume V_w

$f_c = M_o \times t_c \times$ accessibility factor

where

a. M_o = ratio of the leachate concentration to the waste concentration

$M_o = 1.48 \times 10^{-2}$, from Reference C.1, for Nickel-59

b. t_c = fraction of the year in which the percolating water is in contact with the waste

$t_c = 6.47 \times 10^{-3}$, from Reference C.1

c. accessibility factor = 0.1 for metallic waste, with some activated corrosion products, from Reference C.1

$\therefore f_c = 1.48 \times 10^{-2} \times 6.47 \times 10^{-3} \times 0.1 = 9.6 \times 10^{-6}$

5. Combining the four factors from above yields the annual source of radioactive material from the 10 acre disposal site

$$S = \frac{C_w}{T} \times V_w \times f_c$$

$$S = \frac{0.3 \text{ Ci/m}^3}{2000} \times (7.3 \times 10^3 \text{ m}^3/\text{yr}) \times (9.6 \times 10^{-6})$$

$$S = 1.1 \times 10^{-5} \text{ Ci/yr}$$

*For the "agricultural intruder" of Reference C.1, see page C-14.

6. Q = minimum flow of water that dilutes the released radioactive material

   a. well

      $Q = 7.7 \times 10^3$ m^3/yr, from Reference C.1, equivalent to 3.84 gallons per minute, well pumping rate

   b. surface stream

      $Q = 4.5 \times 10^6$ m^3/yr, from Reference C.1, equivalent to five cubic feet per second, the minimum flow rate of a stream usable for human consumption

7. C_a = water concentration at the access location, i.e., at the well or at the surface stream

   $C_a = S/Q$

   a. well

$$C_a = \frac{1.1 \times 10^{-5}\ \text{Ci/yr}}{7.7 \times 10^{3}\ \text{m}^3/\text{yr}} = 1.4 \times 10^{-9}\ \text{Ci/m}^3$$

   b. surface stream

$$C_a = \frac{1.1 \times 10^{-5}\ \text{Ci/yr}}{4.5 \times 10^{6}\ \text{m}^3/\text{yr}} = 2.4 \times 10^{-12}\ \text{Ci/m}^3$$

8. PDCF = pathway dose conversion factor for the well water or the surface stream

   a. well

      PDCF = 8.54×10^6 mrem per year per Ci/m^3 (total body), from Table G-8, Reference C.1, for Nickel-59

   b. surface stream

      PDCF = 9.82×10^6 mrem per year per Ci/m^3 (total body), from Table G-9, Reference C.1, for Nickel-59

9. Total Body Exposure = (PDCF) × (C_a)

   a. well

      Total Body Exposure = (8.54×10^6 mrem/yr per Ci/m^3) (1.4×10^{-9} Ci/m^3)

      = 1.2×10^{-2} mrem/yr

   b. surface stream

      Total Body Exposure = (9.82×10^6 mrem/yr per Ci/m^3) (2.4×10^{-12} Ci/m^3)

      = 2.4×10^{-5} mrem/yr

For comparison, the total body exposure calculated in Section IV of this appendix, for the average exposed individual, would be 6.0×10^{-3} mrem per year, a value that is within the range of the above exposures for well users and surface water users. Considering that the exposure to surface stream users roughly approximates that to the average individual, it may be concluded that the exposure calculated in Section IV (6.0×10^{-3} mrem per year) is conservative.

The exposure to well users could be considered applicable to the maximum-exposed individual. However, Reference C.1 also postulates an "agricultural intruder" who takes up residence on the disposal site and consumes food grown there, without knowing the previous use of the site. An exposure estimate for this case has been made using the methods of Reference C.1, with the inadvertent intrusion assumed to begin several thousand years after disposal since that approximate length of time would be required to make the magnitude of the "agricultural intruder" scenario credible.

The calculation is as follows, employing the notation of Reference C.1.

$$H = \sum_{n} (f_o f_d f_w f_s)_{air} C_w \, PDCF\text{-}3 + \sum_{n} (f_o f_d f_w f_s)_{food} C_w \, PDCF\text{-}4$$

$$+ \sum_{n} (f_o f_d f_w f_s)_{direct} C_w \, PDCF\text{-}5$$

where:

H = annual dose in mrem per year, during the 50th year of exposure

PDCF-3, PDCF-4, PDCF-5 } radionuclide-specific dose conversion factors tabulated in Section 2.4 of Reference C.1 for air, food, and direct exposure pathways, respectively

C_w = radionuclide concentration in the waste

f_o = time delay factor

f_d = site design and operation factor

f_w = waste form and package factor

f_s = site selection factor.

The values of each of these components of the dose equation are listed in Table C-2.

If a maximum of 500 years of radioactive decay were assumed, as suggested in Section 3.3 of Reference C.1, a maximum exposure of 40 mrem per year to the bone would be estimated, primarily due to Nickel-63, which has a 92 year half-life. This exposure rate would be only 8% of the maximum exposure rate (500 mrem per year) on which the concentration limits of Reference C.1 are based. However, in view of the very long containment time provided by the thick reactor vessel (greater than 2000 years) it is not considered appropriate to include any exposure due to Nickel-63, which would be eliminated by radioactive decay well before the reactor vessel could be penetrated or any significant corrosion of metal containing radioactive nickel could occur. Therefore, the values listed in Table C-2 include the long-lived radionuclides Nickel-59, Carbon-14, and Niobium-94.

The annual intruder dose value (H), summed over all radionuclides, is 12.7 mrem per year to the total body, 13.4 mrem per year to the bone, and 12.6 mrem per year to the G.I. Tract—large lower intestine. Adding the well-user exposure to the "agricultural intruder" exposure provides a maximum estimate of 12.7 mrem per year, total body, and 13.5 mrem per year, bone. These extreme estimates are reasonably comparable to the maximum individual exposure estimates of Section V (i.e., 1.5 mrem per year, total body, and 8.9 mrem per year, bone).

B. ESTIMATED EXPOSURE ATTRIBUTABLE TO LAND DISPOSAL OF RESIDENTIAL SMOKE DETECTORS THAT CONTAIN AMERICIUM-241

As a further check on the hypothetical average individual exposure estimates discussed in previous sections, a comparison has been made with the estimated average individual exposures that might result

TABLE C-2. VALUES USED TO CALCULATE "AGRICULTURAL INTRUDER" DOSE

		Units	Ni-59	C-14	Nb-94	Basis for value used
Total Body	PDCF-3 (air)	mrem/yr/Ci/m^3	1.25×10^{11}	2.66×10^{11}	1.40×10^{10}	Table G-5, Reference C.1
	PDCF-4 (food)	mrem/yr/Ci/m^3	3.69×10^{3}	3.72×10^{5}	2.12	Table G-6, Reference C.1
	PDCF-5 (direct)	mrem/yr/Ci/m^3	6.20×10^{3}	0.0	9.63×10^{6}	Table G-7, Reference C.1
Bone	PDCF-3 (air)	mrem/yr/Ci/m^3	7.48×10^{11}	1.33×10^{12}	1.55×10^{10}	Table G-5, Reference C.1
	PDCF-4 (food)	mrem/yr/Ci/m^3	2.21×10^{4}	1.86×10^{6}	7.08	Table G 6, Reference C.1
	PDCF-5 (direct)	mrem/yr/Ci/m^3	6.20×10^{3}	0.0	9.63×10^{6}	Table G-7, Reference C.1
GI-LLI	PDCF-3 (air)	mrem/yr/Ci/m^3	5.08×10^{10}	2.65×10^{11}	1.56×10^{12}	Table G-5, Reference C.1
	PDCF-4 (food)	mrem/yr/Ci/m^3	1.56×10^{3}	3.72×10^{5}	2.39×10^{4}	Table G 6, Reference C.1
	PDCF-5 (direct)	mrem/yr/Ci/m^3	6.20×10^{3}	0.0	9.63×10^{6}	Table G-7, Reference C.1
	C_w	Ci/m^3	3.0×10^{-1}	2.5×10^{-3}	2.0×10^{-4}	Initial curies divided by volume of 400 m^3
	fo (all pathways)	None	1.0	8.0×10^{-1}	1.0	Minimum of 2000 years of radioactive decay
	fd (all pathways)	None	0.125	0.125	0.125	0.5 × 0.25, pp G-59, G-62 of Reference C.1
	fw (air)	None	0.1	0.1	0.1	p G-59 of Reference C.1
	fw (food)	None	1.48×10^{-3}	5.76×10^{-4}	1.11×10^{-3}	0.1 × element-specific values of Table G-14, Reference C.1
	fw (direct)	None	0.1	0.1	0.1	p G-59 of Reference C.1
	fs (air)	None	3.18×10^{-11}	3.18×10^{-11}	3.18×10^{-11}	p G-63, Reference C.1
	fs (food)	None	0.5	0.5	0.5	p G-63, Reference C.1
	fs (direct)	None	0.27	0.27	0.27	p G-65, Reference C.1
	H (total body)	mrem/yr	6.4	0.03	6.3	
	H (bone)	mrem/yr	7.0	0.14	6.3	
	H (GI-LLI)	mrem/yr	6.3	0.03	6.3	

from the disposal each year throughout the United States of 10 million ionization chamber smoke detectors that contain radioactive Americium-241 (Reference C.8). Each of these smoke detectors contains approximately 3×10^{-6} curies (3μCi) of Americium-241, and the total activity of 30 curies per year is expected to be discarded along with other domestic solid waste with no special restrictions.

The principal radiation exposure pathway involving Americium-241 is estimated in Reference C.8 to be the consumption of water that is slightly contaminated by the addition of 0.025 percent of the annual activity to 90 billion gallons of groundwater, i.e.,

$$\frac{(30 \text{ curies})(0.025 \text{ percent})}{90 \times 10^{9} \text{ gallons}} = \frac{0.0075 \text{ curie}}{340 \times 10^{9} \text{ liters}} = 2.2 \times 10^{-14} \text{ Ci/liter}$$

The annual average total body dose commitment reported in Reference C.8, attributable to Am-241 from smoke detectors in drinking water, is approximated below. It should be noted that this calculation uses the rate of water consumption specified in Reference C.8 (370 liters per year) rather than the rate used in this statement (730 liters per year) resulting in a lower dose commitment relative to the dose commitments of this statement.

$$(2.2 \times 10^{-14} \text{ Ci/liter})(370 \text{ liters/yr})(1.6 \times 10^{6} \text{ rem/Ci}) = 1.3 \times 10^{-5} \text{ rem/yr}$$

$$= 1.3 \times 10^{-2} \text{ mrem/yr.}$$

The average annual total body dose commitment attributable to other ingestion exposure pathways (irrigated crops, general crops, and crops grown on landfill) is estimated in Reference C.8 to be less than 1/2 of 1 percent of the water consumption pathway exposure, so that the water consumption pathway is the only significant ingestion path.

The annual average Americium-241 total body exposure, estimated to be 1.3×10^{-2} mrem per year, is higher than the corresponding water consumption exposure estimate attributable to reactor compartment land disposal (1.2×10^{-3} mrem per year, page C-5) by a factor of about 10. This relative difference is consistent with the different water concentrations, consumption rates, and dose conversion factors used to develop each estimate.

It is concluded that the average annual water consumption exposure calculation in this appendix is not only reasonably consistent with a related calculation, but also that the exposure estimate is even smaller than the very low value associated with the unrestricted disposal of smoke detectors.

IX. EXPOSURE TO THE PUBLIC FROM REACTOR COMPARTMENT TRANSPORTATION

Consistent with the approach of References C.13 and C.14, the maximum anticipated individual exposures to the public would be expected to occur if the barge carrying the reactor compartment passes under a bridge with 80 stationary cars (160 persons) waiting for a traffic jam to clear. The population dose calculation for this situation assumes the roadway to be a minimum expected distance of 30 feet above the upper surface of the reactor compartment with the barge moving at 6.5 mph (half normal speed to produce a conservatively high exposure time). With the conservative assumption that the radiation exposure rate would be the maximum allowable (49CFR173.393) 10 mrem per hour six feet above the reactor compartment upper surface, a conversion factor (K value) of 360 mrem-ft^2/hour is used with Figure D-1 of Reference C.13 extrapolated to a 30 foot perpendicular distance. This would yield an individual exposure of approximately 7×10^{-4} mrem and a population exposure for the occupants of the 80 cars of 1.1×10^{-4} man-rem.

At all times during the barge transport, the public along the edges of the oceans, harbors, or rivers would be far enough away from the low level radiation source to avoid any significant population dose, even with a large number of persons along the transportation route. The following estimate, also based on Figure D-1 of Reference C.13, assumes the exposed individuals to be 200 feet away from the barge, which is moving at 13 mph, with one person every tenth of a mile on each side of the river over the entire length of a 350 mile river transit. Therefore, 7000 persons would be assumed to be exposed, with the individual exposure equal to 6×10^{-5} mrem and the population exposure equal to 4.2×10^{-4} man-rem. The assumed population of one per tenth of a mile is based on a uniform density of 100 persons per square mile, which compares with a representative average of 58 per square mile inferred from Appendix E of Reference C.13. Persons located inshore beyond the first tenth of a mile from the water's edge would receive less than one percent of the dose received by those at the water's edge.

X. ESTIMATED IMMEDIATE RADIATION EXPOSURE FOLLOWING A LAND DISPOSAL ACCIDENT

This section of the appendix describes the method used to estimate the **immediate** effects of surface-deposited radioactive material possibly released to the environment as a result of a postulated accident during land disposal operations. The **delayed** effects of such an accident are the same as those described in Appendix J, Section V, for a sea disposal-related accident in which the submarine is lost at a point close to shore without the possibility of recovery.

As described in Chapter 4, Section I.B.1(a), the most severe radioactivity-related accident that can be postulated for land disposal operations is the accidental breaching of the reactor compartment outer containment, and a consequent release of 3.5 curies of surface-deposited activity (crud) from components such as piping outside the reactor vessel. The immediate consequences of this release are postulated to occur in the following way.

A. RELEASE TO THE ATMOSPHERE

The 3.5 curies of released activity are assumed to be Cobalt-60 to maximize the estimated consequences of this accident. Although this kind of release would most likely occur only in the event of submergence of the reactor compartment, a fraction of this material is assumed to become airborne and, based on the use of 0.1 percent airborne release from a similar accident study involving radioactive surface deposits (Reference C.14, page 23), the airborne release is assumed to be 0.0035 curie of Cobalt-60. That is

$$(3.5 \text{ curies})(0.1 \text{ percent}) = 0.0035 \text{ curie}$$

This material is assumed to be released over a two hour period, with a maximum-exposed individual located 100 meters directly downwind during the entire two hours.

With moderately stable atmospheric conditions that would tend to limit the dispersion of airborne contamination ("PASQUILL F" atmospheric stability conditions, wind speed one meter per second), the downwind concentration of radioactivity in the postulated cloud of contamination, without fallout, would be estimated to be

$$\chi = \frac{Q}{\mu \pi M \sigma_y \sigma_z} \text{ (per Reference C.11)}$$

where:

$$Q = \text{release rate} = \frac{0.0035 \text{ curie}}{(2 \text{ hrs})(3600 \text{ sec/hr})} = 4.9 \times 10^{-7} \text{ curies/sec}$$

μ = wind speed = 1 meter per second

π = 3.1416

$M\sigma_y$ = 19 meters, per Reference C.11 (includes meander factor M = 4)

σ_z = 2.3 meters, per Reference C.12

Therefore:

$$\chi = 3.6 \times 10^{-9} \text{ curies/m}^3 \text{ or } 3.6 \times 10^{-9}\ \mu\text{Ci/cc}.$$

If in two hours an individual breathes in one-eighth of a normal day's intake (i.e., 1/8 × 20 m^3 or 150 percent of the normal rate), his intake would be 9.3×10^{-9} curies or 9.3×10^{-3} μCi (Cobalt-60). The 70 year inhalation dose commitment factors for Cobalt-60 are 8.21×10^3 rem per curie (total body) and 5.29×10^6 rem per curie (lung), as shown in Appendix I, Table I-5. These dose commitment factors, combined with the inhalation intake of 9.3×10^{-3} μCi, imply 70 year dose commitments of 0.07 mrem to the total body and 49 mrem to the lung.

Additional accident-related exposure would be received by the individual postulated to remain 100 meters downwind from the accident location. The external exposure caused by immersion in the airborne radioactive material would be 0.016 mrem, based on a total body dose commitment for immersion equal to 2.16×10^3 rem per hour per Ci/m^3 (Appendix I, Table I-8). That is,

$$\left(3.6 \times 10^{-9} \frac{\text{curies}}{\text{m}^3}\right)\left(2.16 \times 10^3 \frac{\text{rem}}{\text{hour}} \text{ per } \frac{\text{curie}}{\text{m}^3}\right)(2 \text{ hours}) = 1.6 \times 10^{-5} \text{ rem} = 0.016 \text{ mrem}$$

Finally, the maximum-exposed individual during the accident could be subjected to direct radiation that could be as great as 0.1 mrem per hour at 100 meters. (See Appendix B, Section III.F.2 for a discussion of the shielding evaluation.) This abnormal exposure rate is attributed to the rearrangement of components within the reactor compartment, and the breach of reactor compartment containment, both of which are postulated to occur as a result of the extreme accident. Hence, the possible direct exposure during the two hour duration of the accidental exposure could be 0.2 mrem. The sum of the three hypothetical accident exposures described above is 0.3 mrem (total body), while the sum for exposure to the lung is 49 mrem.

B. RELEASE TO A SMALL BODY OF WATER

The airborne release of 0.0035 curie of Cobalt-60, from above, could next be hypothesized to be deposited in a small body of water from which a number of individuals (less than 1000) take one day's consumption (2 liters) of water before the water is discovered to be contaminated. The body of water is assumed to be 100 meters in diameter and 3 meters deep, so that its volume is 2.4×10^4 m^3. With 0.0035 curie distributed in a volume of 2.4×10^4 m^3, the Cobalt-60 concentration in the water would be 1.5×10^{-7} μCi/ml. A daily intake of 2 liters (2000 ml) implies a Cobalt-60 intake of 2.9×10^{-4} μCi, which is then combined with the Cobalt-60 ingestion dose conversion factors from Appendix I, Table I-4. These factors are 4.72×10^3 rem per curie (total body) and 8.02×10^4 rem per curie (G.I. Tract). The resulting 70 year dose commitments would be 1.4×10^{-3} mrem to the total body and 2.3×10^{-2} mrem to the G.I. Tract. These hypothetical dose commitments could be received in the one day period following the accident before users might be informed of the contamination of the water supply.

Hypothetical population dose commitments associated with these accident exposures would be 1.4×10^{-3} man-rem to the total body and 2.3×10^{-2} man-rem to the G.I. Tract.

XI. SUMMARY

This appendix describes the radiation exposure estimates associated with land disposal of submarine reactor compartments and the basis for their calculation. The estimates are as follows.

A. LONG-TERM EXPOSURES RESULTING FROM 100 NORMAL LAND DISPOSALS

The maximum long-term releases might cause radiation exposures in the far distant future (several thousand years from the present) not exceeding 6.0×10^{-3} mrem per year, total body, and 3.6×10^{-2} mrem per year, bone, for the average individual. This would mean that the population exposures would be less than approximately 2.1 man-rem per year, total body, and 12.6 man-rem per year, bone, assuming an exposed population of 350,000 persons. The hypothetical maximum individual exposures would be less than approximately 1.5 mrem per year, total body, and 8.9 mrem per year, bone, and would be applicable to only a very limited number of individuals.

The hypothetical population exposures would produce fewer than 0.001 additional health effects per year. This means that additional health effects would be improbable.

All of the above estimates assume that all 100 reactor compartments are buried in the same general disposal area. The exposure could not occur until more than 2000 years after burial, so the estimates are conservative approximations based on possible future populations and continuation of current consumption habits and practices. However, the estimates are biased toward high values and can be considered to be unrealistically high.

Natural background radiation, which is a minimum of 80 mrem per year and averages approximately 100 mrem per year, would be 13,000 to 17,000 times larger than the hypothetical exposure attributable to radioactivity released to the environment from buried reactor compartments.

B. IMMEDIATE EFFECTS RESULTING FROM AN EXTREME ACCIDENT

The maximum immediate effects of a postulated extreme accident involving land disposal operations could cause estimated exposures not exceeding 1.4×10^{-3} mrem to the total body and 2.3×10^{-2} mrem to the G.I. Tract of an average individual. This would yield a total body population exposure less than 1.4×10^{-3} man-rem, based on a population of 1000 individuals. The hypothetical maximum individual exposure would be less than 0.3 mrem to the total body and 49 mrem to the lungs.

The sequence of events required to cause these hypothetical dose commitments is considered to be extremely unlikely. Because of the high-strength reactor compartment, an actual accident of this type would most probably result in much lower values.

The exposure estimates for both normal operations and accident-related releases are intentionally estimated in a way to produce the largest values. Even with this approach, the results show negligible exposures resulting from normal disposal operations and very low accident-related exposures.

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APPENDIX D

DESCRIPTION OF THE SEA DISPOSAL METHOD

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APPENDIX D

DESCRIPTION OF THE SEA DISPOSAL METHOD

I. INTRODUCTION

Sea disposal of defueled and decommissioned naval reactor plants would be consistent with the policy of isolation and containment of radioactive waste required by U.S. Environmental Protective Agency regulations. The locations of any sites that would be considered satisfactory for sea disposal would be remote from man and his activities, including food production. Almost all of the radioactive material would be packaged within two containment barriers, and a third containment barrier for 99.9 percent of the material is additionally provided by the fact that the radioactivity is an integral part of the structural metal of the reactor plant. Essentially all of the radioactive material would be within at least one containment barrier, primarily as an integral part of the structural metal. Only trace amounts of radioactivity (less than 0.0001 percent) would be part of the reactor compartment hull and bulkheads which constitute the first containment barrier.

The approach that would be taken in sea disposal is to maintain the integrity not only of the reactor compartment, which is formed by the outer hull and the forward and aft bulkheads, but also of the entire reactor primary coolant system. The latter includes the reactor vessel, which would be isolated from the remainder of the primary coolant system. To meet these containment objectives, a number of steps would be taken. (Also, see Appendix G, Section II.A for a discussion of the expected containment.)

The reactor compartment would be sealed at the shipyard and completely filled with water to assure that the compartment would not be damaged by submergence pressure after the submarine is sunk. The forward reactor compartment bulkhead would be fitted with a one-way valve (check valve) to permit inward flow for pressure compensation as the submarine travels in free fall from the surface to the desired depth of more than 4000 meters.

The submarine would be towed to the disposal area and intentionally flooded with water to begin the sinking operation. Complete flooding of the ship with water would occur soon after the sinking operation is begun, so that none of the compartments would be crushed by submergence pressure. The maximum terminal velocity has been estimated to be 45 feet per second (27 knots) and this velocity would be reached less than one minute after the sinking is initiated, so that the submarine would reach the bottom in approximately five minutes. It has also been estimated that the submarine would impact the relatively soft clay or mud bottom with a maximum deceleration of approximately 2 g, within 1500 feet of the release point (measured horizontally). The estimated attitude of the ship would be similar to normal ship's attitude, with a bow-up angle between 0 and 5 degrees.

Minor hull damage may be expected to occur upon impact. Breaching of the reactor compartment containment would not be expected, based on calculations, experiments in tanks with submarine models, tests at sea with large cylinders and a submarine model, and on previous submarine sinkings which were somewhat similar to the anticipated disposals, but which were not controlled as the disposals would be. The maximum shock load of deceleration on the reactor plant (that is the reactor vessel piping and components) would be less than the submarine's shock capability known from actual submarine shock tests.

This appendix describes the sequence of steps that would carry out the sea disposal option and the basis for predicting the intact condition of the submarine when it impacts the sea bottom. Total disposal site area is conservatively estimated.

II. SHIPYARD PREPARATIONS

A. REACTOR COMPARTMENT

Radioactive liquids, toxic liquids and resin beads would be removed from the reactor plant systems and disposed of in accordance with existing procedures and regulations. The reactor vessel would be isolated from the remainder of the primary plant and filled with water.

The remainder of the reactor plant would also be filled with water. The reactor compartment would be isolated from the two adjacent compartments and a pressure-equalizing one-way valve or check valve would be fitted on the forward bulkhead to permit flow only in the inward direction. The reactor compartment would be completely filled with water, just prior to towing to the disposal site. This would ensure that the reactor compartment would not contain any significant void spaces and therefore would not be subjected to significant pressure differences which would tend to crush the compartment during the period of submergence. After the submarine is on the bottom, with the pressure inside the reactor compartment approximately equal to or less than the pressure in the adjacent compartment, there would be no driving force for leakage from the reactor compartment. The only leakage through the valve would be into the reactor compartment if pressure in the adjacent compartment were greater.

Compatible materials would be used for the valve, which would be designed to handle the same pressure differentials as the bulkhead. Accelerated corrosion of the valve installed on the bulkhead would not be expected. The size and design of the valve would be such that dirt or small objects would not cause it to stick open and there would be no loose debris remaining in the ships' compartments large enough to interfere with proper functioning of the valve.

B. OTHER SUBMARINE COMPARTMENTS

All other compartments of the submarine would be altered prior to disposal at sea by cutting holes in the top of the hull to ensure that rapid flooding would occur early during the descent to the ocean floor. These holes would be spaced at approximately 12-foot intervals in compartments outside the reactor compartment, and would be approximately 2 feet in diameter. The holes would be fitted with cylindrical raised extension trunks, sealed before the sinking operation with removable covers. The purpose of the extension trunks would be to ensure that the compartments would not ship water while in transit and flood prematurely, because of the low freeboard of submarines. The covers would be removable for the actual sinking operation. To ensure that each compartment would flood with minimum void formation, holes would also be cut in the internal decking.

All other potentially compressible or crushable volumes of significance within the submarine, such as air flasks, sanitary tanks, torpedo tubes, etc., would either be flooded prior to towing operations or be opened and vented to allow rapid and complete flooding.

Some of the submarine's normal ballast material would be removed, along with salvageable equipment, and additional material (gravel) would be placed in an aft compartment to relocate the center of gravity approximately 2.5 feet aft of its normal location. As explained in Section VI.D, this would be the optimum location of the center of gravity for limiting the horizontal movement of the submarine during its descent to the sea floor.

C. SUBMARINE EXTERIOR

Horizontal control surfaces would be removed from the submarine, for the purpose of minimizing the horizontal distance that the submarine would travel during its descent to the ocean floor. A catwalk would be installed on the submarine exterior, fore and aft, to provide access for at-sea removal of the extension trunk covers. An operating station to allow flooding of the main ballast tanks by remote control would be located on the exterior of the hull on the catwalk adjacent to the submarine's "sail."

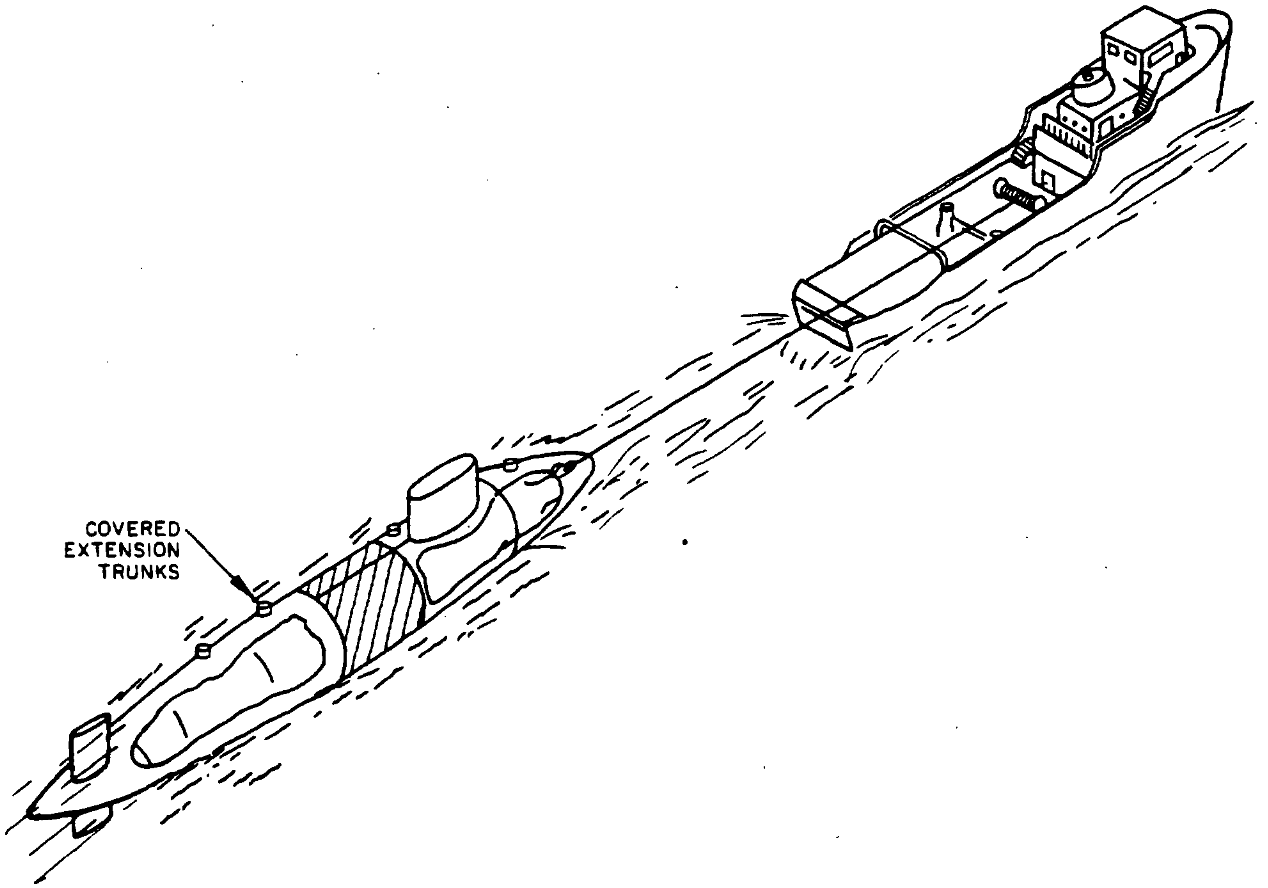


Figure D-1. Tow of Submarine to Disposal Site

III. TRANSPORTATION TO THE DISPOSAL SITE

A. TOWING FROM SHIPYARD TO SITE

The submarine would be towed bow forward from the shipyard to the disposal site by an ocean-going tug (Figure D-1), at a speed of less than 9.5 knots, the maximum stable towing speed in this configuration. The vessels would be accompanied by a Navy escort ship to assure that all other vessels would stay well clear of the tug and the towed submarine. Requirements on weather conditions for the entire time needed for the disposal operation would be imposed to minimize weather hazards. Further assurance that the submarine would be safely delivered to the disposal site for placement on the sea floor at the intended location is provided by consideration of its design and construction in separate watertight compartments. Each of the compartments would be isolated from adjacent compartments. In the unlikely event of an accident in which one or more of the isolated compartments were to develop a serious leak, the submarine would remain afloat even after taking on large volumes of water since its ballast tank vents would be valved shut until intentionally opened just prior to final submergence. The submarine's rugged construction as a warship, its successful operation for many years both in the normal submerged condition and on the surface under all weather conditions, and its restoration to seaworthiness after decommissioning, provide confidence that its final movement to the intended disposal site can be carried out with minimal likelihood of accidental sinking.

Submarines have in the past been towed long distances by the Navy. The towing stability of submarines as described above has been tested using models in towing tanks. All necessary steps would be taken to ensure that the tow would be safely conducted using procedures that have been proved safe by long experience by the Navy in similar tasks.

B. CONSIDERATIONS IN ESTABLISHING THE RELEASE POINT

The release point would be specified in advance of each disposal so that the probability of collision with a previously sunk submarine would be negligibly small. The determination of the release point would take into account the maximum navigational uncertainty, the maximum horizontal excursion or glide, the submarine's length, and the results of all previous disposals. Selection of the release point would have the objective of minimizing the eventual total disposal area consistent with avoiding collision with any previously emplaced submarines. The release point would be uncertain by no more than 0.1 mile, the assumed maximum navigation error. The total required area, as described in Section IX of this appendix, would depend on the maximum navigation error, the average glide distance, the ship length, and the total number of disposals.

IV. SINKING OPERATIONS

A. ACTIONS PRIOR TO SINKING

1. Instrumentation

Two instrumentation packages would be used. An array of sonobuoys would be deployed on the surface to determine the actual glide trajectory and the final bottom position. Other instruments, on the submarine hull, would record external and internal hull pressures, pitch-and-roll motion, and acceleration/deceleration during the sinking operation. These instruments would remain on the submarine until after impact; then they would automatically detach and float to the surface for retrieval and analysis and for re-use in later disposals. Data from both instrumentation packages would be of value in assessing the fate of the ship, particularly during the first disposals when detailed knowledge of hull behavior would be most limited.

An alternate instrumentation system that would be considered for use in monitoring the sinking operation is an array of transponders placed on the sea bottom, with several transponders placed on the hull itself. This fixed grid system could be "surveyed in" prior to sinking, replenished on a yearly basis or in case of failure, and could be used for post-sinking monitoring. These systems are available and considered to be very reliable.

2. Ship Preparations

At the disposal site (Figure D-2) a salvage crew would board the ship. The covers would be removed from the hull holes, the hull-mounted instrumentation would be activated; and the tow line would be released by the tug. Finally the ballast tank vent valves would be opened and the salvage crew would leave the ship. The submarine would settle in the water until the hull holes are submerged, after which rapid flooding would occur (Figure D-3).

B. MONITORING DURING THE SINKING OPERATION

1. Trajectory and Final Location

The array of sonobuoys laid down around the submarine at the release point would monitor the signals emitted from battery-powered precision "pingers" mounted on the bow and stern of the submarine. A reference time for the periodic output of each "pinger" would be established before sinking, and the output of each "pinger" would be relayed by the sonobuoys to the escort vessel or to an aircraft overhead. Sets of three sonobuoys would be selected and their outputs would be used in a triangulation computation to yield the position of one or the other of the "pingers" while the hull is sinking. A number of such sets would be used for the calculation and a best-estimate value of position would be obtained. In this way, not only would the hull's location be determined, but also its attitude. The position of the sonobuoy array on the earth's surface would be located by satellite or LORAN position fixes, so that the absolute position of the sunken hull (± the maximum navigation error) would be accurately determined.

2. Pressure, Acceleration/Deceleration, Roll and Pitch Angles

Recorders connected to sensors at various points on the submarine hull, would be carried down with the vessel as it sinks. Pressures, accelerations, and angles of roll and pitch would be recorded during the sinking.

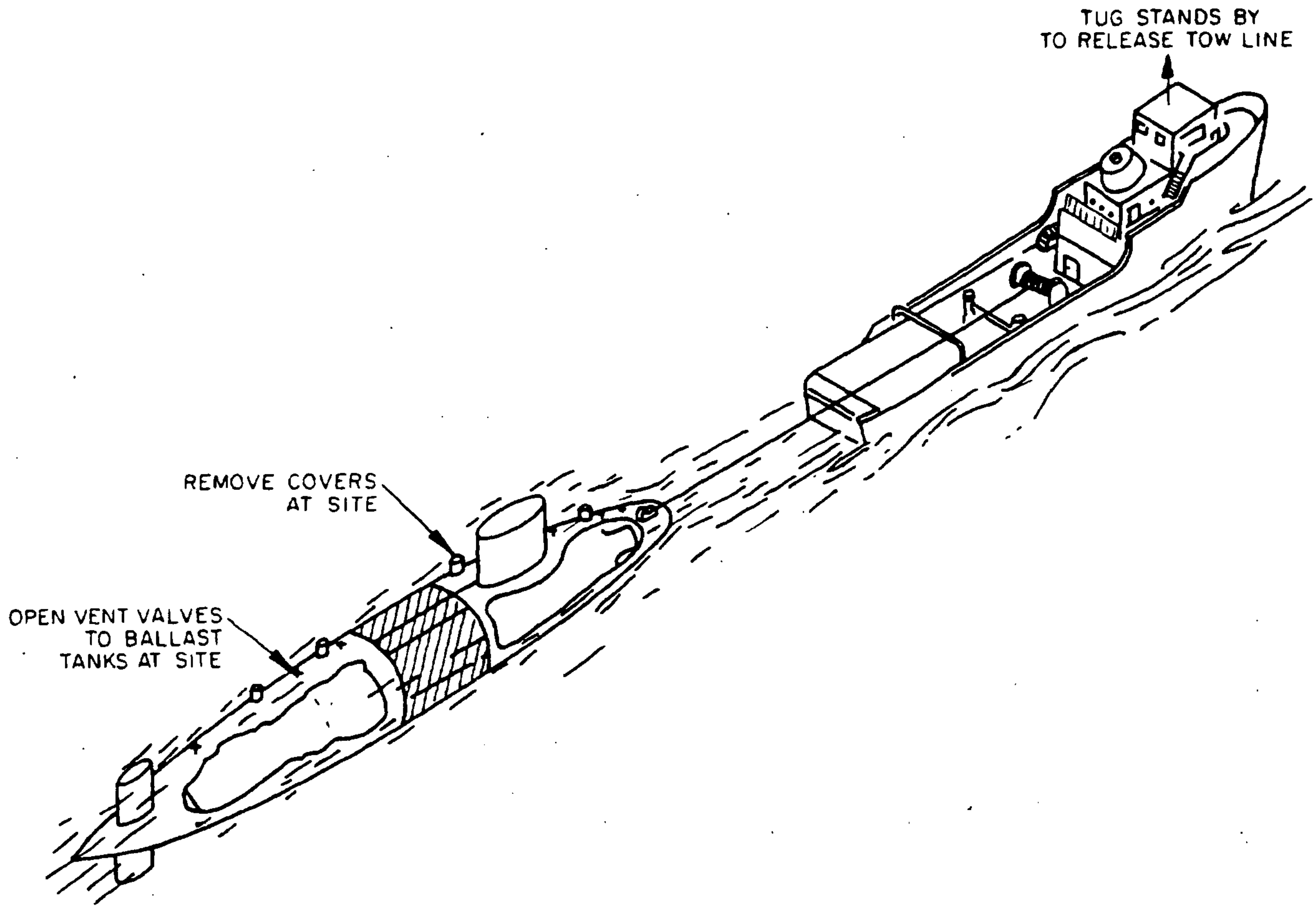


Figure D-2. Prepare to Flood and Free Fall

Each recorder, contained in a pressure cannister, would be released by a time-controlled explosive cutter after the submarine comes to rest. The cannisters would float to the surface and be picked up for analysis and reuse.

V. RESULTS OF SUBMARINE SINKINGS IN THE PAST

A. PLANNED SINKINGS

The expected condition of disposed submarines after they come to rest on the ocean bottom can be predicted from the results of comparable sinkings in the past. The most applicable data come from planned sinkings that were carried out during Project Thurber, a 1973 experiment off the coast of California, in which obsolete diesel-powered submarines were allowed to sink in a controlled way to a depth greater than 4000 meters. The second of the Project Thurber sinkings is the source of the following information. This sinking was selected primarily because of the better instrumentation used in that instance.

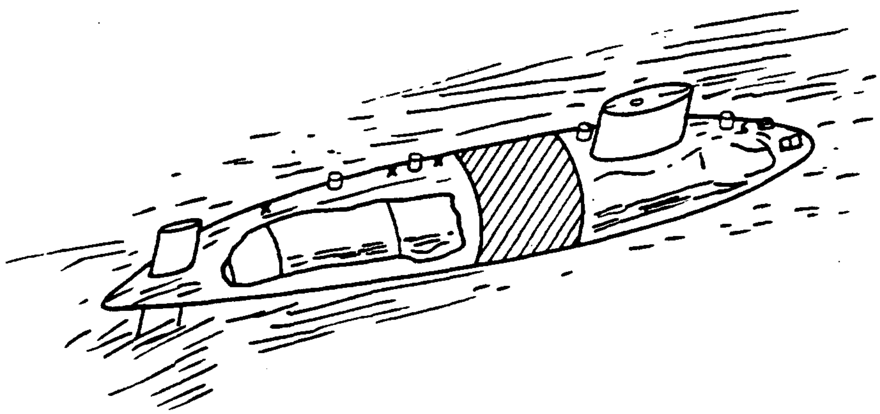


Figure D-3. Submarine Submerged With Compartments Flooding

Numerous instruments both on the submarine (ex-BLACKFIN, SS 322) and on the surface provided information on the hull's underwater velocity and final impact deceleration, as well as the structural events that took place as the initially air-filled hull partially flooded as it sank and collapsed due to hydrostatic pressure when the hull's collapse depth was reached. Hull collapse occurred in this case because the submarine was not provided with holes in its hull to ensure prompt and complete flooding, as would be provided in the event of nuclear submarine disposals at sea. As a result, the ship broke into two roughly equal sections, the stern portion of which filled with water and continued to sink, at a constant velocity of 20.5 feet per second (12 knots). Just before reaching the bottom, the attitude of the hull was slightly stern down. When it struck bottom, it stopped with a maximum deceleration of 1.7 g and penetrated into the bottom 6.5 feet. Similar information from the bow section was not obtained because the "pinger" mounted near the bow broke loose during hull collapse. The general conclusions of Project Thurber were that a satisfactory sinking procedure had been developed and that the several instrumentation schemes used in the experiment produced acceptable data.

B. ACCIDENTAL SINKINGS

An estimate of the most severe condition of the reactor plant containment of disposed submarines can be obtained from the actual results of two accidental sinkings of U.S. Navy nuclear submarines (USS THRESHER, SSN 593, and USS SCORPION, SSN 589). The sea bottom locations where the two submarines were lost have been surveyed on several occasions using submersibles with no evidence of leakage from the reactor vessel, which for these two operational submarines contained uranium fuel and fission product radionuclides, as well as the relatively small quantities of activated components that remain in defueled and decommissioned ships. In particular, the water, sediment, marine life, and debris have been monitored in the neighborhood of these sinking sites, and it has been concluded that no release of radioactivity has occurred from the reactor vessel. Only trace amounts of radioactivity originally contained in the reactor cooling water or on piping and component inner surfaces have been found. An evaluation of the most recent of these sea floor monitoring operations is provided as an annex to this appendix.

VI. RESULTS OF TESTING TO VALIDATE SINKING AND IMPACT EFFECTS

A. SUBMARINE MODEL TESTS IN A TANK

Sinking experiments were carried out in the U.S. Navy Undersea Weapons Tank at the Naval Surface Weapons Center at White Oak, Maryland. A 10-foot long scale model of a large nuclear-powered submarine (SSBN 616 class) was employed. The linear scale was 42.5 to 1. The tank was equipped with still and motion picture and television cameras in viewing ports at eight uniformly spaced depths from the surface to the bottom. The experimental program consisted of various free falls of the flooded model to a number of different depths up to 75 feet, with various configurations including removal of stern planes, fairwater planes, and rudders (Figure D-4). Initial conditions were also modified by varying the initial ballast conditions and initial pitch angles. Videotape, still photographs, and movies of each experimental run were taken. The results of the experimental program were used to verify the accuracy of a generalized computer simulation, or mathematical model, of sinking operations (next section), including ship attitude and terminal velocity.

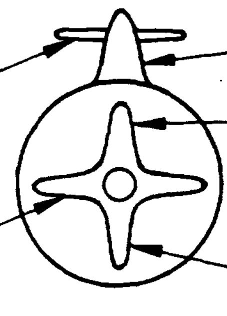


Figure D-4. View From Aft

B. COMPUTER SIMULATION

The motion trajectories for at-sea disposal of a large submarine were predicted utilizing the U.S. Navy Undersea Weapons Tank computer simulation. Such simulations were shown to provide predictions which matched the results of a wide variety of scale model experiments in the Undersea Weapons Tank.

As a result of the combined program of model testing in the tank and computer simulations, it was concluded that the most desirable configuration of the submarine for sea disposal would be as follows.

Stern planes should be removed to reduce both the maximum terminal velocity and the maximum horizontal glide. Fairwater planes should be removed to reduce the tendency toward rolling oscillations and to provide a regular spiral descent path, thereby causing reduced horizontal movement from the release point. The ship's propeller would be removed. To further reduce the maximum horizontal glide distance, ballast would be added to move the longitudinal center of gravity in the aft direction. Based on the successful combination of tank testing and computer simulation, further confirmatory tests at sea were carried out. Part C of this section describes tests at sea involving impact measurements of large cylinders. The submarine model tests are discussed in Part D.

C. IMPACT TESTS ON THE SEA FLOOR

Experiments at sea were carried out in April 1981 and January 1982 to determine the impact forces resulting from the free fall of large cylinders. Two locations were chosen for the impact tests to provide a range of soil properties. A sandy sea floor site was selected at a location 4 miles west of Port Hueneme, California, in 80 feet of water, to represent a relatively hard bottom. A clay sea floor site was selected at a location 30 miles west of Port Hueneme, in 1200 feet of water to represent a relatively soft bottom similar in strength to deep ocean clays. The deeper test location's geotechnical properties are documented in References D.1 and D.2. The objects dropped onto the sea floor were 1/4-inch thick steel-walled tanks 27 feet long and 8 feet in diameter, ballasted with concrete and water-filled, designed to achieve a terminal velocity of about 20 feet per second, and equipped with instruments to measure deceleration and internal pressure changes upon impact. Penetration distances were determined by post impact photographs of the tanks, which had been painted on each end with a grid for that purpose. The tanks used in the second round of testing in January 1982 had hemispherical ends to reduce water resistance effects and therefore increase the terminal velocity. Fully ballasted tanks weighed a minimum of 52,000 pounds in air, and about 31,000 pounds in water.

For each of the four free fall drop tests, a prediction of the maximum deceleration on impact and the penetration distance was obtained using a theoretical impact prediction model based on References D.3 and D.4. The series of tests therefore provided a measure of the accuracy obtainable with the prediction model for large cylinders, and an indication of the uncertainty associated with impact predictions for actual submarine disposals.

Comparison of the actual test data to impact prediction model results showed that the penetration predictions adequately estimated the actual penetration, with greater accuracy for clay floor drops than sandy floor drops. Actual cylinder penetration in clay was 4.5 feet while the predicted penetration was 3.6 feet. The comparison also showed the deceleration predictions adequately estimated the actual cylinder decelerations, with the measured decelerations being about 60 percent of the predicted values. In clay, the predicted deceleration was approximately 1.6 g while the actual value was 1.0 g.

On the basis of the predictions and test results with 27-foot long cylinders, it was concluded that the impact prediction model, when applied to actual submarine impacts, will yield penetration and deceleration estimates that are within ±50 percent of field results. This is considered to be a reasonable accuracy for a dynamics problem in geotechnical engineering.

D. SUBMARINE MODEL TESTS IN THE SEA

Experiments at sea were also carried out using an instrument-equipped 20-foot long scale model of a large nuclear powered submarine (SSBN 598 class). These hydrodynamic tests were performed to determine actual model trajectories during the free fall; the tests not only provided basic information but also served as a basis for comparison with computer simulations of the model's trajectories. This comparison was used to provide an indication of the uncertainty associated with the predicted motion of the actual submarine during its descent to the sea floor at the disposal site. The computer predictions employed an improved version of the predictive model used in the analysis of submarine model tank tests (Section VI.B).

The hydrodynamic experiments in the sea were performed offshore near San Diego, California in May 1981 and off San Clemente Island, California in May and November 1981. The experiments employed the 20-foot model, with a 400-foot recovery line. Various model configurations were tested: with and without stern planes, with and without fairwater planes, and with the center of gravity altered. For the configuration that would represent the submarine under actual disposal conditions, i.e., without stern planes and without fairwater planes, and with the center of gravity moved several feet in the aft direction, the effect of various initial angles was examined by releasing the model in a horizontal attitude, then with the bow 45° above horizontal, and finally with the bow 30° below horizontal.

From previous model experiments, analyses, and computer simulations on the free-fall characteristics of modern submarines, it was anticipated that the normal configuration (that is, with stern planes and fairwater planes attached and with normal center of gravity) would exhibit a pronounced tendency toward forward glide and large horizontal excursions during free fall. This was verified during early model runs.

All of the model configurations without the stern planes installed indicated little forward glide, with vertical descent in a nearly zero pitch attitude. In general, all of the configurations without stern planes and without fairwater planes (refer to Figure D-4) descended with less pitch and roll motion than configurations with only the stern planes removed. This result clearly showed the preferred configuration for actual disposal.

Vertical terminal velocity of the model tests without stern planes was in the range 39 to 45 feet per second, with a steady-state pitch angle from 1 to 5 degrees, bow up. Predicted velocity was 40 feet per second, indicating good agreement between actual test results and prediction.

The model configurations without stern planes installed usually moved in a counter-clockwise direction, such that when extrapolated to a 15,000-foot depth, the submarine would be expected to make up to two full turns (720° or less). Horizontal displacement from the point of sinking at the surface was limited to 100 feet per 1000 feet of descent, or up to 1500 feet in a 15,000-foot descent, when the center of gravity is moved 2.5 feet aft of its normal location. This movement of the center of gravity also results in a terminal velocity of 43 feet per second, with a steady-state pitch angle of 3.9 degrees, bow up.

In experiments with unusually high initial pitch angles (45° bow up and 30° bow down), the model recovered rapidly (less than 50 seconds when translated for the full scale object) with the steady state condition being about the same as for a zero initial pitch angle.

Computer simulation of the model motion was generally quite adequate for the needs of this program. It was observed, however, that much of the horizontal translation of the submarine model was actually lateral to the hull, that is "sidewise" motion not represented by the computer simulation. This indicates that the computer simulation would be of only limited accuracy in predicting precise horizontal translation when longitudinal glide is not a major factor. For this reason, a conservative 10 percent allowance (1500 feet) is made for horizontal displacement from the surface sinking point (termed g_{max} in Section IX of this appendix).

VII. EFFECT OF SEA BOTTOM CONDITIONS

In the event that sea disposal is selected, the sea floor at acceptable sites would be covered by thick layers of sediment, composed of at least 300 meters of clay, silt, sand or mixtures of these materials. The sediment properties would have been measured by core sampling and Doppler penetrometer surveys prior to site selection. The penetrometer surveys would show the degree of uniformity of the entire site area.

With the expected sea bottom conditions, and maximum predicted terminal velocity, the impact shock of the submarine hull on the sea floor would be less than design shock limits, thereby ensuring that the reactor compartment hull and bulkhead containment barriers would not be breached.

VIII. EXPECTED FINAL CONDITION OF THE SUBMARINE

If disposal at sea is selected it would be carried out with all precautions necessary to ensure that the reactor compartment containment remains intact. It is expected that the entire reactor plant would remain intact within the boundaries of the reactor compartment because the forces that would be encountered during sinking would be insufficient to damage the compartment. Of greatest importance to the containment of radioactive material is the integrity of the reactor vessel, and there is no reason to doubt that this extremely strong container would remain intact and completely closed when the submarine has come to rest on the ocean floor. If and when sea disposal of the first decommissioned submarine is performed, monitoring during and immediately after the sinking operation either will confirm that reactor compartment containment has remained intact, or it will reveal that some problem was not anticipated and reactor compartment containment integrity was lost or diminished. In the latter case, the sea disposal of the second decommissioned submarine would not be carried out until the procedure had been altered as appropriate. Since the maintenance of reactor compartment containment integrity is not a 100 percent certainty, the environmental effects of sea disposal have been conservatively estimated with the assumption that a sea disposal action could produce a "worst case" type of radioactivity release associated with complete loss of containment, that is, rupture of the reactor compartment and the reactor vessel. This assumption is very conservative because even if complete containment were not achieved, it is extremely unlikely that the reactor vessel containment would be penetrated even under the most severe landing conditions of the submarine.

IX. TOTAL DISPOSAL AREA REQUIRED

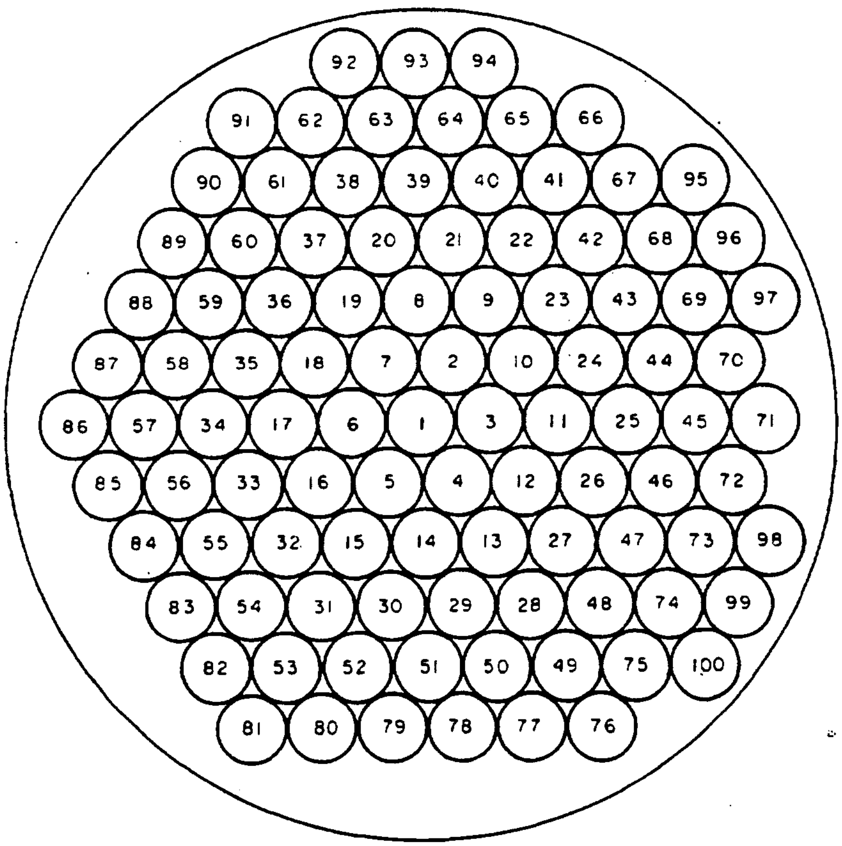
For a conservative estimate of the maximum required sea disposal area, the maximum diameter of a circular area would depend on the maximum navigational error (E_{max}) associated with establishing the surface release point, the maximum horizontal glide (g_{max}) of the submarine during the sinking, the ship length ($\mathcal{L}$), and the total number of disposals (N). As indicated in Figure D-5, when N equals 100 ships the maximum diameter of the circular disposal area would be approximately 12 times the diameter of a uniform size circle of uncertainty associated with each submarine. The latter diameter (or small circle diameter) is

$$d_{max} = 2(E_{max} + g_{max} + \mathcal{L})$$

and

$$D_{max} = 12\, d_{max}$$

The area defined in this way is conservatively large because it is based on the assumption that the final location of the submarine on the sea floor is known only within the possible glide distance. The monitoring that would be performed during sinking, however, would accurately establish the final location which in practice would reduce the actual required area.



Each small circle represents a maximum area of uncertainty associated with one disposal. Its radius equals (E_{max} + g_{max} + $\mathcal{L}$), i.e., the maximum navigational error plus the maximum horizontal glide distance plus the ship length. When 100 disposals are considered, the total area has a diameter somewhat less than 12 times the diameter of the small circle.

Figure D-5. Possible Scheme for Utilization of a Sea Disposal Area

Further conservative assumptions have been made as follows to determine a maximum disposal site area. The maximum navigational area (E_{max}) is taken to be 0.1 mile, g_{max} is assumed to be not more than 1500 feet and ℓ is taken to be a maximum length of 400 feet. The diameter of the circle of uncertainty around each submarine would then be 0.92 statute mile, and the diameter of the entire disposal area would be 11.0 statute miles. The circular area is therefore 96 square miles or 250 square kilometers. The area of a square in which this circle could be inscribed would be 320 square kilometers. These estimates show that the maximum required total area would be about 3 percent of the area limit of 10^4 km^2 proposed by the International Atomic Energy Agency included in the disposal site requirements of Chapter 3, Section II.A. Even if the maximum navigational error were taken to be 1 mile instead of 0.1 mile, the required total area would still be less than 28 percent of the area limit of 10^4 km^2.

Since as noted above the actual glide direction and distance would be known after each disposal action, the actual required area would be expected to be smaller than the estimates arrived at above.

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ANNEX TO APPENDIX D

RADIOLOGICAL ENVIRONMENTAL MONITORING AT SITES OF NUCLEAR-POWERED SUBMARINE THRESHER AND SCORPION SINKINGS

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ANNEX TO APPENDIX D

RADIOLOGICAL ENVIRONMENTAL MONITORING AT SITES OF NUCLEAR-POWERED SUBMARINE THRESHER AND SCORPION SINKINGS

I. INTRODUCTION

There have been two unfortunate occurrences involving the sinking of U.S. Navy nuclear-powered submarines. Reference D.A1 provides the Navy assessment of the radiological aspects of these sinkings as follows:

Loss of USS THRESHER and USS SCORPION

"Two U.S. Navy nuclear-powered submarines have been lost at sea in the Atlantic Ocean. The submarine THRESHER sank 10 April 1963, 100 miles from land in water 8,500 feet deep at latitude 41°45'N and longitude 65°00'W. The submarine SCORPION sank between 21 and 27 May 1968, 400 miles southwest of the Azores in more than 10,000 feet of water. The reactors used in all U.S. naval submarines and surface ships are designed to minimize potential hazards to the environment even under the most severe casualty conditions such as actual sinking of the ship. First, the reactor core is so designed that it is physically impossible for it to explode like a bomb. Second, the reactor fuel elements are made of materials that are extremely corrosion resistant, even in seawater. The reactor core could remain submerged in seawater for decades without releases of fission products while the radioactivity decays, since the protective cladding on the fuel elements corrodes only a few millionths of an inch per year. Thus, in the event of a serious accident where the reactor is completely submerged in seawater, the fuel elements will remain intact for an indefinite period of time, and the radioactive material contained in these fuel elements should not be released. The maximum rate of release and dispersal of the radioactivity in the ocean, even if the protective cladding on the fuel were destroyed, would be so low as to be insignificant.

"Radioactive material could be released from this type of reactor only if the fuel elements were actually to melt and, in addition, the high-strength, all-welded reactor system boundary were to rupture. The reactor's many protective devices and inherent self-regulating features are designed to prevent any melting of the fuel elements. Flooding of a reactor with seawater furnishes additional cooling for the fuel elements and so provides added protection against the release of radioactive fission products.

"Radiation measurements, water samples, bottom sediment samples, and debris collected from the area where THRESHER sank were analyzed for radioactivity shortly after the sinking and again in 1965 by various laboratories with highly sensitive equipment. Similarly, seawater and bottom sediment samples taken near SCORPION's hull were analyzed for radioactivity. None of these samples showed radioactivity above naturally-occurring background levels, and none showed evidence of radioactivity released from either THRESHER or SCORPION.

"In 1977, followup samples of water, sediment, marine life, and debris were collected from the immediate THRESHER debris areas. In 1979, followup samples of water, sediment, marine life, and debris were collected from the immediate SCORPION debris areas. None of these samples showed any evidence of release of radioactivity from the reactor fuel elements in either THRESHER or SCORPION. However, Cobalt-60 released from both THRESHER and SCORPION coolant systems was detectable at low levels in sediment samples in the debris areas. The amount of Cobalt-60 radioactivity in these samples was small compared to the naturally-occurring radioactivity in the sediments. Based on the samples, less than 0.001 curie of Cobalt-60 was estimated to be present in the sediment at either site. Cobalt-60 was not detectable in samples of water, marine life, or debris. Thus, the THRESHER and SCORPION have not had a significant effect on the radioactivity in the environment."

As indicated above, the initial radiological monitoring that was conducted shortly after the sinkings, using state-of-the-art techniques, did not detect radioactivity from either THRESHER or SCORPION. Subsequent returns to these two sites in 1977, 1979, and 1983 were made to reassess the situation after a period of time. The opportunity was also used to obtain some beneficial data from these unfortunate occurrences. It is the purpose of this annex to report the additional information determined in the 1977, 1979, and 1983 surveys upon which the above summary from Reference D.A1 was based. The radiological surveys at both sites consisted of in-situ gamma spectrum measurements of the sediment, obtained by descents to the sites in the submersible TRIESTE, as well as collections of bottom water, sediment cores, and bottom-dwelling marine life samples for later analysis in laboratory facilities.

II. SITE DESCRIPTION

A. THRESHER SITE

The THRESHER debris lies on the upper continental rise east of George's Bank and Brown's Bank in 2590 meters of water. The area where the debris lies is relatively flat and featureless. A slight slope exists which descends gradually to the southeast and the Sohm Abyssal Plain. The sediments in the area of the debris are estimated to be almost 100 meters thick with the first meter consisting of a silty, clayey sand at the surface (0 to 5 centimeters) with silty clay underneath. The sediments are well oxygenated by the overlying water with positive reduction-oxidation potentials occurring throughout the first 0.6 meter of the sediments. Chemical and mineralogical data for the sediments taken in 1977 from the debris site are given in Reference D.A2. A geological description of the sediments in the general area (40°43'N, 65°50'W to 40°16'N, 64°57'W) is given in Reference D.A16.

The THRESHER debris lies in an area along the Western Boundary Undercurrent flow. This current is a rapidly moving mass of cold (~3°C), well-oxygenated water that originates in the Arctic and sweeps down along the continental rise off Canada and the United States, as shown in Figure D-A1. The current velocity at the ocean bottom in the vicinity of the THRESHER debris was observed with the submersible to be roughly one half knot (about 26 cm/sec), flowing in a generally southwesterly direction. This agrees with the velocities of 9.5 to 26.5 cm/sec reported in Reference D.A3 for the Western Boundary Undercurrent. The average dissolved oxygen level in the water at the site was found to be 7.8 mg/liter based on measurements of water samples obtained by the submersible. The undercurrent, as it flows along the ocean bottom, is approximately 500 kilometers wide and varies in thickness (height off the bottom) from about 100 to 500 meters. The top of the undercurrent as it flows along the continental rise is always deeper than 1800 meters below the ocean surface. There is apparently little or no mixing of the Western Boundary Undercurrent with continental shelf water along the entire North American coast (Reference D.A4).

Based on observations from the submersible and examinations of preserved sediments, marine life in the vicinity of the THRESHER debris is relatively abundant and quite varied. Marine animals including nematode and polychaete worms, as well as tunicates, molluscs, foraminifera and brachipods are present in the sediments. Sponges, hydroids, gorgonians, echinoids, holothurians, isopods, amphipods, spider crabs, lobsters, and shrimp are found on the sediments or on the debris. Animal life in the water above the bottom sediments was observed to be much sparser than that found in or on the sediments.

The marine life observed in the water column included small octopus, squid, shrimp, and various fish. The most common fish noted in the debris area are the Macrourid species or rat tails. Rarer fish include Bathypteroids (tripod fish), Synaphobranchids (deep-sea eels), Halosaurids, Synodonts, Brotulids, and Chimaerids. None of these are fished commercially, and the THRESHER depth is over 2000 meters deeper than any known commercially fished areas. The closest commercial fishing is approximately 50 kilometers to the west at a depth less than 1000 meters.

B. SCORPION SITE

The SCORPION debris lies 400 miles southwest of the Azores in over 10,000 feet of water in a basin at the eastern edge of the Mid-Atlantic ridge (Figure D-A2). The area is relatively flat and featureless with very fine carbonate sediment (30-46 percent $CaCO_3$), and very low current. The sediment deposition rate in the region has been estimated at 1.8 centimeters per 1000 years, one of the lowest depositional rates in the Atlantic Basin (Reference D.A5).

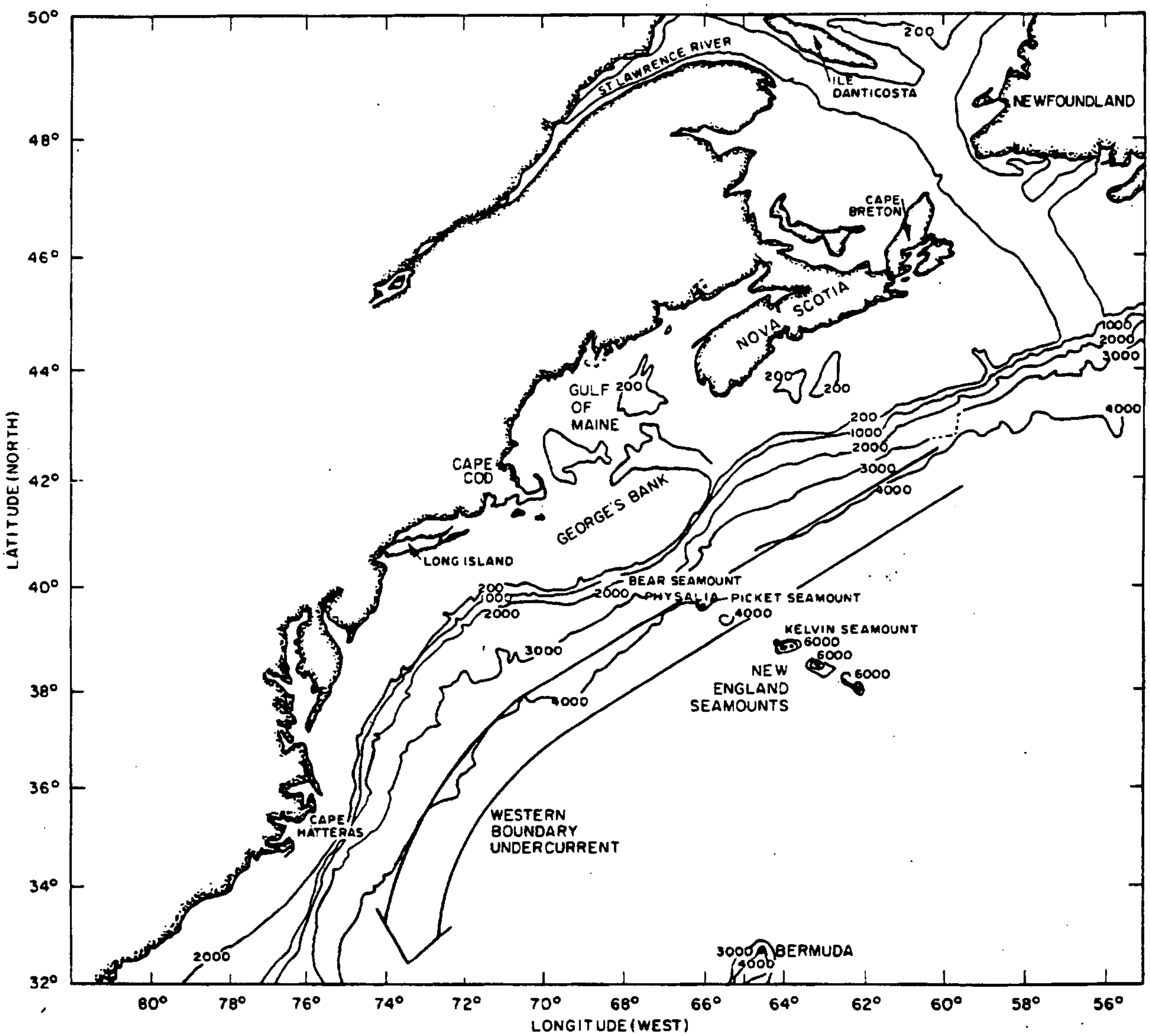

Figure D-A1. Western Boundary Undercurrent and North American Coastline (Depths are Shown in Meters)

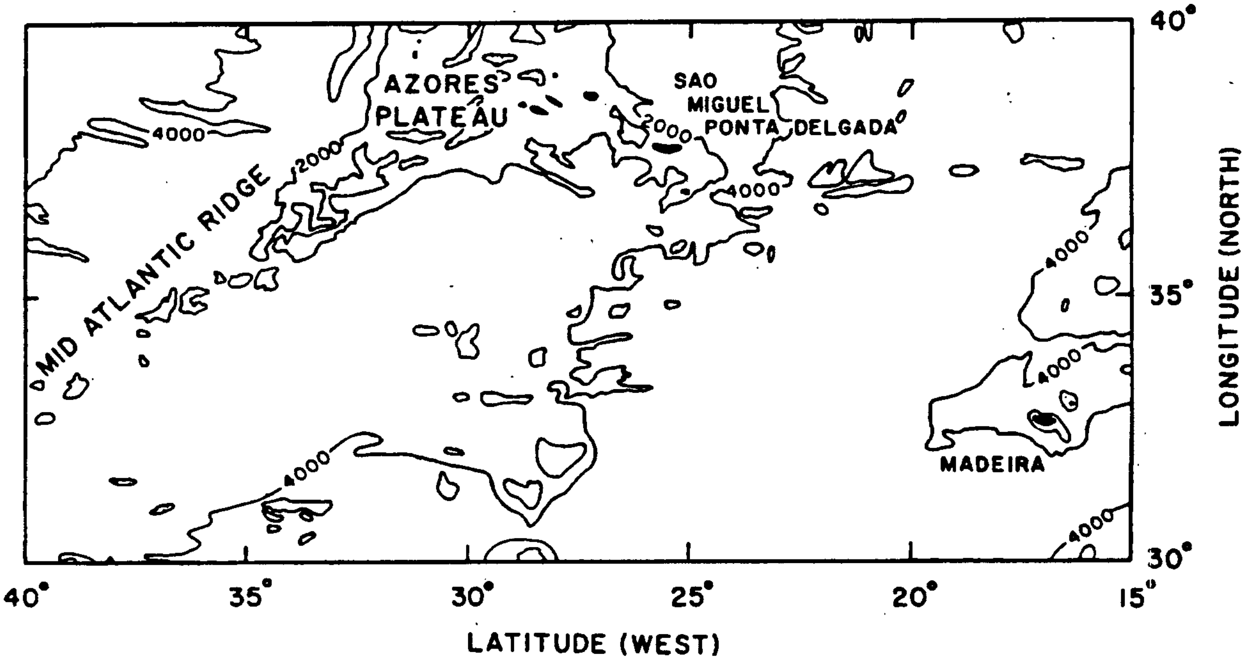

Figure D-A2. Eastern Atlantic Ocean in the Vicinity of the Azores (Depths are Shown in Meters)

Based on measurements of samples collected by the submersible, the sediments at the SCORPION site are well oxygenated by the overlying water with positive reduction-oxidation potentials occurring throughout the first 0.5 meter of the sediments. A detailed geological description of the sediments in the general area is given by Reference D.A5.

The water mass in this vicinity is described in Reference D.A6 as being made up in part of North Atlantic deep water and Mediterranean water. The well-oxygenated North Atlantic deep water originates in the Arctic and flows south, whereas the Mediterranean water, which is higher in salinity, flows down the continental slope out of the Straits of Gibraltar and spreads westward across the Atlantic toward the Mid-Atlantic ridge.

The temperature, salinity, dissolved oxygen, and current data obtained by the submersible at the SCORPION site are consistent with this hypothesis. The average dissolved oxygen measured in the water is 6.6 mg/liter, and the temperature is less than 6°C. The net current velocity measured over a one day period, as shown in Figure D-A3, is extremely low with a varying direction indicative of tidal basin slosh. The net current for the 25-hour period was 0.9 centimeter per second in the direction of 200 degrees magnetic.

Observations from the submersible revealed very little marine life on the surface of the sediments in the vicinity of the SCORPION. The sediment in the area is very fine textured and it is possible that animal tracks would not endure for long periods because of the shifting of the sediment. Debris are colonized by corals, sponges, crinoids, and primitive chordates (ascidians). Several fish consisting mainly of macrourids (rat tails), crustaceans (large and small shrimp), and Munidopsis (squat lobsters), were observed in the vicinity of the debris. Two macrourids approximately 40 centimeters long were caught at the debris site using a surface-deployed modified lobster trap. Bottom photographs of a rocky region in the general area of the

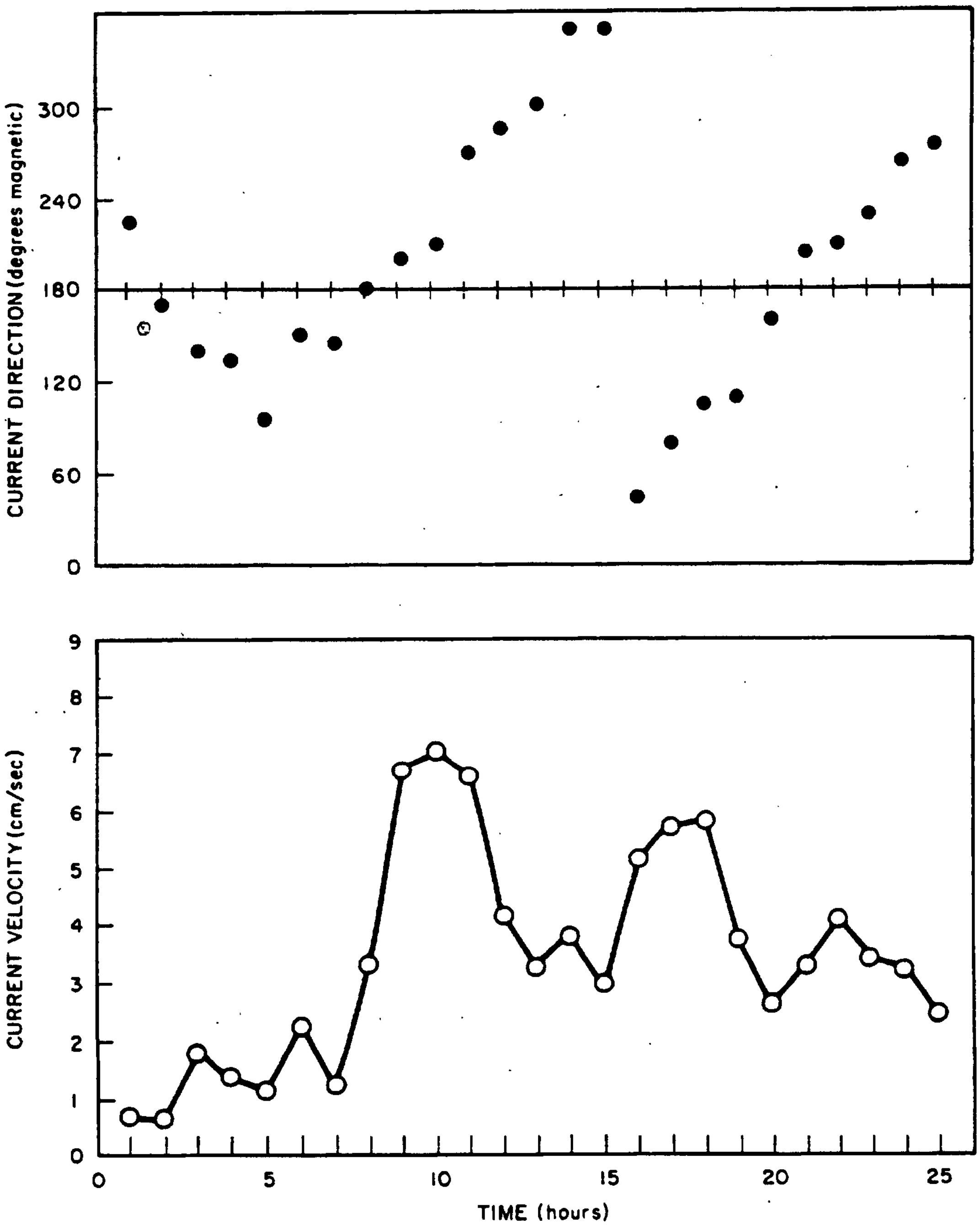

Figure D-A3. Bottom Current Data for 25-Hour Period Taken at the SCORPION Debris Site Area in September 1979

debris site (Reference D.A7) indicate a benthic faunal density of about 100 individuals or colonies per 4000 square meters, or about 0.025 per square meter. This would be equivalent to a biomass of 0.84 g/m^2 to 1.65 g/m^2 which compares with the value of 1.0 g/m^2 suggested in Reference D.A6 as the average biomass of the benthos in deep central Atlantic areas. These values are also similar to the epifaunal biomass at 4067 meters in the Pacific, Reference D.A8, but may be high by a factor of two or three for the actual biomass at the SCORPION site excluding the colonization of debris.

III. RADIOACTIVITY IN THRESHER AND SCORPION REACTOR PLANTS

There are three principal categories of radioactivity within the THRESHER and SCORPION debris. The first is the small amount of waterborne radioactive corrosion products which are formed during the operation of the reactor plant and adhere to the inside surfaces of the piping and components that contact the water coolant that is circulated through the nuclear reactor. These corrosion products are mainly in the form of small magnetic oxide particles that are very insoluble in both water and dilute acids. Less than 10 curies of radioactivity, predominantly Cobalt-60 and Nickel-63, is estimated to be currently present in these corrosion products at either site, with the majority of this radioactivity contained within the reactor vessel.

The second category of radioactivity is the neutron activated, corrosion-resistant metal making up the nuclear reactor pressure vessel and its internal structure. Again, most of the radioactivity is in the form of Cobalt-60 and Nickel-63 in the steel alloys completely within the massive steel reactor pressure vessel. The corrosion products generated by the slow process of corrosion in seawater are generally non-magnetic, and therefore would be distinguishable from the magnetic corrosion products formed during reactor operation. Less than 1000 curies and 5000 curies of radioactivity are estimated to be currently present as an integral part of the activated metals of the reactor plant in the THRESHER and the SCORPION, respectively.

The third category of radioactivity is the nuclear fuel which is protected from exposure to seawater by an alloy that is extremely resistant to seawater corrosion. The total fission product and actinide series radioactivity in the nuclear fuel in either the THRESHER or SCORPION reactor is presently less than 30,000 curies. This radioactivity is retained in the fuel, which is inside the reactor vessel, which in turn is inside the ship's hull.

IV. RADIOLOGICAL MONITORING, SAMPLE ANALYSIS PROGRAM, AND RESULTS

The radiological monitoring of the THRESHER and SCORPION sites in 1977 and 1979 was conducted by the Navy using the deep submersible TRIESTE. The 1983 monitoring of the THRESHER site utilized the deep submergence research vehicle ALVIN and its support ship LULU, and the oceanographic research vessel CAPE FLORIDA. The radiological monitoring program was based on analyzing for Cobalt-60, Cesium-137, and Nickel-63. Cobalt-60 is the predominant gamma-emitting radionuclide and Nickel-63 is the predominant beta emitter present in the small amount of corrosion products present inside the reactor coolant systems and contained in the activated metal structures inside the reactor vessel. Cesium-137 is the predominant long-lived gamma-emitting fission product radionuclide present in the reactor fuel. Potassium-40 is a naturally-occurring radionuclide. The methods of monitoring and analysis for the 1977 and 1979 samples are described below along with the results obtained. This is followed by a discussion of the more recent results obtained during the 1983 expedition to the THRESHER site.

A. BOTTOM WATER

Bottom water samples were taken in the immediate vicinity of the THRESHER and SCORPION debris for measurement of gamma-emitting radionuclides and dissolved oxygen. Water samples were obtained at the THRESHER site with one liter Niskin sterile bag samplers, with the inlet tubing facing forward, mounted to the TRIESTE superstructure. When the desired sampling locations were reached with the submersible, a mechanical arm was utilized to activate the samplers. At the SCORPION site, a similar arrangement using Teflon bag samplers was used to obtain water samples for radioactivity measurement while an electrically-operated General Oceanics Rosette sampler mounted on the submersible's superstructure was utilized to

TABLE G-13. IRON-55 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE 100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	1.5×10^{-3}	50	4.3×10^{-5}
7	3.3×10^{-3}	60	3.4×10^{-6}
24	3.8×10^{-3}	70	2.7×10^{-7}
30	4.1×10^{-3}	101	6.3×10^{-9}
38	9.6×10^{-4}	130	2.6×10^{-9}

TABLE G-14. COBALT-60 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE 100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	2.4×10^{-4}	95	3.0×10^{-7}
7	6.8×10^{-4}	101	1.2×10^{-3}
24	1.0×10^{-3}	130	1.7×10^{-3}
30	1.1×10^{-3}	135	6.5×10^{-4}
40	4.1×10^{-4}	140	3.3×10^{-4}
50	1.2×10^{-4}	150	8.7×10^{-5}
60	3.0×10^{-5}	200	5.5×10^{-8}
70	8.4×10^{-6}		

TABLE G-15. NIOBIUM-94 RELEASE RATES vs. TIME AFTER DISPOSAL EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE 100 Submarines—3 Per Year

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	0.0	133	8.2×10^{-3}
99	0.0	142	6.5×10^{-3}
100	7.7×10^{-4}	525	5.0×10^{-3}
101	1.6×10^{-3}	1460	3.9×10^{-3}
107	2.7×10^{-3}	2500	1.0×10^{-3}
120	6.1×10^{-3}	5210	2.0×10^{-4}

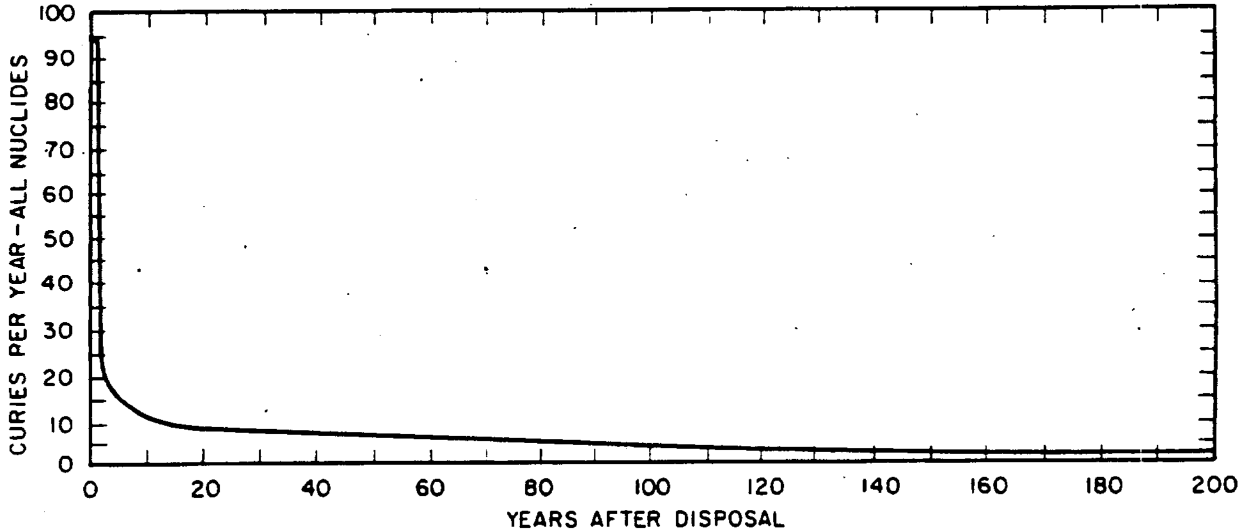

Figure G-4. Total Release to the Environment—One Submarine Minimum Containment—Best Estimate

TABLE G-16. MAXIMUM ANNUAL RELEASE MINIMUM CONTAINMENT—BEST ESTIMATE ONE SUBMARINE

Nuclide	Year When Maximum Occurs	Maximum Release In Any One Year (Ci)
Fe-55	1	48
Co-60	1	31.4
Ni-63	1	9.9
Co-58	1	2.4
Mn-54	1	1.8
Fe-59	1	0.37
Zr-95	1	0.33
Cr-51	1	0.13
Hf-181	1	0.12
Ni-59	1	0.06
C-14	1	5.1×10^{-4}
S-35	1	7.6×10^{-5}
Sc-46	1	6.0×10^{-5}
Nb-94	1	4.4×10^{-5}
Mo-93	1	1.0×10^{-5}
Tc-99	1	2.8×10^{-6}

TABLE G-17. IRON-55 RELEASE RATES vs. TIME AFTER DISPOSAL
MINIMUM CONTAINMENT—BEST ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	48	54	6.4×10^{-6}
2	5.4	58	2.5×10^{-6}
4	2.5	61	1.0×10^{-6}
8	1.0	65	4.1×10^{-7}
11	0.40	69	1.6×10^{-7}
15	0.15	72	6.5×10^{-8}
18	0.063	75	3.9×10^{-8}
22	0.025	76	2.5×10^{-8}
26	0.010	79	1.0×10^{-8}
29	4.0×10^{-3}	83	4.1×10^{-9}
33	1.6×10^{-3}	86	1.6×10^{-9}
36	6.4×10^{-4}	90	6.6×10^{-10}
40	2.5×10^{-4}	94	2.6×10^{-10}
43	1.0×10^{-4}	97	1.5×10^{-10}
47	4.0×10^{-5}	98	1.0×10^{-10}
51	1.6×10^{-5}	200	0.0

TABLE G-18. COBALT-60 RELEASE RATES vs. TIME AFTER DISPOSAL
MINIMUM CONTAINMENT—BEST ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	31.4	99	1.7×10^{-5}
2	6.7	104	7.7×10^{-6}
7	2.9	111	3.0×10^{-6}
14	1.1	118	1.5×10^{-6}
21	0.46	122	8.8×10^{-7}
28	0.18	125	4.8×10^{-7}
35	0.074	132	1.9×10^{-7}
42	0.029	139	7.7×10^{-8}
49	0.011	146	3.1×10^{-8}
56	4.7×10^{-3}	153	1.2×10^{-8}
63	1.8×10^{-3}	160	4.9×10^{-9}
70	8.1×10^{-4}	167	1.9×10^{-9}
76	5.0×10^{-4}	174	7.9×10^{-10}
77	3.0×10^{-4}	181	3.1×10^{-10}
84	1.2×10^{-4}	188	1.2×10^{-10}
91	5.0×10^{-5}	190	1.0×10^{-10}
97	3.2×10^{-5}	400	0.0

TABLE G-19. NICKEL-63 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—BEST ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	9.9	1247	6.1×10^{-4}
2	6.7	1296	5.0×10^{-4}
76	4.6	1297	3.9×10^{-4}
97	4.2	1360	2.2×10^{-4}
99	3.9	1451	1.5×10^{-4}
113	3.6	1452	1.3×10^{-4}
121	3.5	1473	8.6×10^{-5}
122	2.4	1587	3.6×10^{-5}
226	1.0	1700	1.5×10^{-5}
340	0.52	1814	6.6×10^{-6}
409	0.40	1927	2.8×10^{-6}
410	0.34	2040	1.5×10^{-6}
453	0.23	2076	1.3×10^{-6}
512	0.18	2077	1.1×10^{-8}
514	0.15	2154	5.7×10^{-9}
566	0.082	2267	2.4×10^{-9}
680	0.035	2380	1.0×10^{-9}
793	0.015	2492	6.6×10^{-10}
907	6.3×10^{-3}	2493	1.3×10^{-10}
1020	2.7×10^{-3}	2500	1.0×10^{-10}
1133	1.1×10^{-3}	5200	0.0

TABLE G-20. COBALT-58 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—BEST ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	2.4	5	1.4×10^{-7}
2	0.027	6	4.3×10^{-9}
3	1.4×10^{-4}	7	1.0×10^{-10}
4	4.3×10^{-6}	13	0.0

TABLE G-21. MANGANESE-54 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—BEST ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	1.8	15	2.1×10^{-6}
2	0.13	16	6.7×10^{-7}
3	0.021	18	2.1×10^{-7}
5	6.6×10^{-3}	19	6.7×10^{-8}
6	2.1×10^{-3}	20	2.1×10^{-8}
8	6.6×10^{-4}	22	6.7×10^{-9}
9	2.1×10^{-4}	23	2.1×10^{-9}
10	6.6×10^{-5}	25	6.7×10^{-10}
12	2.1×10^{-5}	26	2.1×10^{-10}
13	6.6×10^{-6}	27	1.0×10^{-10}
		57	0.0

TABLE G-22. ZIRCONIUM-95 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—BEST ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	0.33	2	0.0

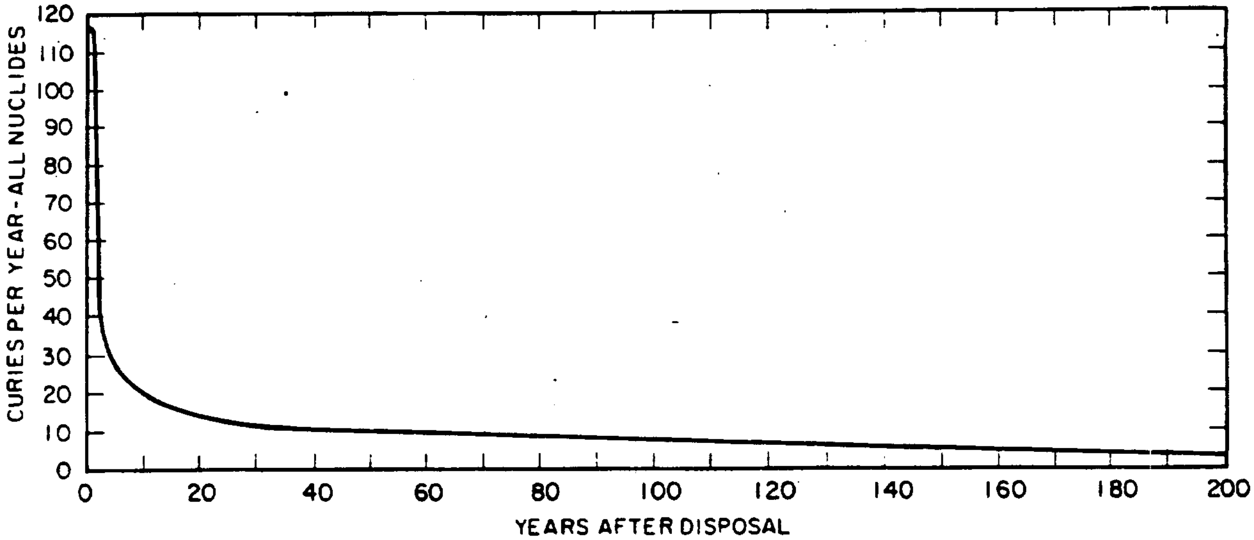

Figure G-5. Total Release to the Environment — One Submarine Minimum Containment — Conservative Estimate

TABLE G-23. MAXIMUM ANNUAL RELEASE MINIMUM CONTAINMENT — CONSERVATIVE ESTIMATE ONE SUBMARINE

Nuclide	Year When Maximum Occurs	Maximum Release In Any One Year (Ci)
Fe-55	1	54.1
Co-60	1	38.9
Ni-63	1	15.7
Co-58	1	2.7
Mn-54	1	2.0
Fe-59	1	0.37
Zr-95	1	0.33
Cr-51	1	0.16
Hf-181	1	0.12
Ni-59	1	0.098
C-14	1	8.7×10^{-4}
S-35	1	1.3×10^{-4}
Sc-46	1	9.9×10^{-5}
Nb-94	1	7.6×10^{-5}
Mo-93	1	1.9×10^{-5}
Tc-99	1	5.5×10^{-6}

TABLE G-24. IRON-55 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	54.1	45	1.0×10^{-4}
2	8.5	50	5.4×10^{-5}
5	4.0	55	9.7×10^{-5}
8	2.1	60	3.5×10^{-6}
11	0.98	65	8.7×10^{-7}
15	0.31	70	2.8×10^{-7}
18	0.098	75	9.7×10^{-8}
22	0.043	80	2.8×10^{-8}
27	9.7×10^{-3}	85	8.7×10^{-9}
32	3.1×10^{-3}	90	2.4×10^{-9}
36	9.7×10^{-4}	95	6.6×10^{-10}
40	3.06×10^{-4}	100	1.8×10^{-10}
		200	0.0

TABLE G-25. COBALT-60 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	38.9	91	9.2×10^{-5}
2	14.3	97	5.8×10^{-5}
7	6.1	99	3.6×10^{-5}
14	2.4	104	2.3×10^{-5}
21	1.0	111	9.2×10^{-6}
28	0.37	118	3.6×10^{-6}
35	0.15	122	1.5×10^{-6}
42	0.059	125	9.2×10^{-7}
49	0.027	132	5.8×10^{-7}
56	9.3×10^{-3}	139	2.3×10^{-7}
63	3.6×10^{-3}	146	9.2×10^{-8}
70	1.5×10^{-3}	153	3.6×10^{-8}
76	7.7×10^{-4}	160	1.5×10^{-8}
77	5.8×10^{-4}	167	5.8×10^{-9}
84	2.3×10^{-4}	174	1.6×10^{-10}
		400	0.0

TABLE G-26. NICKEL-63 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	15.7	1100	2.8×10^{-3}
2	14.2	1249	1.1×10^{-3}
76	7.0	1250	1.1×10^{-5}
123	4.7	1350	5.0×10^{-6}
183	2.9	1499	2.0×10^{-6}
245	1.9	1500	3.6×10^{-7}
305	1.4	1600	1.6×10^{-7}
320	1.1	1712	6.5×10^{-8}
367	0.74	1800	3.7×10^{-8}
428	0.47	1900	1.6×10^{-8}
489	0.29	2000	6.5×10^{-9}
550	0.18	2100	3.7×10^{-9}
612	0.12	2200	1.6×10^{-9}
680	0.072	2300	9.0×10^{-10}
735	0.047	2400	4.1×10^{-10}
800	0.029	2500	1.6×10^{-10}
920	0.011	2600	1.0×10^{-10}
1040	4.5×10^{-3}	3100	0.0

TABLE G-27. COBALT-58 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	2.7	5	5.5×10^{-7}
2	0.020	6	1.6×10^{-8}
3	6.3×10^{-4}	7	4.7×10^{-10}
4	1.9×10^{-5}	13	0.0

TABLE G-28. MANGANESE-54 RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)	Year	Release Rate (Ci/yr)
1	2.0	14	1.3×10^{-5}
2	0.18	16	1.3×10^{-6}
3	0.11	18	4.6×10^{-7}
4	0.041	20	1.2×10^{-7}
5	0.020	22	2.2×10^{-8}
6	0.010	24	4.3×10^{-9}
8	1.4×10^{-3}	26	6.1×10^{-10}
10	3.9×10^{-4}	28	1.0×10^{-10}
12	7.3×10^{-5}	57	0.0

TABLE G-29. ZIRCONIUM-95* RELEASE RATES vs. TIME AFTER DISPOSAL MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—ONE SUBMARINE

Year	Release Rate (Ci/yr)
1	0.33
2	0.0

*Zirconium-95 is only present in the "crud."

IV. THE RELEASE MODEL

This section describes the mathematical model used to estimate the total rate at which radioactive nuclides would be released from the activated metals of the submarine into the nearby ocean environment. This model was constructed to account for the following processes:

(1) The corrosion of the activated components of the submarine plant.

(2) The penetration of various containment barriers within the submarine by corrosion.

(3) The accumulation of activity in the form of corrosion products within the contained volumes of the submarine prior to general penetration of barriers.

(4) The decay of radioactive isotopes during the time period when the materials are contained.

(5) The release of corrosion products into the open ocean environment.

The equations used in this model mathematically represent these processes in a general way, allowing for a wide variety of applications. The specific applications of this model are described in Section II. These applications used conservative values of the various parameters employed in the equations. A discussion of those values is presented in Section IV.D.

A. THE CORROSION OF ACTIVATED COMPONENTS OF THE SUBMARINE

After the submarine has settled on the ocean floor, the metal surfaces of the submarine will be subjected to the process of corrosion. This corrosion process will slowly liberate both stable and activated corrosion product particles which subsequently enter the surrounding water volumes. Details of the various corrosion processes which exist in the deep ocean are presented in Appendix F. The results of that appendix indicate that a simple mathematical model may be used to conservatively estimate the rates at which the metals will be corroded and subsequently released into nearby volumes.

1. Description of the Modeled Components

The metal components which make up the submarine reactor plant are mostly large, complicated structures. In order to estimate the rate at which corrosion products are liberated from a component, a simplified geometry was used for each component. All of the activated components of the reactor plant have a large surface area to volume ratio, thus the thickness of the metal comprising the component will be the limiting dimension in terms of corrosive penetration. Therefore, the components are modeled in a one-dimensional manner, i.e., the fraction of the entire component which is considered to be corroded away is the fraction of its initial thickness which has been consumed by corrosion processes.

2. Corrosion Release From a Single Component

Each component which contains activated metal was assumed in the previous section to be representable as a one-dimensional thickness. Assuming that the activity in the component is uniformly distributed throughout the initial thickness of the component leads to an activity density per unit thickness ($\rho(t)$) given by

$$\rho(t) = \frac{A_o e^{-\lambda t}}{\tau_o}$$

where:

A_o = the initial activity for a particular nuclide in the component at the time of disposal (Ci)

λ = the radioactive decay constant for a particular nuclide (yr^{-1})

t = the time since disposal (yr)

τ_o = the initial thickness of the component (cm).

The factor $e^{-\lambda t}$ accounts for the radioactive decay of the radionuclide while contained within the metal matrix. Multiplying the density of the activity per unit thickness times the rate at which the thickness is released by corrosion gives the rate at which the given component liberates activity, $\omega(t)$, into a nearby volume.

$$\omega(t) = \rho(t) r(t)$$

where:

$r(t)$ = the corrosion release rate, i.e., the total rate at which the thickness of the component enters the surrounding volumes.

Based on Section IV.7 of Appendix F, the corrosion release rate is conservatively given by the long term corrosion rate. As a result, the equation for $\omega(t)$ becomes:

$$\omega(t) = \rho(t)\,(2r_L)\,\xi(t) \qquad (G.1)$$

where:

r_L = the long term corrosion rate for the component. (The factor of two accounts for two sides corroding.)

$\xi(t)$ = a factor which takes into account whether or not the component is corroding at time t

$$= \begin{cases} 0 \text{ if the component has previously corroded away or if corrosion has not started} \\ 1 \text{ if the component is actively corroding at time t.} \end{cases}$$

3. Grouping the Components According to Containment

In Section II.A.1, three levels of containment were discussed with respect to the major portion of the activity. The first level, which includes virtually all of the initial activity, is the containment provided by the structural metals of the submarine reactor plant, since the activated atoms are an integral part of those metals. The second level of containment, which includes most of the initial activity, is that provided by the sealed reactor vessel which encloses the most active components. The third and final level of containment is that provided by the submarine reactor compartment bulkheads and external hull which enclose virtually all of the activated components. These last two levels of containment are made up of metal barriers which would be closed and sealed prior to disposal.

In the "expected containment" scenario, each of these barriers is assumed to be intact once the submarine reaches the ocean floor. As a result, the majority of the activated components are within the reactor vessel containment, a few components are within the reactor compartment but outside the reactor vessel, and one slightly active component (the outer surface of the hull and bulkheads which contain less than 40 mCi) is exposed directly to the environment. With this division in mind, three functions, Ω_{RV}, Ω_{RC}, and Ω_{out} are used to represent the total rate of introduction of corrosion products into the three volumes which receive the corrosion products: the reactor vessel, the reactor compartment volume outside the reactor vessel, and the open ocean, respectively. These functions are defined by the equations:

$$\Omega_{RV}(t) = \sum_{k=1}^{n} C_{(RV)_k}(t)\,\omega_k(t) = e^{-\lambda t} \sum_{k=1}^{n} C_{(RV)_k}(t) \left(\frac{A_{o_k}}{\tau_{o_k}} \,(2r_{L_k})\,\xi_k(t) \right) ; \qquad (G.2i)$$

$$\Omega_{RC}(t) = \sum_{k=1}^{n} C_{(RC)_k}(t)\,\omega_k(t) = e^{-\lambda t} \sum_{k=1}^{n} C_{(RC)_k}(t) \left(\frac{A_{o_k}}{\tau_{o_k}} (2r_{L_k})\, \xi_k(t)\right) \; ; \qquad \text{(G.2ii)}$$

$$\Omega_{out}(t) = \sum_{k=1}^{n} C_{(out)_k}(t)\,\omega_k(t) = e^{-\lambda t} \sum_{k=1}^{n} C_{(out)_k}(t) \left(\frac{A_{o_k}}{\tau_{o_k}} (2r_{L_k})\, \xi_k(t)\right) . \qquad \text{(G.2iii)}$$

where:

$\omega_k(t)$ = activity release rate for a particular component (Equation (G.1))

k = an index specifying a particular component

n = the total number of modeled components

$C_{(RV)_k}(t)$ = the reactor vessel containment coefficients, i.e., the fraction of the kth component which corrodes into the reactor vessel volume.

$$= \begin{cases} 1 & \text{if the particular component is entirely contained within the reactor vessel} \\ 1/2 & \text{if only one side of the component is enclosed by the vessel} \\ 0 & \text{if the component lies entirely outside the vessel.} \end{cases}$$

$C_{(RC)_k}(t)$ = the reactor compartment containment coefficient, i.e., the fraction of the kth component which corrodes into the reactor compartment volume outside the reactor vessel.

$$= \begin{cases} 1 & \text{if the particular component is fully contained in the compartment exclusively} \\ 1/2 & \text{if only one side of the component is enclosed} \\ 0 & \text{if the component lies entirely outside.} \end{cases}$$

$C_{(out)_k}(t)$ = the external containment coefficient, i.e., the fraction of the kth component which is directly exposed to external ocean waters, including those components which were previously unexposed to the external waters at times prior to barrier penetrations.

$$= \begin{cases} 1 & \text{if the particular component is fully exposed to the ocean waters at time t} \\ 1/2 & \text{if only one side of the component is exposed to the ocean waters at time t} \\ 0 & \text{if the component is not exposed to the ocean waters at time t.} \end{cases}$$

NOTE: The values of 1/2 are used only for those components which make up containment boundaries and as such, release material equally into two volumes.

The time dependence of these coefficients has been explicitly included to account for a shift in the containment levels of the components as the containment barriers are penetrated. For example, when the bulkheads which contain the reactor compartment volume are penetrated by corrosion, those components (or fractions of components) which were contained by the compartment are then considered to be exposed to the external ocean waters. Mathematically, this is accomplished by changing the values of the relevant containment coefficients at the appropriate times. Thus the value of the external containment coefficients for each component will gain the value of the corresponding compartment coefficient at the time of bulkhead penetration (t_{BLKD}). The values of the compartment coefficients will then drop to zero for all components indicating that for times **greater than** t_{BLKD}, no containment is afforded by the compartment volume. Similarly, the external containment coefficient for each component will increase by the value of the corresponding reactor vessel containment coefficient at the time when the vessel walls are penetrated by general surface corrosion (t_{RV}). The values of the vessel coefficients will then drop to zero for all components indicating that for times **greater than** t_{RV}, no containment is afforded by the reactor vessel volume.

Thus the containment coefficients are constrained so that

$$C_{(RV)_k}(t) + C_{(RC)_k}(t) + C_{(out)_k}(t) \equiv 1$$

for all times and components. This ensures that each component is fully accounted for at all times.

In summary, the function $\Omega_{RV}(t)$ represents the rate at which the components inside the reactor pressure vessel release activity as corrosion products into the vessel volume. Similarly, $\Omega_{RC}(t)$ represents the rate at which activity is released into the reactor compartment volume. Lastly, $\Omega_{out}(t)$ represents the rate at which the activity is released to the nearby ocean waters from corrosion of components which are directly exposed to those waters.

4. Corrosion Start and Stop Times

The functions $\xi_k(t)$ used in Equations (G.1) and (G.2) indicate whether or not a given component (the kth) is actively corroding at time t after disposal. Critical to the evaluation of $\xi_k(t)$ are the times when the kth component first begins to corrode and when it has fully corroded away. Since all components are exposed to water (either seawater or the water used as a pressure compensating medium), the starting time for all corrosion is t = 0, the time of disposal. The time when the component stops corroding, t_{s_k}, depends on its initial thickness and the applicable corrosion rates as defined by the equation:

$$t_{s_k} = \frac{\tau_{o_k} - (2(r_{s_k} - r_{L_k})(t_B))}{2r_{L_k}} \quad \text{(G.3)}$$

where:

τ_{o_k} = the initial thickness of the kth component (inches)

r_{s_k} = the first year corrosion rate (inches/yr)

r_{L_k} = the long term corrosion rate (inches/yr)

t_B = the time when the corrosion rate changes (= 1 year).

The factor of two in Equation (G.3) accounts for the corrosion of the component from two sides.

Thus the function $\xi_k(t)$ is explicitly defined by

$$\xi_k(t) = \begin{cases} 1 & 0 \leq t \leq t_{s_k} \\ 0 & t_{s_k} < t \end{cases}$$

The set of corrosion stop times defines a sequence of time values between which the functions Ω_{RV}, Ω_{RC}, and Ω_{out} are continuous; as such they are significant in the definition and solution of the various differential equations which follow (Sections IV.B and C). This set of values will be identified by the set notation $\{t_i\}$, where $t_i = t_{s_k}$ for some kth component.

B. THE ACCUMULATION OF CORROSION PRODUCTS

The previous section dealt with the corrosion of activated components and the rates at which activity is introduced by corrosion into various volumes of water. In the "expected containment" scenario, the reactor vessel and reactor compartment volumes are initially self-contained since there is no path for activity to leave these volumes at the time of disposal. As a result, the activity liberated by corrosion from the components within those volumes will accumulate within the two volumes, at least until the components which make up the barriers to movement are penetrated by corrosion. This section presents the functions and equations used in this model to represent the accumulation of activity inside these volumes.

1. Division of Corrosion Products into Transportable and Non-Transportable Fractions

Upon formation, corrosion products can be categorized within this model as either transportable or non-transportable. The transportable fraction of the corrosion products includes all of the material which could easily be transported by ocean waters if it were not contained. In particular, this fraction includes those corrosion products which are soluble or made of extremely small ($<0.45\ \mu m$ diameter) particles which could be carried long distances by ocean currents before settling onto the sediments. The non-transportable fraction of the liberated corrosion products includes the released material which would not be easily transported by ocean currents even if it were exposed to those currents. This fraction specifically accounts for the large corrosion flakes and particles which would settle quickly to the floor of the containing volume or onto the ocean sediments. In addition, a model of the exchange between the transportable and non-transportable fractions has been included to account for interaction processes between the two fractions which occur after formation. These processes include the coagulation and deposition of small transportable particles and the erosion and resuspension of non-transportable material.

2. Equations

a. The Accumulation of Activity Inside the Reactor Vessel

(1) Due to Corrosion of Internal Components

Prior to the penetration of the thick reactor vessel walls (at $t = t_{RV}$), the activity in the corrosion products released from the components inside the reactor vessel will accumulate within the vessel volume. The total amount of this activity, $N(t)$, can be divided into transportable $N_T(t)$, and non-transportable $N_N(t)$ fractions such that:

$$N(t) = N_T(t) + N_N(t)$$

Using a mass balance approach, simple differential equations can be constructed to model the behavior of these functions. Expressing the rate of change of $N(t)$ as the sum of various source and loss effects yields the equation:

$$\frac{dN}{dt} = \overbrace{\underbrace{\Omega_{RV}(t)}_{\substack{\text{corrosion of}\\ \text{internal}\\ \text{components}}}}^{\text{source terms}} - \overbrace{\Big(\underbrace{\Lambda\,(N_T, t)}_{\substack{\text{leakage loss}\\ \text{through}\\ \text{pitting holes}}} + \underbrace{\lambda N}_{\text{decay}}\Big)}^{\text{loss terms}} \qquad \text{(G.4)}$$

Applying the appropriate terms to each fraction yields the following equations for the transportable and non-tranportable functions:

$$\frac{dN_T}{dt} = \underbrace{f\,\Omega_{RV}(t)}_{\text{corrosion}} - \underbrace{\Lambda(N_T,t)}_{\text{leakage}} - \underbrace{\lambda N_T}_{\text{decay}} + \underbrace{\beta_1 N_N - \beta_2 N_T}_{\text{interaction terms}} \qquad (G.5)$$

$$\frac{dN_N}{dt} = \overbrace{(1-f)\,\Omega_{RV}(t)} - \overbrace{\lambda N_N} - \overbrace{\beta_1 N_N + \beta_2 N_T} \qquad (G.6)$$

Initial conditions: $N_T(0) = N_N(0) = 0$;

where:

$\Omega_{RV}(t)$ = the rate of release of corrosion products into the reactor vessel volume (Equation (G.2))

f = the fraction of newly formed corrosion products that are considered transportable*

$\Lambda(N_T,t)$ = the function which describes the rate of loss of transportable material due to leakage through small pitting penetrations (Section IV.B.2.b)

β_1 = the resuspension coefficient for non-transportable material within containment (yr^{-1})

β_2 = the coagulation-deposition coefficient for transportable material within the vessel (yr^{-1}).

The interaction term $\beta_1 N_N$ represents a simple linear model of the erosion and subsequent resuspension of non-transportable material into the transportable fraction. Similarly, the term $\beta_2 N_T$ represents the coagulation and subsequent deposition of transportable material into the non-transportable segment.

(2) **Accumulation of Activity Inside the Reactor Vessel Due to Crud**

For the crud activity inside the reactor vessel volume, the behavior of the transportable and non-transportable fractions $C_T(t)$ and $C_N(t)$, respectively, will be similar to the activity due to fresh corrosion products (N_T and N_N).

The basis of the equations used to describe these functions is essentially the same as that in the previous section; with the exception that the exchange mechanisms have not been included because the total amount of crud activity is relatively small, and that there is no corrosion source term for the crud. This basis leads to the equations:

$$\frac{dC_T}{dt} = -\Lambda(C_T,t) - \lambda C_T \qquad (G.7)$$

$$\frac{dC_N}{dt} = -\lambda C_N \qquad (G.8)$$

Initial conditions:

$$C_T(0) = f_c C_o \ ,$$

$$C_N(0) = (1 - f_c) C_o \ .$$

***In each of the calculated scenarios used in this analysis, the fraction f was assigned the value 1, which conservatively treats all newly formed corrosion products as being transportable. As a result, the terms representing the introduction of non-transportable material directly by corrosion were zero in the applications of this model.**

where:

f_c = the fraction of the initial crud activity which is assumed to be transportable*

C_o = the amount of crud activity present in the vessel at the time of disposal

$\Lambda(C_T,t)$ = the function which describes the rate of loss from the transportable material due to leakage through pitting penetrations (Section IV.B.2.b).

b. **Leakage Out of the Reactor Vessel Through Pitting Penetrations**

A few sections of metal which make up a small part of the reactor vessel containment barrier are made of corrosion resistant alloys which are subject to the pitting processes discussed in Appendix F (Section IV.A.3). As a result, these portions of the barrier would be penetrated by numerous small pits well before general surface corrosion penetrates the remaining bulk of the reactor vessel walls. The area opened by these pits would provide a path through which some of the transportable fraction of the activity in the vessel volume could move into the surrounding compartment. Since little or no pressure differential will exist between the reactor vessel and the reactor compartment, any transport of material through the pits would be due to a diffusion process. The terms used to model the loss of activity from the reactor vessel due to leakage, $\Lambda(N_T,t)$ and $\Lambda(C_T,t)$, are simple diffusion expressions. These expressions are given as the product of a diffusion coefficient, a cross sectional flow area, and the concentration gradient (assuming a zero concentration outside the vessel maximizes the gradient). Mathematically, Λ is given by the equations:

$$\Lambda(N_T,t) = \sum_{\substack{i \\ \text{pitting} \\ \text{components}}} \delta(t) \frac{\alpha_i(t)}{\theta_i} \frac{N_T(t)}{V_{RV}} \qquad \text{(G.9i)}$$

$$\Lambda(C_T,t) = \sum_i \delta(t) \frac{\alpha_i(t)}{\theta_i} \frac{C_T(t)}{V_{RV}} \qquad \text{(G.9ii)}$$

where:

$\delta(t)$ = the diffusion coefficient in seawater for the transportable materials (based upon the particle size) (cm^2/sec)

i = index used to indicate a particular pitting region

$\alpha_i(t)$ = the total area through which diffusion can occur in the particular pitting region (see below) (cm^2)

θ_i = the limiting path length through which the diffusing particles must travel (cm)

V_{RV} = the volume of water in the reactor vessel (cm^3).

The function $\alpha_i(t)$ represents the total area through which diffusion can occur. Initially, $\alpha_i(t)$ would equal the total area of the first pits which penetrate the component. Then, $\alpha_i(t)$ is assumed to increase linearly

*Actual calculations treated all crud as transportable by setting $f_c = 1$.

with time until such time when the area of the pits exceeds any area which occurs in series along the path of the diffusing particles (as in Appendix F, Section IV.A.3). Mathematically, $\alpha_i(t)$ is defined as:

$$\alpha_i(t) = \begin{cases} 0 \ , & t \leq t_{ip} \ , \\ \alpha_{io} + \dfrac{(\alpha_{im} - \alpha_{io})}{(t_{im} - t_{ip})}(t - t_{ip}) \ , & t_{ip} < t < t_{im} \ , \\ \alpha_{im} \ , & t \geq t_{im} \ ; \end{cases}$$

where:

α_{io} = the total area of the pits at the time of initial penetration. This area is defined as the total volume of corroded material divided by the pitted component thickness

$= S_i\,[(r_s - r_L)\,(t_B) + (t_{ip}\,r_L)]/\tau_{pi}$

α_{im} = the limiting diffusion area in series with the pitting area (e.g., the inner cross sectional area of a pipe when the pitted component is the pipe wall)

t_{ip} = the time when the pitted component is initially penetrated

$= [(\tau_{pi}/P) - (r_s - r_L)(t_B)]/r_L$

t_{im} = the time when the total area of the pits becomes equal to the limiting diffusion area

$= [\tau_{pi}\,(\alpha_{im}/S_i) - (r_s - r_L)(t_B)]/r_L$

S_i = the total surface area of the component subjected to pitting corrosion

r_s, r_L = the short and long term corrosion rates for the corrosion resistant alloys (Appendix F, Table F-1)

P = corrosion pitting factor (Appendix F, Section III.D.1)

τ_{pi} = initial thickness of the particular pitting region

t_B = the time when the corrosion rate changes (= 1 year).

The Equations (G.9i) and (G.9ii) complete the definitions of the differential Equations (G.5) and (G.7) respectively, in terms of defined variables or functions.

c. **Accumulation of Activity Outside the Reactor Vessel and Inside the Reactor Compartment**

Prior to general penetration of the enclosing bulkheads, the reactor compartment volume will accumulate corrosion products. During this period, the total activity contained within the reactor compartment outside the reactor vessel W(t), can be divided into transportable $W_T(t)$ and non-transportable $W_N(t)$ portions.

The differential equations for these functions are based on a mass balance as in the previous sections.

$$\frac{dW_T}{dt} = \underbrace{f\,\Omega_{RC}(t)}_{\text{corrosion source}} - \underbrace{\lambda W_T}_{\text{decay loss}} + \underbrace{\Lambda(N_T,t) + \Lambda(C_T,t)}_{\text{leakage gain from vessel}} \qquad (G.10)$$

$$\frac{dW_N}{dt} = \overbrace{(1-f)\,\Omega_{RC}(t)} - \overbrace{\lambda W_N} \qquad (G.11)$$

Initial conditions: $W_T(0) = 0$, $W_N(0) = 0$,

where:

f = the fraction of newly formed corrosion products that is considered transportable

$\Omega_{RC}(t)$ = the rate of release of corrosion products directly into the reactor compartment (Equation (G.2))

$\Lambda(N_T,t) + \Lambda(C_T,t)$ = the rate of transfer of activity from the reactor vessel into the compartment through pitting penetrations (Equations (G.9i) and (G.9ii))

λ = the radioactive decay constant (yr^{-1}).

The interaction terms included for the accumulation functions inside the vessel (N_T and N_N) have not been included here in order to model these functions (inside the reactor compartment volume) conservatively.

d. **Accumulation of Non-Transportable Activity Outside Contained Volumes**

During the entire time period that the corrosion of the submarine components progresses, non-transportable activity can be generated according to the non-transportable fraction $(1 - f)$ of the newly formed activity. In addition, non-transportable activity can be generated inside the reactor vessel volume by the coagulation and deposition of transportable material. The model allows some of the resulting non-transportable material to eventually lie outside containment barriers, either because it was formed by corrosion of components outside those barriers or because it became uncovered as the barriers were penetrated. The total amount of this non-transportable activity outside containment will be designated by the function $O_N(t)$. This function can be divided into four separate parts according to the origin of the activity.

$$O_N(t) = O_{NC}(t) + O_{NRV}(t) + O_{NK}(t) + O_{NRC}(t) \qquad (G.12)$$

where:

$O_{NC}(t)$ = the non-transportable activity outside containment due to the corrosion of components outside contained volumes

$O_{NRV}(t)$ = the remaining non-transportable activity outside containment which was contained by the reactor vessel at the time of vessel penetration (t_{RV})

$O_{NK}(t)$ = the remaining non-transportable activity outside containment due to the crud activity

$O_{NRC}(t)$ = the remaining non-transportable activity outside containment which was contained by the reactor compartment volume at the time of bulkhead penetration (t_{BLKD}).

Because it is assumed that all of the transportable activity available to the ocean is released to the environment and transported by the processes presented in Appendix H, the total amount of transportable activity outside containment is not considered in this section. However, part of the transportable activity released to the ocean waters is composed of material resuspended directly from the non-transportable material outside containment. The rate of release to the ocean waters of transportable material from the resuspension of uncontained non-transportable material S(t), (Section IV.C), is expressed as:

$$S(t) = \beta O_N(t) \tag{G.13}$$

where:

β = the rate coefficient for the resuspension of corrosion products into the ocean waters.

This term acts as a loss term for each of the functions contributing to the total non-transportable activity which leads to the following differential equations for those functions:

$$\frac{dO_{NC}}{dt} = (1 - f)\,\Omega_{out}(t) - \beta O_{NC} - \lambda O_{NC} \tag{G.14}$$

$$\frac{dO_{NRV}}{dt} = -\beta O_{NRV} - \lambda O_{NRV} \tag{G.15}$$

$$\frac{dO_{NK}}{dt} = -\beta O_{NK} - \lambda O_{NK} \tag{G.16}$$

$$\frac{dO_{NRC}}{dt} = -\beta O_{NRC} - \lambda O_{NRC} \tag{G.17}$$

subject to the initial conditions:

$$O_{NC}(O) = O$$

$$O_{NRV}(t_{RV}) = N_N(t_{RV})$$

$$O_{NK}(t_{RV}) = C_N(t_{RV})$$

$$O_{NRC}(t_{BLKD}) = W_N(t_{BLKD})$$

These initial conditions are such that these functions explicitly account for all of the non-transportable activity from the contained volumes after the barriers are penetrated.

3. Solutions of the Accumulation Equations

In order to evaluate the accumulation functions N_T, N_N, C_T, C_N, W_N, W_T, and O_N presented in the previous sections, the solutions of the differential equations defined for each function have been generated.

a. Solutions of the Reactor Vessel Accumulation Equations

(1) Establishment of Currents Inside the Reactor Vessel

After the reactor vessel containment boundary has been penetrated by pitting, the possibility of an ocean bottom current entering the vessel before general penetration of the vessel wall is extremely small. To conservatively account for this possibility, such a current can be assumed to start at a time (t_{ic}) after the pitting penetration time and before the overall vessel wall penetration (t_{RV}). The inception of this current within the reactor vessel volume is modeled within the existing equations by a discontinuous change in the value of the diffusion coefficient ($\delta(t)$) used in Equations (G.9i) and (G.9ii).

(2) Solutions of the Reactor Vessel Accumulation Equations Prior to Current Flow

Prior to the time (t_{ic}) when currents are assumed to flow through the reactor vessel, Equations (G.5), (G.6), (G.7), and (G.8) describe the behavior of the functions N_T, N_N, C_T, and C_N, respectively. During this period, the environment within the sealed reactor vessel would be extremely stable, with little or no water movement. As a result, the coagulation and deposition of transportable material would far outweigh the resuspension of non-transportable material (i.e., $\beta_2 N_T \gg \beta_1 N_N$). Therefore, assuming that the resuspension term is zero during this period simplifies Equations (G.5) and (G.6) while not substantially changing the results. Thus for $t < t_{ic}$, the applicable equations for these functions become:

$$\frac{dN_T}{dt} = f\Omega_{RV}(t) - \Lambda(N_T,t) - \lambda N_T - \beta_2 N_T \tag{G.18}$$

$$\frac{dN_N}{dt} = (1-f)\,\Omega_{RV}(t) - \lambda N_N + \beta_2 N_T \tag{G.19}$$

$$\frac{dC_T}{dt} = -\Lambda(C_T,t) - \lambda C_T \tag{G.7}$$

$$\frac{dC_N}{dt} = -\lambda C_N \tag{G.8}$$

Initial conditions:

$$N_T(0) = 0$$

$$N_N(0) = 0$$

$$C_T(0) = f_c C_o$$

$$C_N(0) = (1 - f_c)C_o$$

The solution of Equation (G.8) is straightforward and is given by the equation:

$$C_N(t) = (1 - f_c)C_o e^{-\lambda t} \tag{G.20}$$

The solutions of Equations (G.18), (G.19), and (G.7) can be approximated by dividing the time intervals defined by the set $\{t_i\}$ (see Section IV.A.4) over which the functions Ω_{RV} and Λ are continuous into small enough increments so that these functions can be represented in a simplified way. In other words, given the ith time interval $t_i \leq t \leq t_{i+1} \leq t_{ic}$, a set of intermediate and closely spaced time values $\{s_m\}_i$ can be constructed such that if $s_m \leq t \leq s_{m+1}$, then the equations:

$$\Omega_{RV}(t) \approx (Z_v)_m e^{-\lambda t} = e^{-\lambda t} \sum_k C_{(RV)_k}(s_m)\left(\frac{A_{o_k}}{t_{o_k}}(2r_{L_k})\,\xi_k(s_m)\right)$$

$$\Lambda(N_T,t) \approx N_T H_m = N_T \sum_i \delta(s_m)\frac{\alpha_i(s_m)}{\theta_i V_{RV}} \tag{G.21}$$

$$\Lambda(C_T,t) \approx C_T H_m$$

are reasonable approximations over the subinterval (s_m, s_{m+1})

where:

$(Z_v)_m$ = a constant defined by the summation for the $\Omega_{RV}(t)$ function defined by Equation (G.2i)

H_m = a constant defined by the summation for the $\Lambda(N_T,t)$ function defined by Equation (G.9i)

s_m = an entry in the set $\{s_m\}_i$ dividing the time interval between t_i and t_{i+1}.

These approximations simplify Equations (G.18), (G.19), and (G.7) so they can be rewritten as:

$$\frac{dN_T}{dt} = f Z_{vm} e^{-\lambda t} - N_T H_m - \lambda N_T - \beta_2 N_T$$

$$\frac{dN_N}{dt} = (1 - f) Z_{vm} e^{-\lambda t} - \lambda N_N + \beta_2 N_T$$

$$\frac{dC_T}{dt} = -C_T H_m - \lambda C_T$$

when t is such that $s_m \leq t \leq s_{m+1}$ is true.

The solutions of these equations are:

$$N_T(t) = N_T(s_m)e^{-(\lambda+\beta_2+H_m)(t-s_m)} + \left(\frac{f Z_{vm} e^{-\lambda t}}{(\beta_2 + H_m)}\right)(1 - e^{-(\beta_2+H_m)(t-s_m)}) \quad (G.22)$$

$$N_N(t) = N_N(s_m)e^{-\lambda(t-s_m)} + (1 - f)e^{-\lambda t} Z_{vm} (t - s_m)$$
$$+ N_T(s_m)e^{-\lambda(t-s_m)} \left(\frac{\beta_2}{\beta_2 + H_m}\right)(1 - e^{-(\beta_2+H_m)(t-s_m)}) \quad (G.23)$$
$$+ f e^{-\lambda t} Z_{vm} \left(\frac{\beta_2}{\beta_2 + H_m}\right) \left[(t - s_m) - \frac{(1 - e^{-(\beta_2+H_m)(t-s_m)})}{(\beta_2 + H_m)}\right]$$

$$C_T(t) = C_T(s_m)\, e^{-(\lambda+H_m)(t-s_m)} \quad (G.24)$$

These approximate solutions to Equations (G.18), (G.19), (G.7), and (G.8) provide a simple way to evaluate these functions at times $t < t_{ic}$, which was used in a computer program for this analysis. In addition, the approximations presented by Equations (G.21) do not introduce large errors in the evaluations of these functions because the specific terms or factors which are represented by the constants H_m and Z_{vm} either vary slowly or are indeed constant over the small time interval specified.

(3) Solutions of the Reactor Vessel Accumulation Equations After the Inception of Currents

After the time when currents are assumed to enter the reactor vessel (t_{ic}) and before general penetration of the vessel side wall (t_{RV}), Equations (G.5), (G.6), (G.7), and (G.8) apply to the functions N_T, N_N, C_T, and C_N, respectively. However, during this period these currents are assumed to cause the resuspension of non-transportable material to dominate the coagulation and deposition of transportable materials. Thus the term $\beta_1 N_N$ is assumed to be much greater than $\beta_2 N_T$ (i.e., $\beta_1 N_N \gg \beta_2 N_T$), which implies that the applicable equations during this time period can be rewritten as:

$$\frac{dN_T}{dt} = f\Omega_{RV}(t) - \Lambda(N_T,t) - \lambda N_T + \beta_1 N_N \quad (G.25)$$

$$\frac{dN_N}{dt} = (1 - f)\,\Omega_{RV}(t) - \lambda N_N - \beta_1 N_N \tag{G.26}$$

$$\frac{dC_T}{dt} = -\Lambda(C_T, t) - \lambda C_T \tag{G.7}$$

$$\frac{dC_N}{dt} = -\lambda C_N \tag{G.8}$$

for times such that $t_{ic} \leq t \leq t_{RV}$.

Since Equation (G.8) is the same in this time interval as in the intervals prior to the currents inception, the solution (G.20) still applies.

The solutions of Equations (G.25), (G.26), and (G.7) are generated in the same manner as before by dividing each time interval (t_i, t_{i+1}) into small subintervals defined by a set of intermediate time values $\{s_m\}_i$. Further, the division between each s_m and s_{m+1} is made small enough so that the approximations used before (Equations (G.21)) are reasonable when t satisfies the condition,

$$t_{ic} \leq t_i \leq s_m \leq t < s_{m+1} \leq t_{i+1} \leq t_{RV} \tag{G.27}$$

These simplifications reduce the above differential equations into the following forms:

$$\frac{dN_T}{dt} = f Z_{vm} e^{-\lambda t} - N_T H_m - \lambda N_T + \beta_1 N_N$$

$$\frac{dN_N}{dt} = (1 - f) Z_{vm} e^{-\lambda t} - \lambda N_N - \beta_1 N_N$$

$$\frac{dC_T}{dt} = -C_T H_m - \lambda C_T$$

whose solutions in terms of the values at the beginning of the subintervals are:

$$N_T(t) = N_T(s_m)e^{-(\lambda + H_m)(t - s_m)} + \frac{Z_{vm} e^{-\lambda t}}{H_m}(1 - e^{-H_m(t - s_m)})$$

$$- (1 - f)Z_{vm} e^{-\lambda t} e^{-\beta_1 (t - s_m)} (1 - e^{-(H_m - \beta_1)(t - s_m)}) \tag{G.28}$$

$$+ \frac{\beta_1 N_N(s_m) e^{-(\lambda + \beta_1)(t - s_m)}}{(H_m - \beta_1)} (1 - e^{-(H_m - \beta_1)(t - s_m)})$$

$$N_N(t) = N_N(s_m)e^{-(\lambda + \beta_1)(t - s_m)} + \frac{(1 - f)Z_{vm} e^{-\lambda t}}{\beta_1}(1 - e^{-\beta_1 (t - s_m)}) \tag{G.29}$$

$$C_T(t) = C_T(s_m)\, e^{-(H_m + \lambda)(t - s_m)} \tag{G.30}$$

for t values between s_m and s_{m+1}.

b **Solutions of the Reactor Compartment Accumulation Equations**

Before the time when the containing bulkheads are penetrated (t_{BLKD}), the reactor compartment volume will accumulate corrosion particles. During this period, the equations which describe the behavior of the transportable (W_T) and non-transportable (W_N) parts for times such that $0 \leq t \leq t_{BLKD} \leq t_{ic}$ are:

$$\frac{dW_T}{dt} = f\Omega_{RC}(t) + \Lambda(N_T,t) + \Lambda(C_T,t) - \lambda W_T \qquad \text{(G.10)}$$

$$\frac{dW_N}{dt} = (1 - f)\,\Omega_{RC}(t) - \lambda W_N \qquad \text{(G.11)}$$

Subject to the initial conditions:

$$W_T(0) = W_N(0) = 0$$

Dividing the intervals defined by the set $\{t_i\}$, once again, into smaller subintervals defined by the sets $\{s_m\}$, so that

$$t_i \leq s_m \leq t < s_{m+1} \leq t_{i+1} \leq t_{BLKD} \qquad \text{(G.31)}$$

is true, leads to the simplifying approximations:

$$\Omega_{RC}(t) = Z_{cm}\, e^{-\lambda t}$$

$$\Omega_{RV}(t) = Z_{vm}\, e^{-\lambda t}$$

$$\Lambda(N_T,t) + \Lambda(C_T,t) \approx (N_T + C_T)H_m$$

Where Z_{cm} and Z_{vm} are defined by the summations in Equations (G.2i) and (G.2ii), respectively, and H_m is defined by Equations (G.9i) and (G.9ii).

These approximations simplify the differential equations above, which become:

$$\frac{dW_T}{dt} = f Z_{cm}\, e^{-\lambda t} + H_m(N_T + C_T) - \lambda W_T$$

$$\frac{dW_N}{dt} = (1 - f)\, Z_{cm}\, e^{-\lambda t} - \lambda W_N$$

Subject to the conditions that W_T and W_N are continuous at time $t = s_m$ and for values of t is such that $s_m \leq t \leq s_{m+1}$ is true.

The solutions of these equations in terms of the values at the beginning of the subinterval are:

$$\begin{aligned} W_T(t) = {} & W_T(s_m)\, e^{-\lambda(t-s_m)} + f Z_{cm}\, e^{-\lambda t}(t - s_m) \\ & + N_T(s_m)\, e^{-\lambda(t-s_m)} \left(\frac{H_m}{H_m + \beta_2}\right) \left(1 - e^{-(\beta_2 + H_m)(t-s_m)}\right) \\ & + f Z_{vm}\, e^{-\lambda t} \left(\frac{H_m}{H_m + \beta_2}\right) \left[(t - s_m) - \left(\frac{1}{H_m + \beta_2}\right)\left(1 - e^{-(\beta_2 + H_m)(t-s_m)}\right)\right] \\ & + C_T(s_m)\, e^{-\lambda(t-s_m)} \left(1 - e^{-H_m(t-s_m)}\right) \end{aligned} \qquad \text{(G.32)}$$

$$W_N(t) = W_N(s_m)\, e^{-\lambda(t-s_m)} + (1-f) Z_{cm}\, e^{-\lambda t}(t - s_m) \qquad (G.33)$$

These equations provide a simple procedure for determining the values of $W_T(t)$ and $W_N(t)$ for any time $t \leq t_{BLKD}$.

c. Solutions of the Accumulation Equations for Uncontained Non-Transportable Activity

The differential equations for the individual parts of the total non-transportable activity outside the containment barriers are:

$$\frac{dO_{NC}}{dt} = (1-f)\,\Omega_{out}(t) - \beta\, O_{NC} - \lambda\, O_{NC} \qquad (G.14)$$

$$\frac{dO_{NRV}}{dt} = -\beta\, O_{NRV} - \lambda\, O_{NRV} \qquad (G.15)$$

$$\frac{dO_{NK}}{dt} = -\beta\, O_{NK} - \lambda\, O_{NK} \qquad (G.16)$$

$$\frac{dO_{NRC}}{dt} = -\beta\, O_{NRC} - \lambda\, O_{NRC} \qquad (G.17)$$

Subject to the initial conditions:

$$O_{NC}(0) = 0$$

$$O_{NRV}(t_{RV}) = N_N(t_{RV})$$

$$O_{NK}(t_{RV}) = C_N(t_{RV})$$

$$O_{NRC}(t_{BLKD}) = W_N(t_{BLKD})$$

Between each of the time intervals defined by the set $\{t_i\}$, the function $\Omega_{out}(t)$ is equal to the product of a constant Z_{oi}, and the decay factor $e^{-\lambda t}$, because all of the terms in the summation of Equation (G.2iii) are in fact constant within each time interval. Expressing $\Omega_{out}(t)$ in this form simplifies Equation (G.14) which becomes:

$$\frac{dO_{NC}}{dt} (1-f) Z_{oi}\, e^{-\lambda t} - (\beta + \lambda) O_{NC}$$

This solution of this equation is

$$O_{NC}(t) = O_{NC}(t_i)\, e^{-(\beta+\lambda)(t-t_i)} + (1-f) Z_{oi}\, e^{-\lambda t}\,(1 - e^{-\beta(t-t_i)}) \qquad (G.34)$$

for $t_{i+1} \geq t \geq t_i$. This formula provides a simple method for evaluating $O_{NC}(t)$ for all times $t \geq 0$.

The solutions of Equations (G.15), (G.16), and (G.17) are relatively straightforward. Assuming that each function is zero prior to its initial time values leads to:

$$O_{NRV}(t) = \begin{cases} 0, & t < t_{RV} \\ N_N(t_{RV})\, e^{-(\lambda+\beta)(t-t_{RV})}, & t \geq t_{RV} \end{cases} \qquad (G.35)$$

$$O_{NK}(t) = \begin{cases} 0\ , & t < t_{RV} \\ C_N(t_{RV})e^{-(\lambda+\beta)(t-t_{RV})}\ , & t \geq t_{RV} \end{cases} \qquad (G.36)$$

$$O_{NRC}(t) = \begin{cases} 0\ , & t < t_{BLKD} \\ W_N(t_{BLKD})e^{-(\lambda+\beta)(t-t_{BLKD})}\ , & t \geq t_{BLKD} \end{cases} \qquad (G.37)$$

Thus the total non-transportable activity outside containment $O_N(t)$ can be evaluated by summing each of the functions above.

C. RELEASES TO THE OCEAN ENVIRONMENT

With the mathematical functions modeling the corrosion release, leakage, and accumulation of corrosion products defined, the overall model giving the release rate of transportable activity to the ocean environment can now be constructed. The total release rate of transportable activity to the ocean is divided into five distinct parts based upon the general means or nature of release. Thus the total release rate function ($R(t)$) is defined by the equation:

$$R(t) = U(t) + K(t) + L(t) + B(t) + S(t)$$

where:

$U(t)$ = the release rate to the environment from the corrosion of structural components directly exposed to free ocean waters

$K(t)$* = the release rate to the environment from initially uncontained "crud" present at the time of disposal

$L(t)$ = the release rate to the environment due to the leakage of corrosion products through pitting penetrations in the otherwise intact reactor vessel

$B(t)$ = the rate of release to the environment of transportable material suspended within a contained volume, immediately after the containing walls are penetrated by surface corrosion

$S(t)$ = the release rate to the ocean waters due to the resuspension of non-transportable material outside contained volumes.

1. Release Rate Due to the Corrosion of Components Directly Exposed to Ocean Waters

For each nuclide the release rate to the environment due to the corrosion of components which are directly exposed to ocean waters, $U(t)$, is simply:

$$U(t) = f\ \Omega_{(out)}(t)$$

where:

f = the fraction of newly formed corrosion products that are considered transportable

$\Omega_{(out)}(t)$ = the rate at which the components exposed directly to ocean waters release activity in corrosion products (Equation (G.2iii), Section IV.A.3).

***In the expected containment scenarios, all of the crud activity is initially contained within the reactor vessel volume at the time of disposal, therefore, the $K(t) \equiv 0$ for these scenarios.**

2. Release Rate Due to Initial Surface-Deposited Activity (Crud)

Since the crud is expected to be initially contained within an intact reactor vessel, then the release of this small amount of activity will be included in the terms L(t), B(t), and S(t). Therefore, in the expected containment scenarios the function K(t) = 0 for all times. However, in the minimum containment case where the crud is assumed to be directly exposed to the ocean waters, the function K(t) is given by:

$$K(t) = \begin{cases} \dfrac{f_c C_o e^{-\lambda t_c}}{\epsilon}, & t_c \leq t \leq t_c + \epsilon \\ 0 , & \text{otherwise} . \end{cases}$$

where:

f_c = the fraction of the crud activity which is readily transportable

C_o = the initial crud activity (Ci)

t_c = the time of crud release (usually $t_c = 0$ in the minimum containment case)

ϵ = the assumed duration of the uniform crud release (yr).

NOTE: The effect of radioactive decay during the period of release was omitted to provide a simple but conservative estimate of the release.

3. Release Rate Due to Leakage of Corrosion Products From Within Containment

Between the time when the reactor compartment bulkheads are penetrated (t_{BLKD}) and the reactor vessel walls are penetrated by surface corrosion (t_{RV}), the total leakage out of the reactor vessel is released directly to the ocean waters. The function L(t) describes this release:

$$L(t) = \begin{cases} 0 , & t \leq t_{BLKD} \\ \Lambda(N_T,t) + \Lambda(C_T,t) , & t_{BLKD} < t \leq t_{RV} \\ 0 , & t > t_{RV} \end{cases}$$

where the leakage functions $\Lambda(N_T,t)$ and $\Lambda(C_T,t)$ are defined in Section IV.B.2.b, Equations (G.9i) and (G.9ii).

4. Release Rate of Transportable Material Immediately After Containment Penetrations

Immediately after a containment barrier is penetrated, the transportable corrosion products which are present with the contained volume are assumed to be released to the environment at a uniform rate over a time period (ϵ). The term B(t) specifically accounts for this release.

$$B(t) = a_1(t) \left[\frac{W_T(t_{BLKD})}{\epsilon}\right] + a_2(t) \left[\frac{N_T(t_{RV}) + C_T(t_{RV})}{\epsilon}\right]$$

where:

ϵ = the time period of the assumed uniform release (yr)

$$a_1(t) = \begin{cases} 0 & t < t_{BLKD} \text{ or } t > t_{BLKD} + \epsilon \\ 1 & t_{BLKD} \leq t \leq t_{BLKD} + \epsilon \end{cases}$$

$$a_2(t) = \begin{cases} 0 & t < t_{RV} \text{ or } t > t_{RV} + \epsilon \\ 1 & t_{RV} \leq t \leq t_{RV} + \epsilon \end{cases}$$

$W_T(t_{BLKD})$ = the amount of transportable activity in the reactor compartment volume at the time of bulkhead penetration (Sections IV.B.2.c and IV.B.3.b)

$N_T(t_{RV})$ = the amount of transportable activity in the reactor vessel volume at the time of vessel wall penetration (Sections IV.B.2.a(1), IV.B.3.a(2), and IV.B.3.a(3))

$C_T(t_{RV})$ = the amount of transportable crud activity in the reactor vessel volume at the time of vessel wall penetration (Sections IV.B.2.a(2), IV.B.3.a(2), and IV.B.3.a(3)).

NOTE: The effect of radioactive decay during the periods of release was omitted to provide a simple but conservative estimate of this release.

5. Release Rate Due to Resuspension of Non-Transportable Corrosion Products Outside the Containment Barriers

The total amount of non-transportable activity outside the containment is given by the function $O_N(t)$ defined in Sections IV.B.2.d and IV.B.3.c. This function was defined so that a fraction (β) of the total activity would be resuspended and removed by the ocean waters per unit time. Thus the release rate to the ocean from the uncontained non-transportable activity is

$$S(t) = \beta\, O_N(t) \qquad (G.13)$$

where:

β = the resuspension coefficient defining the rate at which corrosion products are shifted from non-transportable forms into transportable forms (yr^{-1})

$O_N(t)$ = the total amount of non-transportable activity outside containment barriers at time t (Sections IV.B.2.d and IV.B.3.c).

D. VALUES USED FOR PARAMETERS IN CALCULATIONS

1. Corrosion Release Rates (r_k)

The corrosion constants that were used are developed in Appendix F and presented in Table F-1. The multiplier P to convert average surface corrosion rate to pitting rate of corrosion resistant alloys was also developed in Appendix F. The value of P was assumed to be 46 and was used to establish penetration of corrosion resistant alloys.

2. Transportable Fractions (f and f_c)

All corrosion products and the crud were treated as being transportable at the time of release from the metal matrix. Therefore, both f and f_c were assigned a value of 1.0 for these calculations.

3. Period of Uniform Release (ϵ)

Material released to the environment in the terms dB/dt and dC/dt, was assumed to be released uniformly during a one-year period. Therefore ϵ is assigned a value of 1.0.

4. Decay Constants (λ)

The decay constants (λ) are based on the half-lives presented in Table 1-2 of Chapter 1. The relationship between a half-life and the decay constant is

$$\lambda = \frac{0.693}{T_{1/2}}$$

5. Leakage Coefficient (δ (t))

a. Best Estimate

The leakage coefficient is used to establish the transport rate of material through the water in the reactor vessel and then through the pits in the corrosion resistant alloys to the environment. The larger the particle size is, the slower the transport rate will be. For example, the transport of a particle at the limit of operational solubility (i.e., 0.45 micron) will be slower than that of a molecule. To calculate the transport rate, the leakage coefficient was selected to be the logarithmic mean between that for a molecule and that for particle with the maximum size for operational solubility. The leakage coefficient ($\delta(t)$) is 3.25×10^{-7} cm²/sec, corresponding to an average particle size of 0.015 micron. This size would be considerably smaller than the average corrosion particle size of 1 micron, so the leakage rate should assure that this effect is not underestimated.

This leakage coefficient (3.25×10^{-7} cm²/sec) controls the release from the reactor vessel until a water current is assumed to be established through the reactor vessel. Because of the small size of the pitting penetrations and the large size of the vessel, a current through the vessel would not be possible through the pits. In fact, a current through the reactor vessel would not be expected until general surface penetration of the reactor vessel occurred in the year 1300. However, to be conservative, a current through the reactor vessel was assumed to begin at an intermediate time between the initial pitting penetration of the reactor vessel and the time at which general surface penetration of the vessel is calculated to occur. This current is initiated (t_{ic}) approximately 400 years after disposal. At this time the leakage coefficient ($\delta(t)$) is set equal to an essentially infinite value (10^{99} cm²/sec) and provides for the release to the environment of all transportable material from within the reactor vessel.

b. Conservative Estimate

For this treatment the corrosion particles were assumed to behave as if they were the size of a water molecule. The leakage coefficient for this case is 1.5×10^{-5} cm²/sec. This maximizes the leakage rate from the reactor vessel to the reactor compartment until a flow is assumed to be established in the reactor vessel. The flow in the vessel is assumed to be initiated immediately when the reactor compartment is penetrated 100 years after disposal. At that time the leakage coefficient ($\delta(t)$) is set equal to an essentially infinite value (10^{99} cm²/sec) and provides for the continuing release to the environment of all transportable material from within the reactor vessel.

6. Resuspension Coefficient Outside Containment (β)

a. Best Estimate

The resuspension coefficient was estimated from a simplified model which assumed that settled corrosion products would become transportable by diffusing from a region of high concentration to a region of essentially zero concentration. The rate of resuspension is dependent on the sediment particle size and the flow rate of the water. To obtain a conservative estimate of the resuspension coefficient, the particles were considered to diffuse at the rate that molecular size particles would diffuse. The flow rate of the water was slightly greater than that measured on the ocean bottom. The resulting resuspension constant outside the containment is 5.9×10^{-4} year^{-1}.

b. **Conservative Estimate**

For this estimate an artifically high value of 0.01 was used to conservatively overestimate the resuspension effects. This value would correspond in the model above to a flow rate of 50 cm/sec, which exceeds measured average currents by a factor of 40.

7. Resuspension Coefficient Inside the Reactor Vessel (β_1)

a. **Best Estimate**

Using the same resuspension model discussed above, a value of 1.0×10^{-5} (year^{-1}) was calculated for the resuspension coefficient inside the reactor vessel.

b. **Conservative Estimate**

In the conservative estimate the artifically high value of 0.01 (years^{-1}) used outside containment was also used to conservatively model the resuspension effects inside the reactor vessel.

8. Coagulation—Deposition Coefficient (β_2)

a. **Best Estimate**

The value of the settling coefficient was estimated from the mean corrosion particle size (1 micron), its Stokes law settling velocity, and the average distance over which settling of corrosion products would occur. The settling coefficient $\beta_2 = 6.4$ years^{-1}.

b. **Conservative Estimate**

The value of the settling coefficient was estimated by assuming the corrosion particle size was approximately a factor of 4 smaller than the expected average particle size. The resulting settling coefficient was 0.2 year^{-1}.

APPENDIX H

DESCRIPTION OF THE OCEAN DISPERSION MODEL

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APPENDIX H

DESCRIPTION OF THE OCEAN DISPERSION MODEL

I. INTRODUCTION

This appendix describes the methods used to estimate the possible transport and dispersion of radioactive nuclides through the ocean waters from defueled submarines disposed on the ocean floor to potential entry points into the pathways which might lead to man. The overall process through which this radioactive material might reach man includes (1) corrosion of the radioactive structural materials, (2) corrosion of the reactor plant and reactor compartment containments, (3) the eventual release of the radionuclides into the water or bottom sediment, (4) transport of the nuclides in the water column to locations where they might enter the pathways to man, and finally (5) the movement of these radionuclides along the pathways to man. Items (1) and (2) are described in Appendix F and Items (3) and (5) are described in Appendices G and I, respectively. This appendix concerns Item (4) transport in the water column and will describe the various mechanisms which might act on the released nuclides. This appendix presents the equation used to compute concentrations at the potential pathway entry points; the parameters used in the computations; and the assumptions used in developing and performing the calculations.

II. SUMMARY AND CONCLUSIONS

A mathematical model for estimating the radionuclide concentrations in ocean waters as a function of time and distance from the disposed submarine is presented. This model was developed after investigating a number of models available in the literature, including those formulated by Webb and Morley (Reference H.1) and by J. G. Shepherd (Reference H.2) as well as the plume calculation proposed by the International Atomic Energy Agency (IAEA) in the development of criteria for disposing of radioactive waste in the ocean presented at the London Convention (Reference H.13). Results of calculations performed using measured current speeds and directions as well as coefficients derived from oceanographic observations to describe stirring effects are presented. These calculations were made assuming that the postulated disposal site was approximately 300 kilometers from the shoreline and located in an area where high concentrations might be found because of low dilution by slow currents (advection). The values of the parameters (current speed, diffusion constants, detritus (sedimentation) removal coefficients, etc.) used in the calculations were either determined at one of the oceanographic study sites, taken from values presented in the literature, or inferred from available data. The appropriate study site data were selected for use to provide realistic maximum values for the nuclide concentrations.

The results of the best estimates* based on this model compare well with the observed behavior of Rn-222 near the deep ocean bottom and with the results obtained using conservative estimate* calculations as well as a previously developed model. For example, the action of the boundary layer formed along the ocean floor which would retain particles of corrosion product within the layer and prevent dilution by dispersion into the water above the layer is explicitly represented in this model.

The estimated maximum radionuclide release rates of 1.1×10^{-3}, 7.0, and 39.0 curies per year of Cobalt-60, Nickel-59, and Nickel-63, respectively, from 100 submarines disposed of on the ocean floor (see Table G-2, Appendix G) lead to the best estimates of 9.8×10^{-24}, 7.6×10^{-20}, and 4.2×10^{-19} curies per cubic meter, respectively, for the same nuclides as the maximum concentration at the entry to the pathways which might lead to man (see Table H-4). Since the present model explicitly represents bottom boundary layer effects and stratification of the ocean water column, the concentrations calculated are higher than those predicted by some earlier models.

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*See Glossary.

In addition to the concentrations calculated for the best estimate parameters used for the specified disposal site, Table H-1, calculations were made to evaluate two "transit accident" cases described in Appendix J, e.g., (1) calculations are for the condition where a submarine is assumed to break open after settling to the bottom at the disposal site and lose the reactor compartment and reactor pressure vessel containment and (2) calculations are for the condition where the same minimum containment is reached during transport, but at a location slightly less than one-tenth of the distance from the shore to the postulated disposal site where the water is only about 800 meters deep. These results are presented in Tables H-5 and H-9.

III. GENERAL DISCUSSION

The major source of radiation in an operating nuclear submarine is the reactor fuel. After the ship is defueled, this source is removed and the largest source remaining would be the internal structure within the thick walled steel reactor pressure vessel which previously housed the reactor fuel core. Nearly 100 percent of the radioactivity in a defueled submarine would be in the form of radioactive metal atoms produced by neutron activation of the metal structures inside the reactor pressure vessel and in the inside walls of the pressure vessel itself during reactor operation. Approximately 0.1 percent would be in the corrosion products which were generated during plant operations and adhered to the inside of the pipes, valves, steam generator, and other components of the reactor coolant system.

Since all of this equipment is fully enclosed within an isolated compartment in the submarine, there are several barriers to the release of the contained radioactivity. Another significant barrier is provided by the fact that the radioactive atoms are an integral part of the thick metal structures contained within the sealed reactor pressure vessel. These barriers are described in Appendix G.

If the sea disposal option were selected, a defueled submarine would be allowed to settle to the bottom of the ocean at a depth of more than 4000 meters (about 13,000 feet). The reactor pressure vessel and the reactor compartment would have been filled with water and sealed prior to sinking in order to delay the release of any significant amount of radioactivity for many years. Natural radioactive decay processes would reduce the total radioactivity by more than 85 percent if the activity were contained in the submarine for about 100 years as illustrated in Figure 1-2 of Chapter 1.

When the sealed submarine compartment would eventually be penetrated by corrosion through the thinnest portion of the internal walls of the compartment containing the reactor plant components, (bulkheads), any corrosion product particles released from the reactor pressure vessel or reactor coolant piping would be free to move into adjacent compartments. Since these compartments contain openings to the ocean waters, the movements of small amounts of radionuclides to the external environment could begin at this time. The thick submarine hull would be expected to prevent direct dispersion of the nuclides to the open ocean for several hundred years, except through the openings in the compartments adjacent to the reactor compartment originally provided to ensure rapid and uniform flooding. The residual longer lived radionuclides would gradually be freed to move from the source (submarine reactor compartment) to the ocean environment where they might be transported to the entry points of the pathways to man.

The description of the method used to estimate the transport and diffusion of radionuclides through the ocean waters is based on the concepts described in References H.2, H.3, H.4, H.5, and H.6 and represents in many ways an extension of the model originally proposed by J. G. Shepherd (Reference H.2) to include an explicit representation of ocean stratification and removal of radioactivity by settling particulate matter.

IV. TRANSPORT MODEL DESCRIPTION

For the radioactivity in the submarine on the ocean floor to affect man it must first be converted from solid metal into some transportable form. Then it must be carried from the original site to man by one or more of the following modes of transportation: (1) movement in the sediment, (2) movement through biological processes such as transport by fish or other biota, or (3) by direct movement in the water. It is anticipated that a large fraction, perhaps as high as 95 percent of the corrosion product particles carrying radionuclides would settle to the ocean floor either through direct deposition or by removal by the detritus particles. This newly deposited sediment would be subjected to the usual biological, physical, and chemical processes, such as bioturbation, within the sediment layer. However, this sediment is expected to remain in the vicinity of the disposal area because the disposal location would be chosen to avoid currents which would be energetic enough to resuspend the sediment. Therefore, this material would not be expected to be a significant source of radiation exposure to humans because of its remoteness from human activity and because no known food chain having its beginnings in deep ocean sediment has ever been identified (see References H.3 and H.7).

Physical movement of the corrosion product particles from the sediment or the water in the vicinity of the disposal location by biological processes would be possible. However, an estimate of the relative importance of biological and physical processes in the transport of radionuclides from the ocean bottom to the surface reveals that the biological transport is about one-thousandth of the physical transport (Reference H.3). In addition, the absence of any known path which could directly link the biota in abyssal bottom waters with food consumed by man makes it unlikely that transport in a food chain would provide any important contribution (see Appendix I). Thus it was concluded that the most important pathway for radionuclide transport and concentration calculations would be movement by the ocean waters (see References H.2, H.5, and H.6). However, to allow the possibility that a food chain from the ocean floor to man may be identified in the future, calculations have been made assuming that fish exposed to the maximum concentrations of radioactivity were caught and eaten by man. This hypothetical maximum exposure case is discussed in detail and the results presented in Appendix J.

A. MODEL DEVELOPMENT

This section provides a brief description of the pertinent oceanographic phenomena involved in the transport calculations along with the assumptions and the values of the parameters used in the calculations. In some cases, it has been necessary to use the measured characteristics of specific locations to specify the values of certain parameters. In order to develop a set of measured values which would produce calculated concentrations unlikely to be exceeded for any probable disposal locations, study areas were identified in the Atlantic and Pacific Oceans using existing technical criteria (Appendix E). Examination of these study areas showed that one located in the north-eastern Pacific Ocean was about as close to the United States coast as could be possible to meet the IAEA requirements for a 4000 meter minimum disposal depth. This study area, called the Pacific W-N site, also met all the other criteria for site selection. It was assumed that the characteristics of this region would produce the least dilution and dispersion among the study areas (which also meet the established criteria) and points of interaction with man, thereby yielding maximum estimates of the doses to man.

Therefore, the study area in the Pacific Ocean about 300 kilometers west of the coast of California was identified as the source of data for the calculations. The parameters needed were either obtained from available data, measured at the study area (see Reference H.7), or inferred from the available measurements. The data are intended to represent the minimum dispersion, dilution, and distance to man from the large range of locations which might be chosen for submarine disposal. Use of these measurements does not mean that this study area has been chosen as a disposal location. The results are also intended to be interpreted as upper limits on concentrations which might be calculated for other Pacific or Atlantic Ocean locations.

1. Equation Development

In attempts to account for the distribution of finely divided particulate matter or for properties associated with elements soluble in the ocean such as salinity, oxygen content, and silica, mathematical models have been developed which make use of the knowledge of the general ocean currents (advection) and of the mixing caused by the observed tidal effects, turbulence, or eddies which have results similar to true diffusion.

In modeling these processes, an appropriate solution to an instantaneous unit pulse diffusion problem which estimates a concentration distribution is used to define the effects of these processes. Once established, this solution is then integrated in time to yield results for a continuous or chronic release of material.

The model used in this analysis is essentially an extension of earlier models, where modifications have been made to explicitly represent the well-mixed benthic boundary layer existing in the deep ocean, the removal of activity by detritus particles, and the stratification of the middle depths of the water column. The resulting equations used in this analysis are presented below.

2. Concentration Equation

The concentration of any particular radionuclide, at a given location within the ocean, at any time (t) after the submarine has settled on the ocean floor, is calculated by summing up (integrating) the contributions from a sequence of simple unit releases from the submarine. Each unit release is weighted by the amount of activity released at time (τ) multiplied by the appropriate loss factor accounting for decay and other loss processes.

$$\chi_i(x,y,z,t) = \int_0^t R_i(\tau) e^{-(\lambda + \lambda d)(t-\tau)} G_z(z,t-\tau)\, G_x(x,t-\tau)\, G_y(y,t-\tau) d\tau \qquad (1)$$

where:

χ_i = the concentration of the particular radionuclide at a given time and location in the ocean waters (Ci/m^3)

i = an index specifying the given radionuclide

R_i = the time dependent release rate of a particular radionuclide (Ci/hr)

λ_i = the radioactive decay constant for the particular radionuclide (hr^{-1})

λ_d = a constant defining the removal effects of detritus particles in the water column (hr^{-1})

t = the time since the disposal of the submarine (hr)

τ = the time that a specific unit release occurs (hr)

$(t - \tau)$ = the age of the unit release (hr)

x = the horizontal distance from the disposal point along the east-west direction (positive to the east) (m)

y = the horizontal distance from the disposal point along the north-south direction (positive to the north) (m)

z = the vertical distance above the ocean floor (m)

G_z = the vertical distribution of a unit release of activity as a function of the age of the release (m^{-1})

G_x = the east-west distribution of a unit release of activity as a function of the age of the release (m^{-1})

G_y = the north-south distribution of a unit release of activity as a function of the age of the release (m^{-1}).

3. Horizontal Distribution Equation

The product of the three distribution functions G_x, G_y, and G_z provides an estimate of the three-dimensional distribution of a unit release of activity as a function of the age of the release. These functions are defined in this and the following section and are based upon the diffusion-advection equation.

The functions G_x and G_y are similar in that they are written as gauss normal distributions which have been reflected by the boundaries of the ocean to conserve the amount of activity. These function are given by

$$G_x(x, \theta) = \frac{1}{\sqrt{2\pi}\sqrt{2K_x\theta}} \sum_{j=0}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{x - u_x\theta - x_j}{\sqrt{2K_x\theta}}\right)^2\right] \tag{2}$$

$$G_y(y, \theta) = \frac{1}{\sqrt{2\pi}\sqrt{2K_y\theta}} \sum_{k=0}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{y - u_y\theta - y_k}{\sqrt{2K_y\theta}}\right)^2\right] \tag{3}$$

where:

θ = the age of the release (hr) = $(t - \tau)$

K_x = the coefficient of eddy diffusivity in the east-west direction (m^2/hr)

K_y = the coefficient of eddy diffusivity in the north-south direction (m^2/hr)

exp(x) = the exponential function e^x

u_x = the long term averge east-west velocity (m/hr)

u_y = the long term average north-south velocity (m/hr)

x_j = the east-west position that appropriately models a reflected image source

y_k = the north-south position that appropriately models a reflected image source.

4. Vertical Distribution Equation

The vertical distribution function G_z (z, θ) is defined to account for variations in the eddy diffusivity and vertical velocity as a function of the vertical distance above the bottom. G_z (z, θ) is defined to be the solution of the one-dimensional diffusion advection equation,

$$\frac{\partial G_z}{\partial \theta} = \frac{\partial}{\partial z}\left(K_z(z)\,\frac{\partial G_z}{\partial z}\right) - \frac{\partial}{\partial z}\left(\nu_z(z)G_z\right) \tag{4}$$

θ = the age of the release (hr) = $(t - \tau)$

$\frac{\partial}{\partial \theta}$ = the partial derivative with respect to age of the release

$\frac{\partial}{\partial z}$ = the partial derivative with respect to the height above bottom

$K_z(z)$ = the vertical eddy diffusivity as a function of height (m^2/hr)

$\nu_z(z)$ = the vertical velocity as a function of height (m/hr).

This equation was solved numerically using the methods presented in Reference H.17.

5. Detritus Removal Coefficient

A detritus removal term (λ_d) is included in the formulation of ocean distribution equation used in the prediction of the dispersion of radioactivity in deep ocean waters. It was assumed, in developing this coefficient, that the detritus particles removed all activity from their path as they settled toward the ocean bottom. This coefficient is defined by the equation:

$$\lambda_d = \frac{C \cdot M}{\rho \cdot d} \tag{5}$$

where:

M = the mass flux of the particulate material settling in the deep ocean waters ($g/m^2/yr$)

ρ = particle density (g/m^3)

d = particle diameter (m)

C = constant relating the particle thickness with the major particle dimensions.

Use of the values for mass flux, particle density, and mean sediment particle diameter reported in Reference H.7 lead to a value of $\lambda_d = 5.6\ yr^{-1}$. This result was obtained for a value of C = 6 which represents particles with a major length and/or width dimension six times the thickness of the particle.

B. DESCRIPTION OF THE OCEANOGRAPHIC MECHANISMS

In the deep ocean regions studied and of interest in this appendix, the ocean bottom waters can be described in terms of three general vertical regions. A turbulent well-mixed region called the benthic or bottom boundary layer is found just above the ocean floor, and extends from a few meters to a few hundred meters above the ocean floor (References H.4 and H.7). This boundary layer is usually a well-established and relatively stable region which tends to prevent most water within it from escaping to the layers above it in the water column. This tendency reduces dilution by keeping tracers released in the bottom boundary layer from being vertically displaced.

The mid-depth region extends from the top of the bottom boundary layer up to the bottom of the permanent thermocline which may be as deep as 1000 meters below the ocean surface. The 1000 meter depth was used in the calculations since it would yield the most pessimistic result. This is a weakly stratified zone with slow vertical velocities ranging from about 0 to 3 meters per year (see Reference H.5).

The surface waters of the oceans are well-mixed to a depth of about 100 meters below the surface as a result of the action of solar heating, winds, and surface flow. These waters move generally under the influence of the prevailing surface currents which flow in the southerly direction for the study area from which measurements were obtained for these calculations (Reference H.7). The vertical and horizontal stirring in this region cause the mixing and stirring (diffusion) processes to operate at a higher rate than in the weakly stratified region above the bottom boundary layer. In the calculational model the well-mixed surface region is assumed to be 800 meters deep to add conservatism to the estimates of nuclide concentration and dispersion.

The movement of water has been assumed in these calculations to be controlled by coefficients representing horizontal and vertical velocities and by horizontal and vertical stirring rates, termed eddy diffusivities to differentiate from true diffusion rates. The eddy diffusivities are used to describe the total stirring effect resulting from such phenomena as tidal cycles, flow induced turbulence, eddy passage, and similar variations. The horizontal velocities are assumed to be constant in speed and direction in these calculations, but the vertical velocity is varied to represent the vertical regions. Similarly, the horizontal eddy diffusivity coefficients are assumed to be invariant, but the vertical diffusivity is assumed to vary with depth.

The relative magnitude of these parameters may be seen by using as an example the Eastern Pacific Ocean bottom waters where the measured long term average horizontal current is about one centimeter per second in a southerly direction and the east-west current is near zero (References H.4 and H.7). The horizontal eddy diffusivity, developed from information presented in References H.2, H.4, and H.5, is about 1×10^7 cm^2/sec in all horizontal directions. The vertical velocities and eddy diffusivities are assumed to be as depicted in Figure H-1 where the maximum vertical velocity is about 3 meters/year and the diffusivity is about 0.6 cm^2/sec (Reference H.5) in the middle zone, changing rapidly to about 24 cm^2/sec (Reference H.4) in the top and bottom boundary regions.

These mechanisms are used to calculate the potential for the movement of radionuclides to the entry points to the possible pathways to man. The specific pathways to man are described in Section III of Appendix I.

C. PARAMETER VALUES USED IN CONCENTRATION CALCULATIONS

The potential concentrations in the ocean waters for use in pathways analyses in this statement were calculated using the advection-diffusion method and the most realistic values for each variable in the equation. In as many instances as possible, direct measurements of the parameter obtained from a representative ocean location were used. In other cases values are derived from the literature and in some cases, the needed parameter values had to be inferred from observed ocean behavior. Each of the parameter values used is discussed in this section, including the source of the best estimate and conservative estimate values presented in Table H-1.

The concentrations calculated by using the values of the parameters which have been judged to be the most realistic have been defined as the best estimate results. Concentrations calculated by using highly conservative values for the parameters, that is, those values which lead to high concentrations of radionuclides have been defined as conservative estimates. The best estimate is believed to represent a somewhat conservative estimate of what would actually be expected whereas the conservative estimate is believed to represent the concentrations which would not be reasonably expected to be exceeded.

The vertical current velocity and eddy diffusivity values were developed using the assumption that the ocean water column can be visualized as three general vertically displaced horizontal layers or flow regions: the bottom boundary layer, the stratified mid-waters, and the well-mixed surface layer above the thermocline. The actual values used in the calculation are shown in Table H-1. The shape of the plot of the vertical diffusion coefficients as a function of depth was developed from the observed layering of ocean waters as described in References H.7, H.8, and H.9. The magnitudes of the vertical eddy diffusion coefficient for the bottom boundary layer was based on the information presented in Kupferman and Moore (Reference H.4) and the vertical diffusivity in the surface, well-mixed layer was assumed to be the same as in the bottom boundary layer. The mid-area of the vertical diffusivity was based on the work of Fiadeiro and Craig (Reference H.5). The vertical current speed variation was developed from the water movements reported in Reference H.5 modified by assuming the speed is a maximum at the bottom of the thermocline and decreases to zero at the air-water and sediment-water interfaces.

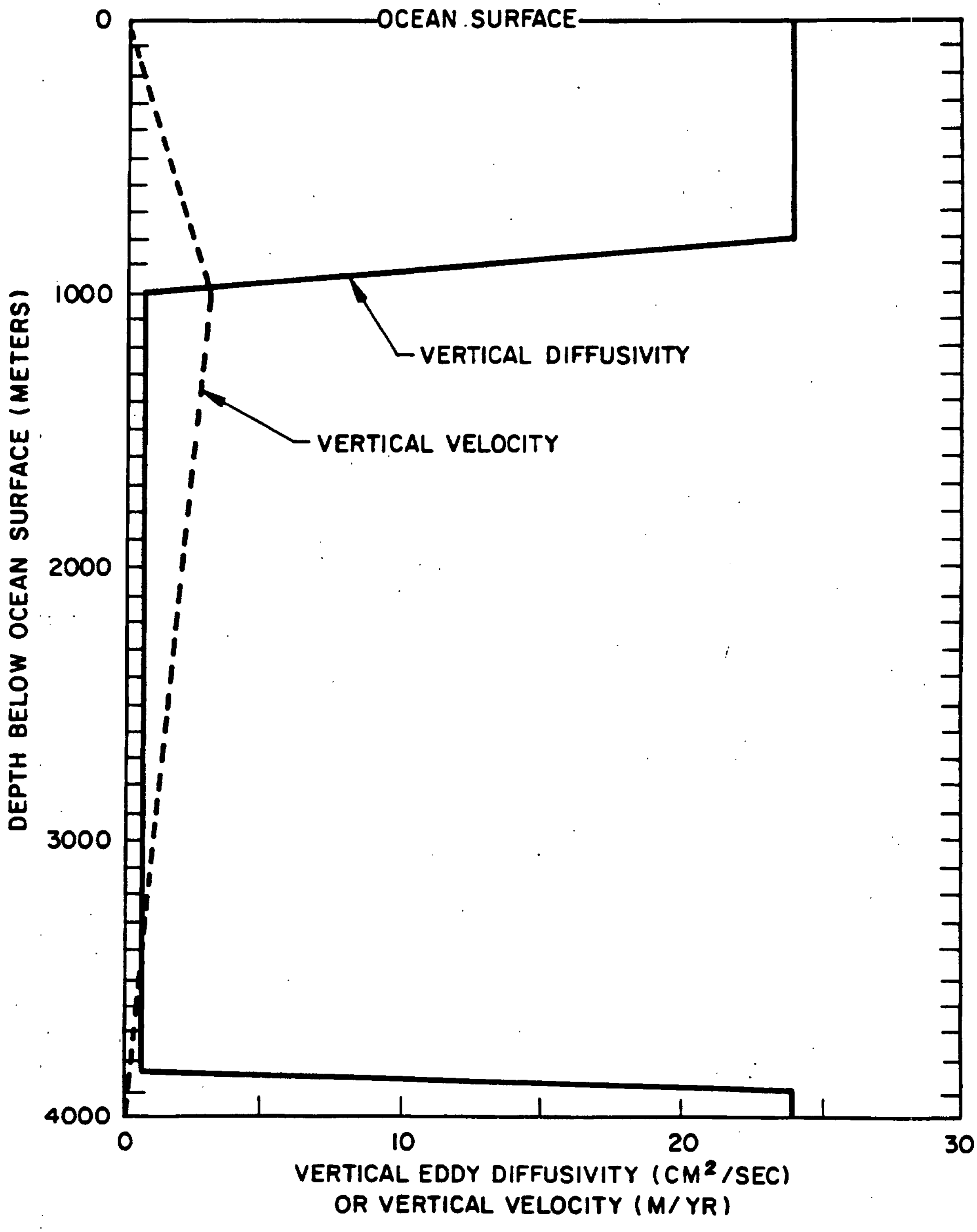

Figure H-1. Vertical Velocity and Eddy Diffusivity in the Pacific Ocean

TABLE H-1. PARAMETERS USED IN THE CALCULATION OF RADIONUCLIDE CONCENTRATION ESTIMATES

Parameter	Best Estimate	Conservative Estimate
1. East-West horizontal diffusivity (cm^2/sec)	1×10^7	1×10^7
2. North-South horizontal diffusivity (cm^2/sec)	1×10^7	1×10^7
3. Long term average east-west current velocity (cm/sec)	0.19 (to east)	0.0
4. Long term average north-south current velocity (cm/sec)	−1.12 (to south)	−1.0
5. Bottom boundary layer thickness (m)	170	200
6. Maximum vertical velocity (m/yr) (at the bottom of the thermocline)	3.0	3.0
7. Maximum vertical diffusivity in the bottom boundary layer and above the thermocline (cm^2/sec)	24.0	15.0
8. Vertical diffusivity in the stratified (mid-depth) region of the ocean (cm^2/sec)	0.6	0.6
9. Coefficient for removal of radionuclides by detritus (yr^{-1})	5.6	0.0
10. Vertical extent of the maximum vertical diffusivity in the bottom boundary layer (m)	92.4	30.0
11. Average corrosion particle settling velocity in the ocean (m/yr)	2×10^{-3}	0.0
12. Vertical distance from the ocean floor to the possible entry point to the pathway to man (m)	385	0.0

The eddy diffusivity in the horizontal plane was assumed to be the same at all points, as mentioned in the preceding section. The value used in the calculations for the eddy diffusivity in all horizontal directions is 1×10^7 cm^2/sec, based on data from References H.2, H.4, and H.5 and was used because application of this value in the preliminary calculations resulted in a spatial domain of occupation of the affected region that agreed with the region suggested by Kupferman and Moore (Reference H.4). In addition, 1×10^7 cm^2/sec fell into the range of values suggested by Shepherd (Reference H.2) and was close to the value used by Fiadeiro and Craig (Reference H.5). The direction and speed at a representative study location (Reference H.7) revealed that the current was 1.12 cm/sec to the south and 0.19 cm/sec to the east. It was assumed that the coast ran in the north-south direction.

The assumed thickness of the benthic or bottom boundary layer used in the calculations was 170 meters based on measurements at the representative study site (Reference H.7). The height above the bottom over which the maximum value of the vertical eddy diffusivity was applied was assumed to be 92.4 meters. This value was obtained by adding the height attained by the released material in the bottom boundary layer in a 12.4 hour tidal period to one half the distance from the top of this layer to the top of the benthic boundary layer.

The detritus removal coefficient of 5.6 per year was selected to reflect the removal of radioactive nuclides from the ocean waters by means of detritus particles. The detritus flux and sediment particle size data reported in Reference H.7 were used to estimate the value of 5.6. The adsorption of nuclides on silicate detritus is supported by the chemical characterization of sediment (Reference H.7) which is formed from the detritus and its similarity to Fuller's earth (Reference H.10) which is a well known purification filter material.

The settling velocity of the activity released to the environment, 2×10^{-3} m/yr, was calculated to correspond to the particles which have transfer coefficients defined in the release model described in Appendix G. A value of 385 meters above the ocean floor was used for the vertical location of the potential entry points of radionuclides to the pathways to man. This value was obtained by first estimating the time required for nuclides to climb from the ocean bottom in the boundary layer along the continental slope to the maximum deep fishing depth. This time period was then used to estimate the vertical movement which could occur in the weakly stratified region of the ocean above the well-mixed bottom boundary layer. This distance was then increased by the vertical extent of the bottom boundary layer, (92.4 m) over which the diffusivity is assumed to be constant, to obtain the vertical location used for the entry points of the radionuclides to the pathways which lead to man.

The range of possible values for each parameter, based on differing measurements, experimental techniques and uncertainties, and other sources of possible variability was evaluated in selecting each value, and in many cases this range can be quite large. Calculations of the concentrations at the potential pathway entry points were performed using a distribution of values for each parameter to determine the relative sensitivity of the calculated results to the variability of each parameter and to establish variations in the final result. These calculations demonstrated that the hypothetical disposal of submarines would not produce significant environmental effects even in the vicinity of the disposal. For example, radionuclide concentrations would not exceed the U.S. Environmental Protection Agency (EPA) drinking water limits (References H.11 and H.12) on the bottom at the submarine resting place.

V. TYPICAL RADIONUCLIDE CONCENTRATIONS AND COMPARISONS WITH OTHER TRANSPORT DISPERSION MODELS

In order to provide an example of the results of this calculation, nuclide concentration estimates have been made for a study site where the defueled nuclear submarines were postulated to be located on the ocean bottom about 4000 meters below the surface at a point 300 kilometers from the shore. This point is located 1600 kilometers south and 300 kilometers west of the northern and eastern boundaries, respectively, of the closed and finite ocean volume assumed in the calculational model and depicted in Figure H-2, where the north-eastern corner of the model is located at approximately 55°N and 127°W. The calculations show that the distribution of radioactive materials, as shown in Figure H-3, is highly concentrated in the immediate vicinity of the source with slight skewing in the southerly direction under the influence of the current. The distribution of radioactive material also shows that the concentrations are primarily restricted to the bottom boundary layer. Calculations have been made with best estimate values for the parameters in the mathematical model and also with conservative estimates for the parameters. The best estimate values represent the values best supported by available oceanographic and other scientific data while the conservative values represent the case where pessimistic assumptions were made to assure that the estimated dose to man was very unlikely to be exceeded.

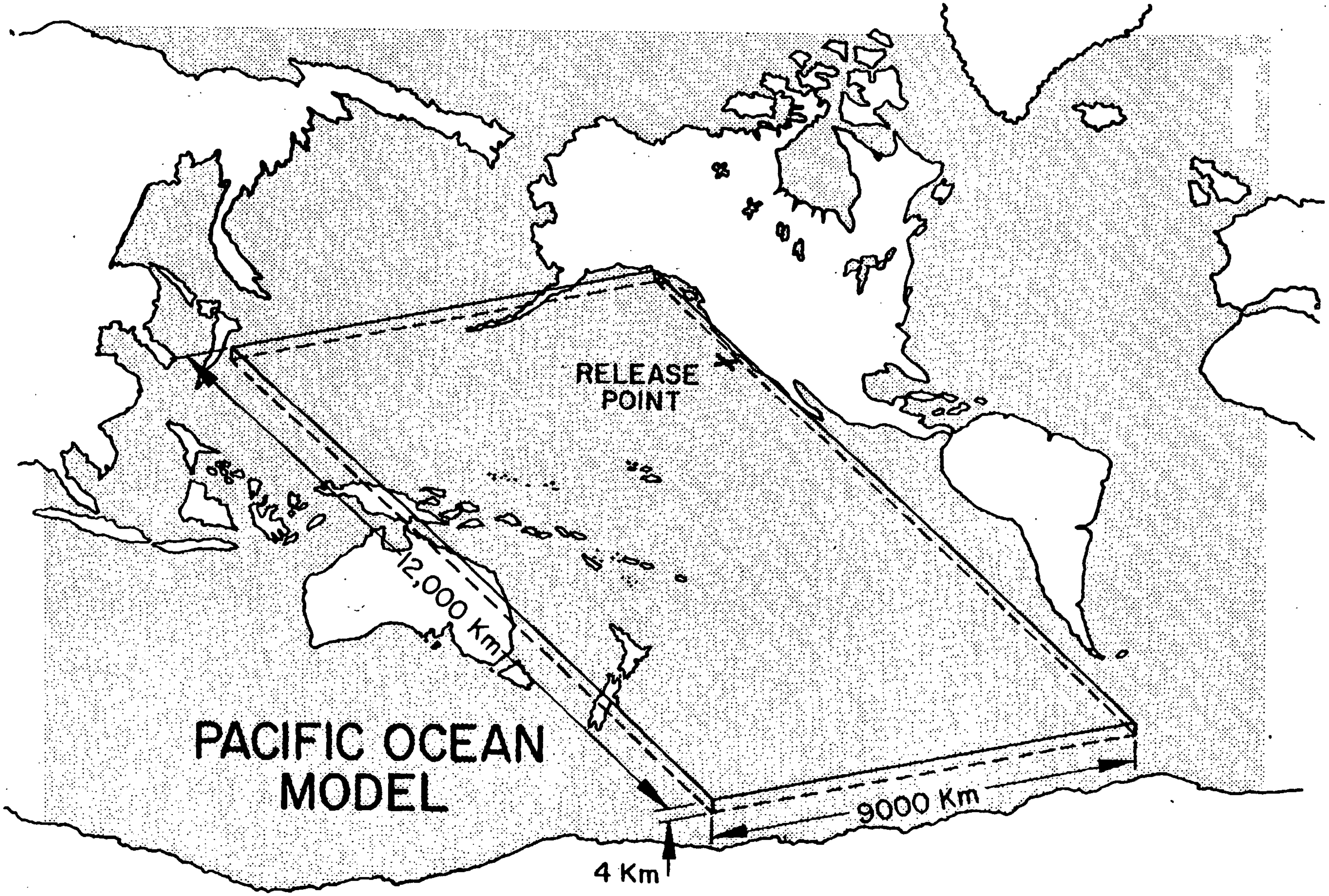

Figure H-2. Calculational Model for a Pacific Ocean Site

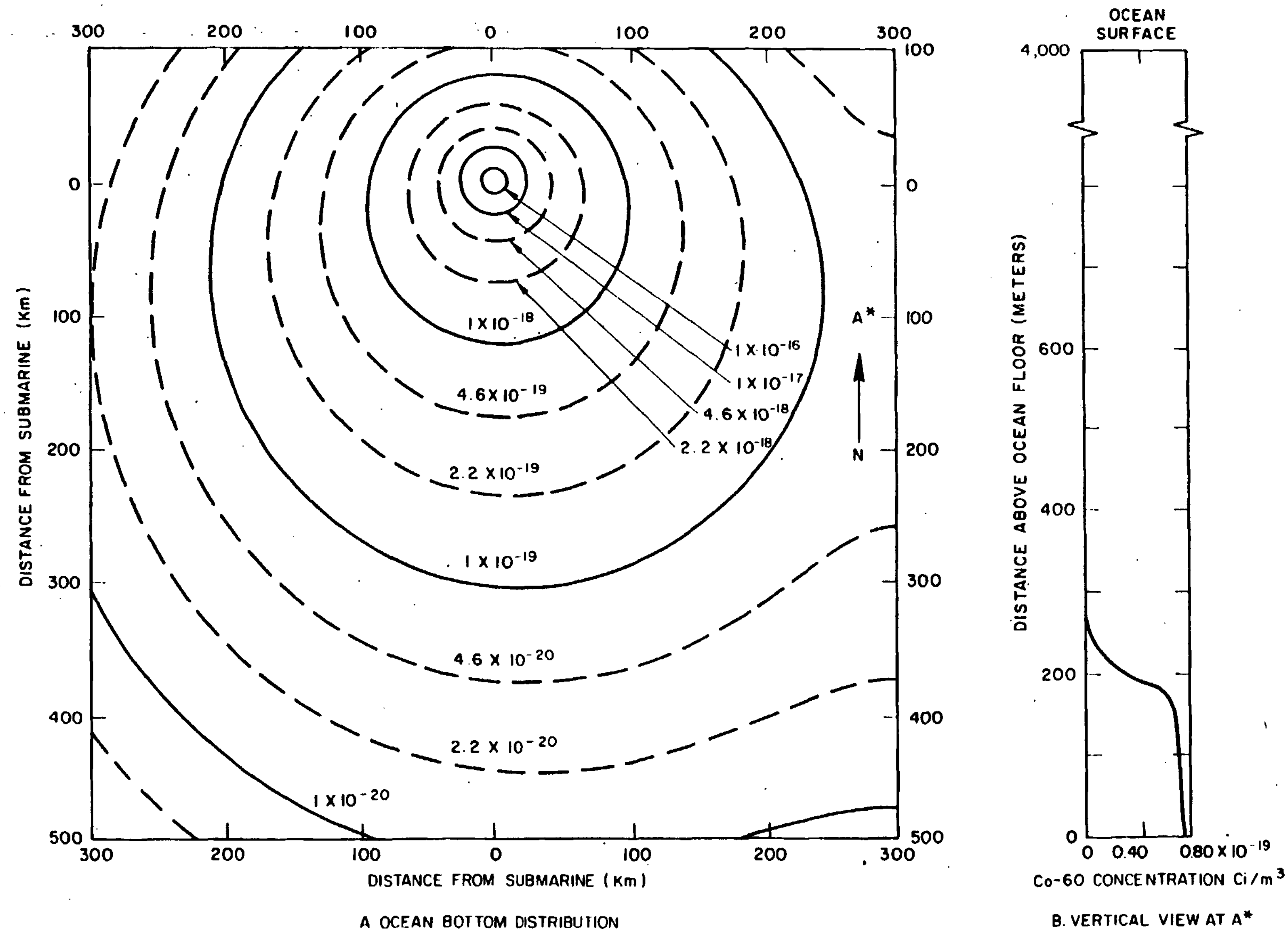

Figure H-3. Best Estimate Co-60 Concentrations Calculated for 100 Years After Disposal (Ci/m^3) – 1 Submarine

A. TYPICAL RESULTS

Based on the best estimate activity release rates developed in Appendix G, only very small amounts of radioactive material would be released from a typical submarine in the initial 100 years after settling to the bottom. The containment barriers might be penetrated by corrosion after 100 years and the initial release of radionuclides could occur. The maximum concentrations at the disposal site are tabulated in Table H-2. The calculations reveal that concentrations of 1.9×10^{-13}, 1.3×10^{-10}, and 1.1×10^{-9} Ci/m^3 could be found for Cobalt-60, Nickel-59, and Nickel-60, respectively (see Table H-2). These concentrations are much less than the NRC limits for unrestricted discharge into the ocean (Reference H.14) as well as the EPA drinking water limits calculated by the methods and element concentrations listed in References H.11 and H.12. Trace amounts of other nuclides would be released during the first year after containment penetration when the maximum concentration of radioactivity is attained. The amount of potential release dies off quickly in the following years as the inventory of corrosion products accumulated prior to containment penetration would be depleted. The new amount of radioactive material which could become available during the fifth year would be less than one-tenth of the quantity released during the first year after containment penetration.

Observations of tracers in the deep oceans and the calculations show that the maximum nuclide concentration would be restricted to the bottom boundary layer on the ocean floor as in Figure H-3. The radionuclide concentrations are predicted, by the calculations, to decrease to less than one percent of the bottom value at about 385 meters above the ocean floor. Predicted vertical distributions of radionuclides are similar to observations of excess Rn-222 tracer behavior in the deep ocean (Reference H.4).

While this tendency of the bottom boundary layer to prevent upward spread of the corrosion particles to higher waters would minimize dilution of the calculated releases, it also greatly retards the movement of radioactive material towards the shallower waters where it might affect human activities or the food chains to man. When combined with the extremely small releases possible from the submarines, the net effect would be to effectively prevent exposure to the general public, even with the restricted dilution permitted by the bottom boundary layer.

The maximum best estimate concentration of radioactivity for 100 submarines at the coastal location nearest the source would be less than approximately 9.8×10^{-24}, 7.6×10^{-20}, and 4.2×10^{-19} Ci/m^3 of Cobalt-60, Nickel-59, and Nickel-63, respectively. These values are, of course, judged to be higher than would actually occur because the calculations use release rates which are greater than expected. (See discussion in Appendix G.)

B. COMPARISON WITH SHEPHERD'S MODEL

The results of the calculations using the model presented in this appendix have been compared to the results of Shepherd's ocean dispersion model calculations for the same location. The comparisons were made using the maximum concentrations calculated for any location at the pathway entry points at any time after the initial release of radioactivity by applying "conservative" parameters to the models being considered.

The model of this appendix differs from Shepherd's model primarily by incorporating explicitly varying values of the vertical advection speed and vertical eddy diffusion coefficient instead of the single constant eddy diffusivity term used by Shepherd to account for both diffusion and advection. It further accounts for the effect of detritus removal which is not considered in the Shepherd model. In addition, Shepherd used a constant activity release rate while this model includes a variable release rate, representing the effects of corrosion on containment and release. Using the maximum vertical eddy diffusivity of 10 cm^2/sec defined by Shepherd, and not including any removal effects associated with detritus, comparisons of the results of the current model with those calculated with Shepherd's model indicate that the Shepherd's model concentrations do not reproduce the well-mixed region of the bottom boundary layer and that the Shepherd's model calculations overestimate the upward transport of the radionuclides. Further, these comparisons indicate that

TABLE H-2. BEST ESTIMATE MAXIMUM RADIONUCLIDE CONCENTRATIONS USED AT THE DISPOSAL SITE EXPECTED CONTAINMENT CONDITION FOR 1 OR 100 SUBMARINES*

Nuclide	Concentration (Ci/m³)
C-14	9.9×10^{-13}
S-35	3.5×10^{-18}
Sc-46	4.1×10^{-19}
Cr-51	5.3×10^{-16}
Mn-54	1.1×10^{-14}
Fe-55	5.0×10^{-13}
Co-58	1.4×10^{-15}
Fe-59	9.5×10^{-16}
Ni-59	1.3×10^{-10}
Co-60	1.9×10^{-13}
Ni-63	1.1×10^{-9}
Mo-93	1.3×10^{-12}
Nb-94	9.1×10^{-14}
Zr-95	0.0
Tc-99	3.8×10^{-13}
Hf-181	0.0

*The local radionuclide concentration in the vicinity of one submarine surrounded by other submarines is not significantly increased (less than 0.01 percent) above the value for one submarine alone because of the spacing between submarines.

the concentrations and therefore the eventual potential doses to man predicted by Shepherd's model are lower than those estimated along the ocean floor by the model developed in this appendix. The use of a vertical eddy diffusivity of 1.0 cm^2/sec will reduce the upward transport of radionuclides predicted by Shepherd's model but will still provide vertical transport estimates which are greater than estimated by the model described in this report.

Overall, this comparison shows that the model presented here better describes observed bottom water movement than Shepherd's model, explicitly representing the restrictions on dispersion. This prevents dilution, maximizing concentrations which might enter the food chain.

C. DETAILED RESULTS

To provide a deeper insight into the calculations made, some of the results have been tabulated and presented to show the concentrations which would result from the disposal of 1 to 100 submarines at the disposal location (Table H-2) and at the potential entry points to the possible pathways to man (Tables H-3 through H-9). The maximum best estimate concentrations for disposal of 100 ships at a rate of three ships per year over a period of approximately 33 years would be from 10 percent greater than for one ship up to approximately 100 times greater than for a single ship, depending on the half-life of the specific radionuclides and the amount of material remaining in each ship when the reactor compartment and reactor vessel containments would eventually be penetrated. All of the concentrations are very low, in most cases far less than the concentrations of the same nuclides already existing in the ocean (References H.7 and H.15).

In addition, the entry point concentrations resulting from an unexpected penetration of the reactor compartment and the reactor pressure vessel containment barriers for a ship during emplacement at the disposal site are presented in Tables H-5 and H-8. Tables H-6 and H-9 present the concentrations calculated for an accident during transit to the planned disposal location. In this case it was assumed that a submarine was irretrievably lost on the ocean floor about 25 kilometers from the coastal region and the reactor compartment and reactor vessel containments were penetrated as the submarine settles on the ocean floor (see Appendix G).

Table H-7 has been included to illustrate the magnitude of the increased nuclide concentration using the conservative values for the parameters used in Table H-1 in conjunction with the calculational model presented on page H-4. These maximum values listed in Table H-7 are still within the NRC and EPA limits.

TABLE H-3. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m^3) EXPECTED CONTAINMENT—BEST ESTIMATE 1 SUBMARINE

Nuclides	Disposal Site	Fish Pathway Entry Point (250 km)	Shoreline (300 km)	
			Air Concentrations at Pathway Entry Point	All Remaining Pathway Entry Points
C-14	9.9×10^{-13}	5.9×10^{-24}	5.9×10^{-35}	5.9×10^{-24}
S-35	3.5×10^{-18}	5.9×10^{-31}	5.9×10^{-42}	5.9×10^{-31}
Sc-46	4.1×10^{-19}	5.9×10^{-32}	5.9×10^{-41}	5.9×10^{-32}
Cr-51	5.3×10^{-16}	2.2×10^{-31}	2.2×10^{-40}	2.2×10^{-31}
Mn-54	1.1×10^{-14}	2.5×10^{-26}	2.5×10^{-35}	2.5×10^{-26}
Fe-55	5.0×10^{-13}	2.2×10^{-24}	2.2×10^{-33}	2.2×10^{-24}
Co-58	1.4×10^{-15}	1.0×10^{-28}	1.0×10^{-37}	1.0×10^{-28}
Fe-59	9.5×10^{-16}	8.2×10^{-30}	8.2×10^{-39}	8.2×10^{-30}
Ni-59	1.3×10^{-10}	7.7×10^{-22}	7.7×10^{-31}	7.7×10^{-22}
Co-60	1.9×10^{-13}	8.9×10^{-25}	8.9×10^{-34}	8.9×10^{-25}
Ni-63	1.1×10^{-9}	6.3×10^{-21}	6.3×10^{-30}	6.3×10^{-21}
Mo-93	1.3×10^{-12}	7.1×10^{-24}	7.1×10^{-33}	7.1×10^{-24}
Nb-94	9.1×10^{-14}	5.6×10^{-25}	5.6×10^{-34}	5.6×10^{-25}
Zr-95	0.0	0.0	0.0	0.0
Tc-99	3.8×10^{-13}	2.1×10^{-24}	2.1×10^{-33}	2.1×10^{-24}
Hf-181	0.0	0.0	0.0	0.0

TABLE H-4. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m^3) EXPECTED CONTAINMENT—BEST ESTIMATE 100 SUBMARINES

Nuclides	Disposal Site* (Same as 1 Ship Value)	Fish Pathway Entry Point (250 km)	Shoreline (300 km)	
			Air Concentrations at Pathway Entry Point	All Remaining Pathway Entry Points
C-14	--	5.7×10^{-22}	5.7×10^{-33}	5.7×10^{-22}
S-35	--	2.0×10^{-30}	2.0×10^{-41}	2.0×10^{-30}
Sc-46	--	2.0×10^{-31}	2.0×10^{-40}	2.0×10^{-31}
Cr-51	--	6.6×10^{-31}	6.6×10^{-40}	6.6×10^{-31}
Mn-54	--	1.5×10^{-25}	1.5×10^{-34}	1.5×10^{-25}
Fe-55	--	3.1×10^{-23}	3.1×10^{-32}	3.1×10^{-23}
Co-58	--	3.4×10^{-28}	3.4×10^{-37}	3.4×10^{-28}
Fe-59	--	2.5×10^{-29}	2.5×10^{-38}	2.5×10^{-29}
Ni-59	--	7.6×10^{-20}	7.6×10^{-29}	7.6×10^{-20}
Co-60	--	9.8×10^{-24}	9.8×10^{-33}	9.8×10^{-24}
Ni-63	--	4.2×10^{-19}	4.2×10^{-28}	4.2×10^{-19}
Mo-93	--	3.0×10^{-23}	3.0×10^{-32}	3.0×10^{-23}
Nb-94	--	5.6×10^{-23}	5.6×10^{-32}	5.6×10^{-23}
Zr-95	--	0.0	0.0	0.0
Tc-99	--	9.0×10^{-24}	9.0×10^{-33}	9.0×10^{-24}
Hf-181	--	0.0	0.0	0.0

*The local radionuclide concentration in the vicinity of one submarine surrounded by other submarines is not significantly increased (less than 0.01 percent) above the value for one submarine alone because of the spacing between submarines.

TABLE H-5. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m³) RELEASES AT THE EXPECTED DISPOSAL SITE* MINIMUM CONTAINMENT—BEST ESTIMATE 1 SUBMARINE

Nuclides	Disposal Site	Fish Pathway Entry Point (250 km)	Shoreline (300 km)	
			Air Concentrations at Pathway Entry Point	All Remaining Pathway Entry Points
C-14	8.9×10^{-13}	3.2×10^{-24}	3.2×10^{-35}	3.2×10^{-24}
S-35	2.4×10^{-13}	2.4×10^{-26}	2.4×10^{-37}	2.4×10^{-26}
Sc-46	2.0×10^{-13}	1.7×10^{-26}	1.7×10^{-35}	1.7×10^{-26}
Cr-51	6.5×10^{-10}	2.0×10^{-25}	2.0×10^{-34}	2.0×10^{-25}
Mn-54	3.1×10^{-9}	3.9×10^{-21}	3.9×10^{-30}	3.9×10^{-21}
Fe-55	8.4×10^{-8}	2.0×10^{-19}	2.0×10^{-28}	2.0×10^{-19}
Co-58	5.0×10^{-9}	3.0×10^{-22}	3.0×10^{-31}	3.0×10^{-22}
Fe-59	6.6×10^{-10}	6.7×10^{-24}	6.7×10^{-33}	6.7×10^{-24}
Ni-59	1.0×10^{-10}	3.7×10^{-22}	3.7×10^{-31}	3.7×10^{-22}
Co-60	5.4×10^{-8}	1.6×10^{-19}	1.6×10^{-28}	1.6×10^{-19}
Ni-63	1.7×10^{-8}	5.8×10^{-20}	5.8×10^{-29}	5.8×10^{-20}
Mo-93	1.7×10^{-14}	6.4×10^{-26}	6.4×10^{-35}	6.4×10^{-26}
Nb-94	7.7×10^{-14}	2.9×10^{-25}	2.9×10^{-34}	2.9×10^{-25}
Zr-95	5.8×10^{-10}	3.2×10^{-23}	3.2×10^{-32}	3.2×10^{-23}
Tc-99	4.9×10^{-15}	1.8×10^{-26}	1.8×10^{-35}	1.8×10^{-26}
Hf-181	2.1×10^{-10}	1.8×10^{-24}	1.8×10^{-33}	1.8×10^{-24}

*The "Best Estimate" parameter values of Table H-1 were used except for an average corrosion particle settling velocity of 9 m/yr to account for the corrosion product adhering to the exposed internal structures reactor pressure vessel. The containments provided by the reactor compartment and the reactor pressure vessel are not considered in a minimum containment scenario.

TABLE H-6. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m^3) ACCIDENT DURING TRANSIT (25 km OFF SHORE)* MINIMUM CONTAINMENT—BEST ESTIMATE 1 SUBMARINE

Nuclides	Disposal Site	Fish Pathway Entry Point	Shoreline (25 km)	
			Air Concentrations at Pathway Entry Point	All Remaining Pathway Entry Points
C-14	8.9×10^{-13}	3.2×10^{-15}	9.5×10^{-28}	9.5×10^{-17}
S-35	2.4×10^{-13}	8.6×10^{-16}	2.4×10^{-28}	2.4×10^{-17}
Sc-46	2.0×10^{-13}	7.0×10^{-16}	2.0×10^{-26}	2.0×10^{-17}
Cr-51	6.5×10^{-10}	2.3×10^{-12}	5.6×10^{-23}	5.6×10^{-14}
Mn-54	3.1×10^{-9}	1.1×10^{-11}	3.2×10^{-22}	3.2×10^{-13}
Fe-55	8.4×10^{-8}	3.0×10^{-10}	8.9×10^{-21}	8.9×10^{-12}
Co-58	5.0×10^{-9}	1.8×10^{-11}	4.9×10^{-22}	4.9×10^{-13}
Fe-59	6.6×10^{-10}	2.3×10^{-12}	6.1×10^{-23}	6.1×10^{-14}
Ni-59	1.0×10^{-10}	3.6×10^{-13}	1.1×10^{-23}	1.1×10^{-14}
Co-60	5.4×10^{-8}	1.9×10^{-10}	5.8×10^{-21}	5.8×10^{-12}
Ni-63	1.7×10^{-8}	6.1×10^{-11}	1.8×10^{-21}	1.8×10^{-12}
Mo-93	1.7×10^{-14}	6.2×10^{-17}	1.9×10^{-27}	1.9×10^{-18}
Nb-94	7.7×10^{-14}	2.7×10^{-16}	8.2×10^{-27}	8.2×10^{-18}
Zr-95	5.8×10^{-10}	2.0×10^{-12}	5.6×10^{-23}	5.6×10^{-14}
Tc-99	4.9×10^{-15}	1.7×10^{-17}	5.2×10^{-28}	5.2×10^{-19}
Hf-181	2.1×10^{-10}	7.4×10^{-13}	1.9×10^{-23}	1.9×10^{-14}

*For these calculational estimates, the values of certain "Best Estimate" parameters listed in Table H-1 were changed to fit the new location. These changes were (1) bottom boundary layer thickness = 800 m; (2) vertical extent of the maximum vertical diffusivity in the bottom boundary layer = 800 m; (3) average corrosion particle settling velocity = 9 m/yr; (4) vertical distance from the ocean floor to the pathway entry points = 0 m.

TABLE H-7. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m^3) EXPECTED CONTAINMENT—CONSERVATIVE ESTIMATE—100 SUBMARINES

Nuclides	Disposal Site	Fish Pathway Entry Point (50 km Off Shore)	Shoreline (300 km)	
			Air Concentrations at Pathway Entry Point	All Remaining Pathway Entry Points
C-14	9.7×10^{-12}	1.9×10^{-15}	1.9×10^{-26}	1.9×10^{-15}
S-35	4.3×10^{-18}	8.6×10^{-24}	7.2×10^{-35}	7.2×10^{-24}
Sc-46	5.1×10^{-19}	9.0×10^{-25}	7.4×10^{-34}	7.4×10^{-25}
Cr-51	6.6×10^{-16}	6.7×10^{-23}	4.1×10^{-32}	4.1×10^{-23}
Mn-54	1.4×10^{-14}	2.9×10^{-19}	2.7×10^{-28}	2.7×10^{-19}
Fe-55	6.2×10^{-13}	5.3×10^{-17}	5.2×10^{-26}	5.2×10^{-17}
Co-58	1.7×10^{-15}	2.0×10^{-21}	1.6×10^{-30}	1.6×10^{-21}
Fe-59	1.2×10^{-15}	4.4×10^{-22}	3.2×10^{-31}	3.2×10^{-22}
Ni-59	9.9×10^{-10}	2.2×10^{-13}	2.2×10^{-22}	2.2×10^{-13}
Co-60	6.6×10^{-13}	2.8×10^{-17}	2.7×10^{-26}	2.7×10^{-17}
Ni-63	7.1×10^{-8}	1.4×10^{-11}	1.4×10^{-20}	1.4×10^{-11}
Mo-93	1.7×10^{-12}	6.5×10^{-17}	6.5×10^{-26}	6.5×10^{-17}
Nb-94	8.5×10^{-13}	1.7×10^{-16}	1.7×10^{-25}	1.7×10^{-16}
Zr-95	--	--	--	--
Tc-99	5.0×10^{-13}	1.9×10^{-17}	1.9×10^{-26}	1.9×10^{-17}
Hf-181	--	--	--	--

TABLE H-8. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m^3) RELEASES AT THE DISPOSAL SITE MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE—1 SUBMARINE

Nuclides	Fish(1)	Inhalation/Air Immersion(2)	Remaining Pathways(3)
C-14	1.8×10^{-17}	1.7×10^{-28}	1.7×10^{-17}
S-35	4.0×10^{-19}	3.3×10^{-30}	3.3×10^{-19}
Sc-46	3.0×10^{-19}	2.4×10^{-28}	2.4×10^{-19}
Cr-51	1.1×10^{-16}	6.6×10^{-26}	6.6×10^{-17}
Mn-54	1.3×10^{-14}	1.2×10^{-23}	1.2×10^{-14}
Fe-55	5.1×10^{-13}	4.9×10^{-22}	4.9×10^{-13}
Co-58	4.7×10^{-15}	3.8×10^{-24}	3.8×10^{-15}
Fe-59	3.1×10^{-16}	2.3×10^{-25}	2.3×10^{-16}
Ni-59	2.1×10^{-15}	2.1×10^{-24}	2.1×10^{-15}
Co-60	4.1×10^{-13}	3.9×10^{-22}	3.9×10^{-13}
Ni-63	2.8×10^{-13}	2.8×10^{-22}	2.8×10^{-13}
Mo-93	3.9×10^{-19}	3.9×10^{-28}	3.9×10^{-19}
Nb-94	1.6×10^{-18}	1.6×10^{-27}	1.6×10^{-18}
Zr-95	5.3×10^{-16}	4.2×10^{-25}	4.2×10^{-16}
Tc-99	1.1×10^{-19}	1.1×10^{-28}	1.1×10^{-19}
Hf-181	9.4×10^{-17}	6.8×10^{-26}	6.8×10^{-17}

(1) Entry point located 50 kilometers offshore (250 kilometers from disposal site) at 2000 meters depth.
(2) Entry points in atmosphere at shore (300 kilometers from disposal site).
(3) Entry points at shore (300 kilometers from disposal site).

TABLE H-9. MAXIMUM RADIONUCLIDE CONCENTRATIONS AT PATHWAY ENTRY POINTS (Ci/m^3) ACCIDENT DURING TRANSIT (25 km OFF SHORE) MINIMUM CONTAINMENT—CONSERVATIVE ESTIMATE— 1 SUBMARINE

Nuclides	Fish(1)	Inhalation/Air Immersion(2)	Remaining Pathways(3)
C-14	1.8×10^{-15}	4.3×10^{-27}	4.3×10^{-16}
S-35	4.6×10^{-16}	1.0×10^{-27}	1.0×10^{-16}
Sc-46	3.7×10^{-16}	8.0×10^{-26}	8.0×10^{-17}
Cr-51	1.1×10^{-12}	2.1×10^{-22}	2.1×10^{-13}
Mn-54	3.9×10^{-12}	9.3×10^{-22}	9.3×10^{-13}
Fe-55	1.1×10^{-10}	2.6×10^{-20}	2.6×10^{-11}
Co-58	6.8×10^{-12}	1.5×10^{-21}	1.5×10^{-12}
Fe-59	7.5×10^{-13}	1.5×10^{-22}	1.5×10^{-13}
Ni-59	2.0×10^{-13}	4.9×10^{-23}	4.9×10^{-14}
Co-60	7.8×10^{-11}	1.9×10^{-20}	1.9×10^{-11}
Ni-63	3.2×10^{-11}	7.7×10^{-21}	7.7×10^{-12}
Mo-93	3.9×10^{-17}	9.6×10^{-27}	9.6×10^{-18}
Nb-94	1.6×10^{-16}	3.8×10^{-26}	3.8×10^{-17}
Zr-95	6.4×10^{-13}	1.4×10^{-22}	1.4×10^{-13}
Tc-99	1.1×10^{-17}	2.7×10^{-27}	2.7×10^{-18}
Hf-181	2.3×10^{-13}	4.7×10^{-23}	4.7×10^{-14}

(1) Entry point in the vicinity of the release site.
(2) Entry points in atmosphere at shore (25 kilometers from release site).
(3) Entry points at shore (25 kilometers from release site).

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APPENDIX I

DOSE COMMITMENT CALCULATION METHODS, SEA DISPOSAL

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APPENDIX I

DOSE COMMITMENT CALCULATION METHODS, SEA DISPOSAL

I. INTRODUCTION

This appendix describes the exposure pathways and the equations and parameters used to estimate potential radiation dose commitments to man if defueled nuclear submarines were disposed of on the ocean floor. In this statement, a dose commitment is the total radiation dose (measured in rems) to an individual which occurs over a period of time due to the exposure of the individual to radioactive materials released into the environment.

The overall process by which radioactive material from a submarine could enter the environment and then reach man includes: the corrosion of the structural materials containing the radionuclides, the release of these corrosion products into the ocean environment, the transport of the corrosion product particles from the disposal site to locations where they could enter the paths which lead to man, and the movement of these corrosion product particles along these paths to man. The corrosion, release, and transport processes are described in Appendices F, G, and H respectively, and the pathways by which the radionuclides might reach man are described in this appendix.

The information presented in this appendix is divided into three sections. The first section describes the pathways by which radionuclides could reach man. The second section describes the equations used to calculate radiation dose commitments to man. The last section describes the parameters used for evaluating the dose commitment equations.

II. SUMMARY

Exposure pathways are presented which describe how radioactivity might be transferred from the seawater to man. Equations are presented which provide a means to estimate the dose commitments to man as a result of being exposed to the radioactivity via the exposure pathways. Values of the parameters in these equations are presented to provide the information required to evaluate the dose commitment equations. The pathways, equations, and parameters presented in this appendix are based on established information found in the literature (see references listed in Section VI).

The exposure pathways presented in this appendix fall into three general categories: ingestion, inhalation, and external exposure pathways. The assumed ingestion pathways include the consumption of fish, crustacea, molluscs, seaweed, plankton, desalinated seawater, and salt from seawater. The inhalation pathway is assumed to include breathing radionuclides released from the seawater and from shore sediments which had picked up radionuclides from the seawater. The assumed external pathways include immersion in seawater, exposure to equipment which had been immersed in the seawater, exposure to shore sediments, and immersion in air which is being breathed. The selection of these pathways is based on the information presented in Reference I.1 and represent the critical pathways by which the maximum amount of radioactivity could be transferred to man. The critical pathways approach used in this statement is within the guidelines provided by the International Commission on Radiation Protection for determining how radionuclides could be transferred to man (Reference I.3).

The equations presented in this appendix are simplified versions of the equations which were developed based on the information presented in References I.1, I.4, and I.5. The equations are based on the concentration factor approach for calculating doses which was used by a group of international scientists in establishing criteria for the IAEA for ocean disposal of radioactive wastes (Reference I.1). The equations are intended to estimate the dose commitment to man which might occur if radionuclides from defueled nuclear submarines emplaced in a deep remote ocean location could reach man through the exposure pathways identified in this appendix. Therefore, equations are presented for each of the ingestion, inhalation, and external exposure pathways.

The values of the parameters used in solving the dose commitment equations are presented. The values of these parameters are based on standard values found in the literature. Information is presented for individual consumption rates and occupancy factors (References I.1, I.9, I.10, I.11, and I.12), concentration factors (References I.1 and I.13), and dose commitment and dose rate conversion factors (References I.5, I.7, I.14, and I.15). The radionuclide concentrations at exposure pathways entry points for all radionuclides which might be present in a defueled nuclear submarine are presented in Section V of Appendix H.

The information in this appendix has been used to calculate the radiation dose commitment estimates to man which could occur as a result of defueled nuclear submarines being disposed of in the deep ocean. For the ingestion and inhalation pathways, the information presented in this appendix was used to estimate the dose commitments that an individual could receive during 70 years after being exposed to the maximum concentrations of the radionuclides. For the external exposure pathways, the information presented in this appendix was used to estimate the dose rate that an individual could receive after being exposed to the maximum concentrations of the radionuclides. In all dose commitment calculations, the maximum radionuclide concentrations which were calculated at any time after disposal operations were initiated were used in solving the dose commitment equations. Therefore, the dose commitment estimates calculated by using the information presented in this appendix represent upper limits of the dose commitments that could be received and are unlikely to be exceeded. The results of these calculations are presented in Appendix J.

III. EXPOSURE PATHWAYS

Radioactive material in ocean water might reach man along the pathways identified in Figure I-1. The pathways identified on this figure are based on the information presented by an international group of scientists who reviewed the radiological and oceanographic basis of the International Atomic Energy Agency (IAEA) recommendations concerning ocean disposal of radioactive wastes (References I.1 and I.2). The pathways identified in Figure I-1 are known as "critical pathways" because, in general, they represent the maximum rates at which radioactivity could be transferred to man by various mechanisms. The critical pathways approach used in this statement is within the guidelines provided by the International Commission on Radiation Protection for determining how radionuclides could be transferred to man (Reference I.3).

The pathways identified in Figure I-1 were used to estimate the amount of radioactivity that could be transported to man if defueled nuclear submarines were disposed of on the ocean floor. The method used in this statement for determining the amount of radioactivity that could reach man is the concentration factor method. The concentration of a radionuclide available in an organism or other physical item in a given pathway may be greater or less than the concentration in the surrounding seawater. If an equilibrium situation or a situation in which concentrations change slowly compared to the turnover rates in the items in the exposure pathways is expected, the use of the concentration factor method is considered applicable for determining the amount of radioactivity that could be transported to man through the exposure pathways (Reference I.1). In this statement, an equilibrium or near equilibrium situation is expected; therefore, the concentration factor method has been used. The concentration factor method directly relates the radionuclide concentration in an item in an exposure pathway to the radionuclide concentration in the seawater from which the item could be picking up the radioactivity.

The pathways presented in Figure I-1 provide a simplified approach for representing how radionuclides could be transferred from the ocean to man. As shown on this figure, organisms in the ocean could pick up radionuclides through their food webs and then transfer the radionuclides to man if he should use these organisms as food. Also, the radionuclides could accumulate in salt produced from seawater and in drinking water produced by desalinating seawater. Both of these pathways could result in radionuclides being ingested by man.

The radionuclides could also be transported to surface waters and then transferred to sediments along the shore. This could result in man being directly exposed to the radionuclides in the water and shore sediments. Additionally, the radionuclides in the surface waters and shore sediments could become airborne and enter the atmosphere. Radionuclides in the atmosphere could then be inhaled by man or result in man being externally exposed to the radionuclides since he would also be immersed in the air that he was breathing.

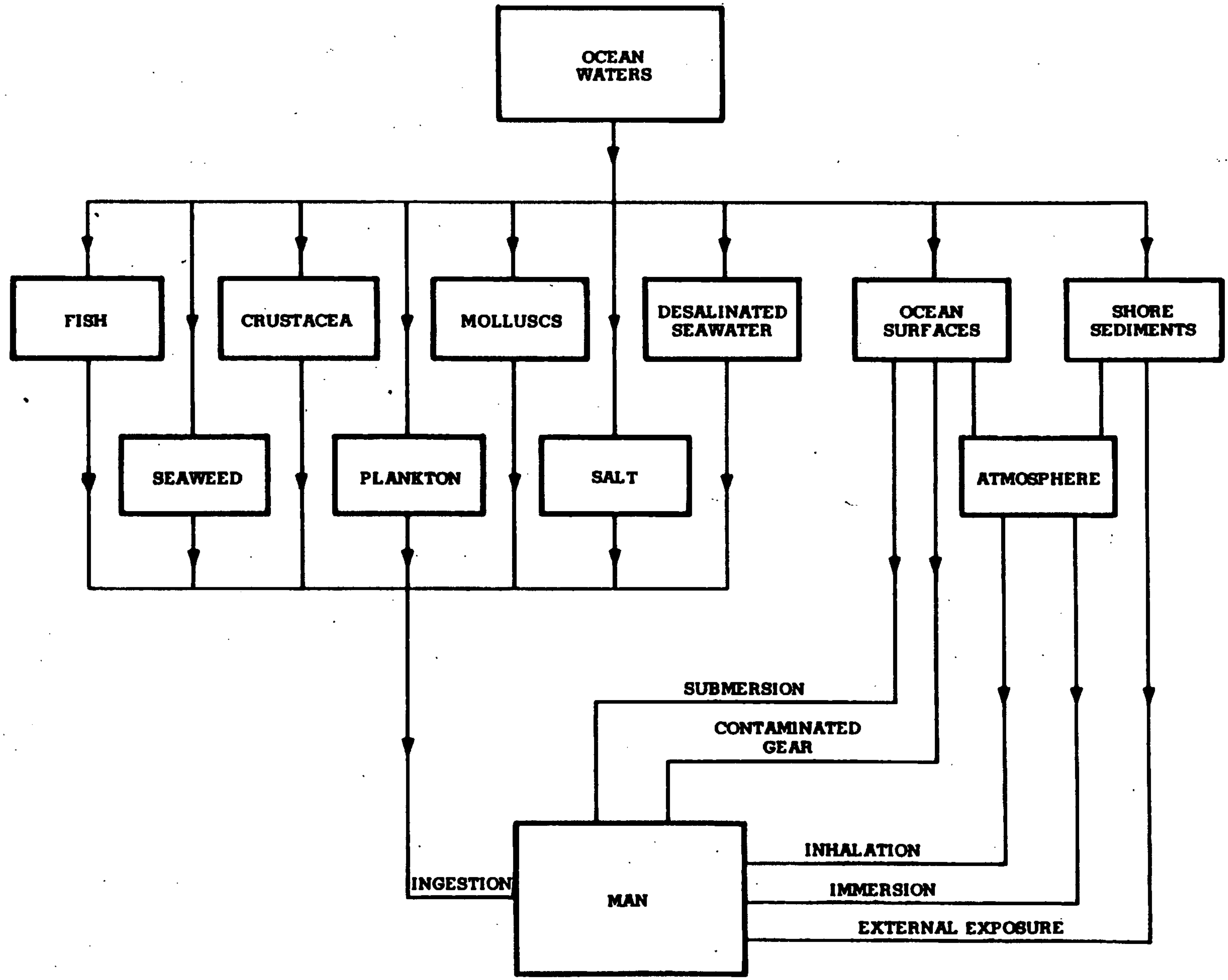

Figure I-1. Pathways to Man

The various pathways identified here can be grouped into the three general categories of ingestion, inhalation, and external radiation exposure. The following sections describe each of these categories of pathways.

A. INGESTION PATHWAYS

Ingestion pathways are those in which radionuclides could be introduced into the body through the gastrointestinal (GI) tract. Ingestion pathways may be divided into direct and indirect pathways. Direct ingestion pathways are those in which the ingested food items could obtain radioactive material directly from the seawater or from their predecessors in the food web. It has been assumed in this approach that the dose commitments to man associated with direct ingestion pathways will be proportional to the concentration of the radionuclides in the seawater in the region of the ocean from which the food item is withdrawn. This is consistent with the normal practice for using concentration factors, but it makes the inherent assumption that the food item is in equilibrium with the seawater. This may not be true in nature if the food item is highly mobile.

The direct ingestion pathways which have been used to provide estimates of the dose commitments to man are:

1. Consumption of fish.
2. Consumption of crustacea.
3. Consumption of molluscs.
4. Consumption of seaweed.
5. Consumption of plankton.
6. Consumption of desalinated seawater.
7. Consumption of sea salt.

The first five of these direct ingestion pathways represent processes through which there could be a biological transfer of radionuclides from the seawater to organisms. This transfer might be accomplished by either the direct assimilation of the radionuclides from the seawater or from the sediment which could pick up radionuclides from the seawater into the organism's tissues, or by the ingestion of predecessors in the food chain which have picked up radionuclides from the seawater or sediment, or by some combination of both. The last two direct ingestion pathways are directly dependent upon the radionuclide concentration in the seawater.

Indirect ingestion pathways are those in which the ingested food items might pick up radioactivity from a secondary medium such as the atmosphere or the soil rather than directly from the seawater. In general, the dose commitments to man associated with indirect ingestion pathways would be proportional to the concentration of the radionuclides in the secondary medium.

The amount of radionuclides available to enter the indirect ingestion pathways would be less than the amount available to enter the direct ingestion pathways because the radionuclides available for the indirect ingestion pathways would be subjected to considerably greater dispersion processes. As a result, the dose commitments associated with indirect ingestion pathways would be significantly less than the dose commitments from the direct ingestion pathways. Since the seawater concentrations which could affect these pathways are small (see Section V, Appendix H), and the resulting doses from the direct pathways are small (see Appendix J), the dose commitments from indirect ingestion pathways have not been calculated since they would not significantly affect the resulting doses, and only the dose commitments associated with the direct ingestion pathways were determined.

B. INHALATION PATHWAY

The inhalation pathway is one in which radionuclides could be introduced into the body through the lungs during the normal breathing process. The dose commitment to man from the inhalation pathway would be dependent on the concentration of the radionuclides in the air. In order for man to inhale the radionuclides, they would need to be transferred to the atmosphere from the seawater and a direct transfer of the radionuclides in the seawater to the atmosphere could occur as a result of wave spray or evaporation. An indirect transfer of the radionuclides in the seawater to the atmosphere could occur as a result of wind causing shore sediments, which had picked up radionuclides from the seawater, to become airborne. Both of these inhalation pathways were used to calculate the dose commitment to man resulting from inhaling the radionuclides.

C. EXTERNAL PATHWAYS

External pathways are those in which man is directly exposed to the radiation emitted by radionuclides outside the body. The external pathways which were used to provide estimates of the dose commitments to man are:

1. Immersion in seawater.

2. Exposure to equipment such as fishing lines, nets, and other items which have been immersed in seawater.

3. Exposure to shore sediments.

4. Immersion in air.

The dose commitments associated with the first two external pathways would be directly dependent on the radionuclide concentration in the seawater. The dose commitment from exposure to shore sediments would also be dependent on the radionuclide concentration in the seawater since the radionuclides in the shore sediments would originate from the seawater. The last external pathway is an extension of the inhalation pathway since an individual would also be immersed in the air that he was breathing.

Other external pathways can be postulated such as exposure to ground deposits of radioactivity formed by radionuclides falling out of the atmosphere, or exposure from using desalinated seawater for bathing, washing clothes, or other purposes. However, these external pathways were not used to estimate dose commitments to man. The amount of radioactive material available to enter these pathways would be considerably less than the amount of radionuclides available to the four previous external pathways since the radionuclides available for these external pathways would be subjected to considerably greater dispersion or dilution processes. As a result, the dose commitments associated with such pathways would be significantly less than those associated with the four previous external pathways. Therefore, only the first four external pathways identified were used to estimate the dose commitments to man resulting from external exposure pathways.

IV. DOSE COMMITMENT EQUATIONS

The equations described in this section were used to determine the radiation dose to man as a result of radioactivity assumed to be released to the environment from defueled nuclear submarines disposed of on the ocean floor. The equations presented are simplified versions of the dose commitment equations which were developed based on the information presented in References I.1, I.4, and I.5. Equations are presented for ingestion, inhalation, and external exposure pathways.

For the ingestion and inhalation pathways, the equations presented in this appendix were used to estimate the dose commitments that an individual could receive during 70 years after being exposed to the maximum concentrations of the radionuclides for a specified time period. For the external exposure pathways, the equations presented in this appendix were used to estimate the dose rate that an individual could receive after being exposed to the maximum concentrations of the radionuclides.

In all dose commitment calculations using the equations presented in this section, the maximum radionuclide concentrations which were calculated at any time after disposal operations were initiated were used in solving these dose commitment equations. Additionally, no removal terms, which would actually be present, were included in any of the equations. For example, no radioactive decay terms were included in any of the equations. Also, for the ingestion pathway, it was conservatively assumed that all of the radioactive material was in the edible portions of foods and would not be removed by gutting, washing, or any other cleaning operations. Therefore, the dose commitment estimates calculated by using the equations presented in this section represent upper limits of the dose commitments that could be received and are unlikely to be exceeded.

Equations are presented for the ingestion, inhalation, and external exposure pathways described in Section III of this appendix. The sources of the parameters identified in the equations presented in this section and the values used are described in Section V of this appendix. The dose commitment estimates obtained using the equations presented in this section are presented in Appendix J.

A. INGESTION PATHWAYS

The equation used for determining the possible dose commitment to man from ingesting radionuclides that could be released from defueled nuclear submarines disposed of on the ocean floor is:

$$D_I = KPqUX_w\Delta T$$

where

D_I is the dose commitment from ingestion of the radionuclide (in man-rem).

K is the dose commitment conversion factor for ingestion for each radionuclide (in rem per curie). This factor converts the amount of radioactivity (in curies) in the ingested material to the dose to the human body (in rem) and includes a consideration of the time the radioactive material may stay in the body.

P is the number of people for which the dose commitment estimate is being made.

q is the rate at which individuals may ingest the particular food considered (in grams per day) or drink desalinated seawater (in liters per day). The liters per day term requires conversion to units of grams per day when solving this equation.

U is the concentration factor which relates the radionuclide concentration in a unit mass of the item ingested to the radionuclide concentration in a unit volume of seawater from which the ingested item was obtained (in curies per kilogram of food per curies per liter of seawater). This term requires conversion to units of curies per gram per curies per cubic meter when solving this equation.

X_w is the concentration of the radionuclide considered in seawater (in curies per cubic meter).

ΔT is the time period over which an individual could be ingesting the food item (in days).

B. INHALATION PATHWAY

The equation used for determining the possible dose commitment to man from inhaling radionuclides that could be released from defueled nuclear submarines disposed of on the ocean floor is:

$$D_B = KPBX_a\Delta T$$

where

D_B is the dose commitment from inhalation of the radionuclide (in man-rem).

K is the dose commitment conversion factor for inhalation for each radionuclide (in rem per curie). This factor converts the amount of radioactivity (in curies) inhaled to the dose to the human body (in rem) and includes a consideration of the time the radioactive material may stay in the body.

P is the number of people for which the dose commitment estimate is being made.

B is the breathing rate for an individual (in cubic meters of air per day).

X_a is the concentration of the radionuclide considered in the air (in curies per cubic meter of air).

ΔT is the time period over which an individual could breathe the affected air (in days).

C. EXTERNAL PATHWAYS

This section presents the equations used for determining the possible dose commitment to man from external exposure to the radionuclides that might be released from the disposal of defueled nuclear submarines on the ocean floor. Hypothetically, humans could be externally exposed to the radionuclides by several routes such as immersion in the seawater, contact with equipment that had been immersed in the seawater, contact with shore sediments, or immersion in air being breathed.

1. Immersion in Seawater

The equation used for determining the possible dose commitment to man due to immersion in the seawater is:

$$D_S = KP\tau_s X_w \Delta T$$

where

D_S is the dose commitment due to immersion in the seawater (in man-rem).

K is the dose rate conversion factor for external exposure for each radionuclide (in rem per hour per curie per cubic meter). This factor converts the amount of radioactivity (in curies per cubic meter of seawater) in the seawater to the dose rate to the human body (in rem per hour).

P is the number of people for which the dose commitment estimate is being made.

τ_s is the amount of time that an individual could be immersed in the seawater (in hours per year).

X_w is the concentration of the radionuclide considered in the seawater which immersion occurs (in curies per cubic meter of seawater).

ΔT is the time period over which an individual could be immersed in the seawater (in years).

2. Exposure to Equipment

The equation used for determining the possible dose commitment to man due to exposure to equipment that had been immersed in the seawater is:

$$D_E = D_S F_e$$

where

D_E is the dose commitment due to exposure to equipment that had been immersed in the seawater (in man-rem).

D_S is the dose commitment due to immersion in the seawater (in man-rem).

F_e is a modifying factor which relates the dose commitment associated with exposure to equipment to the dose commitment associated with immersion in the seawater.

The procedure for using a modifying factor to relate the dose commitment associated with exposure to equipment to the dose commitment associated with immersion in the seawater was based on the treatment presented in Reference I.1. A typical value for the factor, F_e, is 0.1 (as reported in Reference I.1). This number is typical for handling fishing gear, such as nets and lines, and will be used in this statement to estimate the dose commitment due to exposure to equipment that had been immersed in the seawater.

3. Exposure to Shore Sediments

The equation used for determining the possible dose commitment to man due to exposure to shore sediments is:

$$D_V = KP\tau_v UX_w \rho \theta \Delta T$$

where

D_V is the dose commitment due to exposure to shore sediments (in man-rem).

K is the dose rate conversion factor for external exposure for each radionuclide (in rem per hour per curie per square meter). This factor converts the amount of radioactivity (in curies per square meter of sediment surface) in the sediments to the dose rate to the human body (in rem per hour).

P is the number of people for which the dose commitment estimate is being made.

τ_v is the amount of time that an individual could be exposed to the shore sediments (in hours per year).

U is the concentration factor relating the radionuclide concentration in a unit mass of shore sediments to the radionuclide concentration in a unit volume of seawater from which the shore sediments might accumulate the radionuclide considered (in curies per kilogram of sediments per curies per liter of seawater). This term requires conversion to units of curies per gram per curies per cubic meter when solving this equation.

X_w is the concentration of the radionuclide considered in the seawater adjacent to the shore sediments (in curies per cubic meter of seawater).

ρ is the density of the shore sediments (in grams per cubic meter of sediment).

θ is the thickness of the shore sediments which could contribute to the dose commitment (in meters).

ΔT is the time period over which an individual could be exposed to the shore sediments (in years).

The value of the density term, ρ, was chosen to be 2.65×10^6 grams per cubic meter (Reference I.6), based on the very conservative assumption that the density of shore sediments would be similar to pure SiO_2. The value of the thickness term, θ, was chosen to be 0.15 meter. This value was based on the thickness of sediments required to effectively shield the gamma radiation from Cobalt-60 since this radionuclide is the most critical for determining dose commitment estimates for the shore sediments pathway. Both of these values were chosen to be larger than actually expected so that the dose commitment estimates to man due to exposure to shore sediments would be unlikely to be underestimated.

4. Immersion in Air

The equation used for determining the possible dose commitment to man due to immersion in air is:

$$D_A = KP\tau_a X_a \Delta T$$

where

D_A is the dose commitment due to immersion in air (in man-rem).

K is the dose rate conversion factor for external exposure for each radionuclide (in rem per hour per curie per cubic meter). This factor converts the amount of radioactivity (in curies per cubic meter of air) in the air to the dose rate to the human body (in rem per hour).

P is the number of people for which the dose commitment estimate is being made.

τ_a is the amount of time that an individual could be immersed in the air (in hours per year).

X_a is the concentration of the radionuclide considered in the air which immersion occurs (in curies per cubic meter of air).

ΔT is the time period over which an individual could be immersed in the air (in years).

V. PARAMETERS FOR THE DOSE COMMITMENT EQUATIONS

The values of the parameters used to solve the dose commitment equations are described in this section. Information is presented for individual consumption rates and occupancy factors, concentration factors, and dose commitment and dose rate conversion factors. Each of these parameters is discussed in the following sections. The radionuclides which might be released from defueled nuclear submarines and associated radioactive decay data are also tabulated. The radionuclide concentrations at exposure pathway entry points for all radionuclides which might be present in a defueled nuclear submarine are presented in Section V of Appendix H.

A. RADIONUCLIDES AVAILABLE FOR RELEASE

The radionuclides remaining in a defueled nuclear submarine are listed in Table I-1 along with their half-lives and decay constants. The values presented in Table I-1 are based on the information contained in References I.7 and I.8. The radionuclides remaining in a defueled nuclear submarine would be contained either in the structural components of the reactor compartment or in corrosion products which form an adherent film on the inside of the components and piping of the primary coolant system. Nearly 100 percent of the radioactivity would be embedded in the structural components of the reactor compartment and reactor vessel. This radioactivity was formed by exposure of the structural components to neutrons during normal operation of the submarine. These radionuclides could not be released to the environment until the containment afforded by the reactor compartment and reactor vessel would be penetrated and then the rate of release would be limited by the rate of corrosion of the internal structures.

Approximately 0.1 percent of the total radioactivity remaining in a defueled nuclear submarine would be present in the form of an adherent corrosion film on the inside surfaces of the reactor coolant system. These corrosion products were generated during normal operation of the submarine and were incorporated in the corrosion film inside the primary coolant system. They are not removable by system flushing. These radionuclides could not be released to the environment until the containment afforded by the reactor compartment and the primary coolant system would be penetrated.

TABLE I-1. DECAY CONSTANTS AND HALF-LIVES OF RADIONUCLIDES USED IN ENVIRONMENTAL IMPACT CALCULATIONS

Nuclide	Half-Life(1)*	Decay Constant (hr^{-1})
C-14	5734 years	1.379×10^{-8}
S-35	88 days	3.282×10^{-4}
Sc-46	83.9 days	3.446×10^{-4}
Cr-51	27.8 days	1.042×10^{-3}
Mn-54	303 days	9.24×10^{-5}
Fe-55	2.6 years	2.929×10^{-5}
Co-58	71.3 days	4.05×10^{-4}
Fe-59	45 days	6.475×10^{-4}
Ni-59	80,000 years	9.88×10^{-10}
Co-60	5.26 years	1.503×10^{-5}
Ni-63	92 years	8.594×10^{-7}
Mo-93(2)	3500 years(2)	2.259×10^{-8}
Nb-94(2)	20,000 years(2)	3.953×10^{-9}
Zr-95	65 days	4.409×10^{-4}
Tc-99	212,000 years	3.73×10^{-10}
Hf-181	42.5 days	6.79×10^{-4}

(1) All half-life and decay constant data based on decay constants obtained from Reference I.7 unless otherwise noted.

(2) Half-life taken from Reference I.8.

*As described in Chapter 1 (Table 1-1, Note 7), the half-life values used in this final environmental impact statement are the same as those used in the draft statement. The calculations were not revised to reflect the most recent half-life values, shown in Table 1-1, because there would be no significant effect on the results or conclusions but confusion between the DEIS and FEIS would result.

B. CONSUMPTION RATES AND OCCUPANCY FACTORS

The rates at which individuals may consume various items, breathe, and occupy certain areas are listed in Table I-2 for each of the exposure pathways identified in Section III of this appendix. The rates presented in Table I-2 are for an adult individual and are based on the information presented in References I.1, I.9, I.10, I.11, and I.12 or have been estimated using similar procedures. Data are given for both an "average" individual and a "maximum" individual, with the difference being the values of the various consumption rates or occupancy factors.

TABLE I-2. CONSUMPTION RATES AND OCCUPANCY FACTORS

Pathway	Consumption Rates (g/day)(1)		Occupancy Factor (hrs/yr)(1)	
	Maximum Individual	Average Individual	Maximum Individual	Average Individual
Fish	179(2)	15.47(4)		
Crustacea	66.9(3)	2.54(4)		
Molluscs	53.9(3)	1.85(4)		
Seaweed	300	0.12(5)		
Plankton	62.9	0.12(5)		
Drinking Desalinated Seawater	2 liters/day	2 liters/day		
Salt	3	0.03(5)		
Inhalation	20 m^3/day	20 m^3/day		
Seawater Immersion			300	12(5)
Equipment			300	12(5)
Air Immersion			8766	8766
Shore Sediments			1000	50(5)

(1) All values from Reference I.1 unless otherwise noted.
(2) From Reference I.9.
(3) From data presented in References I.1, I.9, and I.10.
(4) From data presented in References I.11 and I.12.
(5) Estimated by authors.

The data presented for an average individual represent the consumption rates and occupancy factors for a typical member of the population along the west coast, Gulf coast, or east coast of the United States and are based on the averages reported in the references. In the dose commitment calculations, the individual with average usage factors, like the individual with maximum usage factors, will be assumed to be exposed to the pathways at the point of highest concentration for each pathway. This means that the dose commitments calculated for the average and maximum individual represent upper limits of the average and maximum dose commitments.

The data for a maximum individual represent the highest consumption rates and occupancy factors for a member of the same population who has unusually high usage of the individual pathways. For a given pathway, the data for a maximum individual represent the highest consumption rate or occupancy factor which is expected to be attained by any individual exposed to that particular pathway. Therefore, it would not be possible for any one individual to be exposed to all the maximum consumption rates or occupancy factors. For example, while one individual might consume a maximum amount of fish, only a separate individual could consume the maximum amount of crustacea, and the other maximum usages are similarly exclusive.

C. CONCENTRATION FACTORS

Concentration factors for each radionuclide present in a defueled nuclear submarine and for each exposure pathway are listed in Table I-3, except for the seawater immersion and equipment exposure pathways. These two pathways were not listed because concentration factors are not applicable for determining dose commitments from the direct exposure to the water assumed for these pathways. The information presented in Table I-3 is based on the information developed by the IAEA (Reference I.1) and the National Academy of Sciences (Reference I.13).

The data tabulated in Table I-3 represent estimates of the concentration of a particular radionuclide in organisms, desalinated seawater, salt, sediments, and air relative to the concentration of the radionuclide in the seawater from which the consumed product originated. For example, if a fish weighing 1 kilogram were to live in seawater which contained 1 picocurie per liter of Cobalt-60, the food web supporting that fish might accumulate the Cobalt-60 so that the fish could end up containing 100 picocuries of Cobalt-60.

D. DOSE COMMITMENT AND DOSE RATE CONVERSION FACTORS

Dose commitment and dose rate conversion factors convert the exposure to a given amount of radioactivity or radiation level to the dose that an individual could receive if he were exposed to that amount of radioactivity or radiation level. Particular organs of the body concentrate particular radionuclides differently; therefore, dose commitment and dose rate conversion factors vary for a particular radionuclide and organ of the body. Additionally, dose commitment conversion factors take into account the exposure resulting from the radioactive material that may stay in the body for a period of time, which is dependent on the material's biological half-life. Dose commitment conversion factors also vary depending on the age of the individual exposed and the time period over which the dose commitment estimate is being made. An adult individual was chosen and the time period chosen for determining the dose commitment was 70 years (see Section I of Appendix J).

Dose commitment or dose rate conversion factors for each radionuclide, pathway, and organ are presented in this section. The radionuclides considered are those that would be present in a defueled nuclear submarine. The pathways include ingestion, inhalation, and three external exposure pathways. The three external pathways represent exposure to shore sediments, water immersion, and air immersion exposure. The "organs" considered are the total body, bone, liver, kidney, gonads, lung, gastrointestinal (GI) tract, thyroid, and skin. These organs are normally used for determining dose commitment estimates (for example, see Reference I.7).

The dose commitment conversion factors for ingestion of radionuclides are presented in Table I-4. The information presented in this table is based on the information presented in References I.5, I.7, and I.14 or has been estimated. The data presented in Table I-4 represent the dose commitment to a particular organ over 70 years if the individual ingested 1 curie of a particular radionuclide.

The dose commitment conversion factors for inhalation of radionuclides are presented in Table I-5. The information presented in this table is based on the information presented in References I.5, I.7, I.14, and I.15. The data presented in Table I-5 represent the dose commitment to a particular organ over 70 years if the individual inhaled 1 curie of a particular radionuclide.

The surface dose rate conversion factors for exposure to shore sediments are presented in Table I-6 and are based on the information presented in References I.7 and I.15. The data presented in Table I-6 represent the dose rate in rem per hour to a particular organ if the individual were exposed to a surface deposit of 1 curie of a particular radionuclide per square meter of sediments.

The dose rate conversion factors for immersion in seawater are presented in Table I-7 and are based on the information presented in Reference I.15. The data presented in Table I-7 represent the dose rate in rem per hour to a particular organ if the individual were immersed in seawater containing 1 curie of a particular radionuclide per cubic meter of seawater.

TABLE I-3. CONCENTRATION FACTORS[1]
Ci/kg per Ci/liter

Nuclide	Fish	Crustacea	Molluscs	Seaweed	Plankton	Desalinated Seawater	Salt	Sediments	Air
C-14	5×10^4	4×10^4	5×10^4	4×10^3	3×10^3	1×10^{-4}	3×10^1	1×10^2	1×10^{-5}
S-35	1	1	1	1	1	1×10^{-4}	3×10^1	1×10^2	1×10^{-5}
Sc-46[2]	7.5×10^3	3×10^3	7.5×10^3	2×10^4	2×10^4	1×10^{-4}	3×10^1	5×10^4	1×10^{-2}
Cr-51	1×10^2	5×10^2	5×10^2	3×10^4	3×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Mn-54	5×10^2	1×10^4	1×10^4	1×10^4	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Fe-55	1×10^3	1×10^3	1×10^3	1×10^4	1×10^4	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Co-58	1×10^2	1×10^3	1×10^3	1×10^3	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Fe-59	1×10^3	1×10^3	1×10^3	1×10^4	1×10^4	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Ni-59	5×10^2	1×10^2	1×10^2	5×10^2	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Co-60	1×10^2	1×10^3	1×10^3	1×10^3	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Ni-63	5×10^2	1×10^2	1×10^2	5×10^2	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Mo-93	1×10^1	1×10^1	6×10^2	2.6×10^2	2.6×10^2	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Nb-94	1	1×10^2	1×10^3	5×10^2	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Zr-95	1	1×10^2	1×10^3	5×10^2	1×10^4	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Tc-99	1×10^1	1×10^3	1×10^3	1×10^5	1×10^3	1×10^{-4}	3×10^1	1×10^4	1×10^{-2}
Hf-181[3]	5×10^4	4×10^4	5×10^4	3×10^4	1×10^4	1×10^{-4}	3×10^1	5×10^4	1×10^{-2}

(1) Based on values in Reference I.1.
(2) Fish, crustacea, and plankton values taken from Reference I.13, mollusc and seaweed assumed equal to fish and plankton respectively, remaining values are assumed to be the highest value found in specific pathway for the referenced nuclides.
(3) Values assumed to be the highest value found in specific pathway for the referenced nuclides.

TABLE I-4. ADULT INGESTION 70 YEAR DOSE COMMITMENT CONVERSION FACTORS[1]
Rem/Ci

Nuclide	Total Body	Bone	Liver	Kidney	Gonads	Lung	GI Tract	Thyroid	Skin
C-14	5.68×10^2	2.84×10^3	5.68×10^2	5.68×10^2	5.68×10^2	5.68×10^2	5.68×10^2	5.68×10^2	5.68×10^2
S-35	2.6×10^3	6.69×10^3	2.6×10^3	2.6×10^3	1.02×10^4	2.6×10^3	6.47×10^3	2.6×10^3	0.0
Sc-46	3.11	5.51	10.7	9.99	3.11	3.11	5.21×10^4	3.11	0.0
Cr-51	3.48	3.48	3.48	1.01	3.48	5.46	9.7×10^2	3.69	0.0
Mn-54	8.72×10^2	8.72×10^2	4.57×10^3	1.36×10^3	8.72×10^2	8.72×10^2	1.94×10^4	8.72×10^2	0.0
Fe-55	4.43×10^2	2.75×10^3	1.9×10^3	4.43×10^2	4.43×10^2	1.06×10^3	1.09×10^3	4.43×10^2	0.0
Co-58	1.67×10^3	1.67×10^3	7.45×10^2	1.11×10^3	1.67×10^3	1.67×10^3	3.06×10^4	1.67×10^3	0.0
Fe-59	3.91×10^3	4.34×10^3	1.02×10^4	3.91×10^3	3.91×10^3	2.85×10^3	5.17×10^4	3.91×10^3	0.0
Ni-59	1.63×10^3	9.76×10^3	3.35×10^3	1.63×10^3	1.63×10^3	1.63×10^3	9.7×10^2	1.63×10^3	0.0
Co-60	4.72×10^3	4.72×10^3	2.14×10^3	7.8×10^2	4.72×10^3	4.72×10^3	8.02×10^4	4.72×10^3	0.0
Ni-63	4.36×10^3	1.35×10^5	9.01×10^3	4.36×10^3	4.36×10^3	4.36×10^3	2.77×10^3	4.36×10^3	0.0
Mo-93	2.03×10^2	2.03×10^2	7.51×10^3	2.13×10^3	2.03×10^2	2.03×10^2	1.22×10^3	2.03×10^2	0.0
Nb-94[2]	1.53×10^2	2.79×10^2	4.16×10^2	4.15×10^2	1.53×10^2	0.0	1.91×10^4	0.0	0
Zr-95	6.6	30.4	9.75	15.3	6.6	6.6	3.09×10^4	6.6	0.0
Tc-99	5.02×10^1	1.25×10^2	1.86×10^2	2.34×10^3	5.02×10^1	1.58×10^1	6.08×10^3	5.02×10^1	0.0
Hf-181	2.25	5.0	2.42	5.25	2.25	2.25	2.77×10^4	2.25	0.0

(1) The highest values from Reference I.5, Reference I.7, or Reference I.14 were used.
(2) These values were calculated by the authors.

TABLE I-5. ADULT INHALATION 70 YEAR DOSE COMMITMENT CONVERSION FACTORS(1)
Rem/Ci

Nuclide	Total Body	Bone	Liver	Kidney	Gonads	Lung	GI Tract	Thyroid	Skin
C-14(2)	4.26×10^{2}	2.27×10^{3}	4.26×10^{2}	4.26×10^{2}	4.26×10^{2}	4.26×10^{2}	4.26×10^{2}	4.26×10^{2}	4.26×10^{2}
S-35	1.95×10^{3}	4.46×10^{3}	1.95×10^{3}	1.95×10^{3}	7.68×10^{3}	2.59×10^{4}	4.27×10^{3}	1.95×10^{3}	0.0
Sc-46(3)	3.11×10^{4}	5.51×10^{4}	1.07×10^{5}	9.99×10^{4}	3.11×10^{4}	2.89×10^{5}	3.23×10^{4}	3.11×10^{4}	0.0
Cr-51	1.74×10^{2}	1.74×10^{2}	1.74×10^{2}	5.3×10^{1}	1.74×10^{3}	2.89×10^{3}	7.11×10^{2}	1.88×10^{2}	0.0
Mn-54	2.59×10^{3}	2.59×10^{3}	1.6×10^{4}	2.59×10^{3}	2.59×10^{3}	1.81×10^{5}	1.07×10^{4}	2.59×10^{3}	0.0
Fe-55	9.45×10^{2}	1.36×10^{3}	4.13×10^{3}	9.45×10^{2}	9.45×10^{2}	6.44×10^{3}	5.34×10^{2}	9.45×10^{2}	0.0
Co-58	2.95×10^{3}	2.95×10^{3}	2.32×10^{3}	2.03×10^{3}	2.95×10^{3}	7.18×10^{5}	1.06×10^{4}	2.95×10^{3}	0.0
Fe-59	1.96×10^{4}	1.96×10^{4}	5.31×10^{4}	1.96×10^{4}	1.96×10^{4}	3.41×10^{5}	1.75×10^{4}	1.96×10^{4}	0.0
Ni-59	2.15×10^{3}	1.29×10^{4}	4.98×10^{3}	2.15×10^{3}	2.15×10^{3}	8.47×10^{3}	7.11×10^{2}	2.15×10^{3}	0.0
Co-60	8.21×10^{3}	8.21×10^{3}	6.5×10^{3}	1.43×10^{3}	8.21×10^{3}	5.29×10^{6}	3.7×10^{4}	8.21×10^{3}	0.0
Ni-63	5.73×10^{3}	1.79×10^{5}	1.34×10^{4}	5.73×10^{3}	5.73×10^{3}	2.3×10^{4}	2.13×10^{3}	5.73×10^{3}	0.0
Mo-93(3)	3.17×10^{1}	3.17×10^{1}	1.17×10^{3}	3.55×10^{2}	3.17×10^{1}	5.11×10^{4}	3.79×10^{3}	3.17×10^{1}	0.0
Nb-94(4)	1.22×10^{4}	2.23×10^{4}	3.33×10^{4}	3.32×10^{4}	1.22×10^{4}	8.19×10^{5}	1.18×10^{4}	0.0	0.0
Zr-95	1.6×10^{4}	6.17×10^{4}	2.61×10^{4}	3.31×10^{4}	1.6×10^{4}	1.97×10^{5}	2.13×10^{4}	1.6×10^{4}	0.0
Tc-99(5)	4.92×10^{1}	1.23×10^{2}	1.82×10^{2}	2.3×10^{3}	4.92×10^{1}	1.03×10^{5}	7.12×10^{3}	4.92×10^{1}	0.0
Hf-181	5.63×10^{3}	1.33×10^{4}	5.91×10^{4}	1.31×10^{4}	5.63×10^{3}	8.83×10^{4}	2.13×10^{4}	5.63×10^{3}	0.0

(1) Reference I.7 used for all values unless otherwise noted.
(2) Values taken from Reference I.5.
(3) Values taken from Reference I.14.
(4) Values calculated by authors using procedures defined in References I.14 and I.15.
(5) Values taken from Reference I.15.

TABLE I-6. SURFACE DOSE RATE CONVERSION FACTORS[1]

Rem/hr per Ci/m^2

Nuclide	Total Body	Bone	Liver	Kidney	Gonads	Lung	GI Tract	Thyroid	Skin
C-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S-35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sc-46	26.6	29.2	22.4	24.9	24.1	24.9	24.1	19.7	34.4
Cr-51	0.67	1.01	0.513	0.486	0.877	0.594	0.486	0.642	0.838
Mn-54	11.6	12.7	9.73	10.8	10.5	10.8	10.5	8.61	15.0
Fe-55	2.11×10^{-2}	3.17×10^{-3}	1.83×10^{-5}	2.5×10^{-6}	1.54×10^{-2}	1.74×10^{-3}	4.34×10^{-3}	8.76×10^{-4}	0.394
Co-58	13.8	15.4	11.5	12.8	12.9	12.9	12.2	11.0	17.6
Fe-59	16.8	18.0	14.0	13.7	13.8	15.9	16.2	14.7	19.9
Ni-59[3]	3.42×10^{-3}	4.38×10^{-4}	3.34×10^{-6}	4.1×10^{-7}	2.48×10^{-3}	2.7×10^{-4}	1.4×10^{-4}	1.71×10^{-4}	5.7×10^{-2}
Co-60	35.2	37.6	29.6	28.2	28.7	33.3	34.1	31.3	41.3
Ni-63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mo-93[2]	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Nb-94[2]	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7
Zr-95	10.3	11.8	8.57	9.37	10.2	9.63	9.34	9.03	12.9
Tc-99[3]	6.29×10^{-6}	9.83×10^{-6}	5.06×10^{-6}	5.19×10^{-6}	8.26×10^{-6}	5.61×10^{-6}	5.19×10^{-6}	8.26×10^{-6}	8.81×10^{-6}
Hf-181[3]	6.07	7.09	5.24	5.44	7.68	5.61	5.4	7.16	8.69

(1) All values taken from Reference I.7 unless otherwise noted.
(2) Values calculated from procedures defined in Reference I.15.
(3) Values taken from Reference I.16.

TABLE I-7. WATER IMMERSION DOSE RATE CONVERSION FACTORS(1)

Rem/hr per Ci/m^3

Nuclide	Total Body	Bone	Liver	Kidney	Gonads	Lung	GI Tract	Thyroid	Skin
C-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8×10^{-4}
S-35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.02×10^{-4}
Sc-46	3.32×10^{-2}	3.64×10^{-2}	2.78×10^{-2}	3.1×10^{-2}	3.0×10^{-2}	3.1×10^{-2}	3.0×10^{-2}	2.46×10^{-2}	4.42×10^{-2}
Cr-51	5.6×10^{-4}	8.44×10^{-4}	4.28×10^{-4}	4.05×10^{-4}	7.3×10^{-4}	4.95×10^{-4}	4.05×10^{-4}	5.34×10^{-4}	7.38×10^{-4}
Mn-54	1.38×10^{-2}	1.52×10^{-2}	1.15×10^{-2}	1.29×10^{-2}	1.24×10^{-2}	1.29×10^{-2}	1.24×10^{-2}	1.02×10^{-2}	1.79×10^{-2}
Fe-55	1.74×10^{-6}	2.62×10^{-7}	1.51×10^{-9}	2.07×10^{-10}	1.27×10^{-6}	1.43×10^{-7}	3.58×10^{-7}	7.23×10^{-8}	7.72×10^{-5}
Co-58	1.62×10^{-2}	1.81×10^{-2}	1.36×10^{-2}	1.51×10^{-2}	1.52×10^{-2}	1.53×10^{-2}	1.44×10^{-2}	1.29×10^{-2}	2.11×10^{-2}
Fe-59	2.15×10^{-2}	2.3×10^{-2}	1.8×10^{-2}	1.75×10^{-2}	1.77×10^{-2}	2.03×10^{-2}	2.07×10^{-2}	1.88×10^{-2}	2.68×10^{-2}
Ni-59(3)	3.96×10^{-5}	5.1×10^{-6}	3.85×10^{-8}	4.71×10^{-9}	2.88×10^{-5}	3.14×10^{-6}	1.63×10^{-6}	1.98×10^{-6}	6.61×10^{-4}
Co-60	4.54×10^{-2}	4.85×10^{-2}	3.81×10^{-2}	3.64×10^{-2}	3.7×10^{-2}	4.29×10^{-2}	4.4×10^{-2}	4.04×10^{-2}	5.45×10^{-2}
Ni-63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mo-93(2)	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}	2.72×10^{-2}
Nb-94(2)	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Zr-95	1.23×10^{-2}	1.41×10^{-2}	1.03×10^{-2}	1.12×10^{-2}	1.22×10^{-2}	1.15×10^{-2}	1.04×10^{-2}	1.08×10^{-2}	1.68×10^{-2}
Tc-99(3)	6.2×10^{-6}	9.7×10^{-6}	5.02×10^{-6}	5.15×10^{-6}	8.14×10^{-6}	5.56×10^{-6}	5.1×10^{-6}	8.14×10^{-6}	8.69×10^{-6}
Hf-181(3)	6.29×10^{-1}	7.3×10^{-1}	5.4×10^{-1}	5.61×10^{-1}	7.94×10^{-1}	5.81×10^{-1}	5.61×10^{-1}	7.42×10^{-1}	8.94×10^{-1}

(1) All values taken from Reference I.15 unless otherwise noted.
(2) Values calculated from procedures defined in Reference I.15.
(3) Values taken from Reference I.16.

The dose rate conversion factors for immersion in air are presented in Table I-8. These factors are based on the information presented in References I.7 and I.15. The data presented in Table I-8 represent the dose rate in rem per hour to a particular organ if the individual were immersed in air containing 1 curie of a particular radionuclide per cubic meter of air.

TABLE I-8. AIR IMMERSION DOSE RATE CONVERSION FACTORS(1)
Rem/hr per Ci/m^3

Nuclide	Total Body	Bone	Liver	Kidney	Gonads	Lung	GI Tract	Thyroid	Skin
C-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.51×10^{1}
S-35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.73×10^{1}
Sc-46	1.58×10^{3}	1.74×10^{3}	1.32×10^{3}	1.47×10^{3}	1.43×10^{3}	1.47×10^{3}	1.43×10^{3}	1.18×10^{3}	2.17×10^{3}
Cr-51	26.6	40.2	20.3	19.3	34.7	23.5	19.3	25.5	37.0
Mn-54	6.56×10^{2}	7.19×10^{2}	5.5×10^{2}	6.14×10^{2}	5.92×10^{2}	6.14×10^{2}	5.92×10^{2}	4.86×10^{2}	8.52×10^{2}
Fe-55	8.32×10^{-2}	1.24×10^{-2}	7.18×10^{-5}	9.83×10^{-6}	6.05×10^{-2}	6.8×10^{-3}	1.7×10^{-2}	3.45×10^{-3}	5.8
Co-58	7.73×10^{2}	8.63×10^{2}	6.47×10^{2}	7.16×10^{2}	7.24×10^{2}	7.25×10^{2}	6.83×10^{2}	6.15×10^{2}	1.02×10^{3}
Fe-59	1.02×10^{3}	1.09×10^{3}	8.55×10^{2}	8.3×10^{2}	8.41×10^{2}	9.63×10^{2}	9.82×10^{2}	8.94×10^{2}	1.35×10^{3}
Ni-59(3)	1.58×10^{-2}	2.03×10^{-3}	1.54×10^{-5}	1.89×10^{-6}	1.15×10^{-2}	1.25×10^{-3}	6.5×10^{-4}	7.89×10^{-4}	2.64×10^{-1}
Co-60	2.16×10^{3}	2.31×10^{3}	1.81×10^{3}	1.74×10^{3}	1.76×10^{3}	2.04×10^{3}	2.1×10^{3}	1.92×10^{3}	2.64×10^{3}
Ni-63(3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mo-93(2)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Nb-94(2)	7.2×10^{2}	7.2×10^{2}	7.2×10^{2}	7.2×10^{2}	7.2×10^{2}	7.2×10^{2}	7.2×10^{2}	7.2×10^{2}	1.84×10^{3}
Zr-95	5.84×10^{2}	6.73×10^{2}	4.89×10^{2}	5.34×10^{2}	5.82×10^{2}	5.48×10^{2}	5.32×10^{2}	5.15×10^{2}	8.71×10^{2}
Tc-99(3)	2.67×10^{-4}	4.16×10^{-4}	2.15×10^{-4}	2.2×10^{-4}	3.5×10^{-4}	2.38×10^{-4}	2.19×10^{-4}	3.49×10^{-4}	3.73×10^{-4}
Hf-181(3)	2.86×10^{2}	3.32×10^{-2}	2.46×10^{-2}	2.56×10^{2}	3.62×10^{2}	2.66×10^{2}	2.56×10^{2}	3.38×10^{2}	4.08×10^{2}

(1) All values taken from Reference I.7 unless noted otherwise.
(2) Values calculated from procedures defined in Reference I.15.
(3) Values taken from Reference I.16.

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APPENDIX J

DOSE COMMITMENT ESTIMATES, SEA DISPOSAL

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APPENDIX J

DOSE COMMITMENT ESTIMATES, SEA DISPOSAL

I. INTRODUCTION

This appendix presents estimates of potential radiation dose commitments to man if defueled nuclear submarines were disposed of on the ocean floor. These estimates have been calculated using the techniques described in Appendices F, G, H, and I, and the values of the parameters presented in those appendices. The dose commitments presented in this appendix represent conservative estimates of the dose commitments that could occur, and it is expected that actual human exposures would be less than those presented.

As explained in Appendix G, the radionuclides remaining in defueled nuclear submarines that might result in dose commitments to man would be contained either in the structural components of the reactor compartment or in corrosion products which form an adherent film on the inside of the components and piping of the primary coolant system. Nearly 100 percent of the radioactivity would be embedded in the structural components of the reactor compartment and reactor vessel. This radioactivity was formed by neutron activation of the metal atoms in the structural components during normal submarine operations. Approximately 0.1 percent of the total radioactivity would be present in the form of an adherent corrosion film formed during normal submarine operations on the inside surfaces of the reactor coolant system.

Radioactive material from defueled nuclear submarines could enter the environment and reach man only after several independent events occur. First, corrosion of the structural materials containing the radionuclides would have to occur which would release the corrosion product particles to the inside of the reactor vessel. Corrosion would then have to penetrate the reactor vessel to allow the corrosion products to enter the reactor compartment volume. After corrosion penetrated the reactor compartment, the corrosion products inside could then be released to the ocean environment. These corrosion product particles could then be transported from the disposal site to locations where they could enter the paths which lead to man. At every point through these steps, radioactive decay, settling, and other processes would reduce the amount of radioactive material in the ocean, thereby reducing the amount available to man. The corrosion, release, transport, and movement to man processes are described in detail in Appendices F, G, H, and I respectively.

Dose commitment estimates are presented in this appendix for the three general categories of exposure pathways described in Section III of Appendix I. These pathways are ingestion, inhalation, and external exposure. The assumed ingestion pathways include consumption of fish, crustacea, molluscs, seaweed, plankton, desalinated seawater, and salt from seawater. The inhalation pathway has been assumed to include breathing radionuclides released from the seawater and from shore sediments which might pick up radionuclides from the seawater. The assumed external pathways include immersion in the seawater, exposure to equipment which had been immersed in the seawater, exposure to shore sediments, and immersion in air which is being breathed.

The radionuclide concentrations available for entering the exposure pathways will vary depending on when the submarines' containment boundaries are penetrated and how corrosion processes release the radionuclides. The maximum calculated radionuclide concentrations for any time after disposal were chosen for determining the dose commitments that critical (maximum exposed) groups of people could receive via the exposure pathways. As a result, the dose commitment estimates presented in this appendix are conservative since the maximum concentrations of particular radionuclides were used in solving the dose commitment equations, and these maximum concentrations were assumed to occur along the entire shoreline, even though the concentrations of particular radionuclides would reach their maximum values at different times, and these maximum concentrations could not occur along the entire shoreline.

In this statement, a dose commitment is the total radiation dose (measured in rems) to an individual which occurs over a period of time as a result of exposure to radioactive material present in the environment for a specified period of time. As stated in Appendix I, the dose commitment estimates for the external exposure pathways represent the dose rate in millirem (mrem) per year that an individual could receive after being exposed to the maximum concentrations of the radionuclides. The dose commitment estimates for the ingestion and inhalation pathways represent the dose in mrem that an individual could receive in 70 years after being exposed to the maximum concentrations of the radionuclides for one year. If it can be assumed that the radionuclide concentrations would remain at their maximum levels over the 70 year period, the individual would maintain the same consumption rates and occupancy factors, and the effect and retention of the radionuclides would not change for the individual over the 70 year period, then the dose commitments for the ingestion and inhalation pathways could also represent the dose that an individual could receive during the 70th year after being exposed to the maximum concentrations of the radionuclides for 70 years. As a result, the dose commitment estimates presented in this appendix are in terms of an annual exposure rate which allows for comparisons to be made with radiation exposure standards and natural background radiation since these exposures are usually cited on the basis of an annual exposure rate. Dose commitment estimates were determined for particular organs of the body which were assumed to include the total body, bone, liver, kidney, gonads, lung, gastrointestinal (GI) tract, thyroid, and skin and for each exposure pathway and each radionuclide that could be released from a defueled nuclear submarine.

A dose commitment to an individual is dependent on the age of an individual when the exposure occurs. In this statement, the dose commitment estimates presented are for an adult individual. Total body dose commitment estimates were determined for adults, teens, children, and infants and the results indicated that the dose commitment estimates were all within a factor of two. On this basis, the dose commitment estimates for adults were judged to be representative of the population and were chosen to be reported in this appendix.

Dose commitment estimates are presented for an individual with average consumption rates or occupancy factors and for an individual assumed to be exposed at higher than average consumption rates or occupancy factors. In this statement, an average individual has been assumed to be an individual who could consume certain foods or occupy certain areas at rates which would be typical for a member of the population living on the west coast of the United States. Dose commitment estimates were determined for an individual living on the west coast because this yields a larger estimate of the dose commitments since a disposal site which might satisfy site selection criteria would be closer to the shoreline for a disposal site in the Pacific Ocean, and less stirring and dilution would be expected for a disposal site in the Pacific Ocean than would be expected for the Atlantic Ocean. A discussion concerning site selection criteria and a description of the ocean study areas is presented in Appendix E. A maximum individual has been assumed to be an individual who could consume certain foods or occupy certain areas at unusually high rates for a member of the population living on the west coast of the United States. The consumption rates and occupancy factors used for determining the dose commitment estimates for an average individual and a maximum exposed individual are presented in Section V.B of Appendix I. For both an average individual and a maximum individual, the maximum radionuclide concentrations which were calculated for any time after disposal operations were initiated were used in calculating the dose commitment estimates.

In order to put the dose commitment estimates presented in this appendix into perspective, they will be compared to exposure estimates from natural background radiation. An average adult individual in the United States receives between approximately 30 and 150 mrem of total body exposure annually from natural sources of radioactivity (Reference J.1). This average exposure does not include the exposure that could result from medical diagnostic procedures, primarily x-rays, which on the average, could add approximately 100 mrem to this exposure. In this statement, an average annual exposure of 100 mrem from natural background radiation will be used for comparison purposes.

The total body dose commitment estimate for ingesting fish which are exposed to naturally-occurring Radium-226 in seawater was also calculated for comparison purposes. This dose commitment estimate was calculated using the same calculational procedures used to obtain the dose commitment estimates presented in this appendix. The concentration of naturally-occurring Radium-226 in seawater is approximately 9×10^{-11} curies per cubic meter (Reference J.2). The concentration factor used for Radium-226 was 1×10^{2} curies per kilogram per curies per liter (Reference J.3) and the total body dose commitment conversion factor used was 3.1×10^7 rem per curie (Reference J.4). The resulting total body dose commitment estimate for an average adult individual is approximately 2 mrem for Radium-226. For a maximum adult individual who could consume fish at a higher rate, the total body dose commitment estimate is approximately 20 mrem.

The dose commitment estimates presented in this appendix are divided into five sections.

1. The dose commitment estimates for the disposal of 100 submarines under expected disposal conditions in which containment is maintained for all 100 submarines.

2. The dose commitment estimates for a postulated accident in which one submarine has its containment penetrated at a disposal site location.

3. The dose commitment estimates for a postulated accident during transit in which one submarine sinks with its containment penetrated at a distance from shore where commercial fishing operations could occur.

4. The dose commitment estimates for the consumption of fish which were postulated to live at the disposal site. Since no biological pathway which links organisms in the deep ocean directly to man is known, these dose commitment estimates were included in case such a pathway is identified in the future.

5. The dose commitment estimates for expected disposal conditions in which containment is maintained for 100 submarines; for a postulated accident in which one submarine has its containment penetrated at the disposal site; and for a postulated accident in which one submarine sinks during transit to the disposal site at a location where commercial fishing operations could occur and also has its containment penetrated. The estimates in this section are based on the same disposal scenarios presented in the first three sections except that the values of the parameters used in calculating the release and transport of radionuclides to man were chosen to be extremely conservative whereas the estimates in the first three sections were calculated using expected values for these parameters. For a detailed discussion on the parameters used and their expected and conservative values, see Sections II and III of Appendix G for the release parameters and Section IV.C of Appendix H for the transport parameters.

Additionally, an example of the calculations performed to obtain the dose commitment estimates presented in this appendix has been included.

The dose commitment estimates presented in this appendix were calculated using the equations presented in Section IV of Appendix I. The maximum radionuclide concentrations calculated for any time after disposal operations begin were used in solving these equations and are tabulated in Section V of Appendix H. The exposure pathways for which the dose commitment estimates were made are described in Section III of Appendix I, and the parameters used in solving the dose commitment equations are listed in Section V of Appendix I.

II. SUMMARY

Estimates of the dose commitments that might occur as a result of defueled nuclear submarines being disposed of on the ocean floor are presented in this appendix. Dose commitment estimates have been calculated using the maximum radionuclide concentrations which were calculated at any time after disposal operations were initiated. Dose commitment estimates have been calculated for average and maximum individuals in the critical (maximum exposed) population group and are presented for the following disposal scenarios: expected disposal conditions in which containment is maintained for 100 submarines, a postulated accident in which one submarine has its containment penetrated at the disposal site, and a postulated accident in which one submarine sinks during transit to the disposal site at a location where commercial fishing operations could occur and also has its containment penetrated. Dose commitment estimates are also presented for a postulated condition in which a hypothetical maximum individual ingests fish which were assumed to be living at the disposal site in close proximity to a submarine disposed under expected conditions. Additionally, dose commitment estimates for average and maximum individuals are presented for the disposal of 100 submarines under expected disposal conditions, for a postulated accident in which one submarine has its containment penetrated at the disposal site, and for a postulated accident in which one submarine sinks during transit to the disposal site at a location where commercial fishing operations could occur and also has its containment penetrated; for this series of estimates, the parameters used in calculating the release and transport of radionuclides to man were chosen to be extremely conservative.

Estimates of the total body and maximum exposed organ dose commitments that might occur as a result of the disposal scenarios identified are listed in Table J-1. The data included in this table represent both the best estimate of the dose commitments for expected and postulated accident disposal conditions, and the dose commitments for expected and postulated accident disposal conditions in which the parameters used in calculating the release and transport of radionuclides to man were chosen to be extremely conservative.

All of the total body dose commitment estimates for each of the disposal scenarios are significantly less than the average annual 100 mrem exposure from natural background radiation. Also, the total body exposures are less than the estimated 2 mrem for an average individual or 20 mrem for a maximum individual total body exposures from ingesting fish containing naturally-occurring Radium-226. All of the total body dose commitment estimates are also significantly less than the U.S. Nuclear Regulatory Commission (NRC) requirement that prevents an individual from receiving a total body exposure of more than 500 mrem per year (Reference J.5). Additionally, the dose commitment estimates are less than the U.S. Environmental Protection Agency (EPA) drinking water requirement that prevents an individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6).

Maximum dose commitment estimates were also calculated for a hypothetical biological pathway in which a maximum individual ingests fish which were assumed to be living at the disposal site in close proximity to a submarine disposed under expected disposal conditions. Two methods were postulated for the radionuclides released to become available for the fish. The first method assumed that the released radionuclides were present in the ocean water close to the disposed submarine with no deposition of the radionuclides in the sediment. The resulting total body dose commitment is approximately 0.2 mrem per year, and the maximum organ dose commitment is approximately 5 mrem per year to the bone. The second method assumed that the radionuclides were released to the ocean waters but then settled to the ocean floor and deposited in the sediment close to the disposed submarines. The resulting total body dose commitment is approximately 2 mrem per year, and the maximum organ dose commitment is approximately 17 mrem per year to the bone. Very conservative assumptions were used, and these dose commitment estimates were calculated only to determine the upper limit of the dose commitments associated with biological transport of radionuclides and are not considered to be a likely result of sea disposal of defueled nuclear submarines.

The dose commitment estimates presented in this appendix were calculated using the maximum radionuclide concentrations which were calculated at any time after disposal operations were initiated. As a result, the dose commitment estimates presented are conservative since these maximum concentrations were used in the calculations and these maximum concentrations were assumed to occur along the entire shoreline, even though the concentrations of particular radionuclides would reach their maximum values at different times, and these maximum concentrations could not occur along the entire shoreline. It is expected that actual human exposures would be less than those presented.

III. DOSE COMMITMENT ESTIMATES

Dose commitment estimates for average and maximum individuals in the critical (maximum exposed) population group are presented in this section for the following disposal scenarios: expected disposal conditions in which containment is maintained for 100 submarines, a postulated accident in which one submarine has its containment penetrated at the disposal site, and a postulated accident in which one submarine sinks with its containment penetrated during transit to the disposal site at a location where commercial fishing operations could occur. Dose commitment estimates are also presented for a postulated condition in which a hypothetical maximum individual ingests fish which were assumed to be living at the disposal site in close proximity to a submarine emplaced under expected disposal conditions. Additionally, dose commitment estimates are presented for expected disposal conditions in which containment is maintained for 100 submarines, a postulated accident in which a submarine has its containment penetrated at the disposal site, and a postulated accident in which one submarine sinks with its containment penetrated during

TABLE J-1. TOTAL BODY AND MAXIMUM ORGAN DOSE COMMITMENTS FOR VARIOUS DISPOSAL SCENARIOS

mrem

Disposal Scenario	Total Body		Maximum Organ	
	Best[(1)] Estimate	Conservative[(2)] Estimate	Best[(1)] Estimate	Conservative[(2)] Estimate
Expected Conditions, Average Adult, 100 Submarines	6×10^{-12}	2×10^{-4}	2×10^{-10} (Bone)	6×10^{-3} (Bone)
Expected Conditions, Maximum Adult, 100 Submarines	1×10^{-10}	3×10^{-3}	3×10^{-9} (Bone)	1×10^{-1} (Bone)
Postulated Site Accident, Average Adult, 1 Submarine	1×10^{-9}	3×10^{-3}	1×10^{-9} (Skin)	3×10^{-3} (Skin)
Postulated Site Accident, Maximum Adult, 1 Submarine	2×10^{-8}	6×10^{-2}	3×10^{-8} (Skin)	7×10^{-2} (Skin)
Postulated Transport Accident, Average Adult, 1 Submarine	5×10^{-2}	1×10^{-1}	5×10^{-2} (Skin)	2×10^{-1} (Skin)
Postulated Transport Accident, Maximum Adult, 1 Submarine	9×10^{-1}	3	1 (Skin)	3 (Skin)

(1) Best estimate dose commitments were calculated using conservative assumptions (for discussion, see Section IV of Appendix I).

(2) Conservative dose commitments were calculated the same as best estimate dose commitments, except the parameters used in calculating the release and transport of radionuclides to man were chosen to be extremely conservative (for discussion, see Sections II and III of Appendix G and Section IV.C of Appendix H).

transit to a disposal site at a location where commercial fishing operations could occur; for this series of estimates, the parameters used in calculating the release and transport of radionuclides to man were chosen to be extremely conservative.

The dose commitment estimates presented in this section have been separated into total body dose commitments and maximum organ dose commitments. The total body dose commitments represent estimates of the dose commitments to the total body that might occur for an individual exposed at each radionuclide-pathway combination. The maximum organ dose commitments represent estimates of the maximum dose commitments that might occur for a particular organ, including the total body as an organ, for an individual exposed at each radionuclide-pathway combination.

Unless otherwise noted, the total body and maximum organ dose commitment estimates presented in this section include all radionuclide-pathway combinations which resulted in a dose commitment within approximately 0.01 percent of the largest total body or maximum organ dose commitment estimate for a particular disposal scenario. Dose commitments below this level would not affect the sum of the dose commitment estimates and were not included.

A. EXPECTED DISPOSAL CONDITIONS

It is expected that the submarines would settle to the bottom of the ocean at a disposal site such that the containment afforded by the submarine hull, bulkheads, and reactor vessel would remain intact. Once the submarines were on the ocean floor, they would be subjected to corrosion processes, and the thinnest port of the reactor compartment bulkheads would not be penetrated before approximately 100 years after disp al. It has been assumed that the radionuclides which might be released by corrosion of the struct components in the reactor compartment and the radionuclides present in the corrosion products in primary coolant system would be immediately available for release as soon as corrosion first penetrates reactor compartment.

The locations at which the radionuclides could enter the exposure pathways, except the fish ingestion pathway, have been assumed to be on the shoreline parallel to the north-south ocean current at a minimum distance of 300 kilometers to the east of a hypothetical disposal site in the Pacific Ocean. The Pacific Ocean was selected for use in this analysis not because it is any more likely to be selected for a disposal location, but because it represents a location closer to shore and with slower currents, and therefore with less dilution than the Atlantic Ocean; therefore, this yields a larger estimate of the dose commitments. The location at which the radionuclides could enter the fish ingestion pathway has been assumed to be 50 kilometers off the coast at a depth of 2000 meters since this is approximately the location and maximum depth where commercial fishing operations could occur. The 2000 meter depth is used in the dose commitment calculations because even though the amount of fish that could be caught in the deep water would be expected to be much less, the radionuclide concentrations would be higher in the deeper water; therefore, this yields a larger estimate of the dose commitments.

1. Average Individual

Estimates of the total body and maximum organ dose commitments that might be received by a member of the population with average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with the disposal of 100 submarines under expected disposal conditions are presented in Tables J-2 and J-3, respectively. The dose commitment estimates for all radionuclide-pathway combinations have been presented in each of these two tables. As shown in Table J-2, the sum of the total body dose commitments would be approximately 6×10^{-12} mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-3, the largest sum of the maximum organ dose commitments for a particular organ would be approximately 2×10^{-10} mrem per year to the bone for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the total body and maximum organ dose commitment estimates would result from Nickel-63 through the fish ingestion pathway. The 6×10^{-12} mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the 2 mrem exposures estimated using the same calculational techniques for an average individual ingesting fish containing naturally-occurring Radium-226. The 6×10^{-12} mrem total body and 2×10^{-10} mrem to the bone maximum organ dose commitment estimates are less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6). The 6×10^{-12} mrem total body exposure to the most exposed average individual would yield a possible population exposure of less than 2×10^{-7} man-rem to the entire population of the three west coast states of the United States, assumed to be 30 million people. This population dose commitment would be less than the background radiation exposure received by one of the 30 million people living in the west coast states.

2. Maximum Individual

As stated in Section V.B of Appendix I, a maximum individual cannot be exposed at all of the maximum consumption rates or occupancy factors associated with all of the exposure pathways. No one individual could be expected to consume all of the items at the maximum ingestion rates, spend all of his time on the beach, or perform all of the functions required by the maximum individual for each pathway. As a result, the total body dose commitment estimates or the maximum organ dose commitment estimates for a particular organ should not be summed over all of the pathways if a realistic dose commitment estimate is desired. Therefore, in this statement, the largest dose commitment estimate for a single pathway will be used to define the dose commitment estimate for a maximum individual. This procedure has been used in this statement for all dose commitment estimates associated with a maximum individual.

TABLE J-2. TOTAL BODY DOSE COMMITMENTS—ADULT AVERAGE INDIVIDUAL EXPECTED CONDITIONS—100 SUBMARINES

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments	Total
C-14	9.1×10^{-14}	1.2×10^{-14}	1.1×10^{-14}	5.7×10^{-17}	4.3×10^{-17}	2.4×10^{-20}	1.1×10^{-19}	1.8×10^{-23}	0.0	0.0	0.0	0.0	1.1×10^{-13}
S-35	2.9×10^{-26}	4.8×10^{-27}	3.5×10^{-27}	2.3×10^{-28}	2.3×10^{-28}	3.8×10^{-28}	1.7×10^{-27}	2.8×10^{-31}	0.0	0.0	0.0	0.0	4.0×10^{-26}
Sc-46	2.6×10^{-26}	1.7×10^{-27}	3.1×10^{-27}	5.4×10^{-28}	5.4×10^{-28}	4.5×10^{-32}	2.0×10^{-31}	4.5×10^{-29}	8.0×10^{-29}	8.0×10^{-30}	2.8×10^{-30}	1.1×10^{-21}	1.1×10^{-21}
Cr-51	1.3×10^{-27}	1.1×10^{-27}	7.7×10^{-28}	3.0×10^{-27}	3.0×10^{-27}	1.7×10^{-31}	7.5×10^{-31}	8.4×10^{-31}	4.4×10^{-30}	4.4×10^{-31}	1.5×10^{-31}	8.8×10^{-23}	8.8×10^{-23}
Mn-54	3.7×10^{-19}	1.2×10^{-18}	8.8×10^{-19}	5.7×10^{-20}	5.7×10^{-21}	9.5×10^{-24}	4.3×10^{-23}	2.8×10^{-24}	2.5×10^{-23}	2.5×10^{-24}	8.6×10^{-25}	3.5×10^{-16}	3.5×10^{-16}
Fe-55	7.8×10^{-17}	1.3×10^{-17}	9.3×10^{-18}	6.0×10^{-18}	6.0×10^{-18}	1.0×10^{-21}	4.5×10^{-21}	2.1×10^{-22}	6.5×10^{-25}	6.5×10^{-26}	2.3×10^{-25}	1.3×10^{-16}	2.4×10^{-16}
Co-58	3.1×10^{-22}	5.1×10^{-22}	3.7×10^{-22}	2.4×10^{-23}	2.4×10^{-23}	4.0×10^{-26}	1.8×10^{-25}	7.1×10^{-27}	6.4×10^{-26}	6.4×10^{-27}	2.2×10^{-27}	9.0×10^{-19}	9.0×10^{-19}
Fe-59	5.5×10^{-22}	9.1×10^{-23}	6.6×10^{-23}	4.3×10^{-23}	4.3×10^{-23}	7.1×10^{-27}	3.2×10^{-26}	3.6×10^{-27}	6.5×10^{-27}	6.5×10^{-28}	2.2×10^{-28}	8.3×10^{-20}	8.4×10^{-20}
Ni-59	3.5×10^{-13}	1.2×10^{-14}	8.4×10^{-15}	2.7×10^{-15}	5.4×10^{-15}	9.0×10^{-18}	4.1×10^{-17}	1.2×10^{-18}	3.6×10^{-20}	3.6×10^{-21}	1.1×10^{-23}	5.2×10^{-14}	4.3×10^{-13}
Co-60	2.6×10^{-17}	4.3×10^{-17}	3.1×10^{-17}	2.0×10^{-18}	2.0×10^{-18}	3.4×10^{-21}	1.5×10^{-20}	5.9×10^{-22}	5.3×10^{-21}	5.3×10^{-22}	1.9×10^{-22}	6.8×10^{-14}	6.8×10^{-14}
Ni-63	5.2×10^{-12}	1.7×10^{-13}	1.2×10^{-13}	4.0×10^{-14}	8.0×10^{-14}	1.3×10^{-16}	6.0×10^{-16}	1.8×10^{-17}	0.0	0.0	0.0	0.0	5.6×10^{-12}
Mo-93	3.4×10^{-19}	5.7×10^{-20}	2.5×10^{-18}	6.9×10^{-20}	6.9×10^{-20}	4.4×10^{-22}	2.0×10^{-21}	6.9×10^{-24}	9.7×10^{-21}	9.7×10^{-22}	5.7×10^{-24}	6.5×10^{-15}	6.5×10^{-15}
Nb-94	4.8×10^{-20}	7.9×10^{-19}	5.7×10^{-18}	1.8×10^{-19}	3.8×10^{-19}	6.2×10^{-22}	2.9×10^{-21}	4.9×10^{-21}	1.1×10^{-19}	1.1×10^{-20}	3.5×10^{-22}	2.6×10^{-13}	2.6×10^{-13}
Zr-95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tc-99	2.5×10^{-20}	4.1×10^{-19}	3.0×10^{-19}	1.9×10^{-18}	1.9×10^{-20}	3.2×10^{-23}	1.5×10^{-22}	3.2×10^{-24}	6.7×10^{-25}	6.7×10^{-26}	2.1×10^{-29}	1.1×10^{-20}	2.7×10^{-18}
Hf-181	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	5.6×10^{-12}	1.9×10^{-13}	1.4×10^{-13}	4.3×10^{-14}	8.5×10^{-14}	1.4×10^{-16}	6.4×10^{-16}	1.9×10^{-17}	1.6×10^{-19}	1.6×10^{-20}	5.6×10^{-22}	3.9×10^{-13}	6.5×10^{-12}

TABLE J-3. MAXIMUM ORGAN DOSE COMMITMENTS—ADULT AVERAGE INDIVIDUAL EXPECTED CONDITIONS—100 SUBMARINES

mrem

Nuclide	Fish	Crustacea	Molluscs	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	4.6×10^{-13} Bone	6.0×10^{-14} Bone	5.5×10^{-14} Bone	2.8×10^{-16} Bone	2.1×10^{-16} Bone	1.2×10^{-19} Bone	5.3×10^{-19} Bone	9.4×10^{-23} Bone	4.0×10^{-21} Skin	4.0×10^{-22} Skin	2.8×10^{-24} Skin	0.0
S-35	1.2×10^{-25} Gonad	1.9×10^{-26} Gonad	1.4×10^{-26} Gonad	8.9×10^{-28} Gonad	8.9×10^{-28} Gonad	1.5×10^{-27} Gonad	6.7×10^{-27} Gonad	3.8×10^{-30} Lung	1.4×10^{-29} Skin	1.4×10^{-30} Skin	1.0×10^{-32} Skin	0.0
Sc-46	4.4×10^{-22} GI	2.9×10^{-23} GI	5.3×10^{-23} GI	9.1×10^{-24} GI	9.1×10^{-24} GI	7.6×10^{-28} GI	3.4×10^{-27} GI	4.2×10^{-28} Lung	1.1×10^{-28} Skin	1.1×10^{-29} Skin	3.8×10^{-30} Skin	1.4×10^{-20} Skin
Cr-51	3.6×10^{-25} GI	3.0×10^{-25} GI	2.2×10^{-25} GI	8.4×10^{-25} GI	8.4×10^{-25} GI	4.7×10^{-29} GI	2.1×10^{-28} GI	1.4×10^{-29} Lung	6.7×10^{-30} Bone	6.7×10^{-31} Bone	2.3×10^{-31} Bone	1.3×10^{-22} Bone
Mn-54	8.2×10^{-18} GI	2.7×10^{-17} GI	2.0×10^{-17} GI	1.3×10^{-18} GI	1.3×10^{-19} GI	2.1×10^{-22} GI	9.6×10^{-22} GI	2.0×10^{-22} Lung	3.2×10^{-23} Skin	3.2×10^{-24} Skin	1.1×10^{-24} Skin	4.5×10^{-16} Skin
Fe-55	4.8×10^{-16} Bone	7.9×10^{-17} Bone	5.8×10^{-17} Bone	3.7×10^{-17} Bone	3.7×10^{-17} Bone	6.2×10^{-21} Bone	2.8×10^{-20} Lung	2.0×10^{-21} Skin	2.9×10^{-23}	2.9×10^{-24} Skin	1.6×10^{-24} Skin	2.4×10^{-15} Skin
Co-58	5.7×10^{-21} GI	9.4×10^{-21} GI	6.8×10^{-21} GI	4.4×10^{-22} GI	4.4×10^{-22} GI	7.4×10^{-25} GI	3.3×10^{-24} GI	1.7×10^{-24} Lung	8.4×10^{-26} Skin	8.4×10^{-27} Skin	2.9×10^{-27} Skin	1.2×10^{-18} Skin
Fe-59	7.3×10^{-21} GI	1.2×10^{-21} GI	8.7×10^{-22} GI	5.7×10^{-22} GI	5.7×10^{-22} GI	9.4×10^{-26} GI	4.2×10^{-25} GI	6.2×10^{-26} Lung	8.0×10^{-27} Skin	8.0×10^{-28} Skin	3.0×10^{-28} Skin	9.9×10^{-20} Skin
Ni-59	2.1×10^{-12} Bone	6.9×10^{-14} Bone	5.0×10^{-14} Bone	1.6×10^{-14} Bone	3.2×10^{-14} Bone	5.4×10^{-17} Bone	2.4×10^{-16} Bone	7.2×10^{-18} Bone	6.0×10^{-19} Skin	6.0×10^{-20} Skin	1.8×10^{-22} Skin	8.7×10^{-13} Skin
Co-60	4.4×10^{-16} GI	7.3×10^{-16} GI	5.3×10^{-16} GI	3.4×10^{-17} GI	3.4×10^{-17} GI	5.7×10^{-20} GI	2.6×10^{-19} GI	3.8×10^{-19} Lung	6.4×10^{-21} Skin	6.4×10^{-22} Skin	2.3×10^{-22} Skin	8.0×10^{-14} Skin
Ni-63	1.6×10^{-10} Bone	5.3×10^{-12} Bone	3.8×10^{-12} Bone	1.2×10^{-12} Bone	2.5×10^{-12} Bone	4.1×10^{-15} Bone	1.9×10^{-14} Bone	5.5×10^{-16} Bone	0.0	0.0	0.0	0.0
Mo-93	1.3×10^{-17} Liver	2.1×10^{-18} Liver	9.1×10^{-17} Liver	2.6×10^{-18} Liver	2.6×10^{-18} Liver	1.6×10^{-20} Liver	7.4×10^{-20} Liver	1.1×10^{-20} Lung	9.7×10^{-21} Total Body	9.7×10^{-22} Total Body	5.6×10^{-24} Total Body	6.5×10^{-15} Total Body
Nb-94	6.0×10^{-18} GI	9.9×10^{-17} GI	7.2×10^{-16} GI	2.3×10^{-17} GI	4.7×10^{-17} GI	7.8×10^{-20} GI	3.5×10^{-19} GI	3.4×10^{-19} Lung	1.1×10^{-19} Total Body	1.1×10^{-20} Total Body	9.0×10^{-22} Skin	2.6×10^{-13} Total Body
Zr-95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tc-99	4.9×10^{-18} GI	8.1×10^{-17} GI	5.9×10^{-17} GI	3.8×10^{-16} GI	3.8×10^{-18} GI	6.4×10^{-21} GI	2.9×10^{-20} GI	6.8×10^{-21} Lung	1.8×10^{-26} Bone	1.8×10^{-27} Bone	5.6×10^{-31} Bone	4.6×10^{-22} Bone
Hf-181	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Estimates of the total body and maximum organ dose commitments that might be received by a member of the population with higher than average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with the disposal of 100 submarines under expected disposal conditions are presented in Tables J-4 and J-5, respectively. As shown in Table J-4, the largest sum of the total body dose commitments for a particular pathway would be approximately 1×10^{-10} mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-5, the largest sum of the maximum organ dose commitments for a particular pathway and organ would be approximately 3×10^{-9} mrem per year to the bone for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the largest total body and maximum organ dose commitment estimates for a particular pathway would result from Nickel-63 through the seaweed ingestion pathway. The 1×10^{-10} mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the 20 mrem exposures estimated for a maximum individual ingesting fish containing naturally-occurring Radium-226. The 1×10^{-10} mrem total body and 3×10^{-9} mrem to the bone maximum organ dose commitment estimates are less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6).

B. ACCIDENT AT DISPOSAL SITE

Estimates of the total body and maximum organ dose commitments for individuals having average and maximum consumption rates and occupancy factors are presented in this section for a postulated accident which might result in one submarine coming to rest on the ocean floor at a selected disposal site with containment penetrated. This condition is assumed to be the result of a mishap during disposal operations at a designated disposal location. Therefore, the radionuclides present in the corrosion products which would normally be contained in the primary coolant system are assumed to be immediately available for release and the metal containing the radionuclides embedded in the structural components in the reactor compartment are assumed to be immediately subjected to corrosion processes in open water. Only one submarine has been considered because a full loss of containment is not a credible accident, and if containment were penetrated during a disposal operation, disposal operations would not continue until appropriate measures were taken to ensure that such an event could not occur again.

As for the case with expected disposal conditions, the locations at which the radionuclides could enter the exposure pathways, except the fish ingestion pathway, have been assumed to be on the shoreline parallel to the north-south ocean current at a minimum distance of 300 kilometers to the east of a hypothetical disposal site in the Pacific Ocean. The location at which the radionuclides could enter the fish ingestion pathway has been assumed to be 50 kilometers off the coast at a maximum depth of 2000 meters since this is approximately the location and depth of where commercial fishing operations could occur.

1. Average Individual

Estimates of the total body and maximum organ dose commitments that might be received by a member of the population with average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with a postulated condition in which one submarine has its containment penetrated during disposal operations are presented in Tables J-6 and J-7, respectively. As shown in Table J-6, the sum of the total body dose commitments would be approximately 1×10^{-9} mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-7, the largest sum of the maximum organ dose commitments for a particular organ would be approximately 1×10^{-9} mrem per year to the skin for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the total body and maximum organ dose commitment estimates would result from Cobalt-60 through the shore sediments pathway. The 1×10^{-9} mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the estimated 2 mrem exposures for an average individual ingesting fish containing naturally-occurring Radium-226. The 1×10^{-9} mrem total body and 1×10^{-9} mrem to the skin maximum organ dose commitment estimates are significantly less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5)

TABLE J-4. TOTAL BODY DOSE COMMITMENTS—ADULT MAXIMUM INDIVIDUAL EXPECTED CONDITIONS—100 SUBMARINES*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	1.1×10^{-12}	3.2×10^{-13}	3.2×10^{-13}	1.4×10^{-13}	2.2×10^{-14}	2.4×10^{-20}	1.1×10^{-17}	1.8×10^{-23}	0.0	0.0	0.0	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	--	--	--	--	--	--	--	--
Fe-55	9.0×10^{-16}	3.4×10^{-16}	2.7×10^{-16}	1.5×10^{-14}	3.2×10^{-15}	1.0×10^{-21}	4.5×10^{-19}	2.1×10^{-22}	1.6×10^{-23}	1.6×10^{-24}	2.3×10^{-26}	2.6×10^{-15}
Co-58	--	--	--	--	--	--	--	--	--	--	--	--
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	4.0×10^{-12}	3.0×10^{-13}	2.4×10^{-13}	6.8×10^{-12}	2.8×10^{-12}	9.0×10^{-18}	4.1×10^{-15}	1.2×10^{-18}	6.8×10^{-19}	6.8×10^{-19}	1.1×10^{-23}	1.1×10^{-12}
Co-60	3.0×10^{-16}	1.1×10^{-15}	9.2×10^{-16}	5.1×10^{-15}	1.1×10^{-15}	3.4×10^{-21}	1.5×10^{-18}	5.9×10^{-22}	1.3×10^{-19}	1.3×10^{-20}	1.9×10^{-22}	1.4×10^{-12}
Ni-63	6.0×10^{-11}	4.5×10^{-12}	3.6×10^{-12}	1.0×10^{-10}	4.2×10^{-11}	1.3×10^{-16}	6.0×10^{-14}	1.8×10^{-17}	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	5.6×10^{-19}	2.1×10^{-17}	1.7×10^{-16}	4.7×10^{-16}	2.0×10^{-16}	6.2×10^{-22}	2.9×10^{-22}	4.9×10^{-21}	2.9×10^{-17}	2.9×10^{-18}	3.5×10^{-22}	5.2×10^{-12}
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--
Total	6.5×10^{-11}	5.1×10^{-12}	4.2×10^{-12}	1.1×10^{-10}	4.5×10^{-11}	1.4×10^{-16}	6.4×10^{-14}	1.9×10^{-17}	3.0×10^{-17}	3.0×10^{-18}	5.5×10^{-22}	7.7×10^{-12}

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-5. MAXIMUM ORGAN DOSE COMMITMENTS—ADULT MAXIMUM INDIVIDUAL EXPECTED CONDITIONS—100 SUBMARINES*

Nuclide	Fish	Crustacea	Molluscs	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	5.3×10^{-12} Bone	1.6×10^{-12} Bone	1.6×10^{-12} Bone	7.1×10^{-13} Bone	1.1×10^{-13} Bone	1.2×10^{-19} Bone	5.3×10^{-17} Bone	9.4×10^{-23} Bone	9.9×10^{-20} Skin	9.9×10^{-21} Skin	2.8×10^{-24} Skin	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	--	--	--	--	--	--	--	--
Fe-55	--	--	--	--	--	--	--	--	--	--	--	--
Co-58	--	--	--	--	--	--	--	--	--	--	--	--
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	2.4×10^{-11} Bone	1.8×10^{-12} Bone	1.5×10^{-12} Bone	4.1×10^{-11} Bone	1.7×10^{-11} Bone	5.4×10^{-17} Bone	2.4×10^{-14} Bone	7.2×10^{-17} Bone	1.5×10^{-17} Skin	1.5×10^{-18} Skin	1.8×10^{-22} Skin	1.7×10^{-11} Skin
Co-60	5.1×10^{-15} GI	1.9×10^{-14} GI	1.5×10^{-14} GI	8.6×10^{-14} GI	1.8×10^{-14} GI	5.7×10^{-20} GI	2.6×10^{-17} GI	3.8×10^{-19} Lung	1.6×10^{-19} Skin	1.6×10^{-20} Skin	2.3×10^{-22} Skin	1.6×10^{-12} Skin
Ni-63	1.9×10^{-9} Bone	1.4×10^{-10} Bone	1.1×10^{-10} Bone	3.1×10^{-9} Bone	1.3×10^{-9} Bone	4.1×10^{-15} Bone	1.9×10^{-12} Bone	5.5×10^{-16} Bone	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	7.0×10^{-17} GI	2.6×10^{-15} GI	2.1×10^{-14} GI	5.9×10^{-14} GI	2.5×10^{-14} GI	7.8×10^{-20} GI	3.5×10^{-17} GI	3.4×10^{-19} Lung	2.9×10^{-17} Total Body	2.9×10^{-18} Total Body	9.0×10^{-22} Skin	5.2×10^{-12} Total Body
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	5.7×10^{-17} GI	2.1×10^{-15} GI	1.7×10^{-15} GI	9.6×10^{-13} GI	2.0×10^{-15} GI	6.4×10^{-21} GI	2.9×10^{-18} GI	6.8×10^{-21} Lung	2.6×10^{-23} Bone	2.6×10^{-24} Bone	3.3×10^{-29} Bone	3.5×10^{-19} Bone
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest maximum organ dose commitment estimate.

TABLE J-6. TOTAL BODY DOSE COMMITMENTS—ADULT AVERAGE INDIVIDUAL SITE ACCIDENT—ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments	Total
C-14	--	--	--	--	--	--	--	--	--	--	--	--	--
S-35	--	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	$9\,6 \times 10^{-15}$	$3\,2 \times 10^{-14}$	$2\,3 \times 10^{-14}$	$1\,5 \times 10^{-15}$	$1\,5 \times 10^{-16}$	$2\,5 \times 10^{-19}$	$1\,1 \times 10^{-18}$	$7\,4 \times 10^{-20}$	$6\,5 \times 10^{-19}$	$6\,5 \times 10^{-20}$	$2\,2 \times 10^{-20}$	$9\,0 \times 10^{-12}$	$9\,1 \times 10^{-12}$
Fe-55	$5\,0 \times 10^{-13}$	$8\,2 \times 10^{-14}$	$6\,0 \times 10^{-14}$	$3\,9 \times 10^{-14}$	$3\,9 \times 10^{-14}$	$6\,5 \times 10^{-18}$	$2\,9 \times 10^{-17}$	$1\,4 \times 10^{-18}$	$4\,2 \times 10^{-21}$	$4\,2 \times 10^{-22}$	$1\,5 \times 10^{-22}$	$8\,4 \times 10^{-13}$	$1\,6 \times 10^{-12}$
Co-58	2.8×10^{-16}	$4\,7 \times 10^{-16}$	$3\,4 \times 10^{-16}$	$2\,2 \times 10^{-17}$	$2\,2 \times 10^{-17}$	$3\,7 \times 10^{-20}$	$1\,6 \times 10^{-19}$	$6\,5 \times 10^{-21}$	$5\,8 \times 10^{-20}$	$5\,8 \times 10^{-21}$	$2\,0 \times 10^{-21}$	$8\,2 \times 10^{-13}$	$8\,2 \times 10^{-13}$
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	--	--	--	--	--	--	--	--	--	--	--	--	--
Co-60	$4\,3 \times 10^{-13}$	$7\,0 \times 10^{-13}$	$5\,1 \times 10^{-13}$	$3\,3 \times 10^{-14}$	$3\,3 \times 10^{-14}$	$5\,5 \times 10^{-17}$	$2\,5 \times 10^{-16}$	$9\,6 \times 10^{-18}$	$8\,7 \times 10^{-17}$	$8\,7 \times 10^{-18}$	$3\,0 \times 10^{-18}$	$1\,1 \times 10^{-9}$	$1\,1 \times 10^{-9}$
Ni-63	$7\,1 \times 10^{-13}$	$2\,3 \times 10^{-14}$	$1\,7 \times 10^{-14}$	$5\,5 \times 10^{-15}$	$1\,1 \times 10^{-14}$	$1\,8 \times 10^{-17}$	$8\,3 \times 10^{-17}$	$2\,4 \times 10^{-18}$	0 0	0 0	0 0	0 0	$7\,7 \times 10^{-13}$
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	$1\,6 \times 10^{-12}$	$8\,4 \times 10^{-13}$	$6\,1 \times 10^{-13}$	$7\,9 \times 10^{-14}$	$8\,3 \times 10^{-14}$	$8\,0 \times 10^{-17}$	$3\,6 \times 10^{-16}$	$1\,3 \times 10^{-17}$	$8\,8 \times 10^{-17}$	$8\,8 \times 10^{-18}$	$3\,0 \times 10^{-18}$	$1\,1 \times 10^{-9}$	$1\,1 \times 10^{-9}$

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-7. MAXIMUM ORGAN DOSE COMMITMENTS—ADULT AVERAGE INDIVIDUAL SITE ACCIDENT—ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C 14	--	--	--	--	--	--	--	--	--	--	--	--
S 35	--	--	--	--	--	--	--	--	--	--	--	--
Sc 46	--	--	--	--	--	--	--	--	--	--	--	--
Cr 51	--	--	--	--	--	--	--	--	--	--	--	--
Mn 54	2.1×10^{-13} GI	7.0×10^{-13} GI	5.1×10^{-13} GI	3.3×10^{-14} GI	3.3×10^{-15} GI	5.5×10^{-18} GI	2.5×10^{-17} GI	5.2×10^{-18} Lung	8.4×10^{-19} Skin	8.4×10^{-20} Skin	2.9×10^{-20} Skin	1.2×10^{-11} Skin
Fe 55	3.1×10^{-12} Bone	5.1×10^{-13} Bone	3.7×10^{-13} Bone	2.4×10^{-13} Bone	2.4×10^{-13} Bone	4.0×10^{-17} Bone	1.8×10^{-16} Bone	1.3×10^{-17} Lung	1.9×10^{-19} Skin	1.9×10^{-20} Skin	1.0×10^{-20} Skin	1.6×10^{-11} Skin
Co 58	5.2×10^{-15} GI	8.5×10^{-15} GI	6.2×10^{-15} GI	4.0×10^{-16} GI	4.0×10^{-16} GI	6.7×10^{-19} GI	3.0×10^{-18} GI	1.6×10^{-18} Lung	7.6×10^{-20} Skin	7.6×10^{-21} Skin	2.7×10^{-21} Skin	1.0×10^{-12} Skin
Fe 59	--	--	--	--	--	--	--	--	--	--	--	--
Ni 59	--	--	--	--	--	--	--	--	--	--	--	--
Co 60	7.1×10^{-20} GI	1.2×10^{-11} GI	8.7×10^{-12} GI	5.6×10^{-13} GI	5.6×10^{-13} GI	9.4×10^{-16} GI	4.2×10^{-15} GI	6.2×10^{-15} Lung	1.0×10^{-16} Skin	1.0×10^{-17} Skin	3.7×10^{-18} Skin	1.3×10^{-9} Skin
Ni 63	2.2×10^{-11} Bone	7.3×10^{-13} Bone	5.3×10^{-13} Bone	1.7×10^{-13} Bone	3.4×10^{-13} Bone	5.7×10^{-16} Bone	2.6×10^{-15} Bone	7.6×10^{-17} Bone	0.0	0.0	0.0	0.0
Mo 93	--	--	--	--	--	--	--	--	--	--	--	--
Nb 94	--	--	--	--	--	--	--	--	--	--	--	--
Zr 95	--	--	--	--	--	--	--	--	--	--	--	--
Tc 99	--	--	--	--	--	--	--	--	--	--	--	--
Hf 181	--	--	--	--	--	--	--	--	--	--	--	--

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest maximum organ dose commitment estimate.

and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6). The 1×10^{-9} mrem total body exposure to the most exposed average individual would yield a possible population exposure of less than 3×10^{-5} man-rem to the entire population of the three west coast states of the United States, assumed to be 30 million people. This population dose commitment would be less than the background radiation exposure received by one of the 30 million people living in the west coast states.

2. Maximum Individual

Estimates of the total body and maximum organ dose commitments that might be received by a member of the population with higher than average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with a postulated condition in which one submarine has its containment penetrated during disposal operations are presented in Tables J-8 and J-9, respectively. As shown in Table J-8, the largest sum of the total body dose commitments for a particular pathway would be approximately 2×10^{-8} mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-9, the largest sum of the maximum organ dose commitments for a particular pathway and organ would be approximately 3×10^{-8} mrem per year to the skin for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the largest total body and maximum organ dose commitment estimates for a particular pathway would result from Cobalt-60 through the shore sediments pathway. The 2×10^{-8} mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the estimated 20 mrem exposures for a maximum individual ingesting fish containing naturally-occurring Radium-226. The 2×10^{-8} mrem total body and 3×10^{-8} mrem to the skin maximum organ dose commitment estimates are less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6).

C. ACCIDENT DURING TRANSIT TO DISPOSAL SITE

Estimates of the total body and maximum organ dose commitments for individuals having average and maximum consumption rates and occupancy factors are presented in this section for a postulated accident during transit which might result in a submarine sinking with its containment completely penetrated at a location where commercial fishing operations could occur. The radionuclides present in the corrosion products contained in the primary coolant system are assumed to be immediately available for release, and the radionuclides embedded in the structural components in the reactor compartment are assumed to be immediately subjected to corrosion processes in open water. Only one submarine has been considered because a full loss of containment is not a credible accident, and if an accidental sinking occurred, disposal operations would not continue until appropriate measures were taken to ensure that such an accident could not occur again. Also, based on the information presented in Reference J.7, only 3.6 accidents per million kilometers of barge traffic would be expected to occur; therefore, an accidental sinking would be highly improbable.

It was postulated that the submarine might accidentally sink at an area 25 kilometers away from the shoreline where commercial fishing operations could occur. This location was chosen because it represents a location closest to the shoreline at a sufficient depth where recovery of the submarine might not be feasible. Therefore, this location yields a maximum radionuclide concentration. As a result, the locations at which the radionuclides could enter the exposure pathways, except the fish ingestion pathway, have been assumed to be on the shoreline parallel to the north-south ocean current at a distance of 25 kilometers to the east of the postulated accident in the Pacific Ocean. The radionuclides have been assumed to be able to enter the fish ingestion pathway at the site of the postulated sinking.

TABLE J-8. TOTAL BODY DOSE COMMITMENTS – ADULT MAXIMUM INDIVIDUAL SITE ACCIDENT – ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Molluscs	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	--	--	--	--	--	--	--	--	--	--	--	--
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	1.1×10^{-13}	8.3×10^{-13}	6.7×10^{-13}	3.7×10^{-12}	7.8×10^{-14}	2.5×10^{-19}	1.1×10^{-16}	7.4×10^{-20}	1.6×10^{-17}	1.6×10^{-18}	2.2×10^{-20}	1.8×10^{-10}
Fe-55	5.8×10^{-12}	2.2×10^{-12}	1.7×10^{-12}	9.7×10^{-11}	2.0×10^{-11}	6.5×10^{-18}	2.9×10^{-15}	1.4×10^{-18}	1.0×10^{-19}	1.0×10^{-20}	1.5×10^{-22}	1.7×10^{-11}
Co-58	3.3×10^{-15}	1.2×10^{-14}	9.9×10^{-15}	5.5×10^{-14}	1.1×10^{-14}	3.7×10^{-20}	1.6×10^{-17}	6.5×10^{-21}	1.5×10^{-18}	1.5×10^{-19}	2.0×10^{-21}	1.6×10^{-11}
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	--	--	--	--	--	--	--	--	--	--	--	--
Co-60	4.9×10^{-12}	1.8×10^{-11}	1.5×10^{-11}	8.3×10^{-11}	1.7×10^{-11}	5.5×10^{-17}	2.5×10^{-14}	9.6×10^{-18}	2.2×10^{-15}	2.2×10^{-16}	3.0×10^{-18}	2.2×10^{-8}
Ni-63	8.3×10^{-12}	6.2×10^{-13}	5.0×10^{-13}	1.4×10^{-11}	5.8×10^{-12}	1.8×10^{-17}	8.3×10^{-15}	2.4×10^{-18}	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	1.4×10^{-20}	5.2×10^{-19}	4.2×10^{-18}	1.2×10^{-17}	4.8×10^{-17}	1.5×10^{-23}	6.9×10^{-21}	3.7×10^{-20}	1.2×10^{-19}	1.2×10^{-20}	1.6×10^{-22}	1.3×10^{-12}
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--
Total	1.9×10^{-11}	2.2×10^{-11}	1.8×10^{-11}	2.0×10^{-10}	4.3×10^{-11}	8.0×10^{-17}	3.6×10^{-14}	1.4×10^{-17}	2.2×10^{-15}	2.2×10^{-16}	3.0×10^{-18}	2.2×10^{-8}

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-9. MAXIMUM ORGAN DOSE COMMITMENTS—ADULT MAXIMUM INDIVIDUAL SITE ACCIDENT—ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	--	--	--	--	--	--	--	--	--	--	--	--
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	2.5×10^{-12} GI	1.8×10^{-11} GI	1.5×10^{-11} GI	8.3×10^{-11} GI	1.7×10^{-12} GI	5.5×10^{-18} GI	2.5×10^{-15} GI	5.2×10^{-18} Lung	2.1×10^{-17} Skin	2.1×10^{-18} Skin	2.9×10^{-20} Skin	2.3×10^{-10} Skin
Fe-55	3.6×10^{-11} Bone	1.3×10^{-11} Bone	1.1×10^{-11} Bone	6.0×10^{-10} Bone	1.3×10^{-10} Bone	4.0×10^{-17} Bone	1.8×10^{-14} Bone	1.3×10^{-17} Lung	4.6×10^{-18} Skin	4.6×10^{-19} Skin	1.0×10^{-20} Skin	3.1×10^{-10} Skin
Co-58	6.0×10^{-14} GI	2.2×10^{-13} GI	1.8×10^{-13} GI	1.0×10^{-12} GI	2.1×10^{-13} GI	6.7×10^{-19} GI	3.0×10^{-16} GI	1.6×10^{-18} Lung	1.9×10^{-18} Skin	1.9×10^{-19} Skin	2.7×10^{-21} Skin	2.1×10^{-11} Skin
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	--	--	--	--	--	--	--	--	--	--	--	--
Co-60	8.4×10^{-11} GI	3.1×10^{-10} GI	2.5×10^{-10} GI	1.4×10^{-9} GI	2.9×10^{-10} GI	9.4×10^{-16} GI	4.2×10^{-13} GI	6.2×10^{-15} Lung	2.6×10^{-15} Skin	2.6×10^{-16} Skin	3.7×10^{-18} Skin	2.6×10^{-8} Skin
Ni-63	2.6×10^{-10} Bone	1.9×10^{-11} Bone	1.5×10^{-11} Bone	4.3×10^{-10} Bone	1.8×10^{-10} Bone	5.7×10^{-16} Bone	2.6×10^{-13} Bone	7.6×10^{-17} Bone	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	6.5×10^{-17} GI	2.4×10^{-15} GI	1.9×10^{-14} GI	5.4×10^{-14} GI	2.3×10^{-13} GI	7.2×10^{-20} GI	3.2×10^{-17} GI	4.6×10^{-20} Lung	1.6×10^{-19} Skin	1.6×10^{-20} Skin	2.4×10^{-22} Skin	1.6×10^{-12} Skin
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--

1. Average Individual

Estimates of the total body and maximum organ dose commitments that might be received by a member of the population with average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with a postulated condition in which one submarine sinks during transit with its containment penetrated at a location where commercial fishing operations could occur are presented in Tables J-10 and J-11, respectively. As shown in Table J-10, the sum of the total body dose commitments would be approximately 0.05 mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-11, the largest sum of the maximum organ dose commitments for a particular organ would be approximately 0.05 mrem per year to the skin for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the total body and maximum organ dose commitment estimates would result from Cobalt-60 through the shore sediments pathway. The 0.05 mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the estimated 2 mrem exposures for an average individual ingesting fish containing naturally-occurring Radium-226. The 0.05 mrem total body and 0.05 mrem to the skin maximum organ dose commitment estimates are significantly less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6). The 0.05 mrem total body exposure to the most exposed average individual would yield a possible population dose of less than 2 man-rem to the affected population of the three west coast states of the United States, assumed to be 30 thousand people. The potentially affected population was assumed to be 30 thousand people rather than the entire population of the three west coast states because this hypothetical event was postulated to occur only 25 kilometers from the shoreline. This nearness to the shoreline would mean that only a limited area and the corresponding limited number of people might be affected.

2. Maximum Individual

Estimates of the total body and maximum organ dose commitments that might be received by a member of the population with higher than average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with a postulated condition in which one submarine sinks during transit with its containment penetrated at a location where commercial fishing operations could occur are presented in Tables J-12 and J-13, respectively. As shown in Table J-12, the largest sum of the total body dose commitments for a particular pathway would be approximately 0.9 mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-13, the largest sum of the maximum organ dose commitments for a particular pathway and organ would be approximately 1 mrem per year to the skin for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the largest total body and maximum organ dose commitment estimates for a particular pathway would result from Cobalt-60 through the shore sediments pathway. The 0.9 mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the estimated 20 mrem exposures for a maximum individual ingesting fish containing naturally-occurring Radium-226. The 0.9 mrem total body and 1 mrem to the skin, maximum organ dose commitment estimates are less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6).

D. HYPOTHETICAL MAXIMUM DOSE COMMITMENTS FOR BIOLOGICAL TRANSPORT

All of the dose commitment estimates presented previously in this appendix have been based on physical transport mechanisms which might move radionuclides from either a disposal site or accident location to pathway entry points and therefore affect the critical population group. This approach is based on the information presented in Appendix A of Reference J.8 which shows that the rate at which physical processes could transport radioactivity from the bottom waters of the deep ocean to the surface is much more important than that for biological processes. The application of the method presented in Reference J.8 indicates that the effect of physical transport in carrying radioactivity from the bottom waters to the surface is at least two orders of magnitude greater than the effects of biological transport.

TABLE J-10. TOTAL BODY DOSE COMMITMENTS—ADULT AVERAGE INDIVIDUAL TRANSPORTATION ACCIDENT—ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments	Total
C-14	--	--	--	--	--	--	--	--	--	--	--	--	--
S-35	--	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	4.5×10^{-9}	9.0×10^{-11}	6.6×10^{-11}	2.6×10^{-10}	2.6×10^{-11}	1.4×10^{-14}	6.4×10^{-14}	7.1×10^{-14}	3.8×10^{-13}	3.8×10^{-14}	1.3×10^{-14}	7.4×10^{-6}	7.4×10^{-6}
Mn-54	2.7×10^{-5}	2.6×10^{-6}	1.9×10^{-6}	1.2×10^{-7}	1.2×10^{-8}	2.0×10^{-11}	9.2×10^{-11}	6.0×10^{-12}	5.3×10^{-11}	5.3×10^{-12}	1.8×10^{-12}	7.4×10^{-4}	7.7×10^{-4}
Fe-55	7.5×10^{-4}	3.7×10^{-6}	2.7×10^{-6}	1.7×10^{-6}	1.7×10^{-6}	2.9×10^{-10}	1.3×10^{-9}	6.1×10^{-11}	1.9×10^{-13}	1.9×10^{-14}	6.5×10^{-15}	3.7×10^{-5}	8.0×10^{-4}
Co-58	1.7×10^{-5}	7.6×10^{-7}	5.5×10^{-7}	3.6×10^{-8}	3.6×10^{-8}	6.0×10^{-11}	2.7×10^{-10}	1.1×10^{-11}	9.5×10^{-11}	9.5×10^{-12}	3.3×10^{-12}	1.3×10^{-3}	1.3×10^{-3}
Fe-59	5.1×10^{-15}	2.2×10^{-7}	1.6×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.7×10^{-11}	7.8×10^{-11}	8.7×10^{-12}	1.6×10^{-11}	1.6×10^{-12}	5.5×10^{-13}	2.0×10^{-4}	2.5×10^{-4}
Ni-59	1.7×10^{-6}	1.7×10^{-9}	1.2×10^{-9}	3.9×10^{-10}	7.9×10^{-10}	1.3×10^{-12}	5.9×10^{-12}	1.7×10^{-13}	5.3×10^{-15}	5.3×10^{-16}	1.5×10^{-18}	7.6×10^{-9}	1.7×10^{-6}
Co-60	5.1×10^{-4}	2.5×10^{-5}	1.8×10^{-5}	1.2×10^{-6}	1.2×10^{-6}	2.0×10^{-9}	9.0×10^{-9}	3.5×10^{-10}	3.2×10^{-9}	3.2×10^{-10}	1.1×10^{-10}	4.1×10^{-2}	4.2×10^{-2}
Ni-63	7.5×10^{-4}	7.3×10^{-7}	5.3×10^{-7}	1.7×10^{-7}	3.4×10^{-7}	5.7×10^{-10}	2.6×10^{-9}	7.5×10^{-11}	0.0	0.0	0.0	0.0	7.5×10^{-4}
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	7.5×10^{-11}	3.4×10^{-11}	2.5×10^{-10}	8.1×10^{-12}	1.6×10^{-10}	2.7×10^{-14}	1.2×10^{-13}	6.5×10^{-12}	8.3×10^{-12}	8.3×10^{-13}	2.9×10^{-13}	1.1×10^{-4}	1.1×10^{-4}
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	2.1×10^{-3}	3.3×10^{-5}	2.4×10^{-5}	3.3×10^{-7}	3.4×10^{-6}	3.0×10^{-9}	1.3×10^{-8}	5.2×10^{-10}	3.8×10^{-9}	3.8×10^{-10}	1.2×10^{-10}	4.3×10^{-2}	4.6×10^{-2}

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-11. MAXIMUM ORGAN DOSE COMMITMENTS—ADULT AVERAGE INDIVIDUAL TRANSPORTATION ACCIDENT—ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	2.6×10^{-6} Bone	1.0×10^{-8} Bone	9.1×10^{-9} Bone	4.7×10^{-11} Bone	3.5×10^{-11} Bone	2.0×10^{-14} Bone	8.9×10^{-14} Bone	1.6×10^{-17} Bone	6.6×10^{-16} Skin	6.6×10^{-17} Skin	4.6×10^{-19} Skin	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	1.5×10^{-6} GI	2.9×10^{-9} GI	5.3×10^{-9} GI	9.1×10^{-10} GI	9.1×10^{-10} GI	7.6×10^{-14} GI	3.4×10^{-13} GI	4.2×10^{-14} Lung	1.1×10^{-14} Skin	1.1×10^{-15} Skin	3.8×10^{-16} Skin	1.4×10^{-7} Skin
Cr-51	1.3×10^{-6} GI	2.5×10^{-8} GI	1.8×10^{-8} GI	7.1×10^{-8} GI	7.1×10^{-9} GI	4.0×10^{-12} GI	1.8×10^{-11} GI	1.2×10^{-12} Lung	5.7×10^{-13} Bone	5.7×10^{-14} Bone	2.0×10^{-14} Bone	1.1×10^{-5} Bone
Mn-54	6.0×10^{-4} GI	5.8×10^{-5} GI	4.2×10^{-5} GI	2.7×10^{-6} GI	2.7×10^{-7} GI	4.5×10^{-10} GI	2.0×10^{-9} GI	4.2×10^{-10} Lung	6.9×10^{-11} Skin	6.9×10^{-12} Skin	2.4×10^{-12} Skin	9.5×10^{-4} Skin
Fe-55	4.7×10^{-3} Bone	2.3×10^{-5} Bone	1.7×10^{-5} Bone	1.1×10^{-5} Bone	1.1×10^{-5} Bone	1.8×10^{-9} Bone	8.0×10^{-9} Bone	5.9×10^{-10} Lung	8.2×10^{-12} Skin	8.2×10^{-13} Skin	4.5×10^{-13} Skin	7.0×10^{-4} Skin
Co-58	3.1×10^{-4} GI	1.4×10^{-5} GI	1.0×10^{-5} GI	6.6×10^{-7} GI	6.6×10^{-7} GI	1.1×10^{-9} GI	4.9×10^{-9} GI	2.6×10^{-9} Lung	1.2×10^{-10} Skin	1.2×10^{-11} Skin	4.4×10^{-12} Skin	1.7×10^{-3} Skin
Fe-59	6.7×10^{-4} GI	2.9×10^{-6} GI	2.1×10^{-6} GI	1.4×10^{-6} GI	1.4×10^{-6} GI	2.3×10^{-10} GI	1.0×10^{-9} GI	1.5×10^{-10} Lung	2.0×10^{-11} Skin	2.0×10^{-12} Skin	7.2×10^{-13} Skin	2.4×10^{-4} Skin
Ni-59	9.9×10^{-6} Bone	1.0×10^{-8} Bone	7.2×10^{-9} Bone	2.4×10^{-9} Bone	4.7×10^{-9} Bone	7.8×10^{-12} Bone	3.5×10^{-11} Bone	1.0×10^{-12} Bone	8.7×10^{-14} Skin	8.7×10^{-15} Skin	2.5×10^{-17} Skin	1.2×10^{-7} Skin
Co-60	8.6×10^{-3} GI	4.3×10^{-4} GI	3.1×10^{-4} GI	2.0×10^{-5} GI	2.0×10^{-5} GI	3.4×10^{-8} GI	1.5×10^{-7} GI	2.2×10^{-7} Lung	3.8×10^{-9} Skin	3.8×10^{-10} Skin	1.3×10^{-10} Skin	4.8×10^{-2} Skin
Ni-63	2.3×10^{-2} Bone	2.3×10^{-5} Bone	1.6×10^{-5} Bone	5.3×10^{-6} Bone	1.1×10^{-5} Bone	1.8×10^{-8} Bone	8.0×10^{-8} Bone	2.4×10^{-9} Bone	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	3.5×10^{-7} GI	1.6×10^{-7} GI	1.2×10^{-6} GI	3.8×10^{-8} GI	7.6×10^{-7} GI	1.3×10^{-10} GI	5.7×10^{-10} GI	8.1×10^{-11} Lung	1.1×10^{-11} Skin	1.1×10^{-12} Skin	4.3×10^{-13} Skin	1.4×10^{-4} Skin
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	5.8×10^{-3} GI	2.0×10^{-5} GI	1.8×10^{-5} GI	6.9×10^{-7} GI	2.3×10^{-7} GI	3.8×10^{-11} GI	1.7×10^{-10} GI	1.2×10^{-11} Lung	2.0×10^{-10} Skin	2.0×10^{-11} Skin	6.6×10^{-14} Skin	3.3×10^{-5} Skin

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest maximum organ dose commitment estimate.

TABLE J-12. TOTAL BODY DOSE COMMITMENTS—ADULT MAXIMUM INDIVIDUAL TRANSPORTATION ACCIDENT—ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	--	--	--	--	--	--	--	--	--	--	--	--
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	5.2×10^{-8}	2.4×10^{-9}	1.9×10^{-9}	6.4×10^{-7}	1.3×10^{-8}	1.4×10^{-14}	6.4×10^{-12}	7.1×10^{-14}	9.4×10^{-12}	9.4×10^{-13}	1.3×10^{-14}	1.5×10^{-4}
Mn-54	3.1×10^{-4}	6.8×10^{-5}	5.5×10^{-5}	3.1×10^{-4}	6.4×10^{-6}	2.0×10^{-11}	9.2×10^{-9}	6.0×10^{-12}	1.3×10^{-9}	1.3×10^{-10}	1.8×10^{-12}	1.5×10^{-2}
Fe-55	8.7×10^{-3}	9.6×10^{-5}	7.8×10^{-5}	4.3×10^{-3}	9.0×10^{-4}	2.9×10^{-10}	1.3×10^{-7}	6.1×10^{-11}	4.6×10^{-12}	4.6×10^{-13}	6.5×10^{-15}	7.5×10^{-4}
Co-58	2.0×10^{-4}	2.0×10^{-5}	1.6×10^{-5}	9.0×10^{-5}	1.9×10^{-5}	6.0×10^{-11}	2.7×10^{-8}	1.1×10^{-11}	2.4×10^{-9}	2.4×10^{-10}	3.3×10^{-12}	2.7×10^{-2}
Fe-59	5.9×10^{-4}	5.8×10^{-6}	4.7×10^{-6}	2.6×10^{-4}	5.5×10^{-5}	1.7×10^{-11}	7.8×10^{-9}	8.7×10^{-12}	3.9×10^{-10}	3.9×10^{-11}	5.5×10^{-13}	4.1×10^{-3}
Ni-59	1.9×10^{-5}	4.4×10^{-8}	3.5×10^{-8}	9.8×10^{-7}	4.1×10^{-7}	1.3×10^{-12}	5.9×10^{-10}	1.7×10^{-13}	1.1×10^{-13}	1.1×10^{-14}	1.5×10^{-18}	1.5×10^{-7}
Co-60	5.9×10^{-3}	6.7×10^{-4}	5.4×10^{-4}	3.0×10^{-3}	6.3×10^{-4}	2.0×10^{-9}	9.0×10^{-7}	3.5×10^{-10}	7.9×10^{-8}	7.9×10^{-9}	1.1×10^{-10}	8.1×10^{-1}
Ni-63	8.7×10^{-3}	1.9×10^{-5}	1.5×10^{-5}	4.3×10^{-4}	1.8×10^{-4}	5.7×10^{-10}	2.6×10^{-7}	7.5×10^{-11}	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	8.6×10^{-10}	9.0×10^{-10}	7.3×10^{-9}	2.0×10^{-8}	8.5×10^{-8}	2.7×10^{-14}	1.2×10^{-11}	6.5×10^{-12}	2.1×10^{-10}	2.1×10^{-11}	2.9×10^{-13}	2.3×10^{-3}
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--
Total	2.4×10^{-2}	8.8×10^{-4}	7.1×10^{-4}	8.4×10^{-3}	1.8×10^{-3}	3.0×10^{-9}	1.3×10^{-6}	5.2×10^{-10}	8.3×10^{-8}	8.3×10^{-9}	1.2×10^{-10}	8.6×10^{-1}

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-13. MAXIMUM ORGAN DOSE COMMITMENTS – ADULT MAXIMUM INDIVIDUAL TRANSPORTATION ACCIDENT – ONE SUBMARINE*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	3.0×10^{-5} Bone	2.6×10^{-7} Bone	2.7×10^{-7} Bone	1.2×10^{-7} Bone	1.9×10^{-8} Bone	2.0×10^{-14} Bone	8.9×10^{-12} Bone	1.6×10^{-17} Bone	1.7×10^{-14} Skin	1.7×10^{-15} Skin	4.6×10^{-19} Skin	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	1.8×10^{-5} GI	7.6×10^{-8} GI	1.5×10^{-7} GI	2.3×10^{-6} GI	4.8×10^{-7} GI	7.6×10^{-14} GI	3.4×10^{-11} GI	4.2×10^{-14} Lung	2.6×10^{-13} Skin	2.6×10^{-14} Skin	3.8×10^{-16} Skin	2.7×10^{-6} Skin
Cr-51	1.5×10^{-5} GI	6.6×10^{-7} GI	5.4×10^{-7} GI	1.8×10^{-4} GI	3.7×10^{-6} GI	4.0×10^{-12} GI	1.8×10^{-9} GI	1.2×10^{-12} Lung	1.4×10^{-11} Bone	1.4×10^{-12} Bone	2.0×10^{-14} Bone	2.2×10^{-4} Bone
Mn-54	7.0×10^{-3} GI	1.5×10^{-3} GI	1.2×10^{-3} GI	6.8×10^{-3} GI	1.4×10^{-4} GI	4.5×10^{-10} GI	2.0×10^{-7} GI	4.2×10^{-10} Lung	1.7×10^{-9} Skin	1.7×10^{-10} Skin	2.4×10^{-12} Skin	1.9×10^{-2} Skin
Fe-55	5.4×10^{-2} Bone	6.0×10^{-4} Bone	4.8×10^{-4} Bone	2.7×10^{-2} Bone	5.6×10^{-3} Bone	1.8×10^{-9} Bone	8.0×10^{-7} Bone	5.9×10^{-10} Lung	2.1×10^{-10} Skin	2.1×10^{-11} Skin	4.5×10^{-13} Skin	1.4×10^{-2} Skin
Co-58	3.6×10^{-3} GI	3.7×10^{-4} GI	3.0×10^{-4} GI	1.6×10^{-3} GI	3.4×10^{-4} GI	1.1×10^{-9} GI	4.9×10^{-7} GI	2.6×10^{-9} Lung	3.1×10^{-9} Skin	3.1×10^{-10} Skin	4.4×10^{-12} Skin	3.4×10^{-2} Skin
Fe-59	7.8×10^{-3} GI	7.7×10^{-5} GI	6.2×10^{-5} GI	3.5×10^{-3} GI	7.2×10^{-4} GI	2.3×10^{-10} GI	1.0×10^{-7} GI	1.5×10^{-10} Lung	4.9×10^{-10} Skin	4.9×10^{-11} Skin	7.2×10^{-13} Skin	4.8×10^{-3} Skin
Ni-59	1.1×10^{-4} Bone	2.6×10^{-7} Bone	2.1×10^{-7} Bone	5.9×10^{-6} Bone	2.5×10^{-6} Bone	7.8×10^{-12} Bone	3.5×10^{-9} Bone	1.0×10^{-12} Bone	2.2×10^{-12} Skin	2.2×10^{-13} Skin	2.5×10^{-17} Skin	2.6×10^{-6} Skin
Co-60	1.0×10^{-1} GI	1.1×10^{-2} GI	9.2×10^{-3} GI	5.1×10^{-2} GI	1.1×10^{-2} GI	3.4×10^{-8} GI	1.5×10^{-5} GI	2.2×10^{-7} Lung	9.5×10^{-8} Skin	9.5×10^{-9} Skin	1.3×10^{-10} Skin	1.0 Skin
Ni-63	2.7×10^{-1} Bone	5.9×10^{-4} Bone	4.8×10^{-4} Bone	1.3×10^{-2} Bone	5.6×10^{-3} Bone	1.8×10^{-8} Bone	8.0×10^{-6} Bone	2.4×10^{-9} Bone	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	--	--	--	--	--	--	--	--	--	--	--	--
Zr-95	4.0×10^{-6} GI	4.2×10^{-6} GI	3.4×10^{-5} GI	9.5×10^{-5} GI	4.0×10^{-4} GI	1.3×10^{-10} GI	5.7×10^{-8} GI	8.1×10^{-11} Lung	2.8×10^{-10} Skin	2.8×10^{-11} Skin	4.3×10^{-13} Skin	2.9×10^{-3} Skin
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	6.7×10^{-2} GI	5.1×10^{-4} GI	5.2×10^{-4} GI	1.7×10^{-3} GI	1.2×10^{-4} GI	3.8×10^{-11} GI	1.7×10^{-8} GI	1.2×10^{-11} Lung	5.1×10^{-9} Skin	5.1×10^{-10} Skin	6.6×10^{-14} Skin	6.9×10^{-4} Skin

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest maximum organ dose commitment estimate.

No biological pathway is known which could link organisms in the deep ocean directly to man; however, it is always possible that such a pathway might be identified in the future. Therefore, dose commitment estimates have been calculated for a hypothetical biological pathway in which radionuclides are postulated to be transported directly to man from the disposal site by biological processes. These hypothetical dose commitment estimates have been calculated only to determine the upper limit of the dose commitments associated with biological transport and are not considered to be a likely result of sea disposal of defueled nuclear submarines. These dose commitment estimates have been calculated using very conservative assumptions, and any other dose commitment estimates associated with biological transport would be expected to be significantly less than the estimates provided here.

The dose commitment estimates for biological transport have been calculated using the very large consumption rates for a maximum individual. The biological process postulated for transporting the radionuclides directly to man from the disposal site has been assumed to be represented by the fish ingestion pathway. Two methods have been postulated for the radionuclides released from a defueled nuclear submarine to become available for the fish. For the first method, it has been assumed that the released radionuclides are present in the ocean water in close proximity to the disposed submarines with no deposition of the radionuclides in the sediment. For the second method, it has been assumed that the radionuclides are released to the ocean waters but then settle to the ocean floor and are deposited in the sediment in close proximity to the disposed submarines. For both of these methods, the radionuclides were assumed to remain close to the submarines so that dilution effects would be minimized and the maximum concentrations of the radionuclides would be available for the fish. Using these assumptions, total body and maximum organ dose commitment estimates have been calculated for a hypothetical fish-eating maximum individual for each of the two methods postulated for released radionuclides to become available for the fish.

1. Radionuclides in Ocean Waters

For this hypothetical biological pathway, it has been assumed that the released radionuclides are present in the ocean water in close proximity to the disposed submarines with no deposition of the radionuclides in the sediment. The maximum radionuclide concentrations which were calculated for any time after the start of disposal operations were assumed to be present in the ocean water. These maximum concentrations are presented in Table H-2 of Appendix H. Also, the fish were assumed to be living near the ocean bottom where these maximum concentrations are postulated to occur. This yields the highest possible radioactivity content in the fish which are ingested by a hypothetical maximum individual.

Table J-14 lists the total body and maximum organ dose commitment estimates for the postulated situation in which an individual eats fish, assumed to be from a proposed disposal site, at a maximum annual consumption rate. Results are tabulated for this individual for all radionuclides which might be released from one submarine under expected disposal conditions. As shown in this table, the sum of the total body dose commitment estimates for this postulated fish ingestion pathway would be approximately 0.2 mrem per year of exposure. The sum of the largest maximum organ dose commitment estimates for a particular organ would be approximately 5 mrem per year to the bone. The largest percentage of the sum of the total body and largest maximum organ dose commitment estimates for a particular organ would be associated with the Nickel-63 radionuclide.

2. Radionuclides in Ocean Sediments

For this hypothetical biological pathway, it has been assumed that the radionuclides are released from defueled nuclear submarines to the ocean waters but then settle to the ocean floor and deposit in the sediment. The radionuclides released were assumed to settle onto the sediment in the immediate vicinity of the disposed submarines within the distance that tidal action during one day might move the particles. This corresponds to an area approximately 560 meters by 140 meters. After taking into account radioactive decay processes, the maximum amount of each radionuclide deposited at any time after disposal operations began were assumed to be present in this small area of sediment. If the maximum amount of a particular radionuclide occurred before 100 years after disposal, the radionuclide was assumed to be uniformly distributed in the sediment to a depth of 1 centimeter. If the maximum amount of a particular radionuclide occurred after 100 years after disposal, the radionuclide was assumed to be uniformly distributed in the sediment to a depth of 10 centimeters.

TABLE J-14. HYPOTHETICAL MAXIMUM DOSE COMMITMENTS FOR BIOLOGICAL TRANSPORT—RADIONUCLIDES IN OCEAN WATERS—ADULT MAXIMUM INDIVIDUAL*

mrem

Nuclide	Total Body Dose Commitment	Maximum Organ Dose Commitment
C-14	1.8×10^{-3}	9.2×10^{-3} (Bone)
S-35	6.0×10^{-13}	2.3×10^{-12} (Gonad)
Sc-46	6.2×10^{-13}	1.0×10^{-8} (GI Tract)
Cr-51	1.2×10^{-11}	3.4×10^{-9} (GI Tract)
Mn-54	3.2×10^{-11}	7.2×10^{-6} (GI Tract)
Fe-55	1.5×10^{-5}	9.1×10^{-5} (Bone)
Co-58	1.5×10^{-8}	2.8×10^{-7} (GI Tract)
Fe-59	2.4×10^{-7}	3.2×10^{-6} (GI Tract)
Ni-59	6.7×10^{-3}	4.0×10^{-2} (Bone)
Co-60	5.7×10^{-6}	9.7×10^{-5} (GI Tract)
Ni-63	1.6×10^{-1}	5.0 (Bone)
Mo-93	1.7×10^{-7}	6.1×10^{-6} (Liver)
Nb-94	9.1×10^{-10}	1.1×10^{-7} (GI Tract)
Zr-95	0.0	0.0
Tc-99	1.2×10^{-8}	2.4×10^{-6} (GI Tract)
Hf-181	0.0	0.0
TOTAL	1.7×10^{-1}	

*The biological pathway was assumed to be associated with the fish ingestion pathway.

All of the radionuclides released from the disposed submarine were assumed to behave in this manner with the exception of Carbon-14. Carbon-14 is expected to be released from the disposed submarines in a soluble form; therefore, it would not be deposited in the sediment. However, it was conservatively assumed that 10 percent of the Carbon-14 would be deposited in the sediment. Table J-15 lists the maximum radionuclide concentrations in the sediment and the year in which this maximum is expected to occur.

Along with the radionuclides deposited in the sediments, stable nuclides of some of the same elements would already be present in the sediments. It was assumed that the radionuclides and stable nuclides in the sediment would have equal availability for uptake by the fish because chemical and biological processes which cause compounds already in the sediment to become biologically available could cause submarine corrosion products to develop similar biological availability. To estimate the radionuclide content of the fish

TABLE J-15. MAXIMUM RADIONUCLIDE CONCENTRATIONS IN OCEAN SEDIMENTS

Nuclide	Maximum Concentration in the Sediment (Ci/m^3)	Approximate Time at Which Maximum Occurs (Years After Disposal)
C-14	7.4×10^{-6}	2500
S-35	5.3×10^{-13}	0.5
Sc-46	5.7×10^{-14}	0.5
Cr-51	3.8×10^{-12}	0.5
Mn-54	5.7×10^{-11}	1.0
Fe-55	6.1×10^{-7}	3.5
Co-58	1.4×10^{-10}	0.5
Fe-59	3.6×10^{-11}	0.5
Ni-59	1.4×10^{-2}	5200
Co-60	1.7×10^{-7}	7.0
Ni-63	3.0×10^{-3}	514
Mo-93	9.1×10^{-7}	2070
Nb-94	8.6×10^{-6}	5200
Zr-95	0.0	0.0
Tc-99	4.5×10^{-7}	5800
Hf-181	0.0	0.0

which were assumed to live close to the disposed submarines, it was assumed that such fish would take up both the radionuclides and stable nuclides in the sediment and replace the same elements present in their bodies with those from the sediments. The concentrations of stable elements in the sediments were based on the information presented in Reference J.9. The elemental composition of fish used in the calculations was based on the information presented in Reference J.10. More recent measurements of the trace metal concentrations in fish (Reference J.11) indicate that the values provided in Reference J.10 may be high by a factor of ten. However for conservatism, the values provided in Reference J.10 were used in the calculations. Additionally, a sediment density of 2.73 grams per cubic centimeter (Reference J.9) was used in the calculations.

Table J-16 lists the total body and maximum organ dose commitment estimates for the postulated situation in which an individual eats fish, assumed to be obtained directly from a postulated disposal site, at a maximum annual consumption rate. Results are tabulated for this individual for all radionuclides which might be released to the ocean waters and then settle to the ocean floor and deposit in the sediments. As shown in this table, the sum of the total body dose commitment estimates for this postulated fish ingestion pathway would be approximately 3 mrem per year. The sum of the largest maximum organ dose commitments for a particular organ would be approximately 17 mrem per year to the bone. The largest percentage of the sum of the total body and largest maximum organ dose commitment estimates for a particular organ would be associated with the Carbon-14 radionuclide.

These hypothetical dose commitment estimates have been calculated only to demonstrate that in the most extreme cases the dose commitments associated with biological transport would not be large. Extremely conservative assumptions were made for each of the two methods postulated for the radionuclides released from disposed submarines to become available for the fish. Any other dose commitment estimates associated with biological transport would be expected to be significantly less than these upper limit estimates. It should be noted that no individual actually catches fish which live at such great depths for a source of food and if these fish were caught, only a small number could live off the energy available in this limited area. For example, for the Tufts Abyssal Plain, which is âbout 3358 to 3655 meters deep, estimates of the mass of benthic fishes present range from 0.197 ± 0.178 grams per square meter to 0.376 ± 0.184 grams per square meter (Reference J.9). If the mass of benthic fishes was taken to be 0.56 grams per square meter, then 44 kilograms of fish would be available in the area assumed in the calculations (560 meters by 140 meters). This is less than the amount of fish assumed to be eaten by the maximum individual (65 kilograms of fish per year) which indicates the conservatism associated with these calculations. However, even under these extreme assumptions, the 0.2 mrem per year total body dose commitment estimate for the radionuclides

TABLE J-16. HYPOTHETICAL MAXIMUM DOSE COMMITMENTS FOR BIOLOGICAL TRANSPORT—RADIONUCLIDES IN OCEAN SEDIMENTS—ADULT MAXIMUM INDIVIDUAL*

mrem

Nuclide	Total Body Dose Commitment	Maximum Organ Dose Commitment
C-14	1.6	8.0 (Bone)
S-35	5.2×10^{-8}	2.0×10^{-7} (Gonad)
Sc-46	6.8×10^{-12}	1.1×10^{-7} (GI Tract)
Cr-51	5.0×10^{-10}	2.1×10^{-12} (GI Tract)
Mn-54	2.6×10^{-11}	5.8×10^{-10} (GI Tract)
Fe-55	1.1×10^{-6}	6.6×10^{-6} (Bone)
Co-58	9.2×10^{-6}	1.7×10^{-4} (GI Tract)
Fe-59	5.6×10^{-10}	7.4×10^{-9} (GI Tract)
Ni-59	4.1×10^{-1}	2.4 (Bone)
Co-60	3.1×10^{-2}	5.3×10^{-1} (GI Tract)
Ni-63	2.2×10^{-1}	6.8 (Bone)
Mo-93	7.5×10^{-2}	2.8 (Liver)
Nb-94	4.9×10^{-1}	6.2×10^{1} (GI Tract)
Zr-95	0.0	0.0
Tc-99	8.5×10^{-3}	1.0 (GI Tract)
Hf-181	0.0	0.0
TOTAL	2.9	

*The biological pathway was assumed to be associated with the fish ingestion pathway.

assumed to be in the ocean water, and the 3 mrem per year total body dose commitment estimate for the radionuclides assumed to be in the sediment are significantly less than the annual 100 mrem total body exposure from natural background radiation. Additionally, these two total body dose commitment estimates are less than the estimated 20 mrem total body exposure for a maximum individual eating fish containing naturally-occurring Radium-226. These two total body dose commitment estimates are also significantly less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5).

E. CONSERVATIVE DOSE COMMITMENT ESTIMATES

The dose commitment estimates presented in Sections III.A through III.C have been based on physical transport mechanisms which were chosen to best represent the transport of radionuclides from a postulated disposal site or accident location to pathway entry points for affecting the critical population group. In this section, dose commitment estimates are presented for various disposal scenarios in which the parameters used in calculating the release and transport of radionuclides to man were chosen to be extremely conservative. For a detailed discussion on the parameters used and their expected and conservative values, see Sections II and III of Appendix G for the release parameters and Section IV.C of Appendix H for the transport parameters.

Total body and maximum organ dose commitment estimates for an average and a maximum individual are presented in this section for expected disposal conditions in which containment is maintained for 100 submarines, a postulated accident in which one submarine has its containment completely penetrated at the disposal site, and a postulated accident in which a submarine sinks during transit to a disposal site where commercial fishing operations could occur and also has its containment completely penetrated. All conditions associated with these disposal scenarios are the same as those discussed in Sections III.A through III.C except that extremely conservative values were used for estimating the release and transport of radionuclides to man.

1. Expected Disposal Conditions—Average Individual

Conservative estimates of the total body and maximum organ dose commitments that might be received by an individual with average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with the disposal of 100 submarines under expected disposal conditions are presented in Tables J-17 and J-18, respectively. As shown in Table J-17, the sum of the total body dose commitments would be approximately 2×10^{-4} mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-18, the largest sum of the maximum organ dose commitments for a particular organ would be approximately 6×10^{-3} mrem per year to the bone for exposure to the maximum concentrations of the radionuclides.

The largest percentage of these conservative total body and maximum organ dose commitment estimates would result from Nickel-63 through the fish ingestion pathway. The 2×10^{-4} mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the estimated 2 mrem exposure for an average individual ingesting fish containing naturally-occurring Radium-226. The 2×10^{-4} mrem total body and 6×10^{-3} mrem to the bone maximum organ dose commitment estimates are less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6). The 2×10^{-4} mrem conservative total body exposure to the most exposed average individual would yield a possible population exposure of 6 man-rem to the entire population of the three west coast states of the United States, assumed to be 30 million people.

2. Expected Disposal Conditions—Maximum Individual

Conservative estimates of the total body and maximum organ dose commitments that might be received by an individual with higher than average consumption rates and occupancy factors exposed to the maximum radionuclide concentrations associated with the disposal of 100 submarines under expected disposal conditions are presented in Tables J-19 and J-20, respectively. As shown in Table J-19, the largest sum of the total body dose commitments for a particular pathway would be approximately 0.003 mrem per year for exposure to the maximum concentrations of the radionuclides. For the data in Table J-20, the sum of the largest maximum organ dose commitments for a particular pathway and organ would be approximately 0.1 mrem per year to the bone for exposure to the maximum concentrations of the radionuclides.

The largest percentage of the largest conservative total body and maximum organ dose commitment estimates for a particular pathway would result from Nickel-63 through the seaweed ingestion pathway. The 0.003 mrem total body dose commitment estimate is significantly less than the annual 100 mrem total body exposure from natural background radiation and the 20 mrem exposures estimated for a maximum individual ingesting fish containing naturally-occurring Radium-226. The 0.003 mrem total body and 0.1 mrem to the bone maximum organ dose commitment estimates are less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and the EPA drinking water requirement that prevents a total body or any organ exposure of more than 4 mrem per year (Reference J.6).

3. Site Accident and Transportation Accident—Average and Maximum Individuals

Conservative estimates of the total body and maximum organ dose commitments for an average and a maximum individual for a postulated site accident and a postulated transportation accident are presented in Table J-21. Individual nuclide-pathway combinations were not included in this table but the sum total is

TABLE J-17. TOTAL BODY DOSE COMMITMENTS—CONSERVATIVE ESTIMATE—ADULT AVERAGE INDIVIDUAL—EXPECTED CONDITIONS—100 SUBMARINES*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments	Total
C-14	3.1×10^{-7}	4.0×10^{-8}	3.6×10^{-8}	1.9×10^{-10}	1.4×10^{-10}	7.8×10^{-14}	3.5×10^{-13}	5.9×10^{-17}	0.0	0.0	0.0	0.0	3.9×10^{-7}
S-35	--	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	--	--	--	--	--	--	--	--	--
Fe-55	--	--	--	--	--	--	--	--	--	--	--	--	--
Co-58	--	--	--	--	--	--	--	--	--	--	--	--	--
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	8.8×10^{-7}	2.8×10^{-8}	2.1×10^{-8}	6.6×10^{-9}	1.3×10^{-8}	2.2×10^{-11}	1.0×10^{-10}	3.4×10^{-12}	1.1×10^{-13}	1.1×10^{-14}	3.0×10^{-17}	1.5×10^{-7}	1.1×10^{-6}
Co-60	7.3×10^{-11}	1.2×10^{-10}	8.6×10^{-11}	5.6×10^{-12}	5.6×10^{-12}	9.3×10^{-15}	4.2×10^{-14}	1.6×10^{-15}	1.5×10^{-14}	1.5×10^{-15}	5.1×10^{-16}	1.9×10^{-7}	1.9×10^{-7}
Ni-63	1.7×10^{-4}	5.7×10^{-6}	4.1×10^{-6}	1.3×10^{-6}	2.7×10^{-6}	4.5×10^{-9}	2.0×10^{-8}	5.9×10^{-9}	0.0	0.0	0.0	0.0	1.8×10^{-4}
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	1.4×10^{-13}	2.3×10^{-12}	1.7×10^{-11}	5.6×10^{-13}	1.1×10^{-12}	1.8×10^{-15}	8.3×10^{-15}	1.4×10^{-14}	3.4×10^{-12}	3.4×10^{-13}	1.1×10^{-15}	7.8×10^{-7}	7.8×10^{-7}
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	1.7×10^{-4}	5.8×10^{-6}	4.2×10^{-6}	1.3×10^{-6}	2.7×10^{-6}	4.5×10^{-9}	2.0×10^{-8}	5.9×10^{-9}	3.5×10^{-12}	3.5×10^{-13}	1.6×10^{-15}	1.1×10^{-6}	1.8×10^{-4}

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-18. MAXIMUM ORGAN DOSE COMMITMENTS—CONSERVATIVE ESTIMATE—ADULT AVERAGE INDIVIDUAL—EXPECTED CONDITIONS—100 SUBMARINES*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	1.5×10^{-6} Bone	2.0×10^{-7} Bone	1.8×10^{-7} Bone	9.4×10^{-10} Bone	7.1×10^{-10} Bone	3.9×10^{-13} Bone	1.8×10^{-12} Bone	3.1×10^{-16} Bone	1.3×10^{-14} Skin	1.3×10^{-15} Skin	9.1×10^{-18} Skin	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	--	--	--	--	--	--	--	--
Fe-55	--	--	--	--	--	--	--	--	--	--	--	--
Co-58	--	--	--	--	--	--	--	--	--	--	--	--
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	6.2×10^{-6} Bone	2.0×10^{-7} Bone	1.4×10^{-7} Bone	4.7×10^{-8} Bone	9.3×10^{-8} Bone	1.5×10^{-10} Bone	7.0×10^{-10} Bone	2.1×10^{-11} Bone	1.8×10^{-12} Skin	1.8×10^{-13} Skin	5.1×10^{-16} Skin	2.5×10^{-6} Skin
Co-60	1.2×10^{-9} GI	2.0×10^{-9} GI	1.5×10^{-9} GI	9.4×10^{-11} GI	9.4×10^{-11} GI	1.6×10^{-13} GI	7.1×10^{-13} GI	1.0×10^{-12} Lung	1.8×10^{-14} Skin	1.8×10^{-15} Skin	6.2×10^{-16} Skin	2.2×10^{-7} Skin
Ni-63	5.4×10^{-3} Bone	1.8×10^{-4} Bone	1.3×10^{-4} Bone	4.1×10^{-5} Bone	8.3×10^{-5} Bone	1.4×10^{-7} Bone	6.2×10^{-7} Bone	1.8×10^{-7} Bone	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	1.8×10^{-11} GI	3.0×10^{-10} GI	2.1×10^{-9} GI	7.0×10^{-11} GI	1.4×10^{-10} GI	2.3×10^{-13} GI	1.0×10^{-12} GI	1.0×10^{-12} Lung	3.4×10^{-12} Total Body	3.4×10^{-13} Total Body	2.7×10^{-15} Skin	7.8×10^{-7} Total Body
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest maximum organ dose commitment estimate.

TABLE J-19. TOTAL BODY DOSE COMMITMENTS—CONSERVATIVE ESTIMATE—ADULT MAXIMUM INDIVIDUAL—EXPECTED CONDITIONS—100 SUBMARINES*

mrem

Nuclide	Fish	Crustacea	Molluscs	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	3.6×10^{-6}	1.0×10^{-6}	1.1×10^{-6}	4.7×10^{-7}	7.4×10^{-8}	7.9×10^{-14}	3.5×10^{-11}	5.9×10^{-17}	0.0	0.0	0.0	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	--	--	--	--	--	--	--	--
Fe-55	--	--	--	--	--	--	--	--	--	--	--	--
Co-58	--	--	--	--	--	--	--	--	--	--	--	--
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	1.0×10^{-5}	7.4×10^{-7}	6.0×10^{-7}	1.7×10^{-5}	7.0×10^{-6}	2.2×10^{-11}	1.0×10^{-8}	3.4×10^{-12}	2.6×10^{-12}	2.6×10^{-13}	3.0×10^{-17}	3.1×10^{-6}
Co-60	8.4×10^{-10}	3.1×10^{-9}	2.5×10^{-9}	1.4×10^{-8}	2.9×10^{-9}	9.3×10^{-15}	4.2×10^{-12}	1.6×10^{-15}	3.7×10^{-13}	3.7×10^{-14}	5.1×10^{-16}	3.8×10^{-6}
Ni-63	2.0×10^{-3}	1.5×10^{-4}	1.2×10^{-4}	3.3×10^{-3}	1.4×10^{-3}	4.5×10^{-9}	2.0×10^{-6}	5.9×10^{-9}	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	1.7×10^{-12}	6.2×10^{-11}	5.1×10^{-10}	1.4×10^{-9}	5.9×10^{-10}	1.8×10^{-15}	8.3×10^{-13}	1.4×10^{-14}	8.3×10^{-11}	8.3×10^{-12}	1.1×10^{-15}	1.6×10^{-5}
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--
Total	2.0×10^{-3}	1.5×10^{-4}	1.2×10^{-4}	3.3×10^{-3}	1.4×10^{-3}	4.5×10^{-9}	2.0×10^{-6}	5.9×10^{-9}	8.6×10^{-11}	8.6×10^{-12}	1.6×10^{-15}	2.3×10^{-5}

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest total body dose commitment estimate.

TABLE J-20. MAXIMUM ORGAN DOSE COMMITMENTS—CONSERVATIVE ESTIMATE ADULT MAXIMUM INDIVIDUAL—EXPECTED CONDITIONS—100 SUBMARINES*

mrem

Nuclide	Fish	Crustacea	Mollusca	Seaweed	Plankton	Desalinated Seawater	Salt	Inhalation	Sea Immersion	Equipment	Air Immersion	Shore Sediments
C-14	1.8×10^{-5} Bone	5.2×10^{-6} Bone	5.3×10^{-6} Bone	2.4×10^{-6} Bone	3.7×10^{-7} Bone	3.9×10^{-13} Bone	1.8×10^{-10} Bone	3.1×10^{-16} Bone	3.3×10^{-13} Skin	3.3×10^{-14} Skin	9.1×10^{-18} Skin	0.0
S-35	--	--	--	--	--	--	--	--	--	--	--	--
Sc-46	--	--	--	--	--	--	--	--	--	--	--	--
Cr-51	--	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	--	--	--	--	--	--	--	--
Fe-55	--	--	--	--	--	--	--	--	--	--	--	--
Co-58	--	--	--	--	--	--	--	--	--	--	--	--
Fe-59	--	--	--	--	--	--	--	--	--	--	--	--
Ni-59	7.0×10^{-5} Bone	5.2×10^{-6} Bone	4.2×10^{-6} Bone	1.2×10^{-4} Bone	5.0×10^{-5} Bone	1.5×10^{-10} Bone	7.0×10^{-8} Bone	2.1×10^{-11} Bone	4.3×10^{-11} Skin	4.3×10^{-12} Skin	5.1×10^{-16} Skin	5.0×10^{-5} Skin
Co-60	--	--	--	--	--	--	--	--	--	--	--	--
Ni-63	6.3×10^{-2} Bone	4.6×10^{-3} Bone	3.7×10^{-3} Bone	1.0×10^{-1} Bone	4.3×10^{-2} Bone	1.4×10^{-7} Bone	6.2×10^{-5} Bone	1.8×10^{-7} Bone	0.0	0.0	0.0	0.0
Mo-93	--	--	--	--	--	--	--	--	--	--	--	--
Nb-94	2.1×10^{-11} GI	7.5×10^{-9} GI	6.5×10^{-8} GI	1.7×10^{-7} GI	7.3×10^{-8} GI	2.3×10^{-13} GI	1.0×10^{-10} GI	1.0×10^{-12} Lung	8.4×10^{-11} Total Body	8.4×10^{-12} Total Body	2.7×10^{-15} Skin	1.6×10^{-5} Total Body
Zr-95	--	--	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--	--
Hf-181	--	--	--	--	--	--	--	--	--	--	--	--

*Blanks in table indicate values which were less than approximately 0.01 percent of the largest maximum organ dose commitment estimate.

TABLE J-21. CONSERVATIVE DOSE COMMITMENTS FOR SITE ACCIDENT AND TRANSPORTATION ACCIDENT—ADULT AVERAGE AND MAXIMUM INDIVIDUALS—ONE SUBMARINE

Disposal Scenario	Total Body		Maximum Organ	
	Dose Commitment (mrem)	Critical Pathway and Nuclide	Dose Commitment (mrem)	Critical Pathway and Nuclide
Postulated Site Accident, Average Adult	2.7×10^{-3}	Shore Sediments Co-60	3.3×10^{-3} (Skin)	Shore Sediments Co-60
Postulated Site Accident, Maximum Adult	5.6×10^{-2}	Shore Sediments Co-60	6.6×10^{-2} (Skin)	Shore Sediments Co-60
Postulated Transport Accident, Average Adult	1.4×10^{-1}	Shore Sediments Co-60	1.7×10^{-1} (Skin)	Shore Sediments Co-60
Postulated Transport Accident, Maximum Adult	2.7	Shore Sediments Co-60	3.3 (Skin)	Shore Sediments Co-60

presented along with the critical pathway by which the largest percentage of the dose commitment might be received. As shown in Table J-21, the sum of the total body dose commitments would be approximately 0.003 mrem per year for an average individual and 0.06 mrem per year for a maximum individual for a postulated site accident. The largest sum of the maximum organ dose commitments would be approximately 0.003 mrem per year to the skin for an average individual and 0.07 mrem per year to the skin for a maximum individual for the postulated site accident. The sum of the total body dose commitments would be approximately 0.1 mrem per year for an average individual and 3 mrem per year for a maximum individual for a postulated transportation accident. The largest sum of the maximum organ dose commitments would be approximately 0.2 mrem per year to the skin for an average individual and 3 mrem per year to the skin for a maximum individual for a postulated transportation accident.

The largest percentage of these conservative total body and maximum organ dose commitment estimates for a postulated site accident and a postulated transportation accident would result from Cobalt-60 through the shore sediments pathway. The total body dose commitments for both postulated accidents and for both an average and maximum individual are significantly less than the annual 100 mrem total body exposure from natural background radiation and the estimated 2 mrem exposures for an average individual or 20 mrem exposures for a maximum individual ingesting fish containing naturally-occurring Radium-226. The total body and maximum organ dose commitments for both postulated accidents and for both an average and a maximum individual are significantly less than the NRC requirement that prevents any individual from receiving a total body exposure of more than 500 mrem per year in an uncontrolled area (Reference J.5) and less than the EPA drinking water requirement that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year (Reference J.6). The 0.003 mrem per year total body exposure to the most exposed average individual for a postulated site accident 300 kilometers from the shoreline would yield a possible population dose of 90 man-rem to the entire population of the three west coast states of the United States, assumed to be 30 million people. The 0.1 mrem per year total body exposure to the most exposed average individual for a postulated transportation accident 25 kilometers from the shoreline would yield a possible population dose of 3 man-rem to the affected population of the three west coast states of the United States, assumed to be 30 thousand people.

IV. SAMPLE DOSE COMMITMENT CALCULATION

An example of the calculations performed to obtain the dose commitment estimates presented in this appendix is provided in this section. The calculation for determining the total body dose commitment for an average adult individual due to ingestion of fish containing the maximum concentration of Nickel-63 is presented. The fish pathway entry point has been assumed to be 50 kilometers offshore at a depth of 2000 meters. The Nickel-63 concentration is the maximum that could occur for the disposal of 100 submarines under expected disposal conditions at a postulated disposal site 300 kilometers offshore at a depth of 4000 meters.

The equation for calculating this dose commitment estimate is presented in Section IV.A of Appendix I and is as follows:

$$D_I = KPqUX_w\Delta T$$

where

D_I is the dose commitment from ingestion of the radionuclide (in rem).

K is the dose commitment conversion factor for ingestion for each radionuclide (in rem per curie).

P is the number of people for which the dose commitment estimate is being made.

q is the rate at which individuals may ingest the particular food considered (in grams per day).

U is the concentration factor which relates the radionuclide concentration in a unit mass of the item ingested to the radionuclide concentration in a unit volume of seawater from which the food item was obtained (in curies per kilogram of food per curies per liter of seawater). This term requires conversion to units of curies per gram per curies per cubic meter when solving this equation.

X_w is the concentration of the radionuclide considered in seawater (in curies per cubic meter).

ΔT is the time period over which an individual could be ingesting the food item (in days).

The data necessary to calculate the total body dose-commitment estimate to an average adult due to a year's ingestion of fish containing Nickel-63 which could originate from 100 defueled nuclear submarines disposed of on the ocean floor at a proposed disposal location 300 kilometers offshore under expected disposal conditions are:

$K = 4.36 \times 10^3$ rem/Ci (Appendix I, Table I-4, Nickel-63, Total Body)

$P = 1$ (Average Adult)

$q = 15.47$ g/day (Appendix I, Table I-2, Fish, Average Adult)

$U = 5 \times 10^2$ Ci/kg per Ci/ℓ $= 5 \times 10^2/1 \times 10^6$ Ci/g per Ci/m^3 (Appendix I, Table I-3, Nickel-63, Fish)

$X_w = 4.2 \times 10^{-19}$ Ci/m^3 (Appendix H, Table H-4, Nickel-63, 100 Submarines, Fish Ingestion Pathway)

$\Delta T = 1$ yr $= 365$ days

Substituting the data into the equation yields:

$$D_I = \left(4.36 \times 10^3 \ \frac{\text{rem}}{\text{Ci}}\right)(1)\left(15.47 \ \frac{\text{g}}{\text{day}}\right)\left(\frac{5 \times 10^2}{1 \times 10^6} \ \frac{\text{Ci}}{\text{g}} \ \frac{\text{m}^3}{\text{Ci}}\right)\left(4.2 \times 10^{-19} \ \frac{\text{Ci}}{\text{m}^3}\right)(365 \text{ days})$$

$D_I = 5.2 \times 10^{-15}$ rem $= 5.2 \times 10^{-12}$ mrem

This value is reported in Table J-2 for Nickel-63 for the fish ingestion pathway.

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APPENDIX K

MONITORING PROGRAM

Contents

APPENDIX K

MONITORING PROGRAM

I. INTRODUCTION

For either land disposal or sea disposal, a monitoring program would be needed to determine the radiological condition of the disposal site environment. Such a monitoring program would sample the pathways to man for the presence of radioactive material from the disposals. The results of these analyses and their evaluations would be published periodically for public information and review.

II. SUMMARY

Land disposal would use the existing monitoring programs that are already in operation at Hanford and at Savannah River. These programs are described in the respective final environmental impact statements for waste management operations at Hanford and at Savannah River, References K.1 and K.2. The National Research Council reported that no measurable harm has resulted from these operations, Reference K.3.

Environmental monitoring reports for these sites are published annually. For sea disposal, a new monitoring program would be required for each site. Such a monitoring program could be performed using existing, proven technology.

III. LAND DISPOSAL MONITORING

In the event of land disposal, the primary pathways to man are expected to be by way of groundwater and surface water. Existing monitoring programs at Hanford and at Savannah River have demonstrated that disposals of activated structural materials have not produced significant releases. Details are available in References K.1, K.2, and K.3. Measured releases are very low in concentration and travel through the surrounding environment very slowly. The result is that direct measurements along the pathways to man have not provided significant measures of the doses to man. Only at locations close to the sources are the measurements adequate to estimate the amount of related nuclides present. Estimates of the doses to man are obtained from these local measurements in conjunction with calculations based on conservative assessments of the pathways to man.

This situation is also expected to be the case for the contemplated disposals. Measurements farther along the pathways to man would probably not be sufficiently distinguishable from the background values to provide a direct measure of the effects of disposal, and the doses to man would have to be estimated from local measurements and conservative calculations. Even so, samples would be taken at other locations to verify that disposal nuclides actually were so low or to detect them if they were unexpectedly high.

At Hanford, for example, routine samples are currently taken of river water, sanitary water, waste water, and groundwater. Air is sampled for particles by measuring the radioactivity in filters and charcoal cartridges. In addition, direct radiation is measured at the waste site and along the river shore. Road surfaces are surveyed by vehicle-mounted detectors, aerial surveys are conducted, and food and other related items are sampled and measured. Many of the measurements at Hanford are associated with monitoring nuclides other than those related to the disposal of activated structural materials, such as Iodine-131 and tritium, but among the routine measurements there are typically 44 air samplers (all analyzed for gross beta activity and 15 are analyzed for total alpha activity), direct radiation at 64 fixed locations (Thermoluminescent dosimetry-TLD), portable-instrument measurements along the river shore, and various immersion measurements (TLD).

Soil and vegetation are currently sampled at 36 locations at Hanford to analyze for selected nuclear-fuel-related nuclides. River sediments at two locations are measured in layers by gamma scans. Surface waters are sampled for radiochemical analysis of water from several locations including the river, waste ponds, and ditches. Drinking water samples from Richland and two on-site locations are checked for total alpha, total beta, and gamma activities. Groundwater is sampled from numerous wells and analyzed for tritium and gross beta activities.

Deer and ducks are periodically sampled from Hanford site locations and whitefish are sampled from the river. Organs from these animals are measured for specific nuclides. Food-stuffs produced by local farms and commercial sources are also sampled and measured, including green goods, eggs, chicken, and beef. Milk is sampled from two groceries and four farms. Typical forage for farm animals is sampled and analyzed for nuclides of interest.

The scope of routine monitoring by Hanford is supplemented by programs conducted by the adjacent states of Oregon and Washington which include investigations of river shellfish, milk, groundwater, and direct radiation measurements in Richland.

Monitoring programs at Savannah River are of similar scope and are designed to measure any contribution from Savannah River Plant operations to off-site exposure by direct radiation, inhalation, ingestion, and deposition. Savannah River operates 12 atmospheric monitoring stations near the site perimeter, 12 more at distances of approximately 25 miles from the site, and four more at distant locations (approximately 60-120 miles away). The Savannah River is monitored above and below the site. Drinking water is sampled at 14 public locations. Vegetation such as grass is sampled at seven perimeter locations, at seven locations at approximately 25 miles distant, and at four locations at approximately 100 miles distant.

Milk is sampled within a 25-mile zone, and farm produce is sampled at 14 localities around the site to obtain 60 samples of four food categories. Deer and wild hogs taken on-site are sampled during hunting season. Fish are sampled from upstream, downstream, and site locations.

All potential effluent paths from the Savannah River Plant are monitored, including stacks, pipes, and basins. The specified frequency depends upon an assessment of the magnitude and the potential for human dose, and the samples range from continuous to periodic samples. At the burial grounds, as well as at other locations, surveillance wells provide data to assess leaching conditions and to monitor horizontal movement of groundwater in the saturated zone. Burial trenches are monitored by samples from trench wells that are screened at the trench-bottom level.

From these samples, Savannah River personnel monitor total activities and the activities of significant nuclides in the local and remote environment and in the potential effluent paths. These data enable dose calculations to be made for the contribution of plant operations to the doses to the surrounding communities. The contributions from the burial operations are a part of the totals.

The cost of monitoring these land disposal sites is provided for in current funding of the U.S. Department of Energy for operating these sites; no additional cost is anticipated.

IV. SEA DISPOSAL MONITORING

A monitoring program for sea disposal would consist of three phases: pre-disposal monitoring, monitoring during the period of submarine disposals, and monitoring after the active disposal period. These phases are discussed below. Additional discussion and background information on the inauguration of new sites for disposal of low-level radioactive waste are provided in Reference K.4.

A. PRE-DISPOSAL MONITORING

As part of site selection, pre-disposal investigations would be performed to provide background baseline data on the undisturbed condition of the site for comparison with results obtained during and after the period of active disposal.

The monitoring program, which would be initiated before the first disposal, would include such typical actions as:

a. Sea floor photography to provide a visual record of the sea floor conditions including animal activity.

b. Bottom water currents (speed and direction); electrical conductivity, temperature, and water density (CTD data); and dissolved oxygen concentration.

c. Sampling and analysis of bottom water for gamma-emitting radionuclides and x-ray and beta-emitting nickel nuclides (Nickel-59 and Nickel-63) dissolved in the water and present in the suspended particles.

d. Sampling and analysis of sea floor sediments for gamma-emitting radionuclides and for Nickel-59 and Nickel-63 adsorbed on the sediment particles and present in the interstitial water surrounding the sediment particles.

e. Collection and analysis of fish and benthic invertebrates for gamma-emitting radionuclides and for Nickel-59 and Nickel-63. The fish and invertebrates would be collected from the sediment surface and the overlying water by trapping.

The samples could be collected by either a manned submersible with mechanical arms or by unmanned apparatus deployed from a surface ship. Both of these techniques have been applied successfully in oceanographic research activities. All the major components of the monitoring program listed above have been successfully utilized by the Navy and the oceanographic scientific community for a number of years and no significant difficulty is anticipated in implementing such a monitoring program at a disposal site.

These measurements would provide reference data for the environmental characteristics of a site before disposal started, and could be acquired during several oceanographic research cruises. The cost of such a cruise is approximately $1.0 million (1978), as reported in Reference K.4. The cost would include a literature search to select an appropriate cruise area and the preparation of a cruise prospectus to define the work to be done. Total costs for the effort required to qualify a sea disposal site are estimated to be approximately $6 million during the required period of two to three years.

B. MONITORING DURING ACTIVE DISPOSAL

After the commencement of submarine disposals, the second phase of the monitoring program would begin. The sunken ships would be inspected photographically. Samples would be taken of the sediment, water, and biota in the vicinity of these ships to investigate whether radionuclides had been released and to observe how the disposals may have changed the local environment. In addition, similar samples and measurements would be made downstream from the sunken ships.

Based upon the analysis and experiments discussed earlier in this statement, the submarines would be expected to land on the ocean bottom with the containment provided by the reactor compartment and primary system remaining intact. Significant concentrations of radionuclides in the environment near the submarines would not be expected. If the initial monitoring surveys performed after commencement of disposal operations confirmed this expectation, the submarine disposals could proceed and the frequency of the monitoring surveys could be reduced.

The cost for a survey to monitor the environment in the vicinity of a disposal site would be approximately $0.8 million.

C. MONITORING AFTER THE PERIOD OF ACTIVE DISPOSAL

Monitoring surveys after the period of active disposal would be similar in scope and cost to those performed during the disposal period. The frequency of these surveys would be determined by the results of earlier surveys. If the analysis presented in this statement were to be corroborated by surveys performed during the period of active disposal, post-disposal surveys would be needed very infrequently.

It is estimated that the ongoing monitoring program for a sea disposal site (during and after the period of active disposal) would have a present-value cost of nearly $9 million. In combination with the effort required to qualify a sea disposal site, the present value of the total monitoring effort would be nearly $15 million, equivalent to approximately $0.1 million per ship for each sea disposal site.

D. DEMONSTRATED CAPABILITIES

As a part of the Navy's on-going program for monitoring the radiological condition of the environment where the nuclear-powered submarine THRESHER lies, comprehensive environmental measurements and sampling in the deep ocean were performed by the Navy during August 1983. This environmental monitoring provided results that are summarized in the Annex to Appendix D (Section IV.E) and also provided a demonstration of capabilities that are currently available for monitoring a deep-ocean site. The location where THRESHER sank in the Northwestern Atlantic Ocean has characteristics that are similar to those which might be anticipated if decommissioned submarines were to be disposed of in the ocean.

The monitoring program conducted at the THRESHER site included the following elements:

- high resolution photography of the submarine debris and adjacent sediment
- measurement of currents and temperature in the bottom water adjacent to the submarine debris
- collection of bottom water and sediment samples for radionuclide analysis
- collection of bottom-dwelling fish and marine life for radionuclide analysis
- operation of an acoustic transponder navigation network to ensure proper placement of oceanographic sampling and monitoring devices.

Some of the operations were conducted by deploying unmanned apparatus from a surface ship and some were conducted by a manned submersible.

Submersible operations were conducted by the Deep Submergence Research Vehicle (DSRV) ALVIN and its support ship R/V LULU. Surface ship operations were conducted by the Oceanographic Research Vessel (ORV) CAPE FLORIDA.

An acoustic transponder navigation network was established by deploying three acoustic transponders surrounding the THRESHER debris site. Each transponder was moored 200 meters off the bottom to minimize bottom interference. The actual locations of the acoustic transponders were determined by satellite navigation and LORAN C. The positions of the ships in relation to the acoustic transponders were tracked by computer, using frequent interrogation of the transponders. This provided precise positioning to navigate ALVIN and surface-deployed monitoring devices to within close proximity to the THRESHER.

Samplers on the end of a long cable attached to CAPE FLORIDA were navigated to within 3 to 40 meters of the desired location. A baited fish trap and a sampling pump were positioned and released at the bottom by CAPE FLORIDA for subsequent recovery as free vehicles after spending the required time on the bottom to complete the sampling objectives. The fish trap provided an excellent sampling of the benthic fish in the immediate vicinity of THRESHER by obtaining 56 fish in a four-day period. The surface-ship-deployed water pumping system included cartridges for collection of radioactivity. It obtained a large sample of seawater constituents by pumping 503 liters through the system. The pump was released from the bottom remotely and was recovered by CAPE FLORIDA. Tetrahedral marine-life traps, launched and recovered as free vehicles, were able to obtain samples of fish and amphipods as close as 50 meters to the target area. Box corers, modified for the collection of undisturbed surface sediment and interfacial seawater, proved to be an excellent means of collecting samples of surface sediment (upper 1/2 meter), interfacial seawater, and epifauna. This sampler was transponder navigated to the desired location and then retrieved by the trawl winch after its sample was obtained and the location recorded.

The submersible-deployed oceanographic sampling and monitoring devices were utilized in the immediate vicinity of the THRESHER. These operations included the collection of sediment core tubes, water samples, marine life samples, in situ gamma ray measurements, and photography at the desired locations. Water samples were collected by the use of Niskin bottles and by a modified version of the pumping system deployed by CAPE FLORIDA. The pumping system mounted on ALVIN pumped separate seawater samples of 440 liters, 392 liters, and 587 liters through its series of cartridges. The marine life samples were obtained using funnel traps and by special suction-type sampling systems for removing sessile organisms from hull surfaces. In addition, samples of marine organisms including polychaete worms were removed from a rock sample obtained at the THRESHER site.

The radiological environmental monitoring conducted from CAPE FLORIDA and ALVIN yielded very useful information on the suitability of various types of equipment for this type of operation. In general, surface-deployed devices, such as the box corer, which are heavier and more streamlined, are easier to deploy at a given target than those devices, such as the fish trap, which are more apt to drift on their way to the bottom. With careful maneuvering of the surface ship, it was possible to place monitoring devices close to the THRESHER debris. During this expedition, the positions of the reference transponders varied by as much as 40 meters due to the effect of the tidal bottom currents on the transponders moored 200 meters off the bottom. In spite of these conditions, it was still possible to navigate the transponder-guided samplers to within 3 to 40 meters of the target. Actual locations of the surface-deployed samplers as observed from ALVIN were at 10 to 20 meters from THRESHER. This is extremely close when compared to the size of the THRESHER. The differences between observed positions and computer-calculated positions are considered to be slight and were attributed to the current-induced drift of the reference transponders.

This demonstration of surface-ship- and submersible-operated radiological environmental monitoring involved two semi-independent means of accomplishing the required objectives. The application of this type of monitoring operation to disposal of decommissioned nuclear submarines could be accomplished by periodically using a surface ship with periodic verification by a submersible.

The estimated cost of conducting this type of environmental monitoring using surface-deployed equipment is $0.2 million, including approximately 10 days of ship time and approximately $0.1 million for equipment, services, and personnel. Similarly, the estimated cost of this kind of monitoring using a manned submersible is $0.3 million, including roughly 10 days of ship time and $0.1 million for equipment, services, and personnel. These costs are included in Section IV.C.

The radiological environmental monitoring conducted with CAPE FLORIDA and ALVIN at the site of the THRESHER sinking demonstrated the capability to conduct deep-ocean monitoring operations with existing means. CAPE FLORIDA was able to place surface-deployed samplers and monitoring devices in the immediate vicinity of THRESHER debris by the use of an acoustic transponder navigation network. The relative positions of these instruments were determined by computer and confirmed by ALVIN to be satisfactory.

This expedition demonstrated that a comprehensive radiological environmental monitoring program could be carried out using existing oceanographic technology at reasonable cost.

V. REFERENCES

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APPENDIX L

FLOODPLAIN/WETLANDS ASSESSMENT

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APPENDIX L

FLOODPLAIN/WETLANDS ASSESSMENT

I. SUMMARY

This floodplain/wetlands assessment addresses the construction and operation of a barge slip on the Savannah River Plant, South Carolina. The potential site at Ellenton Landing (River Mile 156.8) plus other alternative sites on the Savannah River were examined and evaluated. Because the barge slip, by design, must be adjacent to the Savannah River, location of the structure outside the base floodplain would not be possible.

The construction and operation of a barge slip on the Savannah River at the Savannah River Plant would avoid to the maximum extent possible adverse impacts associated with the use and modification of the floodplain for the following reasons:

- There would be no modification of water levels or flow regimes, thus the natural and beneficial values of the floodplain would be maintained.
- If flooded, the barge slip would not create additional consequences to any potential emergency conditions.
- Access to the Savannah River Plant is strictly controlled; no inhabitants, dwellings, hospitals, schools, nursing homes, or other structures are located within the floodplain, thus no individuals or property would be affected.
- No essential and irreplaceable records, utilities, and/or emergency services would be affected or lost in the event of flooding.
- There would be no impact to cultural, agricultural, aquacultural, or forest resources.

The environmental impacts to wetlands resulting from the construction and operation of a barge slip on the Savannah River at the Savannah River Plant would be negligible for the following reasons:

- There would be no modification of the existing hydrological regime, thus wetlands vegetation would be unaffected.
- Although construction of the slip would eliminate a small amount of wetland vegetation, the area that would be eliminated is less than two acres in size and is of minimal value as wildlife habitat.
- If the dredge spoil were to be discarded in nearby upland areas, wetlands in the immediate vicinity or elsewhere would not be adversely affected.
- The potential site of the barge slip does not contain nor provide critical habitat for endangered or threatened species.

The Ellenton Landing Site is superior to the alternative sites along the river at the Savannah River Plant because (1) it contains an existing wharf, and the immediate area has been developed previously, (2) it would not require the construction of new access roads, (3) modification of the existing boat slip would minimize construction costs, (4) its location at the "bend" of the river would facilitate navigability and maneuvering of the transport barges, (5) there would be a very minimal loss (less than two acres) of wetland vegetation, and (6) there would be no impact to endangered or threatened species or their habitat. The alternative sites were less preferred because (1) new access roads would be required, (2) construction of the barge slip would require significantly greater removal of bottomland hardwood and/or swamp forests, (3) the amount of excavated material and dredge spoil would be greater, and (4) the potential of impacting endangered or threatened species would be higher.

It is concluded, therefore, that if land disposal at the Savannah River Plant is proposed, then construction and operation of a barge slip at Ellenton Landing would be the most practicable option available. Furthermore, its implementation would have no irreversible, adverse impacts to the floodplain or its wetlands.

II. INTRODUCTION

The Savannah River Plant (SRP) is being considered as an alternate disposal site for nuclear reactor plants from decommissioned submarines. If this option is chosen, the construction and operation of a barge slip along the Savannah River would be required as part of the transport process as discussed in Appendix B. Because the barge slip would be located on the floodplain and affect wetlands, a Floodplain/Wetlands Assessment is required in accordance with Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands), and also by the U.S. Department of Energy regulation "Compliance with Floodplain/Wetlands Environmental Review Requirements" (10CFR1022).

Principal components of this assessment include a characterization of the affected environment, an environmental analysis of the potential action, and a discussion of alternative barge sites. No such assessment is required for the Hanford Site because an existing barge slip would be used if land disposal were selected.

III. AFFECTED ENVIRONMENT

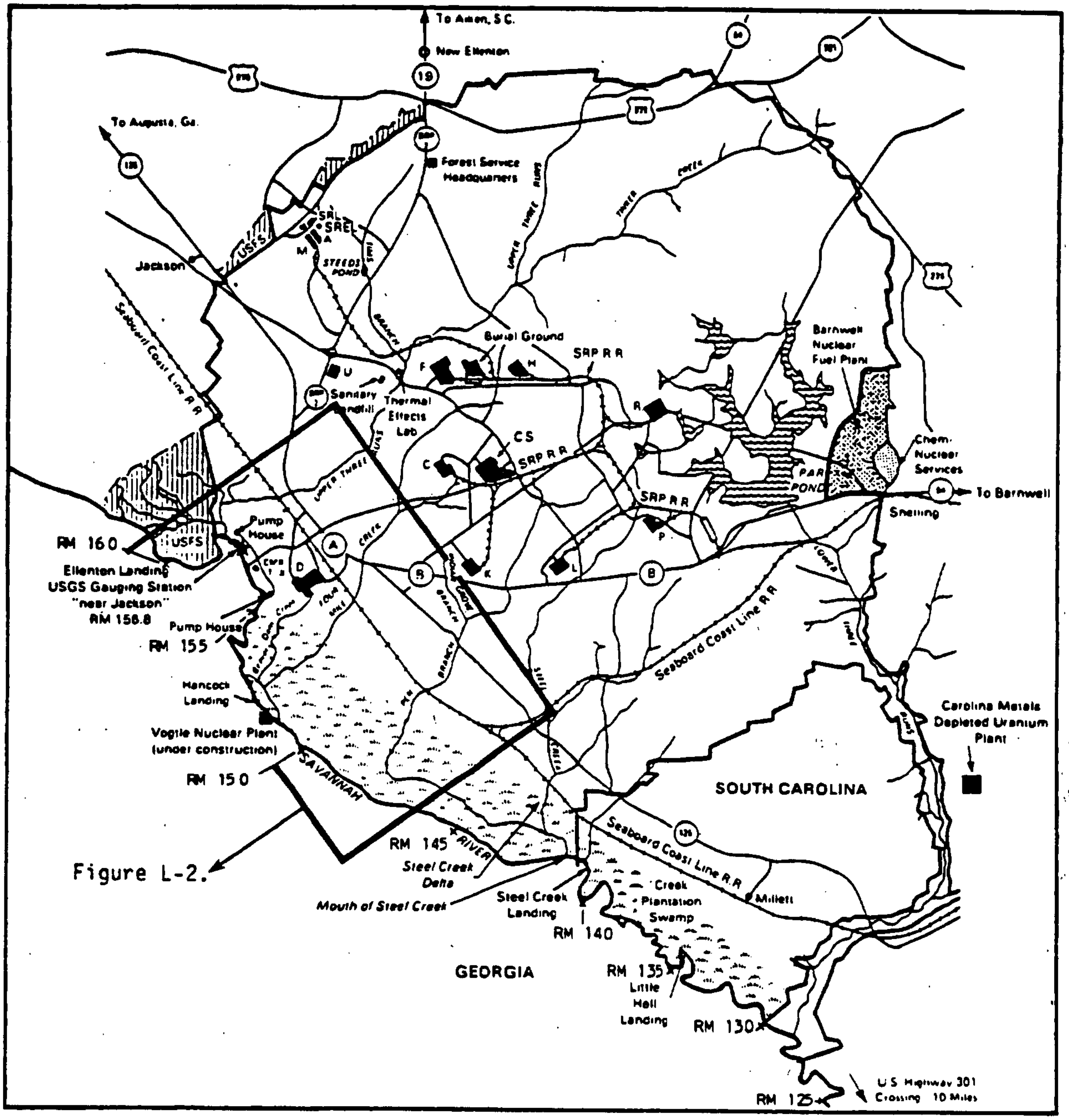
A. THE SAVANNAH RIVER PLANT SITE

The Savannah River Plant was selected in 1950 by the United States Government as a nuclear products facility (Reference L.1). It occupies a 777-square kilometer (300-square mile) site along the Savannah River on the Upper Coastal Plain of South Carolina (Figure L-1). The SRP facilities include five nuclear production reactors (three currently operating), two chemical separations areas, a fuel and target fabrication facility, a heavy-water production facility (on standby), and various supporting facilities. These facilities are used in the production of defense nuclear materials, and occupy less than 5 percent of the total SRP area. Reservoirs and ponds occupy approximately 3000 acres. The remainder of the Savannah River Plant is comprised of pine plantations, wetlands, and other natural vegetation which are managed by the U.S. Forest Service under a cooperative agreement with the U.S. Department of Energy.

The elevation of the Savannah River Plant ranges from 27 to 122 meters (90-400 feet) above mean sea level (Reference L.2). The climate in the SRP area is temperate with mild winters and long summers. The average rainfall at the Savannah River Plant from 1952 through 1978 was approximately 120 centimeters (47 inches). Precipitation is the greatest in March, and the least in November (Reference L.1).

The potential barge slip at the Savannah River Plant location would be at Ellenton Landing near River Mile 157 on the Savannah River (Figures L-1 and L-2). The site currently contains an abandoned wharf, a small boat basin, and a small boat ramp (Figure L-3). The small boat basin lies adjacent to the wharf on the upriver side. The boat ramp, which is located approximately 15 meters (50 feet) upriver from the small boat basin, has a 6.4-meter (21-foot) wide asphalt surface with a 7-percent grade. Approximately 400 meters (1320 feet) upriver are the intake canal and pumphouse which provide the Savannah River Plant with a portion of its cooling water for reactor operations. The wharf, small boat basin, and boat ramp may be reached from River Road by a gravel access road.

A conceptual design for the barge slip at the Savannah River Plant is presented in Figure L-4. This design would require enlarging the existing boat slip and modifying the adjacent landing area to accommodate a grounding pad and sheet pile slip. A maximum of approximately 5950 cubic meters (7780 cubic yards) of soil and associated substrate would have to be excavated to accommodate the barge slip. The size and design of the barge slip shown in Figure L-4 would be similar regardless of the location selected for the unloading process.



Key

C, K, R, L, P Reactor Areas (C, P, K are operating)
F, H Separations Areas
M Fuel and Target Fabrication
D Heavy Water Production
A Savannah River Laboratory and Administration Area
CS Central Shop
RM River Mile

Road A = Highway 125

Wetlands

★ Potential location of barge slip

0 5 10 15 kilometers

Figure L-1. Savannah River Plant Site

B. HYDROLOGY

The Savannah River basin is one of the major watersheds in the southeastern United States (Reference L.2). The flow of the Savannah River is almost completely controlled by multipurpose storage reservoirs (Reference L.3). Clarks Hill Reservoir, which was completed in March 1953, is located 65 miles upriver from the Savannah River Plant and has a storage capacity of about 3.1×10^9 cubic meters (1.1×10^{11} cubic feet). Hartwell Reservoir, which was completed in June 1961, is located 132 miles upriver from the Savannah River Plant and also has a storage capacity of about 3.1×10^9 cubic meters (1.1×10^{11} cubic feet). These large impoundments provide power, flood control, and recreation to the Central Savannah River Area. These reservoirs and the New Savannah Bluff Lock and Dam, which is located 12 miles south of Augusta, Georgia, have stabilized the river flow near the Savannah River Plant to a yearly average of about 295 cubic meters (10,420 cubic feet) per second.

Russell Reservoir, which began filling in December 1983, will furnish about 1.2×10^9 cubic meters (4.2×10^{10} cubic feet) of storage to further stabilize Savannah River flows. Since 1963, it has been the intent of the U.S. Army Corps of Engineers to maintain a minimum flow of 178 cubic meters (6300 cubic feet) per second 80 percent of the time below the Savannah Bluff Lock and Dam at Butler Creek. During extremely dry periods, releases from Clarks Hill Reservoir may be reduced to the extent necessary to maintain a flow of only 164 cubic meters (5800 cubic feet) per second below the New Savannah Bluff Lock and Dam (Reference L.4). The 7-day, 10-year low flow at the Ellenton Landing Site is calculated to be 159 cubic meters per second (5600 cubic feet per second).

Figure L-5 shows the maximum, minimum, and mean monthly flow rates for the Savannah River measured near Augusta from 1964 to 1981. Mean flow rates were generally higher in the winter and spring, and the lowest in the summer and fall.

As noted above, Clarks Hill Reservoir provides flood protection for floodplains below the dam. The maximum discharge that can occur through the outlet works without appreciable downstream flooding is approximately 850 cubic meters (30,000 cubic feet) per second. The flood control storage of the lake (390,000-acre-feet) can be expected to be utilized once every 5 years (Reference L.4). The maximum recorded flood (1929) at Augusta had a discharge of 9911 cubic meters (350,000 cubic feet) per second. Since completion of Clarks Hill Dam in 1953 the maximum flow at Augusta was about 2393 cubic meters (84,500 cubic feet) per second, with a corresponding river stage at the Savannah River Plant (Ellenton Landing) of 31 meters (101.8 feet) from April 12-15, 1964.

In the vicinity of the Savannah River Plant, the Savannah River overflows its banks (or its 3-meter high levee bordering the swamp) when river elevations rise higher than 28 meters (91 feet) mean sea level. This river stage initiates flooding of the SRP Boat Dock (Ellenton Landing), and corresponds to a flow of 439 cubic meters (15,490 cubic feet) per second. Records taken at the SRP Boat Dock indicate that the SRP wetlands bordering the Savannah River have been flooded approximately 23 percent of the time (Reference L.2). Although floods may occur in any season, they are most likely to occur during February through March, and in connection with tropical storms and hurricanes during August through October (Reference L.4). Other facts concerning the flooding of the Savannah River during the 12-year period 1958 through 1969 are presented below (Reference L.1):

- Average number of flooding events (river stage $\geq$ 28 meters or 91 feet) is 6.4 per year.
- Number of consecutive days per flooding event

—Maximum	82 days per event (Feb 5-Apr 26, 1964)
—Mean	11 days per event
—Standard Deviation	14 days per event
—Minimum	1 day per event

The base flood or flood-prone area prior to the construction of Clarks Hill and Hartwell Reservoirs is shown in Figure L-2. Because of the flood controls currently associated with these reservoirs, the base flood area should be smaller than shown. The proposed and alternate barge slip sites at the Savannah River Plant, however, remain within the base flood area (Figure L-2).

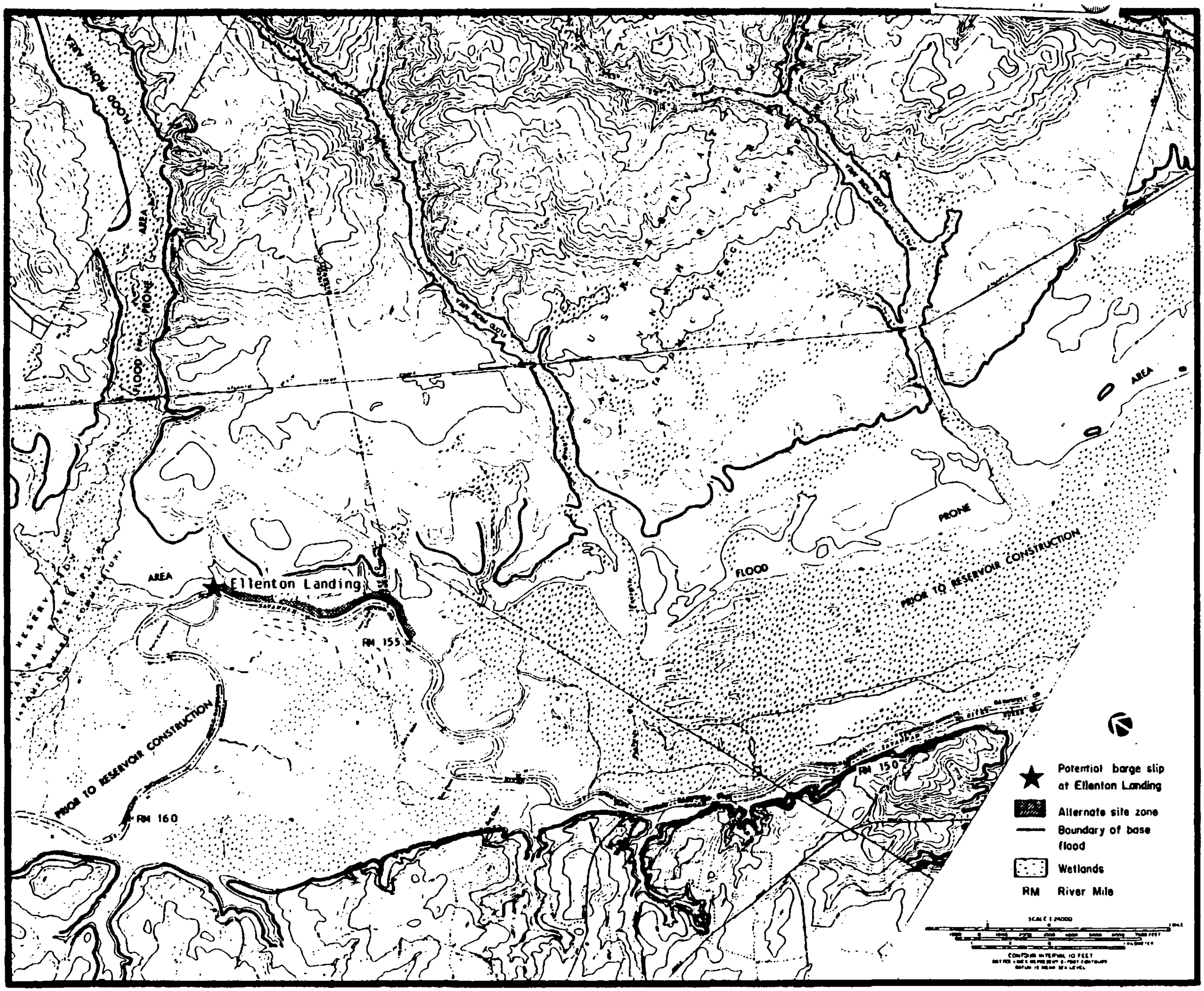


Figure L-2. Delineation of the Base Flood Area Including the Location of the Potential Barge Slip at Ellenton Landing (U.S. Geological Survey, 1972)

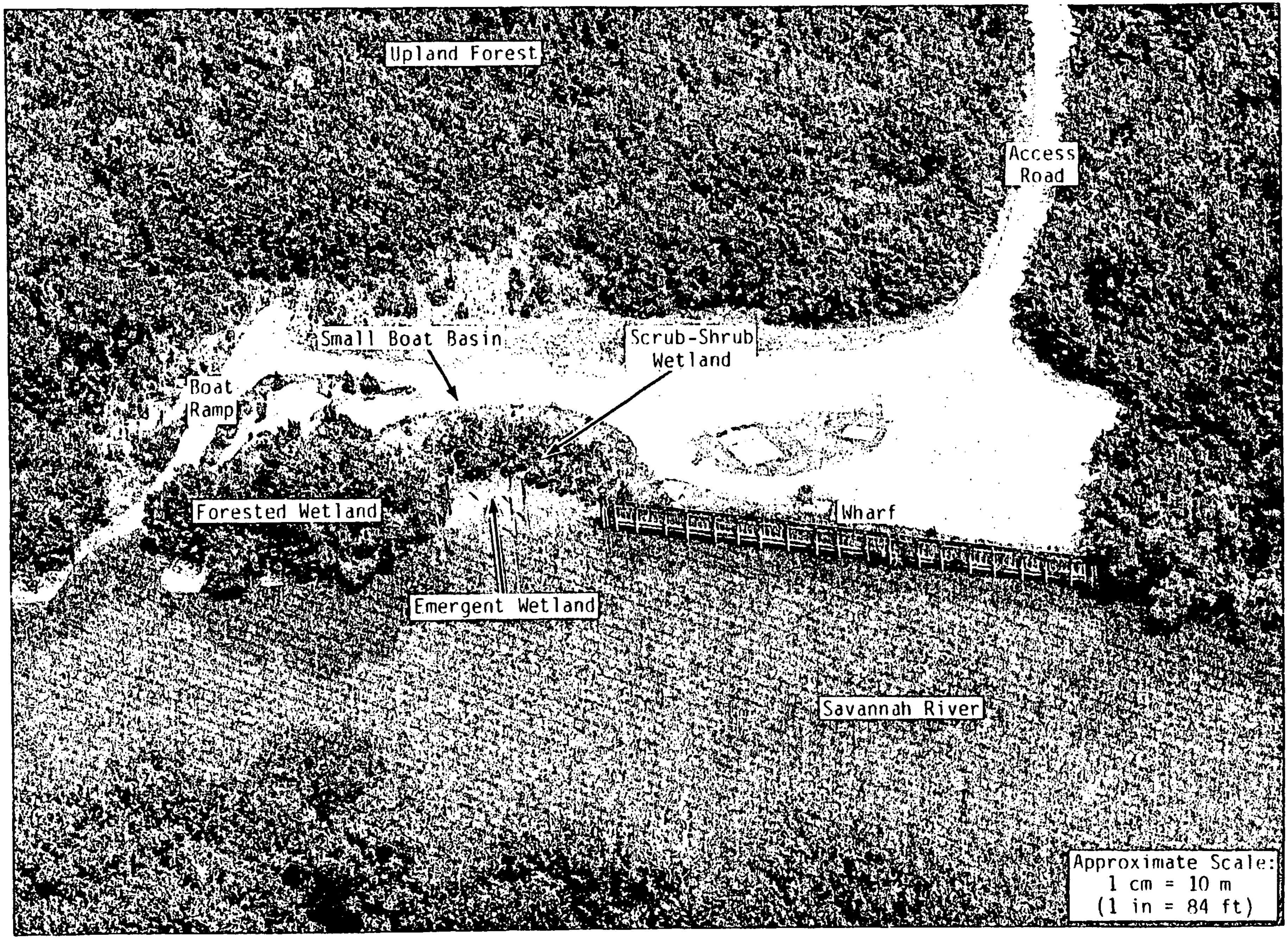
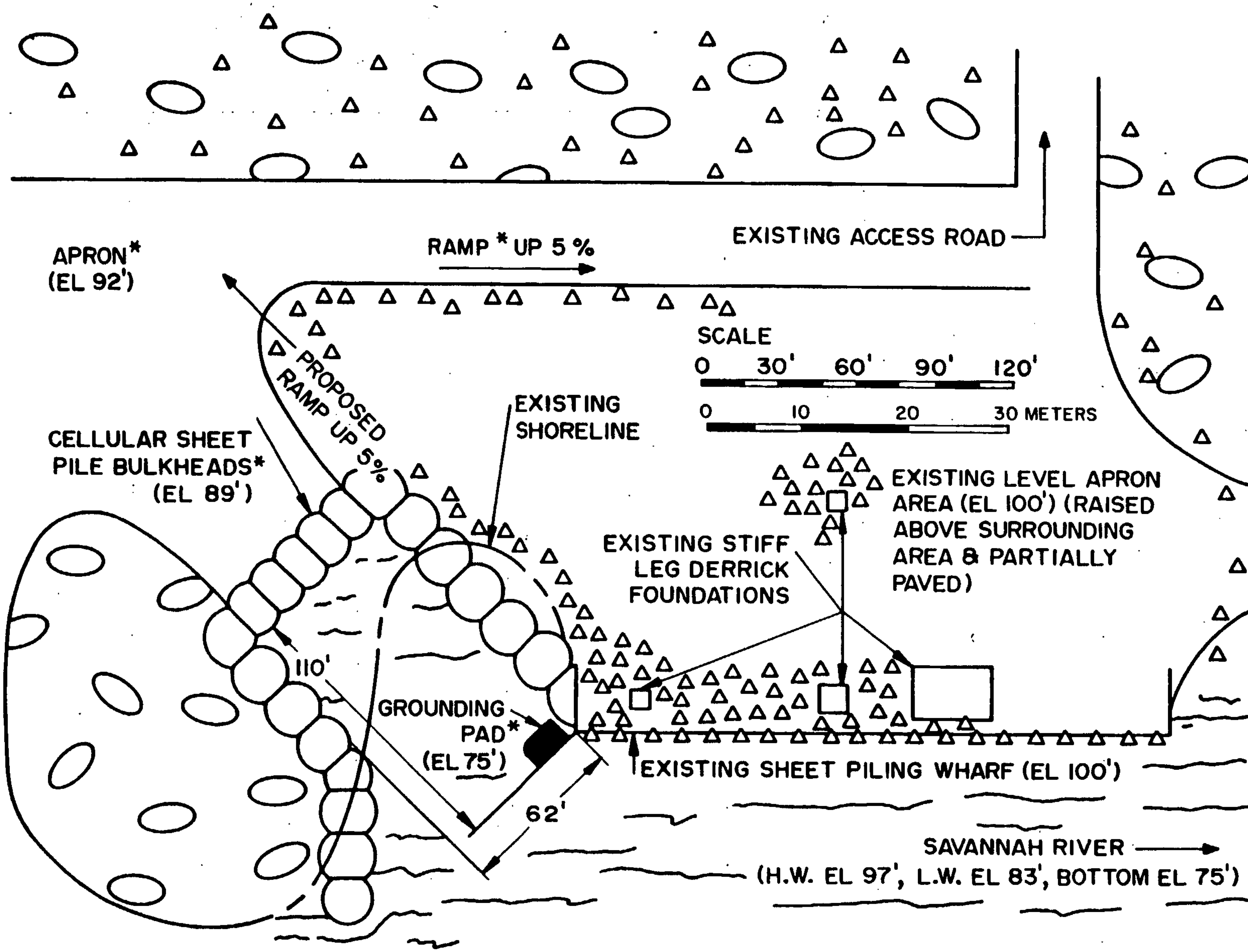


Figure L-3. Aerial Photograph of the Potential Barge Slip Site at Ellenton Landing



* ITEMS MARKED ARE PART OF THE CONCEPTUAL DESIGN AND DO NOT EXIST AT THIS TIME.

Figure L-4. Conceptual Design of the Potential Barge Slip

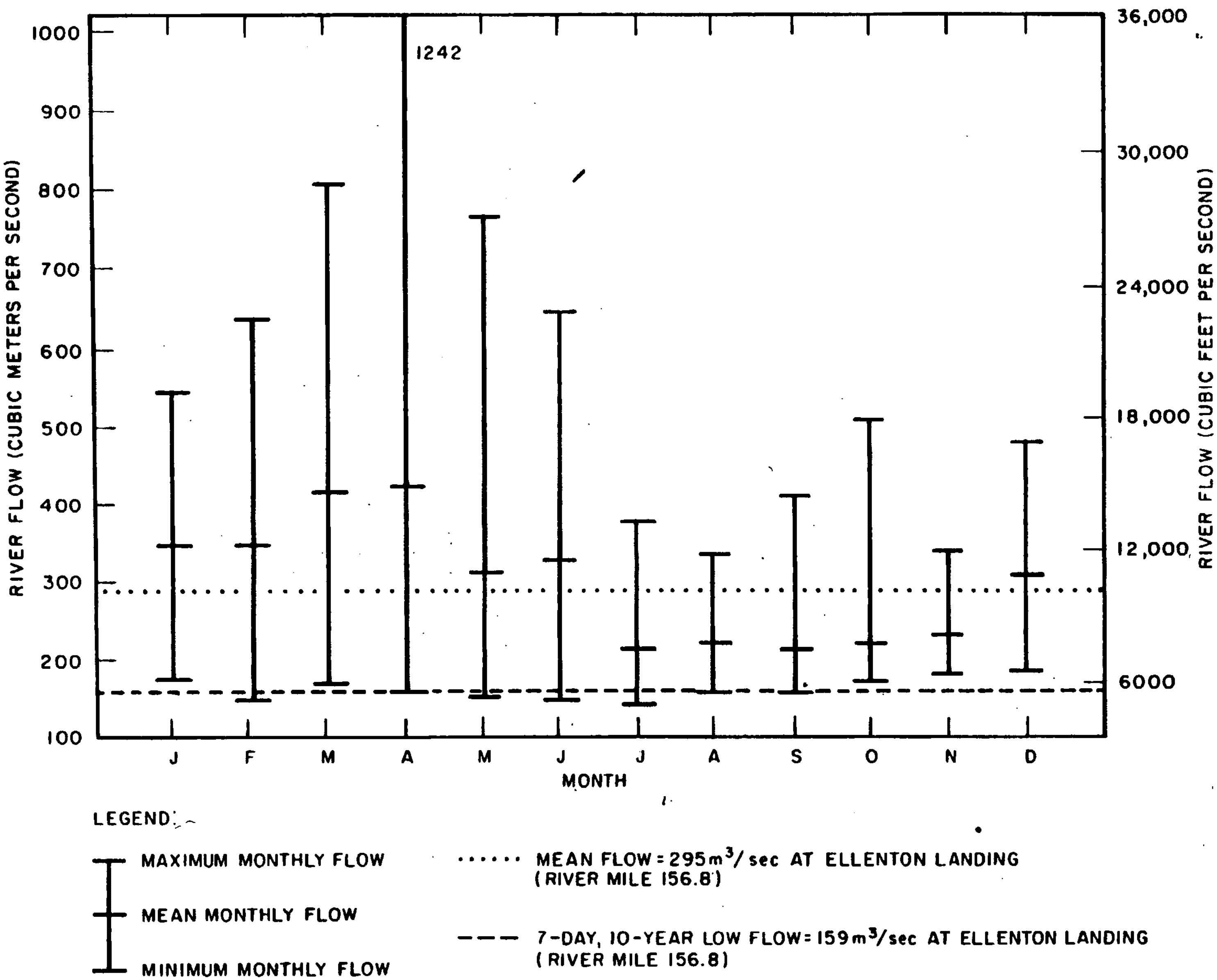


Figure L-5. Mean Monthly Flow Rates of the Savannah River from 1964-1981 at River Mile 187.6 (data derived from USGS gaging station, near Augusta, Georgia, adapted from Reference L.18)

C. ECOLOGY

The Savannah River Plant is located near the line that divides the oak-hickory-pine forest and the southern mixed forest. Consequently, it contains species representative of each forest association. In addition, the vegetation of the Savannah River Plant has been influenced strongly by farming, fire, topography, and the physical and chemical nature of the soil and water. Except for the production areas and their support facilities, many previously disturbed areas have been reclaimed by natural plant succession or planted with pine by the U.S. Forest Service. Currently, the Savannah River Plant contains a mosaic of structurally complex habitats ranging from dry upland hardwoods and conifers to Carolina bays and other wetlands. In turn, these habitats support an abundant and diverse vertebrate fauna.

The Savannah River Plant contains approximately 31,400 acres of diverse wetland types that include Carolina bays, emergent wetlands, aquatic beds, and forested wetlands. One of the largest wetlands on the Savannah River Plant is the forested wetland that borders the Savannah River (Figure L-1). Classified as part of the palustrine wetlands system of the U.S. Fish and Wildlife Service (Reference L.5), this mature swamp forest is approximately 16 kilometers long and 2.5 kilometers wide, and covers 7460 acres. The swamp was lumbered in the late 1800s and the present forest consists of a second growth of bald cypress, tupelo gum, and numerous hardwood species (Reference L.6). The undisturbed areas are also dominated by bald cypress and tupelo gum in the low areas, and along the stream channels by red maple, water ash, water elm, and other bottomland hardwoods in the higher areas (Reference L.7).

The swamp is bordered on the river side by a natural levee which is breached by three major stream outlets (Reference L.2). The swamp experiences seasonal water level fluctuations which are 3 to 4 meters higher in the winter. This seasonal flooding and ebbing cycle provides a renewal input of nutrients that increases the productivity of the swamp, and is critical to its existence (Reference L.7).

Floodplain/Wetlands Vegetation

Reference L.8 examined 58 forest stands along Upper Three Runs Creek and the swamp forest bordering the Savannah River. Two stands that were sampled in the immediate vicinity of the existing boat dock were categorized as *Quercus laurifolia - Ilex decidua* and *Nyssa aquatica - Fraxinus pennsylvanica*. Both stands had similar flooding levels ranging from 1.0 to 1.7 meters.

The forest along the Savannah River between the intake canals appears to be an admixture of both bottomland hardwood and swamp forests. Large mature trees such as water hickory, bald cypress, tupelo gum, sycamore, and red maple are common. In some areas, dense crowns of willow overhang the bank.

The wetland vegetation in the vicinity of the existing boat dock is shown in Figure L-3. The existing boat slip currently supports a predominantly woody community of young saplings dominated primarily by sycamore and water hickory. Adjacent to the water is a small area of duck potato and grasses. This area is less than two acres in size, and does not provide quality wildlife habitat.

Fauna

The Savannah River Plant contains an abundant and diverse wildlife fauna. Because of its temperate climate and interspersion of aquatic habitat, over 90 species of herpetofauna have zoogeographic ranges that include the Savannah River Plant. Reference L.9 provides an overview of the herpetofauna on the Savannah River Plant, including estimates of relative abundance.

The swamp forest along the Savannah River also provides habitat for numerous species of birds including passerines, waterfowl, and herons. Reference L.10 documented a total of 1062 birds representing 59 species during summer surveys in the vicinity of Steel Creek. Additionally, the swamp forest provides excellent habitat for wintering waterfowl (Reference L.11). Forty-one species of mammals have geographic ranges that include the Savannah River Plant (Reference L.19), 25 of which have been documented in the swamp forest.

Common species in the bottomland and swamp forests include small mammals (mice and shrews), gray squirrel, fox squirrel, flying squirrel, opossum, and raccoon. Large mammals inhabiting the swamp include the feral pig and white-tailed deer.

Shallow areas and quiet backwaters and marshes of the Savannah River near the SRP site support diverse aquatic invertebrate assemblages; however, the bottom substrate of most open portions of the river consists of shifting sand that does not provide the best habitat for bottom-dwelling organisms. A sharp decrease in the total number of invertebrate species that occurred in the river during the 1950s has been attributed primarily to the effects of dredging (Reference L.12). The stabilization of the river discharge and the elimination of habitat caused by the reduction in the flooding of backwater areas might also have contributed to the decline. Some recovery occurred during the early 1960s, but complete recovery has not taken place. The groups most affected are those sensitive to the effects of siltation and substrate instability. Results of insect faunal studies conducted during 1972 (Reference L.13) indicated substantial organic loading to the river upstream from the Savannah River Plant.

Like other typical southeastern coastal plain rivers, the Savannah River and its associated swamp and tributaries have a diverse fish fauna. Reference L.14 listed 102 freshwater species from the Savannah River drainage. Seventy-six of these species plus 15 additional species have been reported from water bodies on and near the Savannah River Plant (References L.10 and L.15).

Endangered and Threatened Species

The Endangered Species Act of 1973 (P.L. 93-205) affords protection to some 300 species of native American plants and animals. In addition to the federal list, the State of South Carolina also recognizes and affords protection to fauna in accordance with the South Carolina Nongame and Endangered Species Conservation Act of 1974. The State of South Carolina, however, does not afford protection to flora other than federally-protected species.

The following section addresses those species that (1) are protected by state and federal law, (2) have been documented to occur on the Savannah River Plant, and (3) could be affected by the construction and operation of a barge slip at the proposed Ellenton Landing Site on the Savannah River. Reference L.16 contains listings of unprotected taxa such as those of "special concern" or "peripheral."

Listed as "endangered" by Reference L.17 and "threatened" by the State, the American alligator (*Alligator mississippiensis*) is locally common on the Savannah River Plant and breeds in Par Pond and the Savannah River swamp system (Reference L.9). The population ecology of this species has been intensively examined on the Savannah River Plant. This species does not inhabit the Ellenton Landing area that would be affected by the construction of a barge slip.

The wood stork (*Mycteria americana*) is designated by South Carolina as "endangered," and has been designated as an endangered species by the U.S. Fish and Wildlife Service (49FR7332). As many as 478 observations of the wood stork were recorded in the Savannah River swamp in 1983. This species does not inhabit the Ellenton Landing area that would be affected by the construction of a barge slip.

Red-cockaded woodpeckers (*Picoides borealis*) occur in upland pine forests at the Savannah River Plant. Habitat suitable for colonies of the red-cockaded woodpecker are not located in areas impacted by the construction associated with the potential barge slip at the Savannah River Plant or the disposal of spoils material on the Savannah River Plant Site (Reference L.10). It is concluded that important wildlife habitats would not be affected by the construction and operation of a barge slip at the Ellenton Landing Site.

The short nose sturgeon is listed as endangered by the National Marine Fisheries Service. Since 1982, nine short nose sturgeon larvae have been collected from the Savannah River; of these, seven larvae were collected in the vicinity of the Savannah River Plant. Depending upon the season in which construction of the barge slip might take place and upon the extent and duration of any dredging activity associated with construction of the barge slip and deepening of the river channel, larval sturgeon could be affected. Consequently, consultation with the National Marine Fisheries Service would be initiated and completed prior to any decision to construct a barge slip at the Ellenton Landing Site.

IV. ENVIRONMENTAL ANALYSIS

The possible construction and operation of a barge slip on the Savannah River near River Mile 157 could have direct, indirect, long-term, and short-term impacts to the floodplain and wetlands.

A. DIRECT AND INDIRECT IMPACTS

Direct impacts would be those resulting solely from the construction of the barge slip, and would typically be associated with the following activities:

- on-site activities prior to construction
- non-radiological materials storage
- clearing of the site
- earth excavation and fill
- foundation preparation and construction of barge slip
- disposal of excavated materials
- dredging and placement of dredge spoil.

Because the site on the Savannah River at the Savannah River Plant (Figure L-3) has been previously developed and is near access roads and materials storage areas, the principal direct impacts would be those associated with the excavation of the slip, dredging, and the placement of the dredge spoils.

Excavation of the slip and dredging of the river bottom in order to maintain depth continuity would necessitate the disposal of approximately 5950 cubic meters (7780 cubic yards) of material. Except for the dredge spoil, this material would have no impact on the floodplain or wetlands if it were placed in an upland area, and if no runoff from this mass were permitted to reach the river. Dredge spoil would be discharged into the water if hydraulic dredges were employed, or into land disposal areas if bucket dredges were used. Neither action would cause any irreversible, adverse impact to the floodplain or wetlands, but would temporarily increase turbidity and sedimentation in the river.

Indirect effects of the barge slip would include those associated with its operation. Accidents and the possible release of radioactivity are discussed in Chapter 4. Other indirect effects could result from (1) maintaining the continued navigability of the Savannah River by dredging, (2) periodic cleaning of the barge slip to remove sediments, and (3) discharge or spillage of ballast, oil, or other materials from the transport barges. The U.S. Army Corps of Engineers has historically dredged the Savannah River in order to maintain shipping as far inland as Augusta, Georgia. Sediment build-up in the barge slip should not exceed 1 to 2 feet, and could be removed with a portable dredge. This would cause only minor sedimentation. Spillage of oil or other materials from the transport barges is considered infrequent, and its occurrence would be of minimal magnitude. Direct and indirect effects on the floodplain or wetlands are therefore not considered to be irreversibly detrimental to the environment.

B. SHORT-TERM AND LONG-TERM IMPACTS

Short-term impacts are temporary changes occurring during and immediately following the construction of a barge slip on the Savannah River at the Savannah River Plant, and persist for only a short period of time. Short-term impacts include the temporary disturbance of the site area, and sedimentation resulting from dredging and slip excavation; these would be insignificant.

Long-term impacts typically result from the cumulative effects of certain actions, such as the continued dredging of the river and sustained barge traffic and docking. The impact of dredging, which has been assessed by the U.S. Army Corps of Engineers, has been sedimentation at localized "high spots" along the river, but these were temporary and not detrimental to fish or benthic organisms. The frequency of barge traffic and docking is not considered to be great enough to pose harm to the environment.

C. IMPACTS TO INDIVIDUALS AND PROPERTY

Because there are no dwellings or inhabitants continuously living in proximity to the barge slip, there would be no impacts to individuals or property. Flooding of the barge slip might temporarily halt barge dockings, but would not constitute an extreme hazard to the structure itself.

D. IMPACTS TO NATURAL AND BENEFICIAL FLOODPLAIN VALUES

The construction and operation of the barge slip at the Ellenton Landing Site would result in a modification of less than two acres. Because this type of construction would not affect (1) the water quality maintenance and groundwater, (2) important wildlife habitat (endangered or threatened species), (3) cultural resource values (open space, archeological sites, scientific study areas, or recreational areas), and (4) cultivated resource values (agriculture, aquaculture, and forestry), the natural and beneficial value of the floodplain and wetlands would not be significantly altered.

V. ALTERNATIVES

Because the barge slip, by design, must be contiguous with a navigable waterway, there is no practicable alternative at Savannah River Plant to locating this structure anywhere other than within the base floodplain. Furthermore, the construction and operation of the barge slip at Savannah River Plant, if flooded, would not:

- create additional consequences to any potential emergency conditions;
- affect the occupants of buildings such as hospitals, schools, or nursing homes;
- affect essential and irreplaceable records, utilities, or emergency services.

Therefore, alternative sites at Savannah River Plant for a barge slip outside the base floodplain were not examined. Based on examination of alternative sites within the base floodplain, the most feasible location for a barge slip would be between River Mile 157 and 155 on the Savannah River. Because the environmental impact of constructing a barge slip at the Ellenton Landing Site appears to be less than the impact for any other practical site, it was concluded that the Ellenton Landing Site was the most practicable option for a Savannah River Plant location. The rationale for this conclusion follows.

In order to evaluate alternative sites for a barge slip at the Savannah River Plant, discriminant criteria were selected that would identify the most feasible and practicable options. These included the following:

- the site must be located on the Savannah River Plant and be contiguous with the Savannah River;
- construction and operation of the barge slip must be feasible from an environmental and engineering standpoint;
- the site must be located as near as possible to an existing access road;
- construction and operation of the barge slip at the Savannah River Plant must avoid to the extent possible any adverse impacts to wetlands and floodplains.

The Savannah River Plant adjoins the Savannah River at two locations (Figure L-1). In Allendale County the lower "arm" of the Savannah River Plant extends from River Mile 128 to 130, an approximate distance of slightly less than 2 miles. Because this portion of the Savannah River Plant consists primarily of wetlands, and is significantly remote from an access road and the burial ground, it was not considered further.

The second and principal parcel of SRP property that adjoins the Savannah River is located in Barnwell and Aiken Counties; this segment extends from approximately River Mile 141 to River Mile 157, a distance of about 16 miles (26 kilometers). This portion of the river is bordered by an extensive (7460 acres) swamp wetland, and below River Mile 155 is unacceptably remote from an access road. Additionally, the location of the barge slip along this segment of the river would adversely impact wetlands and significantly increase construction costs. Therefore, areas downriver from River Mile 155 were excluded from consideration (Figure L-2).

Because of the proximity of Upper Three Runs Creek and one of the cooling water pump houses, only that section of the Savannah River from River Mile 155 to the small boat ramp is considered to contain practicable alternative sites to the proposed barge slip.

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APPENDIX M

METHODS FOR REMOVAL OR CONTAINMENT

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*This appendix was not part of the DEIS.

APPENDIX M

METHODS FOR REMOVAL OR CONTAINMENT

I. INTRODUCTION

This appendix describes the feasibility of methods by which low level radioactive nuclides associated with the reactor plants of decommissioned, defueled nuclear submarines disposed of in the ocean could be removed or further contained at some future time.

Essentially all of the radioactive material remaining in the submarine is contained within the metal matrix as an integral part of the corrosion resistant alloys forming the internal components of the reactor vessel. The only mechanism for release of this radioactivity would be through corrosion of the metal components. Details of the sea disposal method are described in Appendix D.

Based on the worst case analysis of this statement, there is no technical basis for expecting that removal or containment would ever become necessary.

Nevertheless, methods for handling this contingency which are feasible using current technology and equipment are described in this appendix. Because of the remoteness of the possibility of actually implementing the methods, the estimated costs have not been included in the overall cost estimates in Appendix A.

The configuration of the nuclear submarines addressed in this appendix is that associated with the free-fall sinking of the complete submarine (see Appendix D).

II. SUMMARY

The least costly course of action would be to envelop the entire submarine with freshly mixed concrete delivered from the ocean surface by means of a drill pipe. The other method would be removal by means of a significantly modified Glomar Explorer or a new, larger Glomar Explorer-type heavy lift ship. Actual use of either method is considered to be a remote possibility.

A. CONTAINMENT

The containment method is feasible using current state of the art technology. It would require no advance preparation of the disposed submarine, could be implemented at any time after disposal, and would completely contain the submarine.

B. REMOVAL

The removal methods are considered technically feasible based on the fact that large objects have been recovered from similar depths using such systems. However, the significantly greater lifting forces required to remove an entire nuclear submarine from the deep ocean floor significantly increase the technical problems and costs associated with these methods. These methods would be practical only while the submarine still retained its structural integrity. In addition, the significantly higher costs associated with these options make them considerably less attractive than containment.

C. SCHEDULE

It is feasible to implement the plan to contain a submarine in freshly mixed concrete placed on the ocean floor in approximately 26 months. To remove the entire submarine would require approximately 60 months from initiation of planning to actual retrieval.

D. COST

The cost to contain one submarine is estimated to be $6.4 million (FY 83). This cost estimate is based on the availability of a large drill ship with dynamic positioning capability such as the Glomar Atlantic, Pacific, or Challenger. The drill ships must have the drill pipe capacity and a dynamic positioning system with the capability of positioning the ship to the accuracy required to control the pipe string position in water depths of 14,000 feet. A program to remove an entire submarine using a new heavy lift ship would cost approximately $508 million (FY 83).

III. DISCUSSION

A. METHODS OF REMOVAL OR CONTAINMENT

The U.S. Navy and commercial deep sea exploration companies have developed and utilized deep ocean large object recovery systems. These systems utilize a large commercial deep ocean drill ship especially configured to handle a heavy pipe string as the lifting strength member.

Methods for containment of an object the size of a nuclear submarine located on the ocean floor have not been used in the past. The use of concrete to form such a containment would be appropriate because of the proven strength and longevity of concrete in a water environment. Concrete has been used as a structural material for underwater construction for nearly 100 years and a large amount of data is available on this technology. Structural concrete has been placed under water in shallow depths in continuous pours on the order of 25,000 cubic yards in the construction of bridge piers. This volume of concrete is greater than the volume that would be required to contain a complete nuclear submarine on the ocean floor. The U.S. Navy has performed initial investigations into techniques for placing large quantities of freshly mixed concrete on the ocean floor in water depths up to 20,000 feet. The investigations were directed primarily toward on-site construction of deep ocean mooring anchors and foundations and secondarily toward large object containment.

B. MOST FEASIBLE METHODS

The use of the large heavy lift ship removal method is considered to be a near-term post-disposal option which would be successful as long as the submarine's pressure hull strength remains adequate. As the pressure hull strength is degraded by corrosion, the complexity of attaching a lifting device to the submarine would increase significantly.

The placement of freshly mixed concrete on the ocean floor to contain the submarine or reactor compartment is a less sophisticated approach and has a greater tolerance for error. It is equally applicable for both near-term and far-term requirements and could even be used on a submarine that had corroded into pieces. Concrete has the characteristic of retaining or increasing in strength in a water environment. Additionally, data exist on the durability of concrete submerged in seawater for more than 60 years (Reference M.1).

C. DESCRIPTION OF REMOVAL OR CONTAINMENT METHODS

1. Containment

a. Description

(1) **Basic concept.** The concept is to contain a defueled nuclear submarine lying on the ocean floor by completely enveloping the submarine in freshly mixed concrete. The concrete would be delivered to the bottom through a 3.5-inch to 5-inch drill pipe which could be precisely positioned relative to the submarine. The concrete flow through the pipe is forced by gravity and pumping, with the velocity of the concrete limited by pipe-wall friction.

The concrete would be built up around and over the submarine to form an elongated solid mound with a minimum covering thickness of approximately 4 feet. The concrete would initially settle into the bottom sediment and as additional weight of concrete was built up the sea floor, soil would be displaced until the bearing pressure could be supported. The concrete loads would average approximately 1.5 psi. With pelagic clay as the primary sea floor soil constituent, it is estimated that the concrete would eventually settle into the bottom sediment a distance of 3 to 5 feet, forming a seal between the concrete and the soil substrate.

The concrete would be mixed in a continuously operated batch process concrete plant located on the drill ship and delivered by concrete pumps to the pipe string swivel head. Concrete, sand, aggregate, and fresh water (if used) would be delivered to the drill ship by barge. A sketch of the concept is shown in Figure M-1. Figure M-2 shows a cross section view of the submarine contained in concrete.

The method for placing concrete on the deep ocean floor was developed at the Naval Civil Engineering Laboratory, Port Hueneme, California for the purpose of in-place construction of very heavy deep ocean (up to 20,000 feet) mooring anchors and foundations. Reference M.2 is the technical report on this proposal and is the basis for the development of the concrete containment method.

(2) **Containment characteristics.** Concrete containment is described in detail for the situation where the complete submarine has been placed on the deep ocean floor using the free fall disposal option, on a pelagic clay bottom at a depth of approximately 14,000 feet (approximately 4000 meters). It is expected that the submarine would be substantially on an even keel and would have penetrated somewhat into the soft bottom sediment. If the submarine were not on an even keel, a small correction might be necessary in calculating the volume of concrete required to contain the hull. For a complete submarine hull with a length of 277 feet to 332 feet, the volume of concrete required would be approximately 18,000 cubic yards to 20,000 cubic yards. The actual amount required would depend on the specific class of the submarine and the depth to which the hull would have penetrated into the bottom sediment. Concrete volumes of this magnitude and greater have been placed underwater, in shallow depths, by continuous pumping methods in the construction of bridge piers.

The delivery of the concrete to the submarine hull would be initiated adjacent to the hull and, after the buildup of sufficient concrete, the dispersal head of the drill pipe would be immersed into the concrete, expanding the volume of concrete from the inside. This technique minimizes the area of concrete exposed to seawater and limits dilution effects to the outer skin. The pipe string would be moved by means of the drill ship and pipe string positioning systems so as to progressively surround the hull with concrete, eventually completing the elongated mound of concrete over the top of the hull.

To maximize homogeneity in the structure, the sequence of placing the concrete would be such as to allow each layer to be placed within 4 to 6 hours of the previous layer. This time interval could be increased to some degree by using retarders. Layers placed at an interval greater than approximately 6 hours would result in a cold joint, which would be a discontinuity but which should still provide a tight seal. Additionally, the random location of cold joints as the concrete structure forms would guard against contiguous discontinuities. Likewise, some local cracking of the concrete is possible but would be random and not likely to result in a breach in the containment due to the great thickness of the concrete.

The resulting structure would cure to full strength (approximately 4000 psi compressive yield, Reference M.3) over a period of about four weeks. The total structure would require 16 to 18 days of continuous mixing and delivery of concrete down the drill pipe.

(3) **Concrete mixing.** The concrete batching and mixing operation would be performed utilizing a portable central mix concrete plant set up on the deck of the drill ship. The plant operation should be automatic to allow continuous operation for a period of 16 to 18 days with provisions for analyzing and adjusting the concrete mix design on a continuous basis. Mixing materials would be cement, sand, and

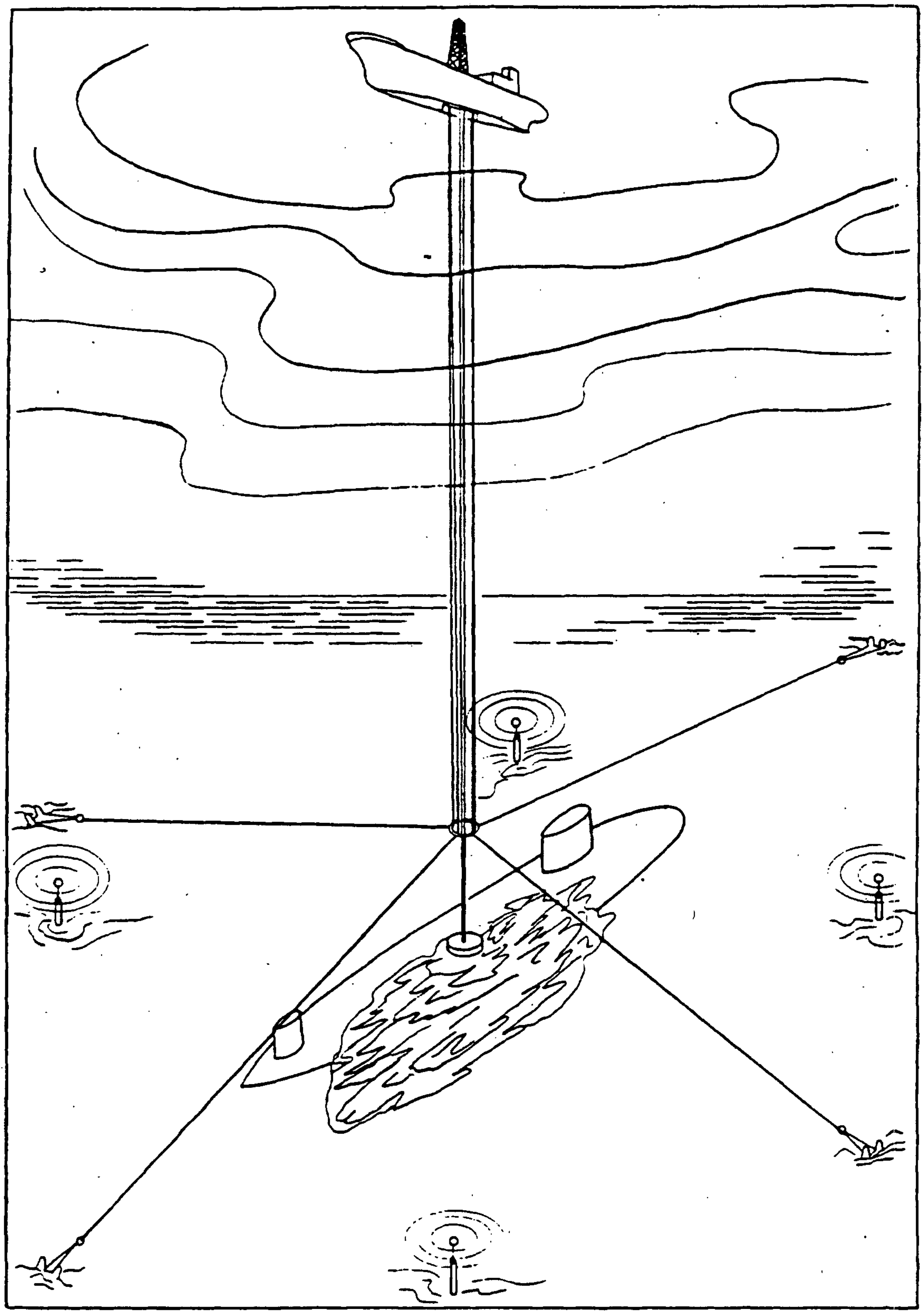

Figure M-1. Drill Ship Placing Concrete Over a Submarine

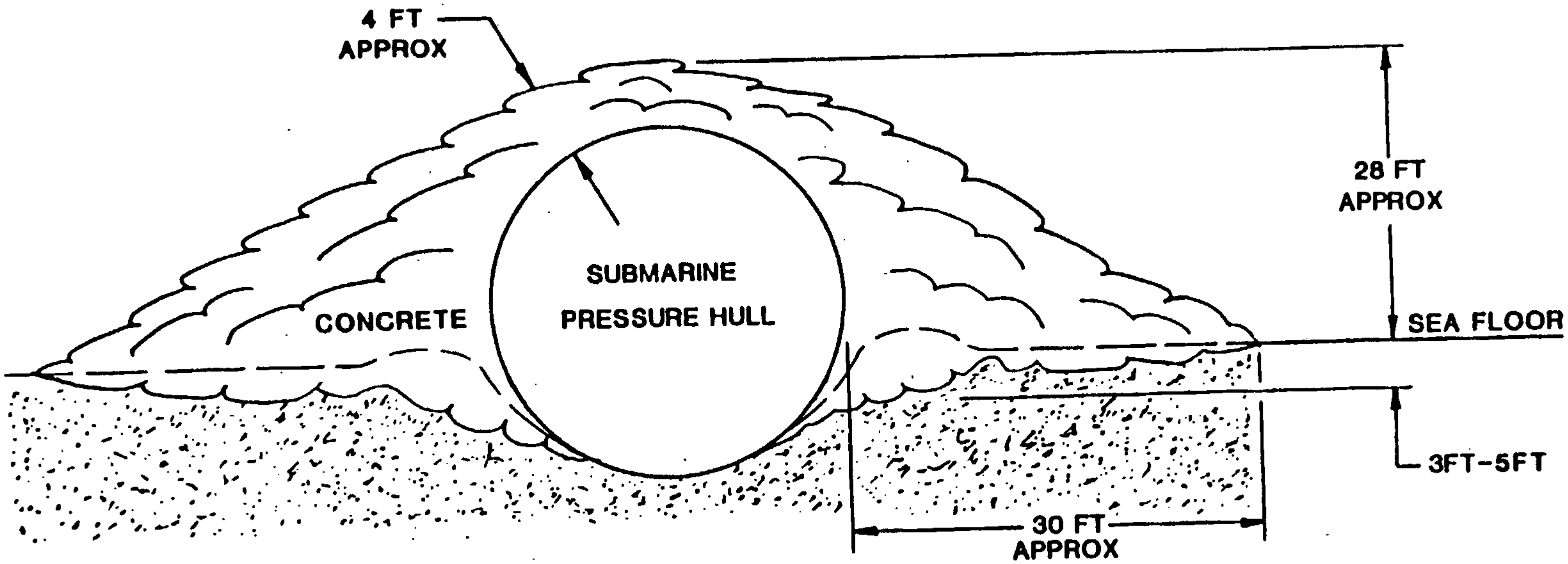

Figure M-2. Cross Section of Concrete Containment

gravel aggregates, water, and admixtures. Bulk materials storage and handling units are commercially available that are suitable for portable shipboard use. Ready materials would be stored on the drill ship with the main material supply located on a barge moored alongside. Resupply would be by barge on a shuttle schedule.

After batching and mixing, the concrete would be conveyed to the hopper of the concrete pumps which in turn would supply the concrete under pressure to the drill pipe concreting head. Rates of supply on the order of 50 cubic yards per hour would be sufficient to place the required volume of concrete with high reliability through the 3.5-inch to 5-inch internal diameter drill pipe. Equipment in the size ranges required is commercially available and is currently used in the heavy construction and offshore oil industries.

b. **Equipment Requirements**

(1) **Drill ship.** The key element of the concrete containment plan is the availability of a drill ship with a dynamic positioning system that will enable it to lower a drill pipe to the ocean floor in water depths of 14,000 feet. Various vessels are known to currently have this capability, such as the Glomar Challenger and the Glomar Explorer, for example. Each of these ships has the capability to carry and extend the pipe string, carry a deck-mounted central-mix concrete plant, and provide storage for sufficient cement, sand, aggregate, and water to sustain a continuous concrete production effort with replenishment materials supplied by barge.

(2) **Pipe string.** The drill pipe size to achieve the desired concrete flow velocity is in a size range (3.5-inch to 5-inch internal diameter) that is readily available. Some modifications to the pipe sections may be required to ensure smooth inside wall transition at the pipe joints. External attachments to the drill pipe string would be required for pipe positioning and concrete exit control.

(3) **Positioning system.** Technology currently exists to position a drill string in water depths up to 20,000 feet with sufficient accuracy to reenter a drill hole using only the drill ship positioning system (Reference M.4). This technology utilizes a sonar transducer which is dropped through the drill string to the tip, sonar reflectors placed on the drill hole reentry cone fixture, and a short baseline transponder drill ship positioning system. Systems which utilize active positioning devices located at the tip of the pipe string have been developed but it has not been necessary to use them in the deep ocean drilling work performed to date. These systems use either active jet propulsors or anchors with cables led through blocks at the pipe string tip and then to winches located on the drill ship (Figure M-3). These systems can be directed by a sonar or TV positioning system utilized in combination with the drill ship positioning system to control the pipe string tip location. It is anticipated that the drag on the pipe string tip resulting from the requirement to immerse the tip into the concrete will necessitate an active positioning system to accurately place the concrete.

(4) **Central mix concrete plant.** Central mix concrete plants of the required capacity (100 cubic yards per hour) are readily available in the heavy construction industry and are suitable for shipboard mounting. A typical off the shelf plant is shown in Figure M-4 along with the necessary ancillary equipment. Total plant weight is approximately 60,000 pounds and foot print area is approximately 610 square feet. In order to maintain continuous production of concrete it would be necessary to store sufficient cement, sand, aggregate, and fresh water on board the drill ship and install loading conveyors to continuously feed the concrete plant. Drill ships of the size required for this project already have sufficient cement storage in pressurized tanks as well as fresh water storage. Concrete can be transferred with compressed air to the central mix plant. Required ready service supplies of sand and aggregate in covered containers can be accommodated on the drill ship deck and storage holds. Table M-1 provides an estimate of required ready service materials to support continuous production of concrete with resupply accomplished by daily barge shuttle.

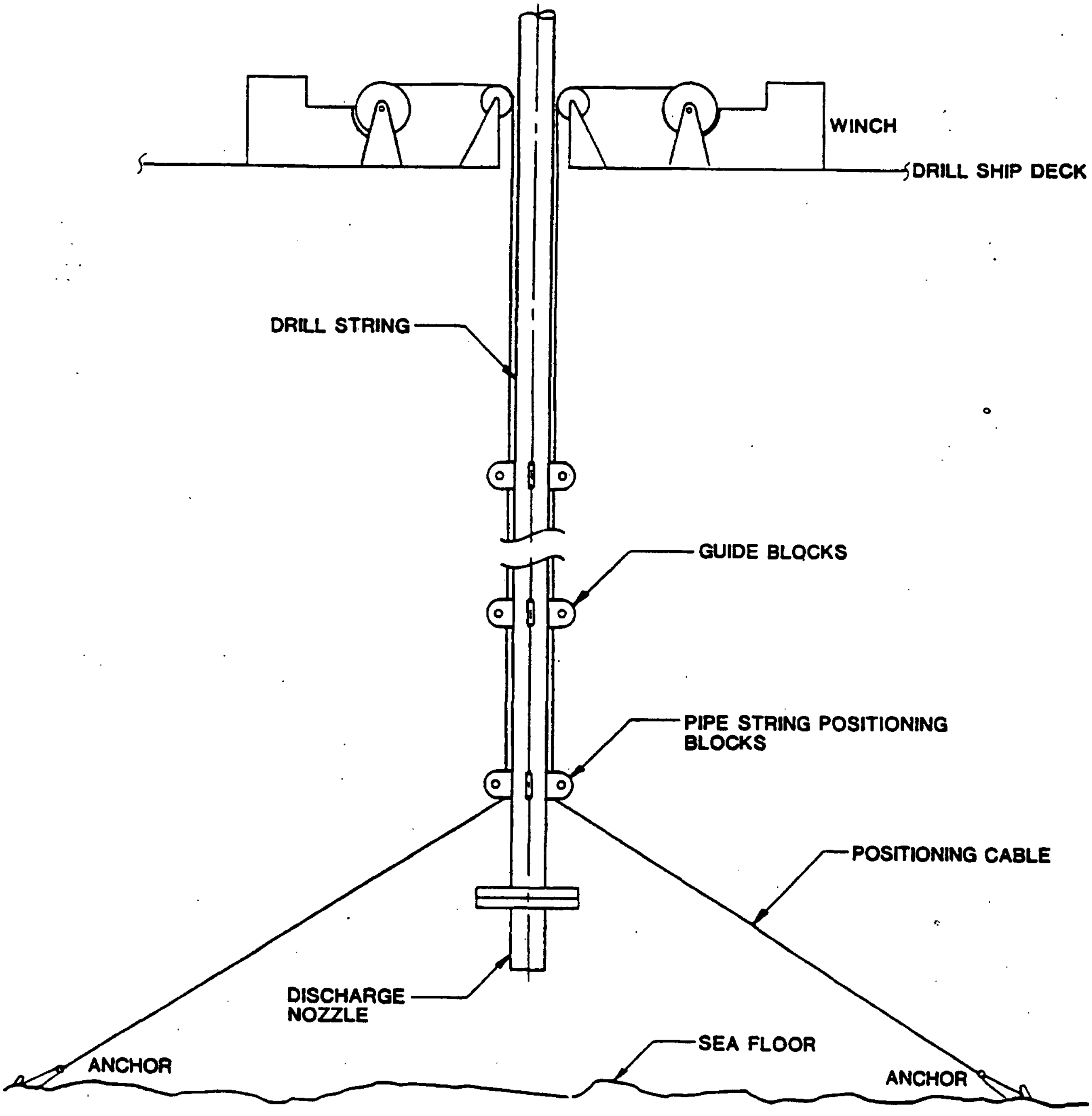

Figure M-3. Drill String Tip Positioning Using Anchors, Cables, Guide Blocks, and Winches Controlled by Positioning System

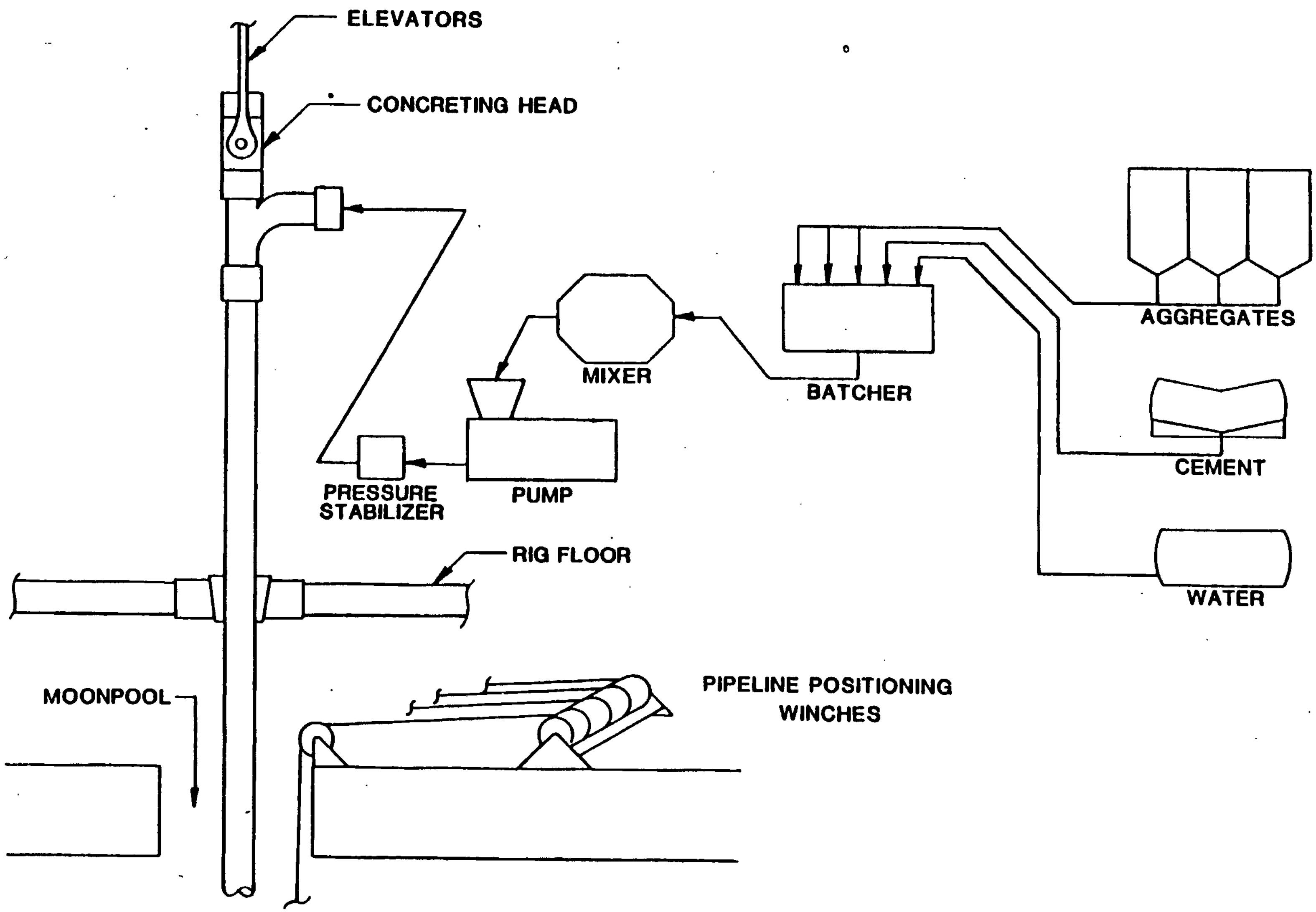

Figure M-4. Central Mix Concrete Plant

TABLE M-1. READY SERVICE MATERIALS REQUIRED ON DRILL SHIP TO ENSURE CONTINUOUS CONCRETE MIXING

	Aggregates	Cement	Water
Weight (lb)	3,600,000	768,000	385,000
Volume (cu yd)	1400	375	230

(5) **Supply barges.** The required resupply of materials would be accomplished through a barge/tug shuttle operated from the nearest port with suitable terminal facilities. The makeup requirements could be met with one barge of approximately 2000 cubic yards capacity per 24-hour day. To meet this requirement for 16 or more days of operation would require four barges and two tugs of about 3000 shaft horsepower size operating on a continuous schedule. This schedule is based on a location approximately 200 nautical miles offshore, a 24-hour offload time at the drill ship, a 24-hour loading time at the terminal, and a tug/barge transit speed of 8 knots.

(6) **Laboratory and engineering support.** In order to ensure a proper concrete mix and the ability to continuously adjust the mix, a portable laboratory would be required on the drill ship. Similar laboratories are utilized at land-based central mix concrete plants for large construction projects. Similarly, on-board engineering support would be required to resolve emergent problems.

c. **Engineering Developments**

(1) **Concrete mix design.** Development of a mix design would be required to achieve the optimum sand and aggregate size graduations and the matching of drill pipe inner diameter to provide proper wall friction forces and resultant flow velocity. This development effort is discussed in References M.2 and M.5.

(2) **Pipe string.** Standard drill pipe appears to be satisfactory for the drill string. However, a technical development program would be required to design a concreting head to supply the pumped concrete to the drill pipe. This equipment is equivalent to the swivel head of a standard drill rig. A second area requiring development would be the discharge or exit diffuser at the tip of the drill string. This device must provide the required back pressure to ensure proper flow in the drill string and may have an additional role in the positioning of the drill pipe through thrust generated by the exiting concrete. This requirement is also discussed in Reference M.2.

d. **Implementation Schedule**

(1) **Engineering development.** Engineering development in the three areas (concrete mix design, drill string hardware, and the positioning system) could be pursued concurrently. It would be necessary to carry out full scale operational tests in water depths of about 2000 feet to verify results. This depth should be adequate to establish steady state concrete flow conditions in the drill pipe while allowing use of readily available equipment. These tests could be executed utilizing small size, barge-mounted equipment such as would be used in local concrete construction. Likewise, small drill rigs exist that could be barge mounted or are installed on small drill ships used for shallow depth coring operations. The required development programs are estimated to require approximately 16 to 24 months.

(2) **Equipment procurement.** The most significant equipment item would be the drill ship itself. Currently, drill ships capable of extending a drill string to the required depths and maintaining the anticipated positioning tolerances are available. It is estimated that approximately 30 days would be required to outfit the drill ship for the concrete placement task.

Procurement of the central mix concrete plant, concrete pump, and support equipment would require from one to three months depending on whether the equipment is leased, purchased used, or purchased new. In any case, the equipment is in current use in the heavy construction industry.

Arrangement for tugs, barges, and port terminal facilities could be made with a minimum amount of lead time, normally one to two months.

(3) **Materials.** The cement, sand, and aggregates in the quantities anticipated for containing a single submarine could be supplied by existing quarry and cement operations. The critical sand and aggregate sizing requirements could, however, impose a greater lead time than for materials used in standard concrete mixes. If special crushing-mill or sand-sizing runs would be required, it is estimated that a lead time of approximately three to six months would be required.

(4) **Organization.** The implementation of the concrete containment plan would require both commercial and U.S. Navy involvement with the probable need for competitive bids for materials, contracting for equipment purchase, and lease hire arrangements for ships, tugs, and barges. It is estimated that a program acquisition organization would be required to be in place for a minimum of 60 to 90 days prior to the start of actual preparations.

(5) **Schedule.** Most of the efforts to develop and implement a concrete containment plan could be executed in overlapping or parallel paths. From the beginning of engineering development through the completion of a containment would require approximately 26 months. If the plan were required to be executed on a succession of submarines, it might be necessary to carry out multiple evolutions requiring several drill ship/concrete plant/tug/barge units.

e. **Cost**

The estimated cost of containment would include engineering development, concrete materials, materials transportation, concrete plant lease, drill ship lease, and engineering and management. Costs are in FY 1983 dollars.

Cost to Contain One Submarine:

Technical Development	$1.6 M
Materials	1.2
Transportation	0.4
Concrete Plant	0.1
Drill Ship	1.8
Engineering and Management	1.3
Total	$6.4 M

The cost of the engineering development, drill ship modifications, and a portion of the engineering management costs are identical for one submarine or for multiple submarines. If more than one submarine were contained, the unit cost would decrease to approximately $3.5 million at five and $3.2 million if a total of ten were contained.

2. Removal

With the horizontal planes removed from the submarine and the longitudinal center of gravity adjusted through addition of gravel, the submarine would descend on an even keel and would bottom within a relatively short displacement from the release point. The rate of descent has been established at about 40 feet per second, which, upon impact, would cause the submarine to penetrate somewhat into the soft bottom. The submarine would subsequently settle farther into the sea floor over a period of time. Depending on the constituent soils in the sea floor, it is possible for the submarine to penetrate up to half of the hull diameter, which would greatly increase the difficulty of later removal and is assumed to be the worst case condition.

According to a Naval Civil Engineering Laboratory study (Reference M.6), the force required to raise a submarine from a one-half diameter position in bottom mud or clay is speed dependent. A fast lift off the bottom (say one hour) might require the application of force equal to twice the submarine weight, but a slow lift over many hours can break out the submarine with a force slightly in excess of the submarine weight. The largest submarine, when flooded and on the bottom, would have a weight in water of approximately 6000 tons. In addition, after retrieval it would be necessary to transport the flooded submarine to another site for further processing.

The Glomar Explorer is an existing asset currently in the U.S. Navy Reserve Fleet. She is a ship approximately 600 feet long with a beam of 116 feet, configured to provide very heavy lifting capabilities through a large midships well. The well measures 199 feet fore and aft and 74 feet athwartships and extends from the keel to the main deck. Over the well, a drill rig type derrick is erected which permits the assembly of drill pipe units into a long string, which may be used as a tension member to raise large weights from the deep ocean. The pipe string with its load can be retrieved at the rate of 6 feet per minute. As presently configured, the Glomar Explorer can raise 4400 tons from a 14,000-foot depth in approximately 40 hours.

Glomar Explorer has the navigational capabilities required to precisely locate a predetermined spot in the disposal area. With the aid of bottom positioned transducers and targets, and an Automatic Station Keeping System, "ASK," the twin screw main propulsion system plus five transverse thrusters have the capability of holding Glomar Explorer to within a very tight circle directly over the predetermined spot. The ASK system can hold the ship within the accuracy of the transponders in fairly rough seas (Sea State of 6. Sea State 6 or less occurs over the Pacific study area about 88.6 percent of the time (Reference M.7)).

There are two options available to provide a retrieval ship which would have both the lifting capacity required and the well size to house a complete submarine. The first method is to lengthen the Glomar Explorer, adding about 140 feet to the mid-body to permit increasing the well size, and to design and fabricate an increased capacity heavy lift system. A new heavier pipe string would also be required. The second method is to design and build a new larger heavy lift ship which would have all the navigational and position-holding capabilities of Glomar Explorer and would have increased lifting capacity and a larger well.

a. Glomar Explorer with Increased Lift Capabilities and Lengthened Well

(1) Description

Increasing both the lift capacity and the size of the well would require that the existing Glomar Explorer be lengthened through the addition of 140 feet of parallel middle body and that a larger heavy lift system be installed. The lifting and well size requirements are the same as those for a new heavy lift ship as discussed below. Additionally, new well closure gates would need to be designed to accommodate the requirements of the larger well. The advantage of this plan is the time and cost savings which might accrue from starting with an existing ship.

(2) Equipment Requirements

The following equipment would be required to be designed, procured, and tested.

(a) The Glomar Explorer itself would require substantial additions to the hull girder to handle the increased bending moments resulting from the increased well length and the heavier lifting loads. The lengthening and strengthening of the hull would be within the state of the art. Sponsons or other means of increasing transverse stability might also be required.

(b) The well closure for the increased length well would need to be redesigned and fabricated, perhaps utilizing a two-stage sliding gate configuration similar to that currently used.

(c) The derrick must be robust enough to handle a "double" made up of two 30-foot pipes welded together from 21-inch diameter pipe with a 6-inch internal diameter. This pipe would weigh a maximum of 1100 pounds per foot or about 70,000 pounds for a double.

(d) The heavy lift system would be required to have a capacity over twice that currently installed aboard Glomar Explorer. To raise a submarine of 6000 long tons from the bottom plus a "claw" with an estimated weight of 3000 long tons would require a pipe string weighing about 5000 long tons in water.

(e) The claw is a device for grappling and holding the submarine. Although a design for this device is not currently available, one could be developed for this application. An estimate of the weight of the claw is 3000 long tons.

(3) **Technical Developments and Implementation Schedule**

(a) Larger pipe size than that previously used by Glomar Explorer must be developed. The largest pipe identified for Glomar Explorer was 15.5 inches in diameter with a 6-inch internal diameter. The largest pipe size that might be required for this operation would be on the order of 21 inches in diameter with a 6-inch internal diameter.

(b) A significant development effort would be required to produce a claw that could be handled from the ship and could raise a 6000 long ton submarine.

(c) The heavy lift system developed for the existing Glomar Explorer was designed for a maximum capacity of 6250 long tons. The new heavy lift system would have to be designed to lift approximately 14,000 long tons.

The time required to develop the engineering to lengthen the ship is estimated to be about nine months and would take about two years to accomplish. This work could be performed in parallel with the technical development efforts. It is estimated that approximately 48 months would be required to implement this plan.

(4) **Estimated Cost of Removing One Submarine**

Development of engineering to lengthen ship	$ 3 M
Technical development of claw	5
Technical development of the heavy lift system	10
Lengthening of Glomar Explorer	144
Fabrication and installation of heavy lift system	60
Fabrication of claw	60
Fabrication of pipe	24
Capital costs (non-recurring)	$306 M
Operating cost for 12 months	36
TOTAL	$342 M

The cost of the technical development of the ship, claw, and heavy lift system as well as the lengthening of the ship and procurement of the pipe string and the preceding items would be identical for removal of one submarine or multiple submarines. If more than one submarine were removed, the unit cost would decrease to approximately $70 million per submarine at five and $40 million per submarine if a total of ten were removed. Costs are for FY 1983.

b. **New Ship Acquisition**

(1) **Description**

(a) This approach would involve the design and construction of a new heavy lift ship which would have the lifting capacity required to raise a complete submarine from 14,000 feet of water. A total lift system capacity of approximately 14,000 long tons would be required. In addition, this ship could bring the submarine into a well and close the well gates under the submarine. The well gates could then be dewatered to provide a seat for the submarine. The submarine would be secured in place for transit to a location where further processing would be implemented (Figure M-5).

(b) The new ship would be about 740 feet long with a beam sized to meet well width and stability requirements. Hull depth of about 55 feet would permit adequate strength to be built in for worst case hull girder bending. The well would measure 340 feet long and about 60 feet wide. The well top would be fitted with hatch covers and the bottom would be closed with hinged buoyant gates. These gates would be opened by flooding and closed by dewatering. The gates would close against gasketing to provide a water-tight closure.

The ship must be equipped with navigational capability at least equal to that existing in Glomar Explorer. Thruster power must be in excess of that provided Glomar Explorer because of the larger profile area of the ship. Position holding equipment must be the equivalent of that installed aboard Glomar Explorer.

(c) The new heavy lift ship would be equipped with the capabilities required to stow and assemble a pipe string of very large diameter pipe. A "claw" similar to that previously used by Glomar Explorer would be used to grapple the submarine. This would increase the total lift required as the weight of the pipe string and the claw must be supported by the heavy lift system.

(2) **Equipment Requirements**

The following equipment would have to be designed, procured, and tested.

(a) The major piece of equipment required would be the ship. This design and procurement would be "state of the art" and would have a very low risk factor. However, equipment to be installed aboard the ship would require considerable development.

(b) The well closure would require some design development to provide a water-tight closure which could be dewatered, and which could also provide adequate strength to support the submarine.

(c) The derrick must be able to handle the same pipe string requirements as the expanded Glomar Explorer. Similarly, the pipe string itself would be the same and would require a storage and handling system of proper size.

(d) The capacity of the heavy lift system would have to be increased to approximately 14,000 long tons. Again, this would require that a new system be designed and fabricated to meet this requirement.

(e) The claw requirements would be the same as for the expanded Glomar Explorer.

(3) **Technical Developments**

The drill pipe string, claw, and increased capacity heavy lift system would be identical to that required for the expanded Glomar Explorer and the technical development requirements and implementation schedule would be unchanged.

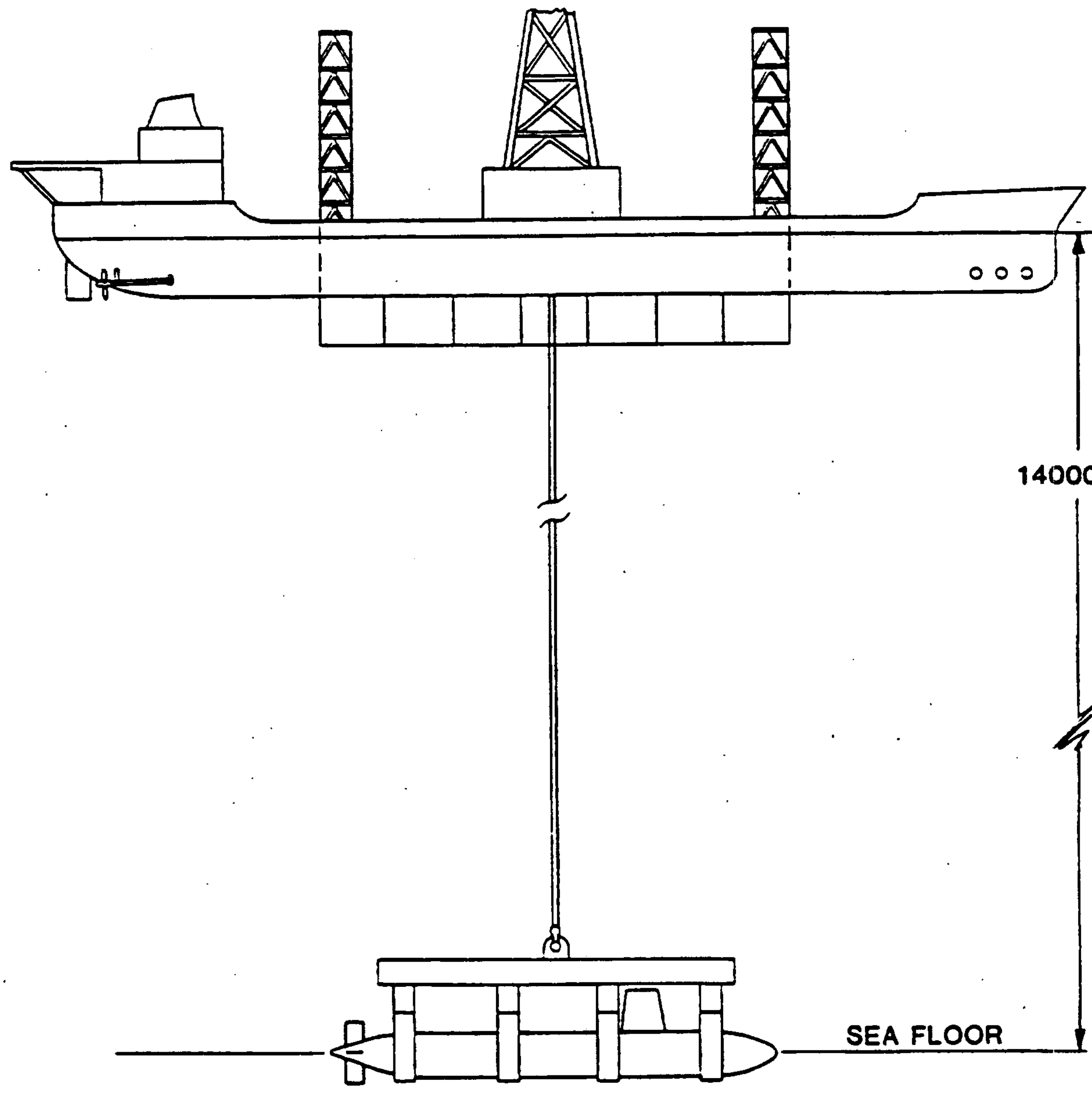

Figure M-5. New Glomar Explorer

(4) **Implementation Schedule**

The implementation plans for design and procurement of the various equipment could be pursued in parallel. From the beginning of preliminary design through detail design and construction of a new Glomar Explorer-type ship would require approximately 60 months.

(5) **Estimated Cost to Remove One Submarine**

Technical development of ship		$ 11 M
Technical development of claw		7
Technical development of heavy lift system		10
Procurement of ship		300
Fabrication and installation of heavy lift system		60
Fabrication of claw		60
Fabrication of pipe		24
Capital costs (non-recurring)		$472 M
Operating costs for 12 months		36
	TOTAL	$508 M

The cost of the technical development of the ship, claw, and heavy lift system as well as the procurement of the ship, pipe string, and the preceding items would be identical for removal of one submarine or multiple submarines. If more than one ship were removed, the unit cost would decrease to approximately $105 million per submarine at five and $57 million per submarine if a total of ten were removed. Costs are for FY 1983.

D. COMPARISON OF COSTS

The high costs associated with the construction and outfitting of a heavy lift ship similar to the Glomar Explorer but with significantly increased lifting capacity, or with the modification of the Glomar Explorer, make the approaches which utilize these options extremely unattractive when compared to the concrete containment method. The costs developed for options using either of the methods are based on realistic current cost data.

Summary of estimated costs for one submarine (FY 1983):

Containment in Freshly Mixed Concrete	**Removal—Modified Glomar Explorer**	**Removal—New Heavy Lift Ship**
$6.4 M	$342 M	$508 M

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ABBREVIATIONS, SYMBOLS, AND ACRONYMS

°C	degrees Celsius
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	curie
cm	centimeter (1×10^{-2} meter)
cm^3	cubic centimeter
DEIS	Draft Environmental Impact Statement
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FEIS	Final Environmental Impact Statement
ft	foot (feet)
FWQA	Federal Water Quality Administration (formerly Federal Water Pollution Control Administration and now a part of the Environmental Protection Agency)
g	gram or the acceleration due to gravity
gal	gallon
gpm	gallons per minute
hr	hour
IAEA	International Atomic Energy Agency
IMO	International Maritime Organization
kg	kilogram
lb	pound
LORAN	long-range navigation
LT	long ton (2240 pounds)

m	meter
m^2	square meter
m^3	cubic meter
μCi	microcurie (1×10^{-6} curie)
mCi	millicurie (1×10^{-3} curie)
MeV	million electron volts
mg	milligram (1×10^{-3} gram)
min	minute
mph	miles per hour
mr	milliroentgen (1×10^{-3} roentgen)
mrad	millirad (1×10^{-3} rad)
mrem	millirem (1×10^{-3} rem)
MT	metric ton (1000 kilograms)
NCEL	Naval Civil Engineering Laboratory
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NRL	Naval Research Laboratory
pCi	picocurie (1×10^{-12} curie)
psi	pounds per square inch
psia	pounds per square inch, absolute
psig	pounds per square inch, gauge
r	roentgen
rad	radiation absorbed dose
rem	roentgen equivalent man
sq mi	square mile
TLD	thermoluminescent dosimeter
USGS	United States Geological Survey
yr	year

GLOSSARY

absorbed dose	When ionizing radiation passes through a material, some of its energy is imparted to the material. The amount of energy retained per unit mass of the material is called the absorbed dose and is measured in rads and usually expressed in rems when referring to the absorbed dose in humans.
abyssal	Pertaining to ocean depths ranging between 4000 and 6000 meters.
abyssal plains	Broad flat areas of fine sediment located at the bottom of the ocean which are typically between ridges, mountain chains, slopes, and other prominent features.
acre-foot	A unit of volume usually used in reference to volumes of water. One acre-foot of water is equal to the amount of water which covers an acre of area and is one foot deep. One acre-foot equals 43,560 cubic feet.
actinide series	The series of chemically similar, mostly synthetic, radioactive elements which have atomic numbers between and including 89 (actinium) and 103 (lawrencium).
activation	The process of making a material radioactive by exposing the material to neutrons, protons, or other nuclear particles. In this statement, a large percentage of the radioactivity present in a defueled nuclear submarine was formed by activating the metal structures in the reactor compartment with neutrons during normal submarine operations. Activation is also referred to as radioactivation.
activation products	The radionuclides formed as a result of a material being activated. For example, Cobalt-60 is an activation product resulting from neutron activation of Cobalt-59.
activity	A measure of the rate at which a material is emitting nuclear radiation. Activity is usually measured in terms of the number of nuclear disintegrations which occur in a quantity of the material over a period of time. The standard unit of activity is the curie (Ci), which is equal to 37 billion (3.7×10^{10}) disintegrations per second.
admixture	Chemical or mineral additives used in concrete or mortar mixes to modify the characteristics of the mix.
adsorption	Taking up of molecules by physical or chemical forces by the surfaces of solids or liquids with which they are in contact; distinguished from absorption.
advection current	A general, prevailing water current.
aft	Toward or close to the rear section of a ship or boat.
aggregates	Sand, gravel, or rock which is used in concrete or mortar mixes to achieve increased strength.
alloy	A mixture of two or more metals.
alluvial fan	A fan-shaped accumulation of sediment on the ocean floor near a land mass which was deposited by flowing water; usually at the mouth of a river.
alpha particle	[Symbol α (alpha)] A positively charged particle emitted by certain radioactive materials. It is made up of two neutrons and two protons bound together, which means it has an electrical charge of +2, and it is identical to the nucleus of the

helium atom. It is the least penetrating of the three common types of ionizing radiation (alpha, beta, and gamma) emitted by radioactive materials and can be stopped by a sheet of paper. It is usually not dangerous to plants, animals, or man unless the material which is emitting alpha particles has entered the body.

aquifer	A geologic unit below the earth's surface which is capable of yielding water to a well or spring.
atomic number	The number of protons in the nucleus of an atom. All atoms of the same element have the same number of protons, whether radioactive or stable.
atomic weight	The average weight of an atom of an element which is usually expressed relative to one atom of the carbon isotope which is taken to have a standard atomic weight of 12.
attitude	The orientation of a ship relative to some reference line or plane.
average individual	An individual who could consume items or occupy areas at rates which would be typical for the population of interest.
background radiation	The radiation which exists in man's natural environment and includes cosmic rays and radiation from naturally-occurring elements, both outside and inside the bodies of humans and animals. Background radiation is also referred to as natural radiation. Typically, an average annual exposure of 100 mrem to the total body occurs from background radiation.
ballast	Any heavy material placed in a ship to enhance stability.
barge	A long, large, usually flat bottomed, unpowered boat which is towed by other craft and is used for water transport of bulky materials or large objects.
barge slip	A docking place for a barge.
base flood	A flood which has a 1 percent chance of occurrence in any given year. Also referred to as a 100-year flood.
bathymetric	Related to the measurement of the depth of large bodies of water.
benthic	Pertaining to the bottom of the ocean.
benthic boundary layer	A zone which separates the water at the deep layers of the ocean from waters directly above. Waters below the benthic boundary layer have relatively greater mixing properties.
best estimate	An estimate in which the factors used in determining the estimate were chosen such that the result approximately represents what would be expected.
beta particle	[Symbol β (beta)] A charged particle emitted by certain radioactive materials. It has a unit electrical charge and a mass which is equal to 1/1837 of a proton. A negatively charged beta particle is identical to an electron and is the more common form of beta activity. A positively charged beta particle is called a positron and is less common. Exposure to large levels of beta particles may cause skin burns, and materials that emit beta particles are harmful if they enter the body. Most beta particles are stopped by a few millimeters of lead or steel.
biofouling	A process in which the growth of plants and animals on the surface of metals causes the corrosion of the metals to increase.

biological half-life	See half-life, biological.
biosphere	All regions of the earth that support self-sustaining and self-regulating ecological systems.
biota	Plant and animal life.
bioturbation	A process in which the upper layers of sediment on the ocean bottom are mixed or disturbed by marine organisms living in or upon the sediment.
bow	The front section of a ship or boat.
bulkhead	An upright, thick, metal partition that divides a ship into compartments.
cement	The principal constituent of concrete, mortar, and grout which effects the bonding of the mixture through hydration. Main ingredient is limestone.
check valve	A device which permits flow in only one direction through pipes or openings.
cladding	A metal casing that surrounds the nuclear fuel.
coagulate	To transform particles which are in a fluid medium into a soft, semisolid, or solid material.
coastal zone	The region along the shore, adjacent to the ocean. A coastal zone is usually defined as the region within three nautical miles of a shoreline.
colloidal	Pertaining to a suspension of particles in water.
concentration factor	A factor which is defined as the concentration of an element or radionuclide in an organism or its tissues divided by the concentration directly available from the organism's environment under equilibrium or steady state conditions.
concrete	A mixture of cement, sand, and aggregate combined with water to form a slurry which hardens through hydration.
concreting head	A device to allow concrete to be pumped into the upper end of a suspended drill pipe.
conservative estimate	An estimate in which the factors used in determining the estimate were chosen such that the result would be unlikely to be exceeded.
containment	The result of enclosing and confining radioactive materials so that the radioactivity cannot be released to the environment.
continental rise	The lower portion of the continental slope.
continental shelf	A generally shallow and relatively flat submerged portion of a continent that extends to a point of steep descent to the ocean floor.
continental slope	The relatively steep area between the continental shelf and the deep-sea floor.
core	The central portion of a nuclear reactor containing the nuclear fuel.
coring	A method for sampling sediments.
corrosion	The process denoting the destruction of metal by chemical or electrochemical action.

corrosion products — The substances produced by corrosion of a metal. Rust is a common corrosion product resulting from the corrosion of iron.

corrosion release rate — Specifies the rate at which corrosion products move away from a corroding surface.

corrosion resistant alloy — An alloy which corrodes slowly compared to ordinary alloys. Stainless steel is an example of a corrosion resistant alloy.

crawler transporter — A large tracked vehicle which is capable of carrying extremely heavy loads either on paved roads or over unpaved terrain.

crinoid — Marine organisms which are characterized by feathery, radiating arms and a stalk by which they attach themselves to a surface. This includes sea lilies, feather stars, and stalked echinoderms.

critical habitat — Specific areas occupied by a species which contain physical or biological features which are essential to the conservation of the species and which may require special management considerations or protection.

critical organ — The limiting organ for evaluating exposure to ionizing radiation. A critical organ is determined by the following criteria: (1) the organ that accumulates the greatest concentration of a radioactive material, (2) the necessity of the organ to the well being of the entire body, (3) the organ most damaged by the entry of a radionuclide into the body, and (4) the organ damaged by the lowest dose. Usually case (1) is the determining factor for choosing the critical organ.

critical pathways — Those pathways which result in the most significant amount of exposure to radiation.

crud — In this statement, the corrosion products which have been activated by passing through the nuclear core during reactor operations and are deposited on and adherent to metal surfaces.

crustacea — Marine organisms which are characterized by a skeleton on the outside of the body and paired, jointed limbs. This includes lobsters, crabs, and shrimp.

curie — [Abbreviation Ci] A unit of radioactivity. One curie of radioactivity in a material results in 37 billion (3.7×10^{10}) nuclear disintegrations per second. This unit does not give any indication of the radiological hazard associated with the disintegration.

decay constant — [Symbol λ (lambda)] A constant which describes the rate at which a radionuclide will undergo the process of radioactive decay. In the equation $N = N_0 e^{-\lambda t}$, N_0 is the initial number of radioactive atoms present, e is the base of the natural system of logarithms, λ is the decay constant, and N is the number of radioactive atoms present after some time t. If N is equal to one-half of N_0, then t is the half-life of the radionuclide.

decay, radioactive — The process of spontaneous transformation of a radioactive nuclide to a different nuclide or different energy state of the same nuclide. Radioactive decay involves the emission of alpha particles, beta particles, or gamma rays from the nuclei of the atoms. If a radioactive nuclide is transformed to a stable nuclide, the process results in a decrease of the number of original radioactive atoms. Radioactive decay is also referred to as radioactive disintegration.

decommission	As used in this statement, to remove a submarine from active service.
defuel	To remove all of the nuclear fuel from a submarine.
demilitarization	The process by which equipment designated for disposal is altered such that any remaining equipment would not reveal any information of military value.
deposited activity	See crud.
detritus	The loose fragments, particles, grains, fecal pellets, or debris which descend to the ocean floor from shallower depths.
diffusion	The process of spreading out or scattering from regions of higher concentration to regions of lower concentration.
diffusivity	See eddy diffusivity.
disintegration, nuclear	A spontaneous nuclear transformation which is characterized by the emission of particles and/or energy from the nucleus of an atom.
dispersion	The process of scattering or distributing over a large region.
diving planes	Horizontal, hinged, movable sections which are mounted on a submarine to control the angle of descent or ascent.
dose	A general term which denotes the quantity of radiation or energy absorbed; usually expressed in rems for doses to man.
dose commitment	The total radiation dose accrued by an individual over a specified period of time due to the exposure of the individual to radiation during a given interval of time. This includes the total time the radioactive material would reside in the body, if ingested or inhaled. Dose commitments are usually expressed in rems and in this EIS generally represent the dose over 70 years following exposure for one year.
dose commitment conversion factor	A factor which converts the quantity of radioactivity taken into the body to the dose to the individual; usually expressed in rems per curie.
dose equivalent	A quantity used to express all radiations on a common scale for calculating the effective absorbed dose. It is defined as the product of the absorbed dose (in rads) and certain modifying factors and is expressed in rems.
dose rate	The amount of radiation dose delivered in a unit amount of time, for example, in rems per hour.
dose rate conversion factor	A factor which converts the exposure to a given radiation level to the dose that an individual could receive. It is usually expressed in rems per hour per curie per cubic meter (or square meter).
dredge spoil	Bottom sediments or materials that have been excavated from a waterway.
drill pipe	A pipe made up of sections used to turn a drilling bit used in the process of drilling into the earth's surface. The pipe may also carry various liquids used in the drilling process.
drogue	A device which is attached to a falling object to retard its speed, for example, a parachute.

dry dock	A large floating or stationary dock from which water can be emptied and is used for maintaining, repairing, or altering a ship.
echinoderms	Phylum of radially symmetrical marine animals consisting of starfishes, sea urchins, and their related forms.
echinoid	Marine organisms which are radially symmetrical and are characterized by a body covered with spines. This includes starfish, sea urchins, and sea cucumbers.
echogram	The mapping of the sea bottom using sound waves to determine the topography of a region.
ecology	The interrelationships between organisms and their environments. Also, the study of these interrelationships.
economic zone	The region of the ocean which is within 200 nautical miles of the shoreline.
ecosystem	A community of plant and animal populations together with their physical environment. An organizational unit which can maintain its biological activities independent of other units.
eddy	A water current that moves contrary to the direction of the main water current.
eddy diffusivity	A term used to describe how eddies, tides, and other processes besides currents affect diffusion or dispersion of materials in the ocean waters.
electron	A negatively charged particle with a mass which is equal to 1/1837 of a proton.
element	A chemical substance that cannot be divided into simpler substances by chemical means. A substance whose atoms all have the same atomic number.
endangered species	A species or subspecies which is in danger of extinction throughout all or a significant portion of its range.
epibenthic	Living on the sea bottom.
erg	A basic unit of work or energy. One erg is equal to approximately 7.4×10^{-8} foot pounds of energy.
excess	The state of being no longer required or of insufficient value for retention.
exposure, external	The subjecting of the outside of the body of an organism to ionizing radiation.
exposure, internal	The subjecting of the inside of the body of an organism to ionizing radiation.
exposure, occupational	The subjecting of an individual to ionizing radiation in the course of employment.
exposure, radiation	The subjecting of a material or organism to ionizing radiation.
fathom	A unit of water depth which is equal to six feet.
fathometer	A trademark for an instrument which is used for determining the depth of water by using sound waves.
fauna	Animals.

filament	As used in this statement, a long shallow section of cool, upwelled water on the ocean surface, extending out from the coast.
fissile	A material whose nucleus is capable of being split (fissioned) by neutrons of all energies.
fission	The splitting of a heavy nucleus into two approximately equal parts which is accompanied by the release of a relatively large amount of energy and generally one or more neutrons.
fission products	The nuclei formed by the splitting (fissioning) of heavy elements, plus the nuclides formed by radioactive decay of the fission products.
floodplain	The lowlands which adjoin inland and coastal waters and relatively flat areas and floodprone areas of offshore islands which are covered with water from a 1 percent or greater chance flood in any given year.
floodplain/wetlands assessment	An evaluation which consists of a description of a proposed action, a discussion of its effects on the floodplain/wetlands, and a consideration of alternatives.
flora	Plants.
food web	The description of the flow of energy and matter between organisms in an ecosystem. Food webs are combinations of several food chains.
fuel	Fissionable material used or useable to produce energy in a nuclear reactor. It may also refer to a mixture, such as natural uranium, in which only part of the atoms are readily fissionable.
g	An abbreviation for the acceleration due to gravity at the earth's surface; also, abbreviation for gram.
gamma ray	[Symbol γ (gamma)] High-energy, short wavelength electromagnetic radiation. Gamma radiation frequently accompanies beta particle emissions. Gamma rays are very penetrating and are stopped most effectively by dense materials such as lead or uranium. They are essentially similar to x-rays but are usually more energetic and originate from the nucleus. Cobalt-60 is an example of a radionuclide that emits gamma rays.
geochemistry	The chemistry of the composition and alterations of the earth's crust.
geology	The study of the origin, history, materials, and structure of the earth.
gross beta activity	Beta particle emissions from a material with no specific identification of the radionuclides present in the material.
groundwater	Water that exists or flows beneath the earth's surface in the zone of saturation between saturated soil and rock.
grout	A mixture of cement and water.
gyre	A circular or spiral form. Used mainly in reference to the circular motion of water in each of the major ocean basins centered in subtropical high pressure regions.
half-life, biological	The time required for a biological system, such as an organ or tissue in an organism, to clear by natural (nonradioactive) processes, half the amount of a substance that has entered it.

half-life, radioactive	The time required for half of the atoms of a radioactive material to decay to another nuclear form.
herpetofauna	Reptiles and amphibians. This includes snakes, lizards, crocodiles, turtles, frogs, toads, and salamanders.
holothurian	A class of echinoderms including the sea cucumbers.
hull	The thick metal casing which forms the outer covering of a submarine.
hydrology	The study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.
hydrostatic pressure	The pressure caused by the weight of fluids at rest. In the ocean, hydrostatic pressure increases with increasing depth.
induced activity	See activation.
inner bremsstrahlung	Electromagnetic radiation produced by the sudden retardation of an electrical particle (electron or positron) in the intense electrical field of the atomic nucleus.
ion	An atom or molecule which has acquired an electrical charge by gaining or losing electrons.
ionizing radiation	Any radiation which displaces electrons from atoms or molecules, thereby producing ions. Examples include alpha, beta, and gamma radiation. Exposure to ionizing radiation may produce skin or tissue damage.
irradiate	To expose to radiation.
isotope	One of two or more nuclides which have the same number of protons but have different numbers of neutrons in their nuclei. Therefore, the isotopes of an element have the same atomic number but different atomic weights. Isotopes usually have very nearly the same chemical properties but somewhat different physical properties.
knot	A unit of speed which equals 1 nautical mile per hour or approximately 1.15 statute miles per hour.
land disposal option	A disposal option in which the entire section containing the radioactive portions of the nuclear power plant is cut free from the rest of the submarine and then moved to and buried at a U. S. Department of Energy operated radioactive waste burial site.
leachate	The liquid that has percolated through a material along with the soluble constituents of the material.
list	The tilting of a ship to one side.
lithology	The study of rocks.
long-lived radioactivity	Radioactive nuclides which decay slowly, therefore, having relatively long half-lives. In this statement, it refers to those radionuclides with half-lives that are long in comparison to the expected time required for penetrating their containment; therefore, the following radionuclides are considered long-lived: Carbon-14,

Nickel-59, Molybdenum-93, Niobium-94, and Technetium-99. Nickel-63 is considered an intermediate between short-lived and long-lived radioactivity (see short-lived radioactivity).

LORAN — An acronym for long-range navigation. It is a long-range navigation system based on the use of pulsed radio signals for establishing position by analyzing the time delay between pulses.

low alloy steel — A high strength structural steel which generally contains less than five weight percent of total alloying additions.

manometer — An instrument which is used to measure pressure.

man-rem — A unit used to measure the radiation exposure to an entire group and to compare the effects of different amounts of radiation on groups of people. It is obtained by multiplying the average dose equivalent (measured in rems) to a given organ or tissue by the number of persons in the population of interest.

maximum individual — An individual who could consume items or occupy areas at rates which would be at a maximum for the population of interest.

maximum organ — The organ which receives or could receive the largest amount of exposure to radiation.

mega fauna — Bottom-dwelling marine organisms whose presence and abundance is typically assessed photographically or by capture by trawls and nets.

mesoscale eddies — Eddies which occur over hundreds of kilometers and with time scales of months and longer.

metric ton — [Abbreviation MT] A unit of mass which is equal to 1000 kilograms or approximately 2205 pounds.

MeV — An abbreviation for the energy unit of one million electron volts. One MeV is equal to one million (1×10^6) electron volts or approximately 1.6×10^{-6} ergs.

microcurie — [Abbreviation μCi] A unit of activity which is equal to one-millionth (1×10^{-6}) of a curie.

mil — A unit of length which is equal to one-thousandth (1×10^{-3}) of an inch.

millicurie — [Abbreviation mCi] A unit of activity which is equal to one-thousandth (1×10^{-3}) of a curie.

millirem — [Abbreviation mrem] A special unit for measuring dose equivalents which is equal to one-thousandth (1×10^{-3}) of a rem.

mollusc (or mollusk) — Marine organisms which include oysters, clams, mussels, squids, and octipi.

monitoring, environmental — The periodic or continuous determination of the amount of radioactivity or radioactive contamination present in a region.

mortar — A mixture of cement, sand, and water.

nautical mile — A unit of length which is equal to 1852 meters or approximately 1.15 statute miles.

neutron	[Symbol n] An uncharged particle with a mass slightly greater than that of a proton, found in the nucleus of every atom heavier than hydrogen. Neutrons sustain the fission chain reaction in a nuclear reactor.
neutron activation	The process of making a material radioactive by exposing the material to neutrons.
neutron irradiation	The exposure of a material to neutrons.
nuclear fuel	See fuel.
nuclear reactor	A device in which nuclear fission is initiated and controlled to produce heat which is then used to generate power.
nuclear submarine	A submarine which is propelled by the power produced by a nuclear reactor.
nucleus	The positively charged central region of an atom which is composed of protons and neutrons and contains almost all of the mass of an atom.
nuclide	An atomic form of an element which is distinguished by its atomic number, atomic weight, and the energy state of its nucleus. These factors determine the other properties of the element, including its radioactivity.
oceanography	The study of the ocean and its properties.
organ	A group of tissues which together perform one or more definitive functions in a living body.
organism	Any living plant or animal.
otter trawl	A trawl using otter boards to spread the net. The otter boards are attached to each side of the net's mouth and are caused to flare apart by pressure of the water.
particulate	Pertaining to a very small piece or part of a material.
pathway	In this statement, it refers to the route or course along which radionuclides from disposed and defueled nuclear submarines could reach man.
pathway entry point	In this statement, it refers to the location where a radionuclide could initially enter a pathway.
pelagic	Pertaining to anything which lives or occurs in the open ocean, as opposed to living or occurring in waters adjacent to land or inland waters.
pelagic clay	Clay which is found on the ocean floor.
percolate	To drain or seep through a material.
pH	A measure of the relative acidity or alkalinity of a solution. A neutral solution has a pH of 7, acids have pH's less than 7, and bases have pH's greater than 7.
photon	An indivisible unit of energy generally regarded as a discrete particle which has zero mass and no electrical charge.
picocurie	[Abbreviation pCi] A unit of activity which is equal to one-trillionth (1×10^{-12}) of a curie.

pinger	A device which emits a pinging sound and is attached to an object so the object can be located.
pipe string	A long length of multiple sections of drill pipe.
pitch	The alternate dipping of the bow and stern of a ship.
pitting	A localized corrosion process where the rate of corrosion is greater than the general rate of corrosion; usually resulting in the formation of small openings in the material.
plankton	The generally microscopic plant and animal organisms that float or weakly swim in a body of water.
positron	A positively charged particle with a mass equal to 1/1837 of a proton.
primary system	The portion of a nuclear reactor plant that contains the nuclear fuel and main coolant. The coolant is heated by flowing past the fuel (see secondary system).
protective storage	The storage of a defueled, decommissioned submarine at a location in which it is floating on water, periodically inspected, and guarded to limit personnel access.
proton	A stable, positively charged particle in the nucleus of an atom.
rad	An acronym for radiation absorbed dose. It is the basic unit for measuring the energy absorbed in a material from ionizing radiation. A dose of one rad is equal to the absorption of 100 ergs of radiation energy per gram of absorbing material.
radiation	The emission and propagation of energy through matter or space by means of electromagnetic disturbances which display both wave-like and particle-like behavior. In this context, the "particles" are known as photons. The term has been extended to include streams of fast-moving particles such as alpha and beta particles, free neutrons, and cosmic radiations. Nuclear radiation is that which is emitted from atomic nuclei in various nuclear reactions and includes alpha, beta, and gamma radiation and neutrons.
radiation field	A region where radiation is present.
radiation level	The measured amount of radiation in a region.
radiation survey	The evaluation of an area or object with instruments to detect, identify, and quantify radioactive materials and radiation fields which may be present.
radioactive contamination	The deposition of radioactive material in any place where it may harm persons, invalidate experiments, or make products or equipment unsuitable or unsafe for some specific use. The presence of unwanted radioactive matter.
radioactivity	The process of spontaneous decay or disintegration of an unstable nucleus of an atom; usually accompanied by the emission of ionizing radiation.
radioisotope	An unstable isotope of an element that decays or disintegrates spontaneously and emits radiation. More than 1300 natural and artificial radioisotopes have been identified.
radionuclide	A radioactive nuclide.

reactor compartment	A separate compartment in a nuclear submarine that contains the nuclear reactor and associated structural components and equipment.
reactor vessel (or reactor pressure vessel)	A very strong, thick-walled steel structure which contains the nuclear fuel and cooling water under high pressure during reactor operation.
rem	An acronym for roentgen equivalent man. A special unit for measuring dose equivalents. A rem gives the same biological effects as one roentgen of x-rays. One rem equals approximately one rad for x-ray, gamma, or beta radiation.
river stage	The level of the surface of a river in relation to some reference elevation.
roentgen	[Abbreviation r] A unit of exposure to ionizing radiation. One roentgen equals the amount of gamma rays or x-rays required to produce ions with one electrostatic unit of electrical charge (either positive or negative) in one cubic centimeter of dry air under standard conditions.
roll	To move or rock a ship from side to side.
salinity	The total amount of dissolved salt in seawater.
sea disposal option	A disposal option in which the entire submarine, after appropriate preparations, would be towed to sea and sunk in an area where the water depth exceeds 4000 meters.
sea urchin	Sea animal of somewhat flattened globular form, with a thin brittle shell, covered with sharp movable spines.
secondary system	The portion of a nuclear reactor plant where steam is produced and used to drive a propulsion turbine or turbine generator. The water in the secondary system is heated by the water in the primary system but does not come in contact with the fuel or other radioactive material (see steam generator).
sediment	Particles of organic or inorganic origin that accumulate in loose form.
seismic	Pertaining to an earthquake or earth vibration.
sessile	Staying in the same place.
shear	To deform a material by subjecting it to forces that tend to produce an opposite but parallel sliding motion of the material.
short-lived radioactivity	Radioactive nuclides which decay rapidly, therefore, having relatively short half-lives. In this statement, it refers to those radionuclides with half-lives that are short in comparison to the expected time required for penetrating their containment; therefore, the following radionuclides are considered short-lived: Sulfur-35, Scandium-46, Chromium-51, Manganese-54, Iron-55, Cobalt-58, Iron-59, Cobalt-60, Zirconium-95, and Hafnium-181. Nickel-63 is considered an intermediate between short-lived and long-lived radioactivity.
soluble	Capable of being dissolved. When water is the dissolving medium, it is often defined in operational terms as being the material in water that is able to pass through a filter having openings smaller than 0.45×10^{-6} meters or approximately 1.77×10^{-5} inches.

sonobuoy	A device which floats in water and receives sound waves and is used to locate items or areas.
sorptive	Pertaining to the ability to sorb;* i.e., to take up and hold, as by absorption or adsorption.
special nuclear material	Materials containing nuclides such as Plutonium-239, Uranium-233, or uranium enriched to a higher percentage than normal in the Uranium-235 isotope.
specific activity	The ratio between the amount of radioactive isotope present and the total amount of all other isotopes of that same element, both radioactive and stable. It is usually expressed in microcuries of radioisotope per gram of total element.
sponson	A buoyant section of hull added to an existing ship hull at the waterline and extending approximately 75 percent of the length of the hull.
stable atom	An atom that does not undergo radioactive decay.
statute mile	A unit of length which is equal to 5280 feet.
steam generator	The portion of the nuclear power plant where the heat from the primary system is transferred to the secondary system without physical contact between the water in the two systems.
stern	The rear section of a ship or boat.
submarine canyon	A canyon which exists on the ocean bottom.
survey meter	Any portable instrument which is used to detect radiation and is especially adapted for surveying or inspecting an area to establish the existence and amount of radioactive material present.
swivel head	A device which allows the introduction of liquids at the top of a drill pipe while the pipe is being rotated.
tectonic	Pertaining to or designating the rock structures which result from the deformation of the earth's crust.
thermocline	The zone of rapid temperature change which separates the layers of ocean water nearer the surface, which are subject to periodic variation in temperature, from the deeper layers of the ocean water where temperatures are essentially unvarying over time.
thermoluminescent dosimeter	[Abbreviation TLD] An instrument used to detect and measure accumulated radiation exposure. Commonly used for personnel and environmental monitoring purposes.
threatened species	Any species or subspecies which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
topography	The detailed physical description of the surface of a region, including the relative elevations of features. The graphical representation of the physical configuration of a region on a map.

tracer	An identifiable substance, such as a dye or radioactive isotope, that can be followed through a physical or biological process to provide information on how the process works.
transfer coefficient	A mathematical factor which describes the rate or probability of movement of a material from one location to another.
transmissivity	A coefficient that relates the volume of flow of a substance through a unit width of groundwater to the driving force (hydraulic potential) that tends to push the volume through the unit width of groundwater. It is a function of the porosity of the medium, the fluid properties, and the saturated thickness of the aquifer.
transmutation	Any process in which a nuclide is transformed into a different nuclide or more specifically into a different element by a nuclear reaction.
transuranic element	An element with an atomic number greater than 92 (uranium). All transuranic elements are produced artificially and are radioactive. They include neptunium, plutonium, americium, curium, berkelium, californium, einsteinium, fermium, mendelevium, nobelium, and lawrencium.
turbidity currents	Ocean water currents caused by slides of sediments down an ocean slope, resulting in the currents being laden with silt. Turbidity currents can reach speeds of up to 50 knots.
upwelling	A process in which the water at lower levels in the ocean moves to higher levels.
uranium	[Symbol U] A natural radioactive element with the atomic number 92 and, as found in natural ores, an average atomic weight of approximately 238. The two principal natural isotopes are Uranium-235 (0.7 percent of natural uranium) and Uranium-238 (99.3 percent of natural uranium). Natural uranium also includes a minute amount of Uranium-234.
vadose zone	The unsaturated region of soil located between the ground surface and water table.
waste, radioactive	Equipment and materials which are radioactive and for which there is no further use. Radioactive wastes are generally classified as high-level waste (those resulting from reprocessing reactor fuel or the used reactor fuel itself), as low-level waste, or as low-level waste containing transuranic elements or Uranium-233.
watershed	The region which drains into a river, river system, or body of water.
water table	The upper surface boundary of an unconfined aquifer, below which groundwater occurs. It is usually defined by the levels at which water stands in wells that barely penetrate the aquifer.
watt	A basic unit of power. One watt is equal to 1×10^7 ergs per second, and approximately 746 watts equals one horsepower.
wetlands	Those areas which are covered by water with a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflow, mudflats, and natural ponds.

x-rays

Penetrating electromagnetic radiations with wavelengths shorter than those of visible light. They are usually produced (as in medical diagnostic x-ray machines) by irradiating a metallic target with large numbers of high-energy electrons. In nuclear reactions, it is customary to refer to photons originating outside the nucleus as x-rays and those originating in the nucleus as gamma rays, even though they are the same.

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FINAL ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS. VOLUME 2. COMMENT LETTERS AND RECORD OF PUBLIC HEARINGS. BOOK 1: EXHIBITS 1 THROUGH 287. BOOK 2: EXHIBITS 288 THROUGH 724

DEPARTMENT OF THE NAVY
WASHINGTON, DC

MAY 1984

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

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FINAL ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

VOLUME 2 OF 3

COMMENT LETTERS AND RECORD OF PUBLIC HEARINGS

BOOK 1

EXHIBITS 1 THROUGH 287

MAY 1984

United States
Department of the Navy

BIBLIOGRAPHIC INFORMATION

PB90-193863

Report Nos: none

Title: Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. Volume 2. Comment Letters and Record of Public Hearings. Book 1: Exhibits 1 through 287. Book 2: Exhibits 288 through 724.

Date: May 84

Performing Organization: Department of the Navy, Washington, DC.**Department of Energy, Washington, DC.

Supplementary Notes: Also available from Supt. of Docs. See also Volume 1, PB90-193855 and Volume 3, PB90-193871.Portions of this document are not fully legible. Prepared in cooperation with Department of Energy, Washington, DC.

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Abstract: Volume 2 presents comment letters and the records of public meetings conducted by the Navy on the Draft Environmental Impact Statement. The public comment period on the Draft Environmental Impact Statement extended from December 22, 1982 to June 30, 1983; however, all comments received through the end of August 1983 are included. The letters and statements have been reproduced exactly as received from their authors or from the records of the public meetings. Where petitions were submitted, the transmittal letter, a copy of the petition, and the number of signers have been included, but the actual list of signatures has not been reproduced. For handling convenience, the volume is divided into Book 1 and Book 2. Unique identification numbers have been assigned to each letter and statement. The identification numbers correspond to the sequence in which the material was received by the U.S. Navy and, therefore, approximate a chronological correlation. An Author Index and an Exhibit Index are provided at the end of Book 2 of the volume.

FINAL ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

VOLUME 2 OF 3

COMMENT LETTERS AND RECORD OF PUBLIC HEARINGS

BOOK 1

EXHIBITS 1 THROUGH 287

MAY 1984

United States
Department of the Navy

i.b

INTRODUCTION

Volume 2 presents comment letters and the records of public meetings conducted by the Navy on the Draft Environmental Impact Statement. The public comment period on the Draft Environmental Impact Statement extended from December 22, 1982 to June 30, 1983; however, all comments received through the end of August 1983 are included. The letters and statements have been reproduced exactly as received from their authors or from the records of the public meetings; however, they are half-size to save space. Where petitions were submitted, the transmittal letter, a copy of the petition, and the number of signers have been included, but the actual list of signatures has not been reproduced. For handling convenience, this volume is divided into Book 1 and Book 2.

Unique identification numbers have been assigned to each letter and statement. The identification numbers correspond to the sequence in which the material was received by the U.S. Navy and, therefore, approximate a chronological correlation. An exception to this chronological order occurs where a respondent provided more than one exhibit. In these cases the identification number for the first submittal was assigned in order and suffix letters have been used with the initial identification number to differentiate submittals.

Exhibits have been sidebarred to identify issues which have been numbered according to the order in which they are presented in Volume 3. The analyses and responses to issues can be located in Volume 3 by using these issue numbers. For example Issue A.1 is the first issue in Section A of Volume 3.

An Author Index and an Exhibit Index are provided at the end of Book 2 of this volume. Both of these indices are comprised of listings of three associated identifiers: (1) name of respondent or organization, (2) identification number assigned to the associated letter or statement, and (3) the page number within Volume 2 where the letter or statement begins. The Author Index lists the letters and statements in alphabetical order by the name of the first author or organization. The Exhibit Index lists each letter or statement by numerical sequence of identification number. The combination of these indices provides a cross reference for readers to readily locate exhibits of a known author and to relate exhibits of interest to respective authors.

#1

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT CORPS OF ENGINEERS
P O BOX 919
CHARLESTON S C 29402

REPLY TO ATTENTION OF

SACEN-E

30 December 1982

SUBJECT: Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OP NAV-22)
Department of the Navy
Washington, DC 20350

1. This is in response to the Draft Environmental Impact Statement (DEIS) dated December 1982 on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

2. We have reviewed the DEIS within the scope of our designated areas of responsibility and expertise and have no comment.

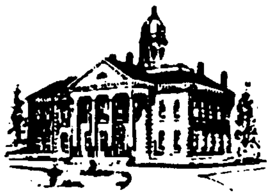
Alvin M Knight
ALVIN M. KNIGHT
Acting Chief, Engineering Division

Copy furnished:
Regional Interdisciplinary Environmental
Assessment Team
Room 834
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, GA 30303

Division Engineer, South Atlantic
ATTN: SADPD-R

Office, Chief of Engineers
ATTN: DAEN-CWP-V
Washington, DC 2031-

#2



CARTERET COUNTY COURT HOUSE

BOARD OF COUNTY COMMISSIONERS

CARTERET COUNTY

BEAUFORT, N.C.

January 5, 1982

Captain Edward F. Wagner
U. S. Navy
Office of the Chief of Naval Operations (OP-22)
Department of the Navy
Washington, D. C. 20350

Subject: Public Comment-Draft Environmental Impact State,
Disposal of Decommissioned Defueled Naval
Submarine Reactor Plants

Dear Captain Wagner:

The Board of County Commissioners of Carteret County has reviewed, discussed and taken formal action on the subject Draft.

While admittedly not experts in the field of nuclear waste disposal and the consequences thereof, we do feel our comments reflect a consensus of feeling among our constituents.

We oppose the Ocean Disposal option for the following reasons:

J.42 1. We do not feel the time factor associated with the USS THRESHER and USS SCORPION (20 years and 15 years respectively) is sufficient to accurately determine the long-term effect of radiation on the surroundings.

L.8 2. We remain unsure as to the cumulative impact of several dozen reactor vessels situated in relatively close proximity.

F.15 3. Being a coastal community, we are familiar with the hazards of ocean towing operations, especially off the notorious Cape Hatteras coast.

L.20 4. Even though preparations will have been made to maximize a controlled sinking situation, it is also true that once the scuttle-cocks have been opened

on the submarines, events afterwards are completely beyond the control of the Navy. Total supervision and control over disposal operations will not be possible as it would be with land disposal. L.20

5. Our community is almost totally ocean oriented. Tourism, commercial fishing and sports fishing is the very essence of our livelyhoods and activities. Our citizens hold a very real concern over any activities which would in any way affect them and future generations. L.53

We favor the Land Disposal option for the following reasons:

1. Land disposal of radioactive is a proven method as experienced by the waste generated from commercial power plants.

2. Disposal sites are available and their use generally accepted.

3. Utilization of only 10 acres of land versus 100 square miles of ocean bottom is advantageous. E.15

4. Transport and disposal operations would not be as sensitive to weather conditions or other unforeseen factors. F.15

5. Supervision and control throughout the total operation would be possible. E.15

We appreciate the opportunity to comment on the Draft. We are confident that the concerns evident within the coastal communities will weigh heavily during the decision-making process.

Yours truly,

Mary Sue Noe

Mary Sue Noe, Chairperson
BOARD OF COUNTY COMMISSIONERS
CARTERET COUNTY, NORTH CAROLINA

MSN/ve

cc: Board of County Commissioners
Walter B. Jones, Congressman

#3

PS This letter represents the views of thousands of people (most probably hundreds of thousands) who cannot make/take the time to write. I make the time, since my energy. LISTEN Please respond with a personal letter answering my questions.

Mrs Eleanor Lewallen
Box 372
Navarro Ca 95463
December 29, 1982.

Captain Edward Wagner
US Navy Office of Naval Operations
Dept of Navy. Washington DC 20350

Dear Captain Wagner,

As I write to you, I am recuperating from a hospitalized illness, have a headache & hurting throat, yet the importance of preventing the proposed dumping of radioactive submarine reactor plants causes me to write. I have been reading the information that the Navy, Sandia, & the EPA puts out & have the Draft EIS before me.

I'm going to comment directly to you and I want you to hear with your mind & heart, as an inhabitant of planet earth ~~what~~ the truth of what I am saying.

THE OCEAN IS NOT YOURS TO POISON. YOU HAVE NO RIGHT TO DUMP RADIOACTIVE MATERIALS INTO OUR OCEAN. OUR OCEAN BELONGS TO ALL OF US, PLANET EARTH and ALL OF HER INHABITANTS. IT IS IMMORAL & SHOULD BE ILLEGAL

L.36
L.14

FOR ANYONE (or AGENCY or GOVERNMENT) TO HARM the LIFE FORMS (all of us, fish, sea vegetable, etc) WHO DEPEND ON A HEALTHY UNPOISONED OCEAN for LIFE. Who will take responsibility for the great harm which the navy proposes to do to our ocean? Will you? Does anyone

2

in the navy really care? Or in the EPA? We live here. We make our living from the ocean, but I'd be writing this letter even if that were not the case. I have been a devoted environmentalist and educator for over two decades & much of my energy has gone for protecting the earth.

Our family of four (we have 2 young children) is supported by our small sea vegetable business. We supply hundreds to thousands of people with wholesome, mineral-vitamin-etc filled sea vegetables from the Mendocino county coast. Our business and thousands of other fishermen's businesses will be ruined if you dump those subs. L.53

WHERE IS RESPONSIBILITY for the EARTH and OCEAN. I don't even see how you could consider dumping these man invented monstrosities into the ocean, on which life depends.

I urge you to have & personally come to hearings in Fort Bragg in 1983 & listen to us. Spend some time here & become earth bonded. I believe that most people in the defense department have lost touch with the earth and basic things such as respect for living things, being surrounded by fear and paranoia. Politics would take another whole letter. Look into your heart and soul. Come to see us here. Listen to us. Peace be with you & your family & in our world in 1983. Sincerely, Mrs Eleanor Lewallen

ω

#3b

Box 372
Navarro, Ca 95463
April 6, 1983

Captain Edward F Wagner
Dept. of Navy
Office of Chief of Naval Operations
Washington DC 20350

Dear Captain Wagner,

This letter is a comment on the DEIS and the Navy's proposed plan to dump radioactive submarine reactor plants (or hulls, or any part there of) into the ocean. NO! It is not a good plan. It is a bad, harmful, and frankly unwise plan. [Were I to also add "stupid" that would sound insulting, so skratch that. My intent is not to insult or anger people who propose this plan.] My purpose is simply to say NO, there's a better way AND we need to change our national priorities and stop producing radioactive weapons which soon become poisonous wastes - all with no safe means of disposal.

My older brother Dr. Joel Leventhal who works for the USGS in Colorado who is a geochronologist and works w/ radioactive
H.2 carbon dating, etc suggested that radioactive waste be stored deep in stable areas of the earth - ask him ... Or I suggest, in the
H.4 area of the Nevada or other test site desert unpopulated all ready irradiated areas.

As I write my two young children are playing & interrupting me. It is a calm sunny spring day as I sit by light blue forget me not flowers w/ a variety of bees buzzing around collecting nectar & pollinating flowers. I need to cut wood to keep us warm tonight, but this letter has to come first. I mention this because I do make the time. There are millions of mothers in our country & the world over who cannot make or take the time to write who love their children and the world as much as I - and I know. I am speaking for them and you must listen to us because we are the majority of the world's population who do not

NOTE: Also see Exhibit 3

2

want nuclear war to happen or to harm/kill/maim ANYONE. NO! You don't have our permission. And the sub dumping issue is related to the whole area of nuclear weapons development, manufacture & threat. We are all nuclear hostages now and it is our government as well as the Soviets who are the terrorists, threatening us every day by planning & thinking the unthinkable and the unacceptable. We must make peace, SHALOM & STOP making nuclear & lager war tools immediately. It's insane to go on like this.

Captain Wagner, I'm directing this letter to you and these words to you because of the position you currently hold. [My children want to talk & eat, but I say no, I have to write this now! -]

Enclosed is the book The Hundredth Monkey by Ken Keyes, Jr. Please read it and include it as part of my comments to the DEIS. I would be glad to have anyone read it before including it in the comment packet - on second thought, I'm enclosing 2: one for you & your colleagues, one for the comment section. They are compliments of the Anderson Valley Nuclear Awareness Committee. We have fund raisers & yard sales to raise our funds for education about nuclear issues.

Now: What I really want to say & want all readers of this letter to hear: The oceans cover the majority of the earth's surface. They live and flow as an interconnected entity. The oceans are holy. All life in the oceans are holy and to be respected and revered. Our health, the health of our earth, our oceans depend on how we relate to them. We now have the

F.8 | opportunity to set a world wide precedent:
<u>No</u> <u>ocean</u> <u>dumping</u> <u>of</u> <u>radioactive</u> <u>waste</u>.
The USA can lead the way in this.
Were we (the gov't) to put our energy in a loving direction instead of greed and fear, there is a good chance that we <u>could</u> change the course of the history of our earth and humankind.
There is no need for armageddon or any greed or wars. Our mother earth really does provide — and its our job to protect and nurture her as well as our families and communities.
Captain Wagner, you heard us speak, you met us face to face in Sacramento.* I'm glad you were the person selected to come, because I could see in your eyes and body language that you <u>were</u> <u>hearing</u> <u>us</u>. Next is what you do, having heard the expertise, experience and wisdom from the ocean guardians of (many) all walks of life. You have the choice to heed

* Please send me a copy of testimony given in Sacramento on Feb 24 at the navy's hearing. I urge all readers of this letter to request a copy. It contains expert testimony all criticizing the navy's DEIS. It's a MAJOR commentary.

our wisdom and use every bit of power and influence you have to protect <u>OUR</u> ocean — and this means ~~ag~~ <u>everyone</u> <u>reading</u> <u>this letter</u> or you can choose to disregard it. I wrote <u>many</u> (similar) letters to Anne Gorsuch about the ocean & the navy's plan, specifically, and ~~on~~ being an earth guardian in general. I devoted a lot of time and energy trying to really reach her on the levels of ethics, morality, concern for the earth — using her power & position to do good. She did not heed my letters & now she's out of the E.P.A. Had she followed my most reasonable suggestions, she might have been removed for not following orders of the gov't & big business, but she might have been a heroine — a true earth guardian. What I'm saying is that you have a real opportunity to use your position, knowledge, & caring — to really help the ocean and the American people. Please do that. Your work will be rewarded. We will thank you. The ocean will not be poisoned needlessly — we will be closer to creating a ~~toxic~~ world where we live in peace and reverence for all living things. Finally: we make our living from the ocean. people depend on our sea vegetables for their health and well | L.53
being. If you dump subs, you poison our food & livelihood source — & we can't let that happen! May you move through this well in guidance. Sincerely, [illegible]

#4

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

CHARLES G. CLARK
~~GEORGE A. L. YUEN~~
DIRECTOR OF HEALTH

JOHN F. CHALMERS, M.D.
DEPUTY DIRECTOR OF HEALTH

HENRY N. THOMPSON, M.A.
DEPUTY DIRECTOR OF HEALTH

MELVIN K. KOIZUMI
DEPUTY DIRECTOR OF HEALTH

ABELINA MADRID SHAW, M.A., J.D.
DEPUTY DIRECTOR OF HEALTH

January 11, 1983

In reply, please refer to:
File: EPHS-SS

MEMORANDUM

To: Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations, Washington, D.C.

From: Deputy Director for Environmental Health

Subject: Environmental Impact Statement (EIS) for Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Thank you for allowing us to review and comment on the subject EIS. On the basis that the project will comply with all applicable Public Health Regulations, please be informed that we do not have any objections to this project.

We realize that the statements are general in nature due to preliminary plans being the sole source of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review.

For MELVIN K. KOIZUMI

cc: OEQC

#5

1-16-83

Dear Captain Wagner,

Thank you for sending me the Draft Environmental Report Report on the disposal of decommissioned nuclear subs. I must convey to you that I remain deeply concerned about this issue. There is nothing in this report that convinces me of the safety or advisability of dumping this kind of nuclear material into our oceans. From what I understand, there is no possibility of retrieving these submarines should leakage occur. No one knows what the long term harm may be if the ocean becomes contaminated. In my opinion, there is no acceptable "dose commitment" when it comes to radioactive poisoning and that is my point. Good luck on figuring out a sane solution to this insanity

W.1
L.20
L.39

Sincerely,
Ann Bauer
P.O. Box 527
Redwood Valley, CA
95470

#5a

4/18/83

Dear Captain Wagner,

I am writing to you to express my deep concern and opposition to the proposed disposal of nuclear submarines in our ocean. The north Pacific
L.53 ocean is one of the richest fishing grounds in the world. I have yet to see the results of a study that adequately addresses the question of radiation and
L.36 the way in which it can enter
L.20 our food chain. How can leakage be prevented when some of the radioactive elements have a half life of 20,000 years? In case of an accident,
L.57 the results will be devastating and
W.1 irretrievable.

Ocean dumping is a non-solution and does not address the basic problem which is the creation of *more* nuclear weapons and *more* nuclear waste. The manufacturers of nuclear waste must take responsibility for the safe disposal of such. Even this belies the more fundamental truth, this being that there is *no safe place* on this planet for this material. Shoot it up into space if you must but please don't ask me to pay for it! H.16

I request further *local* hearings J.15
to discuss this issue. Please consider Fort Bragg or Eureka as possible locations. The safety of our children may lie in your hands. Please consider.

Thank you,

Ann Bauer

Ann Bauer
PO Box 527
Redwood Valley, Ca.
95470

8

#6

Captain Wagner, Jan 22, 1983

Thank you for sending me your environmental impact statement. It's good to see that much energy is going into this project.

Despite your statement, I still do not feel that nuclear dumping into the ocean is safe. So far, history proves that we have not developed any reliable
L.20 method of containing super dangerous
nuclear waste. Dumping in the ocean is certainly the worst possible method - one that relies heavily on the "out of sight out of mind" theory.

After much reading regarding the past records of the U.S. government and its handling of nuclear matters - it can only be concluded that "gross negligence" best describes many decisions.

I feel that we are being used as
L.36 guinea pigs by our government - a
government that is suppose to protect us.

I, with the rest of my community, would
J.15 greatly appreciate a chance to hold
public hearings in costal areas so over

as the will of the local people may be more fully heard.

We are a group of people who dearly love our land and our sea - a group of people who will fight long and hard to protect whats ours - and our childrens - and also belongs to the residents of the ocean. We have no right to so foully pollute the sea.

Please, Captain Wagner, help stop the Navy from destroying the ocean - find somewhere else to stash hot subs. If they are so harmless, perhaps under the Pentagon would be a good location. You could keep a better watch on them then.

Yours truly,

Daniel Sampson
Box 541
Willits, California
95490

#6a

Mr Lehman, Jan 22, 1983

As a resident of Mendocino County, California, I am understandably upset by the Navy's plans to scuttle her used up nuclear subs off our coast.

Although I am not a scientist, I can read and comprehend what is said about radiation. Lets face it - radiation is the most dangerous toxin so far produced by mankind. What continues to amaze me is the way the United States government goes about denying the dangers of radiation.

I have written several letters to the Navy, to date, about my strong opposition to nuclear subs being dumped in the ocean. What I have gotten back is a huge DEIS. This impressive collection of graphs and words does not one thing to change the fact that radiation is dangerous - and dumping it into the sea makes it no safer.

J.15 I would like to request that you set up public hearings in costal communities in order that the will of the people may be heard. Is this, after all, not the ideal of government - to respond to the will of the people? J.15

Please, Mr. Lehman, help turn this potential catastrophe aside. There is no good way to dispose of these subs but ocean dumping is certainly the poorest choice.

Yours truely

David Sampson

Box 541

Willits, Ca. 95490

#7

The Transport Environment

S R 285 Old Squaw Drive Kitty Hawk, North Carolina 27949
919-261-2267 or 261 3068

January 25, 1983

Mr. Edward W. Johnson
Office of the Chief of Naval Operations (OPNAV-45)
Department of the Navy
Washington, D.C. 20350

Dear Mr. Johnson:

This refers to the Draft Environmental Impact Statement on the disposal of decommissioned nuclear submarines.

0.34 I have reviewed the DEIS, and have only one comment. The issue of the potential economic impact on tourism in eastern North Carolina should be dealt with. Technically, the risk is completely insignificant. Emotionally, the public fears anything radioactive, whether in fact hazardous or not. This fear, blown out of proportion by the media or anti-nuclear activists, could result in questions sufficient in the minds of tourists that they would choose to vacation somewhere other than on the Outer Banks of North Carolina. While there are those of us permanent residents of this surf and sand country who would just as soon not increase the number of tourists invading our peace and quiet, a more objective position would be that this potential impact on tourism needs to be explored and explained, and made a part of the record.

I am enclosing a copy of the testimony which I presented at the informational hearing held here in Dare County on October 19, 1982. After reviewing the DEIS, my conclusions regarding the proposed sea disposal remain unchanged. I support the Navy's proposal, and ask that this letter and my earlier testimony be made a part of the record in this matter.

Thank you very much. If I can be of any further assistance, please do not hesitate to call on me.

Sincerely,

W A Brobst

William A. Brobst, CDR USNR (Ret.)
President

Encl.

The Transport Environment

S R 285 Old Squaw Drive Kitty Hawk, North Carolina 27949
919 261-2267 or 261 3068

OCT 19 1982

TESTIMONY
OF
WILLIAM A. BROBST, CDR, USNR(RET.)

Before the Hearing of the House Committee on Merchant Marine and Fisheries, Manteo, North Carolina, October 19, 1982

* * * *

My name is William A. Brobst. I am a resident of Duck, in Dare County.

I appreciate the opportunity to appear before the House Committee on the subject of sea disposal of nuclear submarines. I appreciate even more your taking the time to come here to inform us about your proposals and to listen to our comments and ideas.

By way of background, I am a retired Naval Reserve Commander. In addition to several years of sea duty, I served in the nuclear weapons testing and storage program, and with the Navy's nuclear propulsion program under Admiral Rickover. I have a baccalaureate degree in chemistry, and my graduate work was in nuclear engineering and radiological physics. I presently serve as an advisor to the U. S. Department of Energy and to the United Nations in nuclear transportation. I am president of a small consulting firm which specializes in the transportation of hazardous materials.

For some months now, we've heard rumors here in Dare County that the Navy was planning to dispose of five nuclear subs off the North Carolina coast. We haven't seen much concrete information on the subject, and it's been hard to find out the facts. The result has been a lot of apprehension and, in some cases, downright fear about the possibility of nuclear waste washing up on our coast. Up until now, we haven't known just what was being considered, and what the potential hazards really are. This hearing will much to clear up that problem.

Because of my background in the Navy's nuclear power program, a lot of local citizens have asked me my opinion about this proposed sea disposal of the nuclear subs. I even gave a talk on the subject at the local Lion's Club. In each case, my listeners have been greatly relieved to learn that the hazards are quite minimal. But the public is generally apprehensive about things nuclear, and many people here in Dare County are still very worried about nuclear subs being dumped off their coast. Considering the lack of hard information in the past, it's no wonder. However, I have found most of my neighbors eager to learn more about the Navy's plans. Their minds are quite open on the subject.

#7 (Cont)

The preparation of a detailed Environmental Impact Statement by the Navy will be a big help in filling this information gap. I encourage the Navy and the Congress to ensure that people here in Dare County not only have an opportunity to review that EIS and to comment on it, but also to participate in its preparation. We want to be in on the planning at an early stage, not just informed of the results. It is heartening to see that the Navy is working closely with the Departments of Energy, Interior, and State, and the Environmental Protection Agency on this project. Being as far out in the boonies as we are, we have to rely to a great extent on receiving fair representation by the other parts of the Federal Government. We and they must ensure that all of the potential environmental effects are considered in depth.

Clearly, the nuclear subs which have become excess must be disposed of. The question is how, not if. Based on my own experience in both sea disposal and land disposal of radioactive wastes, I believe that the environmental impact of the proposed sea disposal of the defuelled nuclear subs will be minimal and acceptable. Even long term protective storage in a shipyard or in mothball anchorage would only be delaying the solution to the problem, without much decrease in the degree of potential risk. So there's little advantage to a long delay in getting rid of our excess nuclear hardware. Let's get on with it.

The world has had over thirty years of experience in sea disposal of nuclear waste. The United States has not done much of this in recent years, but overall we have learned a lot about what happens to this waste once it is committed to the deep. One of the things we've learned is that it's much better to commit it to the deep rather than to the shallow. The volume of chemical and hazardous wastes that have been dumped at sea is phenomenal indeed. Nuclear waste has been but a miniscule part of that total dumping effort.

We have learned that there is very little vertical interchange between deep ocean layers. Waste sitting at the bottom of a 17,000 foot deep ocean trench stays there. A nuclear sub is not going to float to the surface. It, too, will stay where it has sunk, as has been the case with the two nuclear subs that sank with all hands some years ago. There were no adverse environmental effects in those two cases, even with the hundreds of thousands of times more radioactivity on the operating subs than there will be in the empty hulks we're talking about here.

Another reason that the hazards will be minimal is that only low levels of radioactivity will be left in the hulks. These amounts will be within the limits set by the International Atomic Energy Agency for sea disposal of nuclear waste.

The Navy has put a lot of ships out there in that trench already. They've learned that, in many cases, it's cheaper to sink them than to try to cut them up. Sea disposal of the nuclear subs is likely to be very much less expensive than land disposal. The costs of removing the reactor shell and components and cutting them up for land disposal would be extremely high, and would probably significantly increase the total population exposure to

radiation as well. This is a good opportunity to save some tax dollars.

In summary, I support the Navy's efforts to investigate the total environmental effects of both land and sea disposal of the excess nuclear submarines. I appreciate your efforts to keep us informed, and I encourage you to bring us in at an early stage in the study. I believe that the environmental effects of this proposed sea disposal will be minimal, and need be of no concern at all to residents of the Carolina coast. And, if your final decision is to go ahead with this project, I shall support you.

Thank you.

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Transcript of Proceedings

BEFORE THE DEPARTMENT OF THE NAVY

TESTIMONY RECEIVED CONCERNING THE NAVY"S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DEFUELED, DECOMMISSIONED NUCLEAR SUBMARINES

Raleigh, North Carolina
Monday, February 14, 1983

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BEFORE THE DEPARTMENT OF THE NAVY

In the Matter of:

A PUBLIC HEARING TO RECEIVE COMMENTS ON THE NAVY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

Appearing for the Navy:

Capt. EDWARD F. WAGNER
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

JAMES MANGENO
Deputy Director
Nuclear Technology Division
Naval Sea Systems Command
Naval Nuclear Propulsion Program
Code 08
Washington, D.C. 20350

Monday, February 14, 1983
Raleigh, North Carolina

MORNING SESSION

9:16 a.m.

CAPT. WAGNER: Ladies and Gentlemen, my name is Capt. Edward Wagner and I am in the Office of the Deputy Chief of Naval Operations for Submarines. I have been appointed the Navy Hearing Officer for this public hearing. Here with me to present an opening briefing in Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Propulsion Program.

This public hearing is being held to receive comments on the Navy's Draft Environmental Impact Statement evaluating alternatives for disposal of nuclear powered submarine reactor plants after the fuel has been removed and the ships are no longer needed. The Navy has conducted studies on the feasibility of burying the defueled reactor plants in government-owned land disposal sites or placing them on the deep ocean bottom.

On December 22, 1982, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement (DEIS) on the disposal of decommissioned, defueled Navy submarine reactor plants. The DEIS contains the results of the Navy's studies of the alternatives available. On the table in the hall as you came in are copies of the Summary of the Draft Environmental Impact Statement. Anyone in the audiehce who would like a complete copy of the DEIS should leave their

name and address on the sheet of paper provided at the registrat: table, and a copy will be mailed to you.

The Navy's Federal Register announcement also scheduled public hearings at various locations which are convenient with an interest in this matter in order to provide them with an opportunity to present their views. I am here to today to conduct one of these scheduled public hearings. The purpose of this hearing is to take testimony regarding the Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case nor to engage in debate. It is my responsibility to receive statements so that they can be considered in preparing the final Environmental Impact Statement.

I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established for this hearing. As set forth in the announcement of the hearing, individual speakers are to limit their testimony to five minutes each, and organizational spokesmen are limited to ten minutes, unless additional time has been requested in advance. Time cannot be relinquished from one speaker to another.

In order to ensure all who desire to speak are given an opportunity, each person whould fill out a registration card and provide it to the registration table. All testimony will be recorded so that it can be considered in the development of the Navy's final Environmental Impact Statement.

If you desire to submit written comments rather than speak that is acceptable. You can provide written comments to me or leave them at the registration table. If you desire to provide written comments at a later date, my address is as follows:

Captain Edward P. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

You should provide your written comments by March 31, 1983 which as stated in the Federal Register notice is the cut-off date for submitting comments.

Before we begin receiving testimony, I would like to introduce Mr. Mangeno of the Naval Nuclear Propulsion program who will provide a general overview of the issues the Navy is addressing and the content of the DRAFT EIS.

MR. MANGENO: Today's hearing is being conducted as a part of the decision making process required by the National Environmental Policy Act. Under this law, the Navy must prepare an environmental impact statement for any action which could have a significant environmental impact or which might be subject to controversy over the environmental effects. The environmental impact statement must include the environmental

impacts for all reasonable alternatives.

The Navy's Draft Environmental Impact Statement, or DEIS, on this subject provides the basis for these hearings and the slides that follow are from the DEIS. It describes the alternate ways the Department of the Navy, in cooperation with the Department of Energy, is considering for permanently disposing of defueled nuclear powered submarines after they are no longer needed. The practical choices are: (1) Bury the radioactive part of the submarine at an existing DOE land disposal facility at the Hanford site in the state of Washington or the Savannah River Plant in South Carolina; or (2) Place the entire submarine on the bottom of the ocean in water more than 2.5 miles deep.

In both choices there would be no nuclear fuel left in the submarine because all of it would be removed before disposal. Nevertheless, there would be some low-level radioactive materials left within the submarine.

Preparation of this Draft Environmental Impact Statement does not mean that the Navy has already decided to dispose of nuclear submarines. The Navy currently has about 120 nuclear-powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases, as shown in this slide, it is evident that a disposal plan must be prepared for use sometime in the future. This DEIS has been prepared now so that all interested agencies, organizations and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

The submarines are constructed with the nuclear power plant enclosed within a single section of the ship called the reactor compartment. This slide shows a typical submarine with the location of the reactor compartment identified.

Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the Uranium and all of the fission products. The removed fuel is handled according to established procedures and is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, to the metal structure supporting the fuel, to the reactor vessel, and to other equipment in the reactor compartment, where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by

the hull of the submarine and by the reactor vessel and coolant piping. In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel, or other metal atoms in the reactor plant. These atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation of the nuclear reactor and the number of Curies of each radionuclide at that time. A curie is a mesure of the amount of radioactivity present, but is not an indication of the possible effect on man or animals. The amount and kinds of radioactive atoms present are described in detail in chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the Federal Government disposal facilities already used for such low level radioactive waste at the Hanford Reservation in the State of Washington or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the-compartment free from the remainder of the submarine, and wld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. Other Government-owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable waterways so that transportation of the reactor compartment to those facilities would be impractical. They Hanford and Savannah River burial grounds are described in Chapter Three.

A transporter of the sort shown in this sketch could then be used to haul the compartment overland to the burial location. There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial, or after burial. This is because radiation outside the compartment would be well below federal limits and the reactor compartment would have been welded shut at the

shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low level radioactive wastes. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burials and would result in no significant additional environmental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot readily be taken into the body. More than 200 years would pass before the reactor compartment bulkhead could be penetrated by corrosion (rust). Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time, exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean in another practical alternative. The maximum radioactivity would be less than the limit specified by international criteria and the triple containment provided by the submarine reactor compartment, by the reactor vessel and piping, and by the radioactive atoms being a part of the metal itself would be an extremely strong and effective disposal containment package.

Locations for possible ocean disposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U.S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site-specific public hearings would be required and the permit process is not part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 160 miles west of Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry and marine biology for very deep ocean locations. The depth of the water in these areas is between 4000 and 5000 meters (13000 and 16000 feet). The scientific information and measurements collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that the environmental impacts could be calculated using realistic data.

Preparation for ocean disposal would be made at one of the shipyards normally servicing nuclear-powered naval vessels. Following defueling, the reactor vessel and the reactor

compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping, and, of course, the metal itself completely intact. The analyses also show that most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping containments or free the atoms from the thick metal.

A comparison of the possible effects on the environment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100 submarine disposals for the year of greatest exposure from both options. This table shows that the radiation exposure would be very small and could have little impact on individuals or the population. These levels are also many times less than any limits established by U.S. regulations or international limits. They are much smaller than the normal fluctuations in annual average background radiation exposure for U.S. residents.

A perspective on radiation exposure can be gained by examining the exposure a person would receive from natural cosmic background radiation if he flew round-trip from New

York City to Los Angeles. That person would receive approximately 2 millirems more radiation than if he had not made the trip because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one-half millirem.

Other environmental impacts are similarly small for both options. The effects on animal life would be small and localized in either case. Land burial of 100 reactor plants would require only about 10 acres of land and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square 10 miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land dispoal would cost about 40% more (about $2 million per submarine more) than sea disposal.

The "No-action" alternative is to place submarines in floating protective storage for an extended period, commonly called "mothballing". However, this would only temporarily delay disposal because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other

alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods and the estimated radiation exposures for the general public would be very small for all available courses of action. Thank you.

CAPTAIN WAGNER: Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing. I will now recess briefly to establish an order for persons who wish to speak. For those people who would like to testify and who have not yet registered, you may do so at this time out at the registration desk in the hallway. We will reconvene the hearing in 5 minutes at 9:40 to receive testimony from the audience.

FROM THE AUDIENCE: Excuse me, sir. Would it be possible to ask any questions about the slide show presentation? I came in a little late.

CAPTAIN WAGNER: We would like to recess now, and we'll come back at 9:40. Thank you.

(At which time a short recess was taken.)

CAPTAIN WAGNER: Ladies and gentlemen, if you'll please take your seats we'll reconvene this hearing. For those of you who got here this morning a little late you might have missed Mr. Mangeno's briefing or my opening statement. I would say again that the summary of the Draft DEIS is available on the front desk registration table. We encourage you to take a copy of that with you. That would answer any or most all questions you might have. If you have some specific question that you don't feel is answered by reading that summary, there is another table at the front hall, and a man by the name of Mr. Anderson, the Chief of Naval Information; if you would please give him your question he will be happy to take it and provide you an answer at a later time.

At this time, simply to establish an order for the statements, I intend to ask individuals representing state government organizations to speak first, in alphabetical order by the speakers last names, followed by individuals representing local government organizations, in alphabetical order by last name of the speaker, and then private organizations and private citizens in alphabetical order by last name of the speaker.

I request your cooperation in providing comments within the time limit so that we may be certain all who wish to speak have an opportunity to do so. Once again, that is five minutes for individual speakers and ten minutes for organizational spokesmen. If your statement is so long that it cannot be given in the time alloted you may summarize in the five or ten minutes, and the entire statement will be included in the record is you submit it in writing.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, proceed

to and use one of the microphones provided, and with the size of the turn-out this morning, we're just going to use this microphone on my left. When you are called and you come to the microphone, state your name and organization, if any. All comments are to be addressed to me.

We are pleased to have as our first speaker this morning Ms. Jane Smith-Patterson, who is the Secretary of the Department of Administration in the state of North Carolina. Ms. Patterson.

#8

MS. PATTERSON: Thank you very much, Captain Wagner. On behalf of the State of North Carolina I would like to welcome you to Raleigh and thank you for coming to Raleigh to hear the concerns of our state and our people on this very important issue.

My comments today will focus on the ocean disposal alternative outlined in the Draft Environmental Impact Statement released by the Navy in December.

The ocean disposal alternative would employ a site about 200 miles off the North Carolina coast. The state of North Carolina has a strong economic interest in this 200 mile zone. Our state depends heavily on the good fishing and clean beaches we now have to keep our coastal economy strong. The state also is concerned about protecting the safety and well-being of her people.

The ocean disposal plan at issue today, if implemented, F.8 L.9 could set a dangerous precedent. The precedent would extend far beyond the risks associated with 100 defueled submarines. That action could lead to renewed dumping of radioactive or other hazardous wastes.

Before any decision on submarine dumping, we must have a comprehensive national ocean use policy - a policy developed openly with full public participation. Sound regulations for the disposal of low-level radioactive wastes in the sea cannot be developed before there is a national ocean use policy. Policy must come first.

L.5 Now, there is no regulatory structure to control the ocean disposal of low-level radioactive wastes. Furthermore, there is not an adequate scientific basis for such a regulator system. L.1 We need scientific data regarding deep water biology and the interrelationships with other marine ecosystems.

Everyone here should understand that the ocean disposal F.2 alternative is now inconsistent with current federal law. Recent amendments to the Ocean Dumping Act call for a two-year moratorium on ocean disposal of low-level radioactive wastes. The amendments also require EPA to establish a regulatory system. The intent of the two-year moratorium is to provide federal officials with time to identify scientific study needs and ultimately to find those answers. Congress acted to ensure that the EPA Administrator will have the right information to determine the full effects of ocean

disposal.

The issue of retrievability of the submarines is also a policy issue as well as a scientific and engineering matter. W.1 The Ocean Dumping Act Amendments specifically call for a monitoring program on the effects of disposal as a requirement for a permit. This requirement presumes that the applicant will be able to detect the effects of the disposal and would be able to reverse the action if the effects were unacceptable J.76 Your EIS does not address retrievability, and that deficiency leads to a conceptual problem that permeates the entire W.1 document. It leads to the notion that the ocean disposal alternative is a "permanent" solution. Without scientific documentation, it is not responsible to state that ocean L.1 disposal of low-level radioactive wastes is an acceptable permanent solution. Without adequate proof, ocean disposal is "out of sight, out of mind" philosophy. This philosophy has failed time and again, and the mistake should not be repeated with ocean disposal.

On the basis of these concerns, it is the policy of the State of North Carolina to oppose the ocean dumping of nuclear submarines until a national ocean use policy has been developed with a consistent and complete regulatory system. L.5 We hold the same position on ocean disposal of any other hazardous wastes.

Because of the issues raised here, we have a general reluctance to accept the proposition that the oceans are the best disposal site for low-level radioactive wastes. We believe the issue is larger than the radiation levels of 100 defueled submarines, and that a decision now on the ocean disposal alternative would be premature.

The issue should be discussed in the context of a national ocean use policy - particularly due to the precedent-setting nature of this action. What other low-level radioactive wastes would be eligible for ocean disposal? What expectations would be raised with other military and private sources of waste? What are the federal government's priorities regarding the proper use of the oceans?

In addition to my comments today, the State of North Carolina will make a formal written response to the Draft EIS and the Navy's determination of the proposal's consistency with the North Carolina Coastal Management Program when it is submitted.

I would like to comment the Navy for entering into the public review process well in advance of the decision date. This allows us all to ask important questions while there is still time to seek answers before a decision is made.

Again, I would like to thank you for this opportunity to present the position of the State of North Carolina. Thank you, Captain Wagner.

CAPTAIN WAGNER: Thank you, Ms. Patterson. Our

next registered speaker is Mr. Edmund B. Welch. Mr. Welch is the Chief Counsel for the House Merchant Marine and Fisheries Committee, and Mr. Welch is representing Congressman Walter Jones, Chairman of the House Merchant Marine and Fisheries Committee.

#9

MR. WELCH: Thank you, Captain. I am Edmund Welch, formerly of Greenville, North Carolina, and presently Chief Counsel of the House Committee on Merchant Marine Fisheries for the U.S. House of Representatives.

Today I am speaking on behalf of Congressman Walter B. Jones, who is not only Chairman of the Merchant Marine and Fisheries Committee, but who also represents North Carolina's First Congressional District, which includes the Outer Banks of North Carolina.

The statement which I will give today represents Congressman Jones' views.

Captain Wagner, I would like to thank you and the Department of the Navy for allowing us to present our comments on the Draft Environmental Impact Statement for the permanent disposal of decommissioned, defueled nuclear submarines. The possible disposal of these submarines at deep ocean sites off the coast of North Carolina is of very serious concern to me and to the citizens of North Carolina. I want to commend you for conducting these field hearings and allowing the residents of North Carolina and other areas to express their concerns to you. I believe that the opportunity for us to comment is of critical importance to guarentee that the process for reaching decisions on these crucial issues is open, balanced, and reliable. I hope that all of us who are interested in the proposal will be provided an ample opportunity to comment and to participate, and in reviewing today's testimony, please remember that Raleigh is some 5 hours from Cape Hatteras, so clearly, many concerned citizens are not able to be present today, especially in view of the traveller's advisories that were broadcast last night.

As you know, in October of last year in Manteo, North Carolina, Congressman Jones convened his Committee on Merchant Marine and Fisheries for hearing on this proposal, and Captain, we appreciate your participation at that hearing. At the hearing witnesses from the Government described their respective responsibilities for licensing and monitoring ocean disposal. Experts in the field also offered impressive analyses for selecting ocean sites and estimating potential hazards. In addition, witnesses from a wide range of commercial and environmental organizations expressed great concern for the potential adverse impacts that such disposal could have on the coastal communities of North Carolina. I share that concern, and believe it to be well founded. I regard this proposal as raising very difficult, complicated issues, and I look to this DEIS to provide guidance to the decision makers on the

scientific and policy questions raised by it.

There are four specific comments on the DEIS that I want to make today. The first addresses the recently adopted amendments to Title I of the of the Marine Protection, Research and Sanctuaries Act which impose new restrictions on ocean disposal of low-level radioactive wastes. The second concerns the analyses of potential impacts on coastal communitie. in North Carolina. The third discusses the site evaluations, and the fourth raises the general issue of credibility, citing specific points in the DEIS where certain revisions may be appropriate.

In December of 1982 Congress passed an amendment to Title I of the Marine Protection, Research and Sanctuaries Act which is commonly known as the Ocean Dumping Act. This amendment may prove to have a significant impact on the disposal of decommissioned nuclear submarines. These amendments had earlier been reported out of the House Committee on Merchant Marine and Fisheries and passed by the House in a package of amendments to Title I of the Ocean Dumping Act, and eventually these changes were passed by the full Congress as part of other legislation. F.2

Frequently referred to as the Anderson amendments, after their primary sponsor in the House, these amendments impose a two-year moritorium on the ocean disposal of any low-level radioactive wastes and substantially modify the permit processes governing such disposal after the moritorium expires. Applicants for permits to dispose of low-level radioactive wastes must submit with their applications a comprehensive radioactive material disposal impact assessment. These assessments must contain, among other things, site specific analyses of potential environmental effects; plans for the removal or containment of the nuclear material if the container leaks or decomposes; consistancy determinations by each affected state; and a comprehensive monitoring plan to occur

F.2

after the disposal is completed. In light of these new requirements, it will be necessary to revise substantially certain portions of this DEIS for it to serve as a later assessment in a permit application to the Environmental Protection Agency (EPA).

Furthermore, if EPA decides to issue a permit for such disposal after the two-year moritorium, it must submit the permit to both Houses of Congress for affirmative Congressional approval. If within 90 days Congress fails to pass a resolution of approval the permit will not take effect, and ocean disposal will not be able to take place.

The provisions of these amendments clearly reflect the seriousness with which Congress views the disposal of radioactive wastes, and they impose upon the potential applicants new and higher standards of study and public

F.2

participation. I would urge the Navy to examine these amendment closely and to modify their program as may be necessary to

comply fully with them.

Therefore, to summarize my point 1, the new law will make it much more difficult to obtain a permit for ocean disposal.

L.53

Secondly, the DEIS fails to address adequately, and in fact virtually ignores the potential impacts that ocean disposal could have on the coastal communities lying adjacent to the disposal areas. Adverse impacts may include both environmental and economic impacts. While the complicated analyses of direct radiation exposures lie beyond my expertise, the summary dismissal of potential adverse impacts on the economies of coastal areas is unsatisfactory. As a matter of fact, there are only three sentences in this entire document that deal with the economic impact of submarine disposal by

O.34

ocean dumping. Although the potential for harmful exposures through, say, swimming on the beach or eating fish from the area may as a point of fact be minimal, the public may nonetheless perceive the potential for harm. That perception, in turn, could severely damage important industries in the coastal areas, such as tourism or fishing. These potential impacts must be examined more closely and factored into the decision making. The economic wellbeing of the Outer Banks depends on the public's perception of them as a safe, unspoiled, natural haven.

To summarize point two, the DEIS is totally inadequate in its study of the economic consequenses of ocean disposal of radioactive wastes off the coast of North Carolina.

My third comment addresses the site specific information on the Hatteras Abyssal Plain area and the lower continental rise area. One runs into difficulty attempting to reconcile the summary comments on the Atlantic sites with the absence of site specific information. The DEIS summarizes that "In general, the Hatteras Abyssal plain study area would likely prove acceptable as an ocean disposal site, based on the site specific selection criteria", and that "Information gathered to date on the lower continental rise study area supports the belief that it would be possible to select an area in the Atlantic on the lower continental rise, within 200 miles of land, and meeting all study area identification guidelines". The technical basis of these admittedly tentative conclusions is not clear, and the potential drawbacks associated with each site should be discussed. Comparative analyses of the sites should be undertaken so that in the end, if ocean disposal is chosen, the most suitable site will be selected. J.9

With regard to the Abyssal Plain site, there is extremely scant data on biological pathways, and too little information on the potential effects of turbidity currents, a potential which the DEIS raises and then dismisses. J.9

As for the lower continental rise area, there is clear evidence of a major submarine canyon system, inter-canyon levee deposits, and the potential for sediment slumping.

The topography of the area could complicate post disposal monitoring, and the dynamic currents within the water column J.77 and on the bottom along the boundary of the continental rise and the Abyssal Plain create further complexity, and again, the lack of deep ocean biological data on the area is evident J.9 in the analyses, throwing into doubt the empirical basis of the pathways analyses.

Finally, the relevence of the 200 mile limit, which has no juridical relationship to ocean disposal, is unclear. Without it, the discussion appears to favor areas beyond 200 miles; yet with it, with the 200 mile criteria, a less suitable site within 200 miles may be unavoidable. Why is the 200 mile limit so critical? The DEIS does not explain it adequately enough. J.18

To summarize point 3, the data on the Atlantic site is still much too sketchy to provide a basis for a decision, and there is no judgement as to which ocean sites are superior to others, and why.

The fourth and final point relates to the overall issue of credibility. Because of the extreme sensitivity of the issue of radioactive waste disposal, it is imperative that the Navy make every effort to present all relevent information on its proposal in an unbiased objective manner. These hearings are an excellent start in fulfilling that objective, but any attempt to skew the analyses one way or the other could do nothing but undermine the public and Congressional confidence that will be crucial to the success of the project. In this respect, portions of the DEIS require revision to examine fully the important policy issues raised by the proposal.

F.8

For instance, in examining the discussion of the effects of the proposal on national policy, it appears less than forthright by skirting the issues raised by the United States resuming ocean disposal of radioactive wastes after espousing a policy of no dumping for well over a decade. The policy shift is important.

L.9

Does a decision in this instance portend further or greater domestic licenses for other radioactive wastes, and if so, for what types of wastes and in what quantities? If a site for this proposal is selected off the North Carolina Outer Banks, what is the probability that it will become the general low-level radioactive waste site for the United States for other wastes produced by the United States? What, then, will be the cumulative effects of this decision on North Carolina? Further, how will the U.S. policy shift affect international ocean disposal practices since other countries are now actively considering disposal?

W.1

Another issue that requires further discussion is that of retrievability. In light of the recently adopted amendments to the Ocean Dumping Law, and the decision by Congress to retain retrievable disposal options for high level wastes in the Nuclear Waste Policy Act of 1982, the issue of retrievability

requires more explicit elaboration as both a technical and policy issue. Retrievability is the Achilles heel of ocean disposal. At least with land disposal, if we decide in the future that we have made a mistake, we have a chance to correct it. But with ocean disposal we cannot correct the error. The choices are irrevocable. Are we willing to gamble today that we cannot make a mistake?

W.1

That concludes my specific comments on the DEIS. In closing, I want to emphasize that I intend to retain an open mind on this matter, knowing that eventually we must dispose of these submarines in some way. But at the same time it is essential that before proceeding with any specific proposal, members of the general public, myself included, must be assured by reasoned scientific evidence that ocean disposal at a specific site is safe, necessary, and the best solution to a difficult problem. The present DEIS does not give that assurance to the people of North Carolina.

Thank you, Captain Wagner.

CAPTAIN WAGNER: Thank you, Mr. Welch. The next registered speaker is Mr. Elbert Felton, who will be speaking on behalf of Congressman Steve Neal.

#10

MR. FELTON: Thank you, Captain Wagner. I will be presenting a statement made by Congressman Steve Neal, the Fifth Congressional District Representative here in North Carolina. I'm on the Congressman's staff, and my name is

Elbert Felton. This is Congressman Neal's statement:

I want to thank the Department of the Navy for affording an opportunity to citizens here in North Carolina to participate in this hearing. The proposals on disposing of decommissioned nuclear submarines are gaining more and more attention and raising more and more questions.

I support the intent of Section 424 of H.R. 5211 calling for restrictions on ocean dumping of low level radioactive wastes and a two year moratorium. The provisions for monitoring, for analysis of economic impact, for retrieval and removal possibilities, and for precise description of dumped material are all reasonable requirements.

There needs to be a compelling reason behind any decision in favor of marine disposal, and that compelling need has not been demonstrated to me. The number one advantage listed in the DEIS is the reported lower immediate cost of this option (page 2-14). In such a controversial situation, this cost difference, even if accurate, does not lead me to conclude that sea disposal is the desired alternative.

I am also concerned about the Navy's earlier reluctance to appear before a hearing of the House Merchant Marine and Fisheries Committee, chaired by Congressman Walter Jones. It is vital that our citizens know exactly what the Navy's plans are, and to have their questions and fears addressed in a direct and timely fashion.

We live on an ocean planet and this predominant feature of our globe should be respected for the impact it has on the entire nation, not just on those narrow sandy beaches of our coastal area.

My staff will be reporting to me on the statements made at the hearing so that I might be aware of the public attitude expressed at this forum. Thank you for allowing my remarks to be a part of the public record. Sincerely, Stephen L. Neal, U.S. Congressman.

Thank you, Captain.

CAPTAIN WAGNER: Thank you, Mr. Felton. The next registered speaker is Mr. John Bone, Executive Vice-President, Outer Banks Chamber of Commerce, Kitty Hawk, North Carolina. Mr. Bone.

#11

MR. BONE: Thank you, Captain Wagner. I also appreciate this opportunity to speak for the Outer Banks Chamber of Commerce.

The Outer Banks Chamber of Commerce at this time reiterates its opposition to disposal of nuclear submarines off the coast of North Carolina. Basically, our business community depends upon either commercial fishing or tourism for its life blood. We can see no benefit or advantage from the disposing of nuclear submarines off our fragile coast.

At the same time, this disposal could be potentially harmful both environmentally and psychologically. Even if we L.53

O.34 could be assured that the disposal would have no environmental effect, we still see a real danger and a misinterpretation which could lead people to choose seafood caught elsewhere over that caught in North Carolina waters near nuclear submarines.

Similarly, this same kind of thinking could cause vacationers to choose alternate vacation sites.

In the absence of any real clear-cut advantage, and conversely much potential harm, the Outer Banks Chamber of Commerce would reemphasize its opposition to nuclear submarine disposal at sea. For these reasons, the Outer Banks Chamber of Commerce encourages the Department of the Navy to reconsider any plan for ocean disposal of nuclear submarines.

Thank you for the opportunity to be here this morning and express our concerns.

CAPTAIN WAGNER: Thank you, Mr. Bone. Our next registered speaker is Mr. Daniel F. Read, representing the Environmental Law Project. Mr. Read.

#12

MR. READ: Good morning, Captain Wagner and fellow North Carolinians. My name is Daniel F. Read and I am representing the Environmental Law Project, which is an independent group of law students at the School of Law at the University of North Carolina in Chapel Hill, North Carolina.

We are particularly concerned with the proposed sea disposal, and I would like to point out what we perceive as

several serious inadequacies in the Draft Environmental Impact Statement. We would urge that the decision making process not go forward until these concerns are resolved.

First, is the lact of thorough site data for many of the parameters listed. J.9 For example, the number of core samples seems severely limited at best: only seven were taken in the Atlantic Ocean study area, which hardly seems to offer more than a few weak scientific generalizations for an area of some 8000 square kilometers. J.28 More importantly, bottom currents are still not fully quantified, being still under study at at least one location, E-11. The available data indicate that although currents are not particularly rapid at the other two sites, there are still currents sufficient to assure a wide distribution of radionuclides in a worst-case scenario. For example, even at the lowest speed measured, which was 0.7 Kilometers per day, the current is sufficient over a one half-life of Nickel-63, which is 92 years, and is one of the more frequently occurring radionuclides in the reactor compartment, to move the radionuclide several thousand kilometers. Ordinarily, a radionuclide is considered detoxified after 10 half-life's, so that's certainly a cause for concern. The data from the Thresher and Scorpion sinkings were showing negligible releases which are summarized in the DEIS offer little consolation, since the very toughness the Navy claims J.42 to have built into these vessels probably means that the

J.42 radiological effects of these comparitively recent events are only just now beginning to be recorded. Given these concerns, ocean dumping should be delayed at a minimum until complete environmental studies have been done.

A second concern we have is the potential effect of an accident during towing of the sub to the site. Accident would also include interference by a third party. The DEIS claims that because of the rugged construction and proven seaworthiness of these vessels, they can be towed to the disposal site with confidence. Similar claims were advanced, one recalls, for other ships including the Titanic. The L.57 absence of any analysis of the results of the sinking of a sub in shallow waters, either accidentally or by an act of God or war or third party negligence, is thus a further inadequacy.

The effects of proposed sea dumping also need to be analized with respect to their effect on providing an implicit F.8 incentive for domestic and foreign producers of waste to join in and increase their own ocena cumping efforts. Additionally, other future military waste disposal at sea is not discussed: L.9 to the extent the military is considering such activity, it should be included in the EIS, since going ahead with this F.8 would probably mean a tacit end to our national policy of no ocean dumping.

S.25 Finally, the EIS provides no illumination with respect to what happens if the projections in the report may be wrong,

and I would reiterate there that all I've seen in this report are projections. There's very little hard analysis of what L.1 we know will happen. Many predictions have been made about disposal of nuclear waste in the past, and many predictions have been wrong. Is there a plan for reducing radionuclide W.1 dispersion is the scenarios listed in the EIS are wrong? The costs set out do not include any such expenses, and that's for a good reason since they would probably be prohibitive, and perforce, the problem would be ignored in the hope that damage would be minimal. "Out of sight, out of mind." That is neither good ecological thinking, nor in accord with the mandate of the National Environmental Policy Act to avoid adverse environmental impacts where possible. Since land disposal would at least offer the chance of repairing or reducing harm from mistaken predictions, it would appear to be the better of the options presented. In any event, the DEIS needs more careful analysis before it can present the kind of basis for rational decision-making contemplated by NEPA. Thank you.

CAPTAIN WAGNER: Thank you, Mr. Read. The next registered speaker is Ms. Joyce Rosenthal, who will be representing Greenpeace. Ms. Rosenthal, please.

#13

MS. ROSENTHAL: Yes, good morning. My name is Joyce Rosenthal, and I will testify here today on behalf of Greenpeace, U.S.A., the passive campaign coordinator for the

*Issues discussed in Ms. Rosenthal's testimony are side barred in Exhibits 13a and 13b.

issue of ocean dumping. Greenpeace is an international environmental organization who's sole purpose is the promotion of the protection of the environment over the long term. Since the inception of Greenpeace in 1971 the oceans have been a central concern of the organization, largely due to our efforts to protect marine life and the ocean environment. Greenpeace presently has over 270,000 contributing members in the United States, and more than a million worldwide.

I am here to address the Navy's examination of the ocean dumping option for the disposal of radioactive nuclear submarines, as outlined in their Draft Environmental Impact Statement released on December 22, and its policy implications. Thank you for this opportunity to comment on this proposal.

Although the Navy's DEIS has not stated a preferred method of submarine disposal, environmentalists, fishermen, scientists, policy-makers and citizens around the country and in other nations have been concerned over the possible resumption of ocean dumping of radioactive wastes by the United States.

Greenpeace opposes the ocean disposal of radioactive wastes. In approaching the question of nuclear waste disposal, we assume the objective goal is to endure the protection of public health and the environment over a very long term. The activity of isotopes present in all categories of nuclear waste, and present in the irradiated reactor compartment,

pressure vessel and steam generator of decommissioned submarines guarantee that levels of radioactivity will persist for thousands of years. To pursue ocean disposal at this time means resuming a practice before the impacts on public health and the marine environment of past radioactive waste ocean dumping are fully understood.

Once dumped, these submarines are irretrievable according to the Navy's DEIS. This is a critical drawback that land storage does not have.

A review of past radioactive waste dumping in this country in comparison to the Navy's proposal elucidates our concern. The DEIS estimates that one defueled submarine reactor plant contains about 62,000 Curies of radioactivity, which is approximately one-half of the entire amount of radioactivity that has been calculated to have occurred in dumping operations off the U.S. coastline between 1946 and 1970. The isotopes in the induced radioactivity in each sub includes: Cobalt 60, nickel 63, cesium 137, nickel 59, and niobium 94. There are 16 different radioactive nuclides in the initial 62,000 Curies and traces of Plutonium 239 and Strontium 90. Half-lives of these isotopes range from 5.26 years for Cobalt 60, to 80,000 years for Nickel 59. With over 100 nuclear submarines scheduled for decommissioning over the next 30 years, choosing the ocean dumping option would result in sea disposal of quantities of radioactive materials that dwarfs the previous U.S. dumping program by comparison. In the over 100,000 containers of nuclear waste and one submarine reactor vessel dumped within the 24-year period of ocean disposal in this country, approximately 120,000 curies of radiation was dumped. These figures on the magnitude of past dumping were recently revised by the EPA, which has been unsuccessful in determining the full extent of past dumping.

The Navy's consideration of ocean dumping as a disposal option stands as a tacit acknowledgement of the failure to fulfill a promise to provide appropriate methods for handling of the waste products from the Nuclear Propulsion Project. A formal request to the EPA to dump radioactive submarines would constitute the most formidable pressure to reverse a 12-year de facto ban on the practice of ocean dumping of nuclear wastes. The practice was halted in 1970 when the Council on Environmental Quality issued a report which concluded that ocean dumping of any radioactive waste presented a very serious and growing threat to the marine environment.

A new policy of considering nuclear waste dumping on a case by case basis by necessity would have to replace the present 2-year moratorium, without developing EPA guidelines. That point was pointed out by many other speakers today. If the Navy pursues the ocean dumping option, that represents an undeniable policy shift that has implications far beyond

the specific proposal. The Navy's DEIS should have assessed the cumulative impacts of ocean scuttling in the context of other past and proposed ocean dumping and other sources of radioactivity.

The Navy is breaking ground here for a great variety of radioactive wastes that could be dumped into the ocean if the EPA permits this practice on a case by case basis. Evidence of this is the February 1 notice by DOE that the ocean dumping option is being considered for disposal of FUSRAP soils, wastes from the Manhattan Project currently being stored in New York. I think the recent Anderson amendments to the Ocean Dumping Act, which place a two-year moratorium on issuance of new ocean dumping permits pending a more detailed study and consideration of their environmental consequences, reflect the spirit of the constituency around the country opposed to renewed nuclear waste ocean dumping.

Politically, the resumption of dumping nuclear wastes is bound to be increasingly unpopular with a growing number of nations that are opposed to this practice, including Pacific Island nations and European nations opposed to the current dumping by the United Kingdom, Belgium and Switzerland into the Northeast Atlantic Ocean. Clearly, the U.S. role in influencing global decision making must be given more consideration. Does the United States want to continually isolate itself in global opinion, as it has recently by not ratifying the Law of the Sea Treaty, and by the United Nations vote, 111 to 1, against a Comprehensive Test Ban Treaty resolution? Japan and Canada are two nations that are watching the development of U.S. policy on this issue very closely in considering their own possible resumption of radioactive waste ocean dumping.

These policy implications of the scuttling plan are why we must examine the entire issue of ocean dumping in judging them; including the under-researched effects of past dumps and potential future dumps of nuclear wastes. An inventory of radioactive materials going into the oceans has never been created, despite recognition by international maritime organizations of it's need.

Ocean dumping is currently subject to review by the more than 50 nations that have signed a treaty called the International Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter, better known as the London Dumping Convention. Today is an appropriate day to consider the international aspects of the Navy's scuttling option, as it marks the first day of the seventh meeting of the LDC, and the day that the LDC nations will consider a proposal by Pacific Island nations to ban radioactive waste ocean dumping as an amendment to their treaty.

In light of the current unanswered questions regarding biological and oceanic current transport of radionuclides,

we hope that the LDC nations today will recognize the risks of continued ocean dumping, and support a ban on its practice.

Time constraints in preparation of this testimony following the release of the DEIS do not permit me to engage in a technical review of the Navy's supporting studies on the ocean disposal option, or to review the Navy's studies of possible land burial sites at Hanford, Washington and Savannah River, South Carolina. The 90-day commentary period provided by the Navy is not sufficient for the public to analyze the bulk of technical data and consideration in the scope of this DEIS. Greenpeace has submitted a request as part of a coalition of environmental groups requesting a 90-day extension of public commentary time. We hope the Navy agrees to this for the benefit of the public. North Carolina has barely had time to obtain a copy of the DEIS, much less read the 400-page document and comment on it.

Careful consideration must be given to today's testimony by the Oceanic Society and others as they critique the DEIS on technical grounds. These scientists have pointed to unacceptable gaps of essential information that would be used to predict the transport or fate of radioactivity in the marine environment.

Returning to the question of what to do in order to dispose of obsolete submarines, Greenpeace proposes that the Navy should continue to maintain irradiated submarines in protective storage in naval shipyards where they are decommissioned to allow for the anticipated early rapid decay of short-lived radioisotopes. We have presently asked a technical expert to evaluate data on decay of radioactivity in the subs and hope to present the findings that pinpoint the earliest optimum time for shipping from protective storage to land-based storage. Information in the DEIS indicates that a proper time frame for that shipment would be from 20 to 50 years.

Supporting this recommendation is a statement in the DEIS; "Nuclear submarines can also be placed into storage for a long time without risk to the environment. The submarines would be kept in protective storage. About every 20 years each ship would be taken out of the water for an inspection and repainting to assure continued storage."

The questions we must ask ourselves after that time to assess the differences between land disposal options include: What is the shortest, safest transportation route for these radioactive wastes? Recognizing that shipment is the weakest link in the disposal process, due to the possibility of accidents and public exposure, great consideration must be given to the shortest route. What are the chances of a barge towing accident in case the shipment transverses deep or shallow water and rivers?

What environmental concerns have been raised by the

public near the two land burial sites that the DEIS does not cover? Are there more appropriate burial sites not covered in the DEIS? Can the monitoring plans for a land based burial be developed, as they are not in the DEIS?

In conclusion, I note the problems that every nuclear nation around the world has had in disposing of their radioactive wastes. We must examine our posicies carefully to determine whether it is acceptable to society to continue producing materials for which there exists no environmentally sound disposal practice.

Thank you.

CAPTAIN WAGNER: Thank you, Ms. Rosenthal. The next registered speak is Ms. Jane Sharp, representing the Conservation Council of North Carolina.

#14

MS. SHARP: I am Jane Sharp, President of the Conservation Council of North Carolina. CCNC has about 500 members throughout the state, and 15 member organizations, similarly dispersed. All are interested in the wise use of our national resources and of conservation practices assuring that our children and grandchildren can inherit at least as good an earth as we found here.

Nuclear submarine dumping in the Atlantic Ocean during the '80's and '90's does not seem to be in accord with our ideas of maximum wisdom or conservation. While any nuclear burial only defers the problem, we are impressed with the relative rates of corrosion of metals under sea water and underground, in the Draft EIS, pages F-1 to F-25. Q.12 Experiments show that both water and ocean bacteria contribute to more rapid corrosion under sea water than underground. Because the radioactivity of the disposed materials decays gradually over time, the faster the corrosion, the more active radioactiv is released to the environment in water. L.37 Also, because of the ocean food chain, where radiation can be concentrated 400 to 800 times by bottom-dwelling organisims, which are subsequently consumed by fish, the unwary fisherman may receive a much larger dose than anyone could calculate, based on even dispersio into the environment.

L.53 North Carolina's fishing and tourism industries are among the most important in the state, and would be harmed by O.34 such possibilities lon- before measured amounts of radiation appear in sea water or fish at the surface.

The corrosion rates of the metals involved are slower underground, according to our reading of the DEIS, allowing for greater decay of radioactive metals, and less chance of contact with future populations.

L.9 Our second main point is the temptation of using such a dumping ground for other items than nuclear submarines, given the great resistence to underground disposal of both low level and spent fuel wastes throughout the country, not to mention military reprocessing wastes, which are,

unbelievably, still building up in the United States.

When we pause to determine where we really want this civilization to be heading in the latter twentieth century, we do not see nuclear proliferation as a viable option to the people of any country of which we are aware. The tremendous resistance to land disposal will be equalled by that to ocean disposal, in our view, once the relative corrosion and dispersal rates are studied. And while nuclear proliferation is not the issue today - only how we should dispose of the wastes from past nuclear devices - it becomes clearer with each year, as we return again and again to testify, that the entire nuclear industry is a source of all of these problems. When you try to staunch the flow of a pollutant into the environment, you try to control the source, not merely to mitigate the resulting problem; if you are wise.

Therefore, with all its problems, werecommend the land disposal option over the ocean dumping proposal at this time, but people need to be much more aware of what is happening in order to react at all.

We thank you for allowing us this whole day as an opportunity for us to become more informed ourselves, and also to inform the Navy of our increasing opposition to the ocean dumping option for nuclear submarines.

CAPTAIN WAGNER: Thank you, Ms. Sharp. Our next registered speak is Mr. Thomas C. Jackson, who is representing

#15

the Oceanic Society. Mr. Jackson.

MR. JACKSON: Thank you, Captain Wagner. I am Thomas C. Jackson, vice president of the Oceanic Society, a 60,000 member national marine conservation organization which publishes Oceans magazine as part of a global research, education and conservation program. The Society's principal offices are in Stamford, Connecticut and San Francisco, California with Oceanic Society Chapters in San Francisco, Los Angeles, San Diego, Dallas/Fort Worth, and the Long Island Sound region.

This morning I am speaking on behalf of the Oceanic Society's 60,000 members to address an inadequate Draft Environmental Impact Statement (DEIS) and argue against the sea disposal of obsolete nuclear submarines. A primary fault *W.1 with this "ocean alternative" for worn out subs stems from the irretrievability of these ships once they have been sunk on the deep ocean floor. This alone is sufficient cause under federal law to reject the sea disposal concept.

The draft environmental assessment holds four significant defects:

L.7 1. Cumulative impacts of incremental increases in radioactivity entering the marine environment from these submarines are not considered in the DEIS;

J.76 2. The monitoring program proposed in the DEIS is I.13 inadequate for either sea or land disposal;

L.57 3. Effects of accidental sinking of the submarines on

the Continental Shelf are not adequately considered; and

4. The disposal alternative which minimizes corrosion and hence release of radioactivity - is not even considered in this document. H.3

Based on our consultation with scientists around the country, it appears the most sensible solution is to place reactor compartments in an arid or semi-arid environment. In this alternative, the submarine's reactor compartment would be placed in a trench or left on the ground. Unlike the land alternative considered by the DEIS, the compartment would not be buried. H.3

Scientists believe that by not burying the reactor compartment, corrosion of the submarine's hull and bulkheads would be minimized. Clearly, a compartment which is left exposed to dry air will rust at a much slower rate than one which is buried in the earth. A submarine sunk in salt water will, as shown in the DEIS, corrode at a much faster rate than either of these land disposal options.

We must remember that we are speaking here of placing the entire reactor compartment on land. The reactor compartment is a section of the hull stretching between two watertight bulkheads which contain the reactor, primary piping and steam generator. The uhull and bulkheads are built out of metals strong enough to withstand the high pressure of operating at great depths. Together, the hull and the bulkheads provide

*Other issues discussed by Mr. Jackson are side barred in Exhibits 15a and 37b.

a barrier protecting the environment from radioactivity for a substantial period of time. This hull will last longest, however, if it is not buried or scuttled in the sea.

In revising the DEIS, the Navy must consider this modification of the land disposal alternative. The current text contains neither mention of this option nor any reason for discounting it as a viable solution to the Navy's radioactive waste disposal problem. This inadequacy in the DEIS is just one of our prime concerns.

Both a "Lower Continental Rise Area and a "Hatteras Abyssal Plain Area" of the North Carolina coast have been considered in the DEIS. Published scientic research on the Lower Continental Rise Area suggests a more complete investigation J.28 by the Navy will find bottom current velocities which are, for the deep ocean, significant. In revising the DEIS J.8 assessment of oceanographic data, the Navy must make clear the weight to be given to site selection guidelines developed by Dr. Charles D. Hollister and Dr. G. Ross Heath and reported in Appendix E of the environmental assessment.

L.55 The DEIS must also be revised to consider the "artificial reef effect" scuttled subs are expected to have on the deep ocean ecology. Experience with radioactive waste dumpsites, oil platforms and ships sunk for fishing reefs has established that, on the continental shelf, any such structure attracts and holds new and more abundant communities of fishes and

invertebrates. Whether the subs will serve as an attractive nuisance, attracting new communities of life to the deep sea bottom, must be considered in the DEIS. Estimates of exposure to humans must reflect the "artificial reef effect".

The DEIS must also be expanded to provide a baseline J.9 description of fish and other forms of marine life which inhabit the abyssal plain of North Carolina. Data on trace materials, radionuclides and metel-sequestering proteins should be addressed. Specific attention must be paid to species like the greradier, a fish recognized as the most abundant large organism at these depths, and one which has the potential to serve as a mechanism for horizontal and vertical transport of material released from these submarines.

Sea disposal of radioactive waste is a complex issue. If the Navy really expects informed public comment on this topic, specifically the DEIS, why has it scheduled this hearing only 2 months after the DEIS was released, and why has the Navy limited the comment period to only 90 days?

The DEIS released by the Navy a few days before Christmas is a think and imposing document containing a summary, four chapters of explanatory text and 12 appendices, Two volumes of equal size contain scientific studies compiled to support the DEIS and its conclusions. Both volumes cite an impressive list of references from a myriad of sources. While some of these references are available, others - such as a State

Department press release - are not easily accessible to citizens, conservationists or elected officials. Despite the complexity of this issue and the DEIS, the Navy has alloted only 90 days for public comment on this issue and has not bothered to answer reasonable requests for limited extensions of time.

Many organizations, including the Oceanic Society, have written the Navy to request an expanded comment period and a delay in these hearings. As we noted in our request to Secretary of the Navy John Lehman, it is difficult to assess - let alone promote informed public consideration of - this draft environmental assessment within 90 days. The Navy's refusal to extend the time for public comment raises a fear among those who wonder if this might be because the DEIS cannot withstand prolonged examination.

The Oceanic Society has been concerned about the risks of radioactive waste disposal in the marine environment since 1978. During 1980 we convened a public policy forum in Washington, D.C. to examine the sea disposal of nuclear waste. Two years later we published Nuclear Waste Management: the Ocean Alternative, the first comprehensive text on this issue. We have coordinated scientific testimony before Congressional Committees, followed international standards for radioactive waste disposal at sea and spoken before the National Advisory Committee on Oceans and Atmosphere in this

matter. Yet, we have found it most difficult to assess the DEIS on the tight schedule established by the Navy. By scheduling these hearings in the midst of the 90-day comment period, the Navy has effectively prevented any informed effort to educate the public about the DEIS so they can participate in the hearings.

Our analysis of this DEIS centers on an independent committee of scientists which met in San Francisco on February 3 and 4 to review the document. The committee's report will not be complete until the end of this month. Clearly, we cannot utilize this independent scientific evaluation to help citizens and elected officials understand and then comment intelligently at hearings which conclude next Thursday. The Society urges concerned citizens to submit written comments on the DEIS before the March 31 deadline. We are working with North Carolinians to convene workshops in Winston-Salem and at the Duke Marine Labs March 5 and 6 to help people consider this DEIS. But this is a poor substitute for the degree of informed public participation which could have developed with as few as 60 more days before the hearings began. In the light of Congressman Glenn Anderson's ammendment to the gas tax law, a measure which imposes a 2-year moratorium on sea disposal of any nuclear waste, one has to wonder why the Navy is in such a hurry.

Recent action at the U.S. Environmental Protection Agency have done little to allay these concerns. The current Administration has transferred the man who was in charge of drafting this DEIS for the Navy to direct the EPA office charged with regulating sea disposal of radioactive wastes - and incidentally reviewing this DEIS. This administrator's refusal to allow any EPA staff to assist in our review of the DEIS further weakens the Agency's credibility as a regulatory agency which will protect the public. Rarely has the Reagan Administration provided a clearer example of inviting the fox to guard the hen house.

L.7
J.76

In revising the DEIS, additional attention must be paid to the twin problems of cumulative impact and monitoring. Neither the DEIS not scientific research cited in support of the document consider disposal of decommissioned nuclear submarines within the context of cumulative sources of radioactivity. This is a significant omission which makes it difficult, if not impossible, to adequately consider the incremental increase in radioactivity entailed in land or sea disposal of decommissioned nuclear submarines. Revision of the DEIS must incorporate adequate data, information and discussion to address this issue.

In considering the sea disposal option, consideration of cumulative impacts should begin with development of a comprehensive register of all radioactivity known or reasonably expected to enter the marine environment. This global inventory should include, but not be limited to, past, present and

potential levels of radioactivity from: weapons testing (Atmospheric fallout); historic U.S. and foreign radioactive waste operations; accidental losses of nuclear materials (including submarines); sea disposal of low level wastes under IAEA standards; other U.S. and foreign proposals for low level waste disposal; implacement of high level wastes in the seabed; operation of and/or discharges from civilian and military reactors; scientific experiments; accidental release; and disposal of decommissioned nuclear submarines as well as other military wastes.

This assessment should include an estimate of the marine environment's capacity to assimilate radioactivity without damage. This estimate must be based on sound science and will, in all probability, require additional research. Assessment of cumulative impacts would include descriptions of past, present and projected effects both in terms of human health and specific components of the marine ecosystem.

Consideration of cumulative effects must be complemented by a comprehensive monitoring program. We believe the marine monitoring programs considered in the DEIS are inadequate to gauge environmental effects. Absence of a comprehensive monitoring program prohibits sea disposal of nuclear submarines. In revising the DEIS, the Navy must consider and describe in detail the scope and costs of long-term monitoring of submarines on the deep ocean floor. Specific attention must be given to locating monitoring stations within 25 meters of the reactor compartment and in a network of sites where the plume of radioactivity from a submarine can be monitored. Details of plans for biota sampling, sediment sampling, use of submersibles and development of in situ monitoring equipment must be considered. Costs and assured sources of funds must be clarified.

The best estimate for corrosion described in Appendix G of the DEIS suggests the reactor compartment would be penetrated within 100 years and that bottom currents would begin flowing through the reactor compartment itself within 400 years of disposal. This estimate is used in Figure G-2 to show release of radioactivity to the environment as occurring in +/-100 and +/-400 years. Comprehensive monitoring programs, then, must extend beyond short-term studies to include releases of radioactivity projected for 100 to 400 years from now. Yet the monitoring program described in Appendix K of the DEIS proposes only a $9 million budget for monitoring "during and after the period of active disposal." Further, in Section IV-C, the DEIS states frequency of post-disposal monitoring will be determined by initial results - results from a period when the DEIS predicts no release of radioactivity to the marine environment.

The Deis must also consider instirutional impediments to conducting monitoring programs for a very long (400+ years) period. Experience during the past three decades has

demonstrated the difficulty in retaining records - let alone continuing monitoring programs - of nuclear wastes placed in the marine environment. To a significant degree, records of more than 100,000 curies of radioactive wastes dumped at sea from 1946 to 1970 are inadequate or missing. Research and monitoring of historic sites is virtually non-existent following only limitedly successful and sporadic research and retrieval efforts conducted at high cost.

Effects of accidental sinking of a submarine while the ship is being towed to a sea disposal site also merits additional considertaion. The 0.3 percent probability cited in the DEIS for an accident of a sib makes the likelihood of such a loss much higher than conceded in the document. Hazardous weather conditions frequently found off Cape Hatteras and Cape Mendicino further increase the likelihood of an accident occuring. | L.57 | L.61 | L.58

Neither the DEIS nor the scientific studies cited in support of this document justify selection of the sea disposal option over land disposal. Our inability to retrieve complete submarines from the deep ocean floor combined with the institutional impossibility of guaranteeing support for long term environmental monitoring make the marine environment an unsuitable site for disposal of this waste. | W.1 | J.76, J.79

These factors should combine to compell the Navy to withdraw the DEIS for extensive revision. Concerns expressed at this and other hearings should be considered and reflected in a new DEIS. THat assessment must be written in clear language and use consistent terms to allow citizens a fair opportunity to understand the issue. Release of a revised DEIS should be preceded by a public education effort which allows citizens in states like North Carolina, South Carolina, California and Washington and Oregon to question the scientists whose work supports the Navy's assessment. Then and only then will the Navy mave met the requirement for informed public participation inherent to a democracy.

Land disposal appears to offer a safer, more sensible solution to the dilemma now facing the Navy. If nothing else, the land alternative insures these submarines will not be sent out to sea, out of sight, out of mind.

CAPTAIN WAGNER: Thank you, Mr. Jackson. I previously had a preregistration for the Community Alliance for Nuclear Disarmament by Ms. Melissa Gehrman. Ms. Gerhman has not filled out a registration card this morning. Is there anyone here to represent the Community Alliance?

#16

MS. GERHMAN: I did fill out a card when I came in.

CAPTAIN WAGNER: Fine, Ms. Gerhman, you're the next speaker then.

MS. GERHMAN: Good morning. My name is Melissa Gerhman and I am here today on behalf of the Winston-Salem based Community Alliance for Nuclear Disarmament. We appreciate

the opportunity to participate in this forum today.

CAN-Disarm is a grass-roots organization which provides a resource center and support system for thoes in our community and across North Carolina who are concerned about the ever-increasing threat of nuclear war. This threat is the greatest threat facing our world today, and the proposal to dump these decommissioned nuclear submarines in the ocean is an example of how our priorities have focused on continuation of the arms race rather than pr-serving the earth.

According to my understanding, some of the submarines are being decommissioned because they are old, and others are being decommissioned to make room for new weapons systems such as the Trident. I also am familiar with the statement that the number of submarines to be decommissioned in the next 20 to 30 years is so great that the procedure of mothballing is not feasible for permanent storage. Our concern, however, is that the ocean bottom option for disposal may merely be the most convenient option for the Navy.

It is the contention of the disarmament movement that there are enough nuclear weapons now in the world. Thus, to allow the Navy to use the ocean option because it is the most economical method is to give our permission to continue the arms build-up in the most expedient manner.

This issue clearly shows how nuclear armaments create irreversable environmental problems. There are almost 60,000 nuclear weapons in the world today. As these systems age and become outdated, we must determine how to dispose of them safely. Otherwise, we find ourselves building up armaments in the name of self defense only to end up disposing of them in a manner which threatens the health and lives of the very people they were supposed to protect.

There is much concern that the DEIS glosses over too many problems and that the Navy is willing to go ahead with a plan without recognizing the full impact on the community or the implications the plan has for the future. For example, in the Forward, the statement is made that: "The decision to prepare the DEIS was based on the anticipated high interest in the disposal method decision rather than the expectation that either option would significantly affect the quality of the human environment."

Twelve years ago scientists recommended that the United States halt all radioactive dumping in the ocean because of their inability to determine its effects on the environment. A de facto moritorium was passed then, and recently the Congress passed a law which provided for a 2-year extension of that moratorium.

The ocean option would significantly affect the quality of the human environment because of the precident it would set for future dumping of nuclear wastes in U.S. waters. Once an L.9

ocean site is selected and approved, it will become the object of many more military and commercial requests for nuclear waste disposal.

How much would the North Carolina economy have to suffer in order to be considered significant? On page 4-23, it says that because of the remote location "The economy of coastal areas would not be subjected to limitations on the use of land, water, fisheries or other resources." L.53 On the contrary, the impact on coastal areas would be great. People who eat seafood caught off the North Carolina coast and who vacation there are not going to check out the monitoring data of the Navy before they buy their seafood or make summer reservations. O.34 They will simply take their business elsewhere. This would indeed have a significant affect on the quality of the human environment.

The word "significant" is used frequently in the DEIS, but its definition is no doubt subject to interpretation. Also the words "expected", "anticipated", "undetectable", and "eventual" are words that reflect uncertainty as to the safety of the ocean option. L.39 I site the following examples: On page 4-23, "The radiological consequences to the local sea life population would be undetectable, with no expectation of significant deletorious effects."

On page K-3, "Significant concentrations of radionuclides in the environment near the submarines would not be expected."

On page K-3, "No significant difficulty is anticipated in implementing such a monitoring program as a disposal site."

On page 2-12 it states that, "An unavoidable adverse environmental effect would be the eventual release of about 120 curies of Nickel-59 per submarine."

At the rate of 100 submarines decommissioned and buried over the next 20 to 30 years, that is 12,000 curies of Nickel-59. This certainly seems like a significant amount of radiation when you consider that Nickel-59 has a half-life of 80,000 years.

W.1

It is stated on 2-13 that "Retrievability would not be feasible with current technology." If we make a mistake with this radioactive waste now, will our grandchildren have the technology to retrieve these submarines if they find that the quality of their human environment is being significantly affected?

Other statements that cause doubt about the reliability of the DEIS are the following: On page 4-23, "The overall effects of this action on the local environment and ecology are expected to be negligible."

Same page: "Although a non-recoverable premature sinking is unlikely, it is not impossible."

On page D-1, "Minor damage may be expected to occur upon impact. Breaching of the reactor compartment containment would not be expected."

These conclusions seem to be based on expectations rather than on sound scientific evidence. L.1

Another area of concern is the monitoring of the ocean site. These were some of the statements made about monitoring practices: On page 4-23 in regard to public assurances of safety, "...Since the economies of many coastal regions depend on recreation, tourism and fisheries, an effective environmental monitoring program would be essential to assure the public that no adverse impact had occured."

But in regard to monitoring during active disposal, and on the page where costs are discussed, this is said: "If the initial monitoring surveys performed after commencement of disposal operations confirmed the expectations, the submarine disposals could proceed and the frequency of the monitoring surveys could be reduced." J.76

On the same page, regarding the monitoring of sites after the active disposal period, this is said: "If the analysis presented in this statement were to be corroborated by surveys performed during the period of active disposal, post-disposal surveys would be needed very infrequently."

Would "very infrequent monitoring" be considered "an effective environmental monitoring program" which a few pages back was said to be essential for assuring the public of its safety?

The adverse effects of radioactivity are often not detected until years after exposure, and so in terms of the half-lives of these wastes and corrosion rates of the container it seems that reduced or infrequent monitoring would be inadvisable even under the best of conditions and test results.

The time period of 90 days is extremely short for adequate study of this DEIS. Many of the people who have requested copies of the document have not yet received one, and others in the state are just now applying for one. For these reasons and for the benefit of all concerned North Carolinians, I request an extension of 90 days for the public comment period.

In conclusion, CAN-Disarm is opposed to the ocean option and particularly to the selection of the North Carolina site because:

L.1

1. The DEIS reveals too many uncertainties to believe ocean disposal is an environmentally sound option.

L.9

2. The ocean option sets a precedent for ocean dumping that would lead to extensive use of the North Carolina site by military and commercial waste producers.

3. The ocean option allows the Navy to have an expedient and economical method of disposal of weapons systems which encourages the current pace of the nuclear arms buildup.

Captain Wagner, thank you for allowing me to speak here today. I'm certainly of a differing opinion when discussing the DEIS, but I believe that ultimately we are on the same

side. I know that you and I both are working for the peace and security of our homes and for the future of our children. Thank you.

CAPTAIN WAGNER: Thank you, Ms. Oehrman. I have no further registrations for people representing organizations. Is there anyone registered representing an organization upon whom I have not called? Then I'd like to proceed with the testimony by individuals. Again, I would remind those individuals that we have a 5-minute time limit for individuals, and our first speak is Mr. Bill Barlow from Winston-Salem, North Carolina. Mr. Barlow.

#17

MR. BARLOW: Good morning ladies and gentlemen. My name is Bill Barlow, and I would like to speak as a concerned citizen. I would like to thank those of you who have arranged the opportunity to receive public comment on this controversial delimma of how to dispose of our man-made radioactive wastes. I cherish this democratic forum, and would note that people throughout the world envy it. That is why the decision we make on breaking a 12-year moratorium on ocean dumping of radioactive wastes is so significant, for we as Americans are leaders. Should we choose the ocean dumping option many other ocean dumps will be created throughout the world ocean network, many of which will not even match the integrity of those designed in this proposal. Whereas the ocean is an ever changing environment and a basis for our

F.8

future life on this planet, it is important that we note that what we dispose of now to be released in the next century will be the planning problems we present to our children's children.

I have read the DEIS, and I find within the volume many statements that lead me to doubt that no significant impact A.16 on the environment will be affected by the disposal of these reactor cores. Beside the continual use of phrases like "almost entirely" and "it might be expected", facts like "except for Nickel-63 which exceeds the Class A segregated waste limit by 30 percent...the disposal package...would be required to provide stability of the waste for at least 150 years..." for land disposal burial, and yet we expect a release in 100 years in the sea dumping option. These statements cause me some concern. Even comparisons with television viewing and transcontinental flights do not convince me that the "materials will decay to environmentally innocuous levels within the lifetime of the container." This dissolved L.20 radioactivity of the proposed ocean dumping is an added radioactive contaminant which does affect the delicate balance of nature.

One might view my attitude as one providing no action or no option. I will say I advocate one of the land disposal options at this time. I consider this the most responsible action on the basis of the retrievability. I declare it is

the responsibility of those commercial and military agencies and our federal government who encourages production of fission materials to provide the best method of disposal. I least approve of the military powers being given the priveledge of ducking this responsibility. The land disposal option will do more to encourage development of future long range best disposal method practices. I contend that if the Environmental Protection Agency, the Atomic Energy Commission and the Department of Energy ignore this retrievable aspect they are W.1 also ducking their responsibility and are diminishing the possibility of eventually solving the radioactive waste problems.

I am truely impressed and thoroughly amazed by our country's ability to harness the release of energy from an atomic reactions. However, as may be obvious, I am appalled by the lack of concern for pollution problems associated with its utilization. The current arbitrary designation of low level material locked in the submarine reactor core is merely the tip of the iceburg of the horendous monsters the Navy is cultivating. How many more spent fuel storage pools will be created to accomodate high level wastes from the decommissioning of 100 submarines? How much more Uranium and Plutonium will be processed to make life-threatening mechanisms? And ultimately, how many more new launch tubes will be fabricated for how many new improved multiple warhead missles?

I abhor any promotional avenues for nuclear proliferation, especially in a time of supposed reduction talks.

At least the land option can be viewed as practicing jobs for peace. Training men and women to dismantle nuclear weapons is at least a conforting thought for the extra money spent.

In the same vein, I would like to conclude with a formal request: as the nuclear power industry has not yet been saddled with the responsibility for the costs of effective plant shut-downs and radioactive disposal, I now call on the leaders in the nuclear weapons reduction proposals; Conte, Zablowski, Kennedy, Hatfield and McClosky to demand that these decommissioning costs be directly included in the cost

0.4 estimates for putting new submarines on line. For by agreement, we may only add new launchers as we retire old. Let the cost not be hidden at the bottom of our oceans.

Thank you.

CAPTAIN WAGNER: Thank you, Mr. Barlow. I have no further registrations. Has anyone registered to speak who has not been given the opportunity?

Ladies and gentlemen, additional comments for consideration in the final environmental impact statement may be sent to the address that I gave you earlier, to myself.

There will be two additional hearings today. The next one will be at 1:30 this afternoon, and then there will be one

at 7:30 this evening. You are all invited to attend either or both of those hearings. This hearing is adjourned, and I thank you on behalf of the United States Navy for your participation and interest.

(Whereupon, at 11:00 a.m., the morning session was concluded.)

AFTERNOON SESSION

1:30 p.m.

(At the beginning of the afternoon session, Captain Wagner gave his opening remarks exactly as found in the beginning of this text that he gave at the outset of the morning session. After Captain Wagner's opening remarks, Mr. Mangeno presented his statements and slide presentation, also exactly as found in the beginning of this test, and exactly as he gave them in the morning session. This transcript will commence with Captain Wagner's remarks made at the conclusion of Mr. Mangeno's presentation.)

CAPTAIN WAGNER: Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing. I will now recess briefly to establish an order for persons who wish to speak. For those people who would like to testify and who have not yet registered, you may do so at this time. We will reconvene the hearing in 5 minutes and start testimony at 10 minutes after 2:00.

(At which time a short recess was taken.)

CAPTAIN WAGNER: Simply to establish an order for the testimony, I intend to ask individuals representing state government organizations to speak first, in alphabetical order of the speaker's last names, followed by individuals representing local government organizations, in alphabetical order by last name of the speaker, and then private organizations

and private citizens in alphabetical order by last name of the speaker.

I request your cooperation in providing comments within the time limit so that we may be certain all who wish to speak have an opportunity to do so. Once again, that's five minutes for individual speakers and ten minutes for organizational spokesmen. If your statement is so long that it cannot be given in the time alloted, you may summarize in the five or ten minutes and the entire statement will be included in the record if you submit it in writing.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, proceed to the microphone on my left, state your name, address and organization, if any. All comments are to be addressed to me.

Our registered speaker at the moment is Mr. John Runkle from Chapel Hill, North Carolina, representing the Conservation Council of North Carolina. Mr. Runkle.

#18*

MR. RUNKLE: The president of the Conservation Council of North Carolina spoke at this meeting this morning, Ms. Jane Sharp. I am the coordinator of the Conservation Council, and I'm here to expand on her testimony and raise some other issues that we have with the environmental impact statement. I will preface my remarks by saying that our technical committee is looking very closely at the DEIS, and we will be submitting written comments, but these are sort of

*Other issues discussed by Mr. Runkle are side barred in Exhibit 468.

an outline of the areas that we're having problems with right at this present time. Maybe our technical committee will come up with others.

* F.9

The first thing is that all the way through the DEIS we see that in a lot of places the Navy is relying on the criteria developed under the Law of the Sea. We have a concern that since the Reagan Administration saw fit not to sign the Law of the Sea will the Navy still hold itself to those criteria for the disposal of wastes into the ocean? I'd like to see that in the final DEIS to be clarified. Actually, if the Navy will be following these criteria, whether we have to or not, some kind of statement saying that we are going along with criteria should be included.

We also are concerned as to whether this reactor within the submarine should be classified as low level radioactive waste under 10 CFR 61. This is a definitional problem - looking over how much radioactive material is in it, especially the radioactive Nickel that has a very long half-life - whether this should be considered something else, in fact; gigh level radioactive waste. You know, a reclassification, which would entail new guidelines for disposal of that kind of waste.

The biggest problem our technical committee is having looking at the DEIS, is that the; and we're talking about some hypothetical study areas here. I realize that these are

areas off the coast of North Carolina, but to this point would you not have any idea where the actual sites will take place? I realize that there will be site specific hearings later on, but it seems to me that any decision should be withheld until that time that specific sites can be talked about, so our oceanographers can look at the actual bottom current at that site, and what kind of pressure, what kind of upwellings are at that specific site. We realize that the Navy probably has more extensive surveys done of most of the coastal areas of the United States. We realize also that a lot of this, no doubt, is classified secret, but this kind of information and a specific site might be released, and that will allow us to be able to, and allow you and allow the scientists at the EPA and elsewhere, to look more closely at a specific site. And that's the biggest problem we're having with the whole thing right now.

J.9

J.28

J.31

Q.13

We had some serious questions about the effect of the high pressure and the 13,000 to 16,000 feet; what th- high pressure would be on the corrosion rate. And then it seems to me that there was a study done of an actual corrosion of; well, a study conducted in May of corrosion under that kind of pressure, and what the effect of that pressure would have on the effect of it being so cold on the outside and being radioactive on the inside. The difference between the heat and the cold may do other things to the corrosion; may crack

*Other issues discussed by Mr. Runkle are side barred in Exhibit 468.

things faster.

The biggest problem we have with the dumping off the coast of North Carolina is that first of all there is no monitoring. We will not ever know what has happened to these decommissioned submarines when they are sitting on the bottom of the ocean. We don't know if they are remaining structurally sound for 100 years and will not be releasing radioactive materials within that time. There is no effective monitoring of the submarines. And part of that is the retrievability aspect. If something happens that one of the submarines cracks wide open in the first week of being decommissioned, being disposed of, there is nothing we can do. We can't go down there - practically, we can't go down there and remove that submarine; which is one of the advantages of mothballing. At least in mothballing there is someplace you would have access to the vehicle to monitor this radioactivity in the submarine very closely and retrive them in the long run if necessary, or encase them within another layer if they started releasing radiation into the air.

J.76

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Now, I did speak with some of our friends down in South Carolina, the Palmetto Alliance, that's been monitoring the Savannah River Plant for years, and that part of the DEIS is inadequate, and I'm sure that they will comment more in your hearings down there in South Carolina.

We talk in terms of background radiation, and our concerns

are that we are not looking at the cumulative effects of all of the radiation that's going into this Savannah River Plant. The start-up of the L reactor will make that area more radioactive; the new interstate low level radioactive waste compact where wastes from 5 or 6 of the southeastern states is going down to the Savannah River will make that area more radioactive.

E.17

Nuclear power plants in the near future will have to be decommissioned. Where will those reactors go? We pray that they do not be disposed of in the ocean, and if they are disposed of on land in the Savannah River Plant Reservoir we'll have more and more radioactivity in that area.

The Conservation Council of North Carolina has about 600 members across the state, and many of them are down at the coast. Six or eight of our member organizations are coastal groups that have been concerned and have been working on the coast for years, and there's something about our coast of North Carolina that is worth saving. We have the most beautiful beaches in the world, we have beautiful natural areas, we have an extensive tourist industry, and fishing industry - both commercial and sport fishing. Knowing that this radioactivity is off our coast upsets us. In the long run, this is the very thing - I think it will cut down on our industry and cut down on our economics of the coast, and we would like to see the consideration of what the effects of this kind of thing

L.53

O.34

will do to our coastal industry.

As a last question in this hearing, we are talking in terms of roughly 100 submarines that have to be decommissioned in the next 25 to 30 years. This does not take into consideration submarines which may be built starting now, which may be another 100 submarines, another 500 submarines. There's no telling how many nuclear submarines the Navy does want to decommission, and once they start dumping this waste, this radioactive waste off our coast where is it going to stop? We have to stop it right here. We're really concerned about what's happening on the coast of North Carolina.

A.1
N.12

Thank you.

CAPTAIN WAGNER: Thank you. We had a pre-registration for Mr. Doug Guild, representing AMUSE. Is there anyone in the audience to speak for AMUSE this afternoon? I have no further registrations; is there anyone who has registered to speak who I have not yet identified and would like to speak now?

I thank you very much ladies and gentlemen. We will adjourn this hearing, and we will hold another hearing this evening at 7:30. You are all welcome to attend that, and we thank you very much for your interest and testimony this afternoon.

(Whereupon, at 2:22 p.m., the afternoon session was concluded.)

EVENING SESSION

7:45 p.m.

(At the beginning of the evening session, Captain Wagner gave his opening remarks exactly as found in the beginning of this text that he gave at the outset of the morning session and afternoon session. After Captain Wagner's opening remarks, Mr. Mangeno presented his statements and slide presentation, also exactly as found in the beginning of this text, and exactly as he gave them in the morning and afternoon sessions. This transcript will commence with Captain Wagner's remarks made at the conclusion of Mr. Mangeno's presentation.

CAPTAIN WAGNER: Thank you, Mr. Mangeno. Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing.

I will now recess briefly to establish an order for persons who wish to speak. For those people who would like to testify and who have not yet registered, you may do so at this time. We will reconvene the hearing at ten minutes after 8:00 and start testimony at that time.

(At which time a short recess was taken.)

CAPTAIN WAGNER: The hearing will come to order. Simply to establish an order for the statements, I intend to ask individuals representing state government organizations to speak first, in alphabetical order of the speakers' last names, followed by individuals representing local government organizations, in alphabetical order by last name of the speaker, and then private organizations and private citizens in alphabetical order by last name of the speaker.

I request your cooperation in providing comments within the time limit so that we may be certain all who wish to speak have an opportunity to do so. Once again, that's five minutes for individual speakers and ten minutes for organizational speakers. If your statement is so long that it cannot be given in the time alloted, you may summarize in the five or ten minutes, and the entire statement will be included in the record if you submit it in writing.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, proceed to and use one of the microphones provided. State your name, address and organization, if any. All comments are to be addressed to me.

Our first registered speaker is Ms. Jane Ballus, representing the American Friends Service Committee.

#19

MS. BALLUS: I am Jane Ballus representing the American Friends Service Committee, Southeastern Regional Office, Atlanta, Georgia.

Thank you for the opportunity to present this statement tonight regarding the disposal of nuclear submarines at sea. We appreciate the fact that the Navy has an interest to meet here in Raleigh to consider the views of the citizens of

North Carolina.

The disposal of radioactive materials at sea is an issue of major concern, not only for people of coastal areas but for people everywhere who depend on the oceans for both economic and spiritual sustenance. The environmental impact statement has stated that the submarines would be sunk too deep to pose any threat on the ocean ecosystem. We would suggest that more studies are needed on bottom currents, artificial reefing and marine life cycles.

J.9
L.55
L.13

In contrast to the unfounded optimism of the Navy, is the history of ocean dumping of nuclear wastes. Above all else, the main lesson of ocean dumping of nuclear wastes is that no one can accurately predict what will happen in the future, and that adequate monitoring of ocean dumps is extremely difficult, if not impossible.

L.39
J.76

From 1946 to 1970 nearly 90,000 containers of radioactive wastes were dumped in the sea off the U.S. coast. Reports from California and Maryland are now showing that radioactive contaminants from these dump sites are being found in the open water and in marine life. Keep in mind that at the time of the dumping, ocean disposal of radioactive wastes was considered to be quite safe and would pose no future problem.

What we need to emphasize is that once submarines, or any other objects, are dumped into the sea they are virtually impossible to remove or recover, and difficult to monitor;

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J.76

L.20 L.36 T.32

which means that any unanticipated result, such as leaching of contaminants into the sea or uptake by marine life, is likely to be impossible or prohibitively expensive to correct.

One of two assumptions is implicit in this Navy proposal. The Navy either:

1. Expects its analysis and projections are perfect and will perform perfectly; or

2. They are willing to run an experiment in which more studies are needed and which could cause broad reaching impacts.

We reject moving ahead on the basis of either assumption.

F.8

There is also a major policy impact of this proposal. The United States and a number of other countries are reviewing plans for the permanent storage of stockpiled high level nuclear wastes. Here again, several proposals for ocean and seabed disposal of high level radioactive wastes have

L.9

been presented. Again, once placed on the seabed these wastes would be virtually irretrievable. Our concern is that a precedent of dumping nuclear submarines at sea would serve

F.8

as further incentive for ocean disposal of other radioactive wastes. Indeed, U.S. leadership in ocean dumping could provide an added incentive to other coutries to adopt ocean dumping plans. Conversely, U.S. restraint in ocean dumping could provide added weight towards an eventual prohibition on all ocean dumping of nuclear wastes.

For a project of this magnitude it is most essential for the general public to have access to information in order to make an educated review of the possible impacts. The Navy and other arms of the Department of Defense and Department of Energy are notorious for not releasing complete information about nuclear related projects which could have an impact on human and natural environments. A case in point is the construction of a Naval nuclear weapons storage bunker in the flight path of the international airport in Honolulu. The Navy opposed preparation of an Environmental Impact Statement for that project and fought their case all the way to the Supreme Court. The same has been true with accidents involving nuclear weapons; the Department of Defense and Energy have repeatedly avoided disclosure of such accidents and restricted the amount of information released.

A.6

In the case before us it would be most important for the public at large to know specifically the make-up of reactor

L.24

components and other potentially radioactively contaminated parts in order to review their impact. Such a public review can only provide positive results in improving the safety of any proposed actions. As an example, we might point out that for reviewing the long term impact of civilian nuclear reactors, the U.S. Nuclear Regulatory Commission failed to include the impact of radioactive nickel until it was exposed by an independent review by the New York Public Interest Research

Group under the direction of Dr. Marvin Resnikoff. In additicr public review of civilian reactors has resulted in the improvement of reactor safety by requiring the addition of non-standard back-up features. In these cases, the federal agencies involved opposed the public's position initially but later adopted it as a standard practice.

In summary, we offer the following: Ocean disposal of decommissioned nuclear submarines sho-ld be opposed for the following reasons:

W.1

1. Once deposited on the ocean floor the submarines would be virtuallly irretrievable; thus any unforseen occurrences resulting in the release of radioactivity could not be controlled; and

F.8
L.9

2. Ocean disposal of nuclear submarines could serve as additional incentive for ocean disposal of other radioactive materials by the U.S. and othe- countries.

Finally, we urge legislation requiring permanently retrievable land disposal of the decommissioned submarines. Retrievable land disposal is the only sane option for the safe, long-term management of the decommissioned submarines.

H.5

One possibility which we suggest the Navy explore is the dismantling of the radioactively contaminated components for entombment in civilian nuclear reactors scheduled for decommissioning.

Thank you for your consideration of these comments.

#20

CAPTAIN WAGNER: Thank you, Ms. Ballus. The next registered speaker is Mr. Wells Eddleman, representing North Carolina Public Interest Research Group.

MR. EDDLEMAN: Thank you, Captain Wagner. I am Wells Eddleman, staff scientist with the Nort- Carolina Public Interest Research Group.

I was able to receive a copy of the DEIS by telephoning for it. My collogue, Ruffin Slater here, wrote for one and has not gotten it, and we understand that some others haven't gotten theirs either. This reflects, I think, some of the difficulty that some of the public groups and individuals have had in getting hold of information on the study. However, I have gotten the DEIS, and I would like to make the following comments:

First, if the situation really requires no rush, as is repeatedly stated in the DEIS, it appears that the schedule of these hearings is too close to the time of its issuance, and the comment period is too restrictive, and the Public Interest Research Group respectfully joins with those other organizations in requesting an extension of the comment period. I should think, given that the actual disposal of these submarines has been banned by statute now for two years, that an extension of 180 days would be appropriate. There certainly is nothing to be lost by a thorough scientific study of the implications of this project.

I believe that this waste disposal might be characterizeu by saying that want to boldly dump wastes where no one has ever dumped before, and there are some difficulties with that that I don't think have been proved out in practice.

F.20

I was interested to read in the DEIS of tests of sinkin cylinders. However, these weren't strealined like a submarine, and the ones that were sunk with hemispherical heads, even they would have only some of the characteristics of a submarine, and I would think that the effect of impact on the sea bottom should be analysed, not only with respect to the submarine itself, but on to the reactor bulkheads, because the water in the after compartments is independent, really, of the metal of the submarine, and as a person who has worked on crash tests of automobiles, I can tell you that when we have de-coupled impact like this - that is, the vehicle, the sub-marine, is stopped by crashing into the sea bottom but the water still has this momentum, you're dealing with a situation of enormous force, and I'm not sure what that those bulkheads were designed to withstand, and I'm not sure what they will withstand after having been stored for some time. But it should certainly be assured that this will not result in ruptureing the bulkheads.

I would also note that the 62,000 curies of radioactive material in each sub initially, after defueling, is really a substantial amount of radioactivity, particularly when 22,000

of it is that very nast species, Cobalt 60.

In the ocean currents under which the DEIS discussed the dispersal and diffusion of the submarines' radioactive contents, they must go somewhere. There's not just a potential for biological concentration at the site, although the effects of ocean bottom bacteria do not appear to have been adequately explored. But also, this water must upwell at some point, and this may very well be one of these nutrient rich areas, like the Carribean Sea, or our Gulf Stream, or off the Coast of South America, in which you have numerous life forms of many stages, and the hierarchy nad food web which concentrates radioactive materials - and I'm particularly concerned about the Cobalt, because as you know, many forms of marine life have Cobalt based blood.

L.55 Q.12 Q.13 J.31 L.37 L.18

It appears to me that there are a great many unknowns that just are assumed to work out here. For example, the submarines will not leak early. If this is the case then certainly better monitoring of the site is advisable.

L.40 L.20

The DEIS seems to minimize the cost of monitoring, but I think that both the radioactive material and biological activity; the sites need to be very well monitored. It appears that right now, that the monitors to locate the sub when it sinks are adequate, but the monitors for radiation both on sinking and later are not. And I further would question how we could guarantee such monitors for 400 years, which the Navy

J.76 J.79

expects to be the critical time for the release of these materials, and what that would cost. And I'm not just talking about the future dollars to the point where, you know, a million dollars 100 years from now might be worth two cents. I think we need to be realistic about what it might cost.

L.55 Q.12 We also need more information concerning life forms making these submarines their homes. What is their impact on corrosion rates? Would it be possible, for example, for sea bottom gnaqing worms to penetrate corroded areas earlier than the Navy has assumed? What would be the impact of iron-based bacteria that is, that use iron in their biological process - and sulfur - attaching themselves to parts of the submarine where the reactor compartment is, and increasing corrosion?

H.3 It appears that it will be much more desirable to store the defueled reactor plant above ground, preferably in a shed or in some protected area in a dry area. And there are such places. For example, the desert in Hanford.

W.1 I would also question what the cost might be, and feasibility of raising even one submarine from a depth of 4000 or 5000 meters if things have gone wrong. What would be the cost to raise 50 if it were determined that the first sub was leaking as the 51st was being sunk. I would question how marine salvage at such a depth is becomming more or less feasible, and

what its cost might be.

Finally, it appears that the comparisons of radioactive impacts in the DEIS are unrealistic in the sense that they do not integrate all persons and all biological forms that are exposed to this radioactivity. When you consider this cumulative fact of larger areas of submarines, of submarines being disposed, the impact could be substantially greater, very substantially greater than has been supposed. And this has been the case in the past with radioactive disposal in the ocean at other places, and I would urge you to consider these comments in preparing a final impact statement, and I hope that more time will be available for the public and various interested parties to further review this document. L.7

Thank you.

CAPTAIN WAGNER: Thank you. I would like to interject here that I think I mispronounced both names tonight. Please accept my apologies, but rest assured that our reporter will get your name properly for the record.

Our next registered speaker is Mr. Doug Lowe representing People's Alliance. Mr. Lowe.

#21

MR. LOWE: Thank you. My name is Doug Lowe. I am spokesperson for the North Carolina People's Alliance, and I live in Durham, North Carolina, where our citizens organization has a large chapter. The rest of our membership tends to be concentrated in the Triangle area, in Chapel Hill and Raleigh, but we have other members across the state, some of whom are at the coast.

First let me say thank you for holding this hearing, and I know it's a thankless job you have sitting up there and hearing all of this. It's kind of a tough process. I go to hearings a lot because I'm an activist, and you go to hearings a lot because you are paid to hear us, but what we're really after here, I suppose, is a combination of a scientific conference on a report, which I'm not qualified to make; and the process of democracy that says we have to see what the citizens feel and think about this, and unfortunately I suspect that in the process of these environmental impact statements citizens emotions don't count for very much, but let me state a couple of things.

One is that we have had trouble getting a copy of the Draft Environmental Impact Statement also. It was not available in the library in Durham, and so it wasn't convenient for me. And I share the sentiments of our organization that anything of this import certainly needn't be rushed into, and we have your assurances in the Draft EIS in the summary that you are not rushing into it, but you're certainly rushing the hearing process by allowing only 90 days for comment after the DEIS is available.

I first came to North Carolina because of the Outer Banks. I first came here to go to the Outer Banks, and they

are kind of a magical place, and I know magic also doesn't figure in science. I wonder if the environmental impact statement is going to be taking into account impacts in the business environment that have to do with people's image of the Outer Banks changing if they know that there is some radioactive material out there a few hundred miles away. I can assure you as a former advertising man that things like image are very real, and that as most businessmen know, good will or what the public thinks of you can count in dollars and cents, and I don't see really, that you are taking that into account. You offer assurances that it's not going to really affect our fishing industry and other things, but I don't think there's a way; or, there has been very little attempt to measure the cost to the business environment on one of our largest industries, the tourist industry, of sinking a submarine with radioactivity in it out there, because the reality of the matter is just how people perceive it.

L.53

O.34

I'd like to discuss the issue of land versus ocean disposal. It seems to me that your proposal has dollar amounts being in the ocean disposal's favor, and I suppose the Navy is always in favor of dealing with the ocean rather than dealing with land, but you have some other reasons for it that I can't get behind some of your assumptions. There were some words you used that the only feasible way or practical way was to dump it in the ocean. There's no mention of land options other than burial on land. There's no mention, for instance, of this idea just mentioned before me of putting it in the open air, or in the air above ground under a shelter. I happen to have grown up just in the high desert of Washington state, just next door to Hanford where I can testify on the weather conditions up there. And it seems to me that the cost of disposing this on land is artifically inflated when you make it necessary to bury it, when you have an environment there that doesn't require burial, and in fact, being in contact only with the air rather than the ground would keep the metal from corroding. This option would contain a radioactive container much longer than either contact with land or the contact with the sea. And in fact, the sea, if you wanted to choose a natural medium that corroded metals as fast as it could, I don't think you could choose a better one. So some of the logic of this I don't understand, and I wonder how much thought has been given to this, or whether it really has to be buried on land rather than be put above ground. And if you could put it above ground, how much would you save in costs by getting rid of the expense of having to dig the earth and all of that.

H.3

H.3

H.3

It seems to me that some other advantages by having it sitting above ground would be that you can look at it. The monitoring, of course, is very easy and very inexpensive, and as we've already heard, the monitoring that we see in the

objective for the ocean is, or appears to be very inadequate, and even if done adequately, inpractical and incredibly costly. There's no estimate as to what the cost would be, but somehow it seems that keeping it above ground would make it easy to monitor and easy to recover.

J.76

H.3

Again, we're talking about something that's virtually impossible to do - recover a sub from a depth of 4000 or 5000 meters, and we certainly wouldn't want to incur that expense, and we're not really planning on that, but it seems like Murphy's Law would say that if you plan on it, then you should also not plan on it.

W.1

I think there's another advantage to having it on the land, or that may be a disadvantage depending on your point of view, but from my point of view it's an advantage because the whole nation can see, or we have these visual reminders of how much radioactive material we are building up and storing, rather than throwing it away, out of sight, out of mind. And as ecological awareness is teaching all of us, there is no other way - you don't throw anything away, you just put it somewhere else, and it's all connected. By putting it in the ocean it appears to be away, definately out of sight and out of mind. So I want to see it on the ground where I can see it.

H.3

There's a very interesting book written by Garrett Holden called <u>Tragedy of</u> Commons, which says that we cannot divide something that everybody has in common. You know, so we throw our stuff there, and that's away, but that belongs to everybody, and yet the full circle of responsibility says that if you cause a problem or you create a material you should live with it or solve the problem yourself. And so I would say that this material should be disposed of on government land. The government created it and the government should keep it on its land and not put it on the ocean floor that belongs to all the peoples of the world.

F.8

It's very interesting for us to say to all of the people of the world that we've got undesirable materials there, but we don't want them following in our footsteps, if we can help that.

I.9

There wasn't anything in the EIS about the Savannah River site, and I would like to say that it's an above-ground site, or a land site. To me it seems far inferior to the Hanford reserve. And there was some comment made in 1976 included in the DEIS on the Savannah River site saying that it's, you know, very safe for the materials that are beinghandled there. And I've seen something very recently about the degree of radio-

I.4

activity in the ground water, and so I suggest that that be checked into further to see if you are really aware of that latest information that seems to suggest that the Savannah River site is unsafe.

There's also the question of a negligible exposure, and

it's something that's referred to - well, I won't dwell on it, but it is kind of the metaphor, or whatever, of the straw that broke the camel's back. Each straw is negligible, but the last one had an impact, and if you think that law is negligible, it increases our level of radioactivity, and if it's negligible compared to background, compared to television, compared to an airplane flight, at what point do all of those negligibles add up to something that is not negligible. I don't think that question is addressed at all.

L.7

Two final points: I've already referred to Murphy's Law, which as I understand it is that anything that can go wrong will. I see a possibility for two accidents: one which the DEIs mentions briefly - accidents in the towing of the subs to the location you intend on sinking them. It seems that a possibility, in fact, a great possibility, given the seas off the Outer Banks of losing a sub before you get it to where you want it to start sinking it. In other words, the sub may end up on the continental shelf somewhere much closer than the Navy would like it. And therefore that means having to remove it.

L.57
L.60

Also, I gather you're thinking of a much wider or bigger area for sinking the subs in the water than on land, because you want to give plenty of room for those subs to sink and not hit one another. And that's very wise, but this I think - I didn't see anything at all in the DEIS about the probabilitie:

F.23

of one sub hitting another. And it seems that there ought to be some figures on that such as: what are the chances? How much control do you really have in your ability to sink something like that and have it go down and not have one sub accidently hitting another that has already been sunk and causing a rupture and a much earlier dispersion of this radioactivity.

Those are our comments and our concerns. Thank you again for the chance to express them.

CAPTAIN WAGNER: Thank you, Mr. Lowe. I have no further registrations for people representing organizations. Has anyone registered to represent an organization whose name I have not called? At this time, then, we will proceed to testimony by individuals. Again, I would remind that we have a 5-minute time limit for those people speaking for themselves so that everybody will have an opportunity to speak. The same procedure will be used; proceed to the microphone and state your name when I announce it. The next registered speaker is Mr. James F. Berry from Raleigh, North Carolina.

#22

MR. BERRY: How do you do? I'm James Berry, and I want to say also that I appreciate the opportunity to be able to say what I have to say. I'm a retired Colonel with the U.S. Air Force. I've worn a uniform for a large number of years and I understand a little bit about the position you're in. I didn't come to speak in my capacity as a retired colnel;

I'm an ecologist. I've become an ecologist since I've retired, and I want to speak from the standpoint of an ecologist and a North Carolinian.

I would like to support the statements that have previously been made by some respected authorities from the Oceanic Society and from Greenpeace in which they state that they really would like to have some more time to study the DEIS. Others have said the same thing, and I want to repeat that I believe that there is a need that there be more time allowed for study and comment.

I would like to affirm the one great lesson that we have learned in the ecological field in recent years, which is that everything is connected to everything else. Wherever you put these submarines you're going to put them in the middle of a life system. There is a web of life that surrounds the universe. You can't put anything anywhere that you do not interact. So you're going to interact with the earth wherever you put them, and where you're going to put them, if you do put them off the coast of North Carolina two and one-half miles deep, you're going to put them in a place where they are in contact with an earth system and you've got to know what's going to happen to that earth system as a result of their presence there. And you stated in your opening statement that one requirement on you to produce an environmental impact statement is that this will have a significant impact on the environment.

I do affirm, and I think that I can get a lot of support for this, that no matter where you put it you're going to interact with the environment, and I understand that you're trying to find that place that's going to cause the least interaction with the environment, and I say now that there is going to be a life system wherever you put it.

W.1

If you discover, after you have put these, this large number of submarines there, that the interaction with a life system is going to be something very important, or very critical, you're not going to be able to retrieve them and move them.

L.14

I would like to point out also that the impact on the human life system is not the only impact to be considered. The impact on any life system ought to be looked at.

I would like also to point out that mistakes can be made, and we have the horrible circumstances of the things that happened by the way of radiation up in Utah in the salt flats. We had one happen with Agent Orange in Viet Nam; we've had the results of what's happened to all of the chemical dumps where unexpected results have ensued - some of them very bad.

I would like also to state that the study of how to handle the radioactive problem is a study that is receiving a whole lot of attention all of the time. I suppose that sometime science may find out some way to deactivate radioactive waste.

If they do, then you're not going to be able to deactivate that submarine 2 and one-half miles down at the bottom of the sea.

The last thing I want to say is that this is my home. I don't want stuff in my back yard of such potential harm. I think that once you put any radioactive waste in the sea off North Carolina, that then that's going to be a place where people are go-ng to want to put all radioactive wastes. L.9

Thank you very much for the opportunity to speak.

CAPTAIN WAGNER: Thank you, Mr. Berry. Our next registered speaker is Ms. Laura Drey from Durham, North Carolina.

MS. DREY: Could I ask for another couple of minutes? Is there anybody after me?

CAPTAIN WAGNER: Certainly. We'll come back to you after two or three more speakers. The next registered speaker is Mr. Robert Eidus of Raleigh, North Carolina.

#23

MR. EIDUS: Good evening, and how are you doing? I'd like to wish you a happy Valentine's Day gentlemen, if nobody's done that to you today.

Although my remarks are basically critical of the DEIS, I would like to state that these comments should be taken as constructive criticism. They are directed both at the Navy and my opportunity to talk about EPA. I think they are linked. I sincerely hope that these hearings will underscore the concern of many North Carolinians represented here tonight to have our oceans safe and healthy, and that they not be infected by environmental radioactive pollutants.

EPA has changed its role recently, and they are now, so I'm told, involved with enforcement of our environment to a lesser degree, and more with an attitude of industrial compliance. Personally, I think that this is not in the best interests o- the citizens of this country.

I thought that EPA should stand for Environmental Protect: Agency, and that the protection was for all of the citizens of this great country, not for the protection of the polluting industries or the military.

The EPA, to have hired Glenn Sjoblom to review the Draft Environmental Impact Statement, should be held as a blatant inexcusable act. Mr. Sjoblom should have enough ethical character as a U.S. Navy engineer to withdraw from participation in the review process. He should be relieved of his duties if he does not do so, because this report should get a fair and impartial hearing.

I think EPA should refrain from making suggestive stateme-- also in Congress concerning people who were consulted in this matter; that the ocean dumping of nuclear wastes is harmless. We have reports from the EPA that rat-tail fish caught near
U.9 an old dump site near New Jersey were contaminated with levels of radioactivity many times higher than background. And just

because human beings do not eat rat-tail fish does not mean this is not a problem, as EPA thinks.

As Jasques Cousteau advised President Reagan at a White House luncheon on June 23, no dumping which has been; there should be no dumping which has irreversable impact, that that should never be allowed in this country. I contend W.1
that nuclear dumping is known to have irreversable contaminants of the ocean environment, and ultimately on mankind. These studies are known and should be a part of this DEIS. F.12

Now, let's talk about the options stated in the DEIS. The land option proposed has the scrapping of metal, and shows it as a negative cash flow. So why should be even consider it if it has a negative cash flow? Where is the imagination that is necessary for a project of this nature and magnitude to come forth? Why is it not proposed to separate the core section? You could seal it and then take it to the land site, O.10
could open it and fill it with concrete or line it with lead. Then you can take the other sections of the submarine and do with them what you will; take out the intelligence equipment and use it somehow. Take it out to the sea and make a man-made reef out of it, or let the Navy tow it out and blow it up.

The subs at sea are reported by the Navy to be posing no more of a hazard than watching TV or taking a long airplane flight. I'm insulted. There is a big difference. Each individual can choose whether to watch TV or take an airplane ride, but we're not given a choice if you dump the radioactivit into the ocean.

L.40

The point being made is that realistic options were not examined so far, and that the human possibility of error is always there. A case in point is an EPA administrator in the office of toxic wastes who was fired recently, cited with contempt of court for lying under oath; not something that the EPA or the Navy should be proud of. Of course, now, the EPA, they are not dealing with this problem. The sites are not being monitored now. You talk about monitoring sites, but they're not monitored sites. If EPA could mis-represent the hazardues waste situation in this case as it recently has done it abuts our ability to understand what people are trying to protect our interests.

L.6

In the past they have said that there is no problem with the dumping. They went to Massachusets, they opened some barrells and they determined there was no problem with toxic wastes. But they couldn't find the barrells. So, if they couldn't find the barrells then there was no problem with toxic wastes. This does not give the average citizen a deep-seated confidence in EPA that they are really protecting our interests.

L.36

or the interests of people who like to eat seafood.

What I want the Director of EPA right now to do is to turn over the materials Congress wants. This sounds very

suspicious. Are we going to be getting the same presidential executive privilege stuff and national defense rhetoric in the future years? All I can say is that I would like to implore and ask you to consider the future consequences for the sake of the children who will occupy this earth in years to come. It is for them that I come here today to support an international desire to continue the moratorium on dumping; not to pollute the oceans with its fragile ecosystem that we are all so fortunate to enjoy.

Thank you. I hope you have a good evening.

CAPTAIN WAGNER: Our next registered speaker is Mr. Robert B. Ginnis from Cary, North Carolina.

#24

MR. GINNIS: My name is Robert B. Ginnis, and I would like to speak in favor of the ocean disposal matter. I seem to be quite a minority here today.

Basically, it seems rather clear from the Draft Environmental Impact Statement, which by the way, I had no trouble getting - I received it quite promptly in the mail - that all of the impact from either land or ocean disposal would be very minimal, and actually the difference between the two is probably not worth considering.

However, there is one potential problem with the land disposal that I do not see in the impact statement, the draft statement, and that is the potential that at some point down

E.33 the line, the way that I understand the reactor compartment would be prepared, the reactor compartment would fail, would rust through and create a void in the landfill which presents the possibility of water infiltration into the landfill through a broken cover, which would be a problem.

The problem would be less so at the Hanford site than at the Savannah River, basically, and I think that's the only difference between the two, and I believe the cost is sufficient cause in and of itself to justify the ocean disposal.

Thank you.

CAPTAIN WAGNER: Thank you, Mr. Ginnis. I have one remaining individual registered to speak, and that is Ms. Drey. Are you prepared yet, Ms. Drey?

MS. DREY: All right.

CAPTAIN WAGNER: Ms. Drey is from Durham, North Carolina.

#25

MS. DREY: My name is Laura Drey, and I've been out of town for the past week and I didn't expect to get into town until tomorrow, so I wasn't anticipating speaking.

L.36 Mainly what I would like to address is the radioactivity once it gets into the food chain; and I'm not really used to speaking at these hearings. Basically, you know, when you dump radioactive materials into the ocean they get into the food chain like a couple of people have said earlier tonight, and internal damage can be done to people through the

food chain. And, as you know, from studies, I'm sure, radioactive materials can go through the food chain to man through water and soil and water plants, food crops and animals, fish and milk products. And the closer the food is to being irradiated, it's more apt that the irradiated food is to get into people.

Basically, once you dump radioactive materials like the nuclear subs into the bottom of the ocean, they can then be;- the water can evaporate into the air and come back down, and that's how the radioactive materials can get into the food chain. Once that happens - or if, you know, as the ocean mixes, radioactivity can get on the top of the ocean, and when that happens you get the eggs, the fish eggs and stuff are there, and that means that the radioactive materials are then passed on to young fish.

And basically, I guess what I want to say is that as the radioactivity passes, let's say, from small fish to larger fish, as in the case in the ocean, it gets the radioactivity which becomes more and more concentrated as it moves up the food chain. L.37 And I guess that's about it, since I'm not really, you know, prepared to speak. Thank you.

CAPTAIN WAGNER: Thank you very much, Ms. Drey.

Ladies and gentlemen, I have no further registrations. Has anyone registered to speak that I have not yet given you the opportunity? Then I would like to thank you all very much on behalf of the United States Navy and myself for your intere. and your testimony tonight. Thank you again; this hearing is adjourned.

(Whereupon, at 9:00 p.m. the afternoon session was concluded.)

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#25a

Laura Drey
113 W. Trinity
Durham, NC 27701

DISPOSAL OF NAVAL SUBMARINES OFF NORTH CAROLINA COAST

My purpose is to present two reasons why, in my opinion, the Navy and government officials ought to be concerned about the ocean being polluted by radioactivity emitted from nuclear submarines that have been disposed of in the ocean.
L.36 first, radioactive materials are passed through the sea food chain to man, and second, radiation causes health problems to man.

L.20 The radio isotopes in the nuclear submarines will not remain contained within the submarines. The reactor vessels are bound to corrode, releasing radio isotopes into the ocean, since the submarines will not be able to outlast the life of some of the radio isotopes. Once the radioactive substances are discharged into the
L.14 marine environment individual organisms, whole populations, and the food chain will be contaminated by radioactive materials.

Radioactive substances are passed through the ocean food chain. Radioactive materials are carried through the sea food chain from tiny floating plants to small crustaceans to intermediate flesh eaters to larger flesh eaters to man.

TABLE 4 APPROXIMATE CONCENTRATION FACTORS OF DIFFERENT ELEMENTS IN MEMBERS OF THE MARINE BIOSPHERE. THE CONCENTRATION FACTORS ARE BASED ON A LIVE WEIGHT BASIS.

Element	Form in Sea water	Concentration in sea water (micrograms/L.)	Algae (Non-calcareous)	Concentration Factors: Invertebrates, Soft	Invertebrates, Skeletal	Vertebrates, Soft	Vertebrates, Skeletal
Na	Ionic	10^7	1	0.5	0	0.07	1
K	Ionic	380,000	25	10	0	5	20
Cs	Ionic	0.5	1	10		10	—
Ca	Ionic	400,000	10	10	1,000	1	200
Si	Ionic	7,000	20	10	1,000	1	200
Zn	Ionic	10	100	5,000	1,000	1,000	10,000
Cu	Ionic	5	100	5,000	5,000	1,000	1, 0
Fe	Particulate	10	20,000	10,000	100,000	1,000	5,000
Ni	Ionic	2	500	200	200	100	—
Mo	Ionic-Particulate	15	10	100	—	20	—
V	?	1	1,000	100		20	—
Ti	?	1	1,000	1,000	—	40	—
Cr	?	0.05	300	—	—	—	—
P	Ionic	70	10,000	10,000	10,000	40,000	2,000,000
S	Ionic	900,000	10	5	1	2	—
I	Ionic	50	10,000	100	50	10	—

* Values from Lowman and Thompson (1956).

"The lower or more primitive forms are generally more resistant to ionizing radiation than are the more complex vertebrate forms." (p. 96 National Academy of Science)

> The algae and protozoa are most resistant with LD_{50} values in the order of many thousands of roentgens. The molluscs and crustaceans are somewhat more sensitive, with LD_{50} values of a few thousand roentgens (aquatic insects probably also fall in this category) and the fish are most sensitive with an LD_{50} of about one thousand roentgens- in the same order of magnitude as that of other cold-blooded vertebrates. (p. 96-7 National Academy of Science)

There are factors that determine how radioactive substances work in the sea food chain. The behavior of the radioactive materials depends on the distance between the source of the radioactive contaminant and where the contaminant is taken up in the food chain, and the mixing characteristics of the sea. Radiomaterials act differently in the "three trophic levels: (1) the distribution of elements among the three levels, (2) the concentration factors in different organisms within the same level, and (3) the transport of radiomaterials from one trophic level to another." (p. 76 National Academy of Science)

> In general, the radiomaterials taken up by organisms of the first trophic level will be primarily in the ionized state although a certain amount of particulate radiomaterials will be adsorbed to the body surfaces. When uptake occurs, the rate of uptake will probably be more rapid than the rate of uptake in the other trophic levels.
> Particulate radiomaterials tend to be concentrated in the second trophic level. Findings from the Wigwam and Castle tests (Goldberg, unpublished data) showed that the principal organisms which concentrated particulate radiomaterials were the mucous, ciliary, and pseudopodial feeders among the zooplankters. These organisms contained much more radioactivity per unit weight than either the algae or the petal or rapacious feeders. (p. 77 National Academy of Science)

> The transfer of radiomaterials from one trophic level to another is not only dependent upon the concentration of the radiomaterial in the organism but also is governed by the rate of growth of the organism and the rate of increase in the size of the population. (p. 77 National Academy of Science)

> In any event, there is always a loss in the total amount of radiomaterials in the transfer from one trophic level to another (though not necessarily a decrease in the concentration in individual organisms). Such a loss may be relatively small or it may be very great depending upon the organism and the particular food web involved.
> Not all radiomaterials that enter the first trophic level are passed on to higher levels. At each trophic level there are certain species that, for one reason or another, are not widely used as food by the organisms of higher levels. Also, some of the plants of the first trophic level may die before they are eaten and thus will be returned to the environment

#25a (Cont)

as organic matter. (p. 77 National Academy of Science)

The introduction of radioactive products into the marine environment, like from the dumpin. of nuclear submarines, has the potential to be a serious hazard to man when organisms used for human food are irradiated.

> There are several reasons why:... (1) The radiation recieved from a given quantity of an isotope ingested as food is much greater than the dose from the same quantity in the external environment.[2] (2) Many elements...are concentrated by factors up to several thousands by organisms in the sea; (3) the vertical and horizontal migrations of organisms can result in the transport of radioactive elements and thereby cause distributions different from those that would exist under the influence of physical factors alone; for example, certain elements may be carried from the depths of the sea into the upper mixed layer in greater amounts than could be transported by the physical circulation. (p. 5 Natioanl Academy of Science)

How radiotoxic a radioactive substance is on a person, thus the extent of damage done to a person's health by radioactive substance, is determined by a number of factors. The magnitude of the health effects that are apt to occur to a person who has eaten irradiated food will depend on- 1. the types of radiations emitted, their concentration, and the chemical transformations undergone during various stages of absorption and distribution through the body; 2. the size, location, and types of cells that are exposed by the metabolic pathway the radion took, and the cells sensitivity; 3. the age,[3] sex, and physical condition of the person involved; and 4. the accumulation of the dose which is determined by the decay rate of the radio isotopes, the length of time between exposures, the person's daily intake, the rate of excretion,[4] and the total body dose. "The most important radio isotopes from the stand point of accumulation in organisms are...those (radio isotopes) which are concentrated in a large degree by organisms, are retained by them for relatively long periods of time, and have slow decay rates." (p. 18 National Academy of Science)

There are absorption and distribution rules that radio isotopes follow in the human body. "The uptake of various elements by organisms are not entirely independant of one another." (p. 16 Natioanl Academy of Science)

> The uptake of one radioelement by an organism may be altered by the relative abundace of another element in the environment. In instances in which more than one element is involved, one of three phenomena may be observed: First, elements of similar chemical properties may substitue for one another...Second, some elements may have an inhibitory effect on others...Third, there may be a synergistic effect of one element on another. (pp 73-4 National Academy of Science)

"Elements of similar chemical properties tend to be taken up together very roughly in the same proportions as they exist in the environment." (p. 16 National Academy of Science)

> Since the isotopes of most chemical elements are similar in chemical behavior, it can be assumed that organisms do not appreciabley distinguish between the radioactive and non-radioactive isotopes, and that, to a good degree of approximation, the path of a radioactive element through the biological system is the same as that of its non-radioactive isotopes. (p. 17 National Academy of Science)

A person's eating irradiated food is an example of chronic exposure. The chronic form of exposure is gotten from repeated small doses of the toxic substances over a long period of time. The symptoms of a person who has been chronically exposed does not occur for a long period of time. Chronic exposure to radio isotopes can lead to somatic and genetic injury.

What causes man to have somatic injury from radio isotopes? There are disruptions within the cells, that "may occur at any time of growth and development from conception to adult life,"[5] that affect the cells functions. After individual body cells are exposed to radiation the cells continue to grow or reproduce abnormally: more rapidly than neighboring cells. In addition, somatic injury can be the consequence of membrane damage, enzyme inactivation, and genetic changes. Damage of the cell membrane impairs the transporation of nutrients and other substances to and from the cell. Damaged enzymes within the cell impairs the support role of the cell. This "involves the stimulation or inhibition of active enzyme systems in liver. These (enzyme) systems normally moderate the toxic effects of foreign substances in the body, with the result that modification of the activity of the liver through the effects of one agent may alter its ability to deal with a second agent." (p. 30 Lucas) Since there is damage to the nucleus, especially to the genetic material, the hereditary or germ cells are effected. Within the nucleus are chromosomes, and a component of the chromosomes is DNA, which "directs and controls the normal functioning of the cell," (p. 24 Lucas) therefore with the damage of the nucleus, the cells cease to function properly.

Radiation can indirectly damage individual cells. Radiation effects cells by acting on water that is inside the cells. A fractional amount of the water is decomposed into reactive fragments, called free radicals. These free radicals react readily to form peroxides. Peroxides are capable of moving around for a short time until "they alter a receptive molecule...(then these enzyme) molecules (that have been) modified by radiation may transform 100,000 or more molecules needed for perpetuation of the metabolic activities of the cell."[6] So the effects or radiation are amplified. Changes in the surrounding tissue occur because the cells are bathed in radioactive products.

Tissues vary in their response to radiation. In general, tissues which divide and grow fast, and those dependant upon recieving a large quantity of blood appear to be the most sensitive to radiation. "Consequently the most radiosensitive organs include blood-forming organs such as bone marrow (where white and red blood cells are formed), spleen, growing bone, and the lining of blood vessels and the stomach and the intestines." (p. 68 Schubert) After being effected the skin, the membranes lining the body cavities, and the secreting glands resume normal functioning. However, other parts- muscle, brain, and portions of the kidney and eye are incapable of producing new cells or when they do produce new cells scars, non-healing ulcers, and cancer may develop.[7] Harm to leukocytes, the endocrine system, and the productive organs (examples of what can be damaged) by man's being exposed to radiation will be discussed below.

Leukocytes and a constituent-- lymphocytes, a form of white cells produced in the lymph nodes and spleen, are suceptible to radiation. Once the body has been irradiated, the body is incapable of carrying out the lymphocytes function. This makes a person increasingly susceptible to infections, have a tendency to bleed, and not be as able to repair damaged tissues. Studies show the chance of developing leukemia is higher among people who have relieved an over-exposure of radiation than those who have not. Leukemia is a latent change in a persons blood cell count. According to Webster's New Collegiate Dictionary leukemia is characterized by an abnormal increase in the number of leukocytes in the tissues and often in the blood.

Radiation alters the endocrine system and hormones. The endorcrine system is made up of secreting glands, and secreting glands can be affected by radiation. Most cells in the body are regulated by hormones. Therefore, hormonal imbalance is a response to the impairment of the endocrine glands, the organs responsible for hormones.

Genetic injury (see Appendix 1) varies in its severity. "Radiation can affect the reproductive cells in three ways: (1) it can kill the cells outright; (2) it can break or damage the chromosomes, and (3) it can cause the genes to mutate." (p. 186 Schubert) Genetic injuries are responsible for producing degenerative diseases including crippling disablilities, diabetes, and metabolic deficiences.

Genetic injuries can affect a person's reproductive cells, because "during reproduction there is a transfer of materials from the parent to the offspring." (p. 75 National Academy of Science) Genetic (or hereditary) injuries include

"effects that occur in gonads (the germ cells) and affect the health" (p. 23 Lucas) of subsequent generations when the reproductive cells that have been altered are used in reproduction. Thus there can be a latent period, a delay, between the exposure of an organism to radiation and the time the radiation-induced changes appear.

Radiation is also responsible for evolutionary changes from mutation. "Those mutations involving chromosome aberrations are generally quite drastic and are expressed in the generation immediately following the generation" (p. 30 Lucas) that has been exposed, when the abnormal gene is dominant. Every generation afterwards is affected whenever the abnormal gene is dominant. The reason for this is that a cell that has had a dose of radiation will never fully recover. Therefore, the effect on chromosomes and genes are irreversible. The rule above is broken rarely when further restorative mutation occurs. There is another type of mutation.

> The gene or point mutations, on the other hand, are normally recessive and may be hidden (the person shows no obvious sign, or effect of carrying the recessive gene) in the genetic pool of the population for several generations until an identical mutant is encountered in the conjunction with the sperm and egg cells. (p. 30 Lucas)

Men and women's reproductive capabilities are affected by radiation. Spermatogonia, mature spermatozoa, are especially sensitive to radiation. Men can become permanately sterile with about 500r to 600r, while a lesser dose of radiation may leave men temporarily sterile for two years because the number of spermatogonia are fewer. When an adequate amount of spermatogonia have matured fertility returns.

> Since a female child contains at birth all the ova she will ever use...exposure of the ovaries to radiation affects eggs which may be fertilized in the future. Thus radiation damage is preserved by the ova and may result in defective children. Even if the children appear normal they may carry defects in their hereditary make up (genes) which will be manifest in later generations. (p. 71 Schubert)

With radiation being so harmful to man[8] I suggest no more nuclear submarines be built so the old submarines will not have to be disposed of, creating more nuclear waste. | H.12

Thank you for giving the public the chance to air our views.

Sincerely,

Laura Orey

APPENDIX I

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#25a (Cont)

TABLE 7.2

ESTIMATED EFFECTS OF RADIATION
FOR SPECIFIC GENETIC DAMAGE*

	Current incidence per million live births	Number that are new mutants	Effect of 5 rem per generation: First generation	Effect of 5 rem per generation: Equilibrium
Autosomal dominant traits	10,000	5,000	50-500	250-2,500
X-linked traits	400	65	0-15	10-100
Recessive traits	1,500	?	very few	very slow increase

Estimates of cytogenetic effects from 5 rem per generation. Values are based on a population of one million live births. Unbalanced rearrangements are based on male radiation only.

	Current incidence	Effects of 5 rem per generation: First generation	Effects of 5 rem per generation: Equilibrium
Congenital anomalies			
Unbalanced rearrangements	1,000	60	75
Aneuploidy	4,000	5	5
Recognized abortions			
Aneuploidy and polyploidy	35,000	55	55
XO	9,000	15	15
Unbalanced rearrangements	23,000	360	450

Source: National Academy of Sciences, (1972) pp. 56, 55.

*The range of estimates is based on doubling doses of 20 and 200 rem. The values given are the expected numbers per million live births.

TABLE 7.3

ESTIMATED EFFECTS OF 5 REM PER GENERATION
ON A POPULATION OF ONE MILLION*

Disease classification	Current incidence	Effect of 5 rem per generation: First generation	Effect of 5 rem per generation: Equilibrium
Dominant diseases	10,000	50-500	250-2500
Chromosomal and [illegible] diseases	10,000	Relatively slight	Very slow increase
Congenital anomalies	15,000		
Anomalies expressed later	10,000	5-500	50-5000
Constitutional and [illegible] diseases	15,000		
Total	[illegible]	[illegible]-1100	[illegible]-7500

Source: National Academy of Sciences (1972), p. [illegible]

*[illegible] a greater [illegible].

FOOTNOTES

1. The Effects of Atomic Radiation on Oceanography and Fisheries. National Academy of Science. (Washington D.C.: National Academy of Science--National Research Council) 1957 P. 16

2. Man's total body dose is not soley based on his eating irradiated food but includes inhaling radioactive materials and the skins coming in direct contact with radioactive materials.

> ...radioactive materials that entered the water usually provided three types of exposure to the aquatic organisms: (1) some of the radiation come from contamination of the environment, (2) particulate matter, such as specks of radioactive debris often settle on organisms or adhered to mucus coverings, etc., or (3) the radioactive materials entered the organism through the food chain where it was absorbed and incorporated into the organism or eliminated by the usual biological processes. (p. 99 National Academy of Science)

3. "The very early embryonic stages of an organism are more radiation sensitive thanthe older mature forms." (pp98-99 National Academy of Science)

4. "The usual pathways of excretion are through the urine, feces, skin, respiration, and particle ejection, and the method of excretion (used) depends on the particular organism and element involved." (p. 74 National Academy of Science)

5. Our Polluted Food: A Survey of the Risks. Jack Lucas. (New York: John Wiley and Sons) 1974 p. 23

6. Radiation: What It Is and How It Affects You. Jack Schubert and Ralph E. Lapp. (New York: Viking Press) 1957 p. 67

7. Cancer may in turn damage nerve cells, lead to mental impairment, or infectious diseases.

8. "All amounts of radiation (a person is exposed to) above the normal (level of) background (radiation) increase(s) the probability of late harmful effects." (p. 71 Schubert) "Exposure of the body to the maximum permissible dose of radiation, 0.3r a week, directly disrupts about 300 molecules in each of the 140 trillion cells in the human body." (p. 67 Schubert) The life expectancy of a man is shortened by the effect of radiation "2.5 days for every 1r...(or) about one month for every 10r of radiation exposure." (p. 77 Schubert)

#25a (Cont)

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6. Schubert, Jack and Ralph E. Lapp. Radiation: What It Is and How It Affects You. (New York: Viking Press) 1957

#26

Concerning disposal of Nuclear Submarines.

Questions/Alternatives

. Of the two alternatives — burial on land (sinking offshore — neither of these are positive alternatives in that both require the ultimate "trashing" of valuable material.

I have two ideas on this subject which I would like to pass along. One fantastic, one pragmatic.

G.3

In the future: before complete defueling, investigate the possibilities of leasing these vessels after complete marine survey of hull and power plant, and sufficient overhauling to ensure safety at shelf depths for 10 yr. periods. These vessels could then be secured to the sea floor and established as undersea research and emergency power stations. Granted the safety aspects of this operation would be involved and under no circumstances should action be taken in this matter until the Navy could establish that these vessels would not be either stolen or sabotaged.

In view of this rather unrealistic view I would like to offer a more practical solution.

Upon defueling, remove entire power plant and lease or sell unit to research facility i.e. Academia/Industry. Undeniably these are some of the world's most concentrated/compact nuclear engines and therefore worthy of study. After defueling remove that section of the submarine contaminated with radioactivity and either store it, or sell it to those firms concerned with the neutralization of low level residual radiation.

As for the remainder of the boat — scrap it. Granted steel prices are low — but certainly making any profit upon sale would be more beneficious than wasteful "throwing away".

0.10

Shawn Walsh
912 Willowbrook
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#27

TEXAS A&M UNIVERSITY
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Geodynamics Program
(713) 845 8477

10 February 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OP 22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Further to my telephone conversation with you last week, and earlier discussions with Lt. Cmdr. Swartz, I am writing to you about deep-sea trenches as potential nuclear waste disposal sites and in particular their possible relevance for the disposal of decommissioned nuclear-powered submarines. As you suggested, I talked with Mr. Mangeno. He advised me that written comments should be sent to you as specified in the December 1982 DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

Judging by the thickness of the DEIS, I suspect that you, Mr. Mangeno and others concerned with this problem are not anxious to read additional long documents. I will, therefore, be brief.

J.17

The possibility of using deep-sea trenches (subduction zones) for waste disposal underwent a brief debate about a decade ago and was rather summarily dismissed. Since then trenches have been excluded from any serious consideration with the often repeated statement that nuclear waste should not be placed in such geologically unstable regions. Based on my research and that of others, this is too simple a conclusion and one that could result in possibly overlooking a highly desirable ocean waste disposal site. Trenches may be especially well-suited for the disposal of large items such as submarines. When looked at carefully, I believe they may not only meet the criteria (as set forth in the December 1982 DEIS) for the sea disposal option, but provide certain advantages that other ocean sites do not.

I invite you to review the enclosed document which describes why trenches may be suitable waste disposal sites. It is a copy of a proposal made to a Texas State agency last year that was funded at a modest level. The essential point is that in most trenches large grabens (fault-formed depressions) exist within the oceanic plate that may provide the stable, isolated and remote environment desired for submarine disposal. Please note modified figure 1 of the enclosed proposal in which I suggest the fate of materials placed in trench graben structures. Also enclosed are a separate set of figures which show Pacific-wide distribution of trench graben structures and models of the variations that exist in trench structures.

The time relationship between geologic processes and radioactivity is one that may be better accomodated in trenches than elsewhere in the oceans. Waste volume, which as is noted in the DEIS will eventually be great, could certainly be easily accomodated in trench grabens; they are ubiquitous and very large.

I do not suggest that at this stage we know enough about trenches to conclude that they are the ideal waste disposal site. However, those of us who have been doing research on trenches have learned much that has not generally been considered in the past routine dismissal of trenches as potential sites. It might be worthwhile to include trenches in future ocean disposal considerations.

Should you find any of this of interest I will be happy to provide you with more detailed information. What I have enclosed is only a brief summary of data that exists on the trench regions.

Sincerely yours,

Thomas W.C. Hilde

TWCH:kab

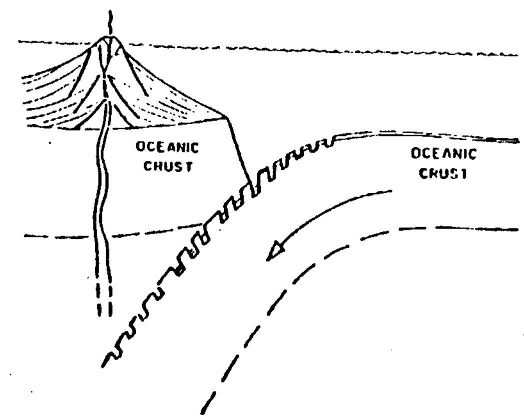
Enclosure

#27 (Cont)

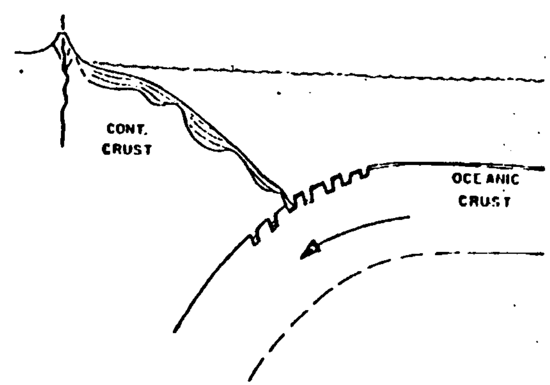
FIGURE 1. Sediment Subduction Models.

A. Sediment subduction within subducting plate grabens where the overriding plate is oceanic. In this case the terrigenous sediment supply is likely to be low and the graben volume exceed the trench axis sediment volume. If the graben volume is greater than the combined terrigenous and pelagic sediment trench axis volume, then all trench axis deposits are likely to be subducted and the lower shoreward trench slope to be devoid of sediments as shown (except for minor *in situ* deposits).

B. Same as A, except the overriding plate is continental. Case shown is for a low terrigenous sediment supply. Therefore, the shoreward slope is covered with relatively thin and undeformed *in situ* deposits.



A.



B.

Figure 1.

FIGURE 2. Sediment Accretion Models.

A. Model of subduction where thick deposits of sediments exist at the trench axis and no graben structures exist within the surface of the subducting plate. These cases generally also involve a shallow angle of initial subduction. Accretion of sediments to the overriding plate may be expected.

B. Same as A, except with grabens. Accretion may still be expected, if sediment volume exceeds graben volume as shown.

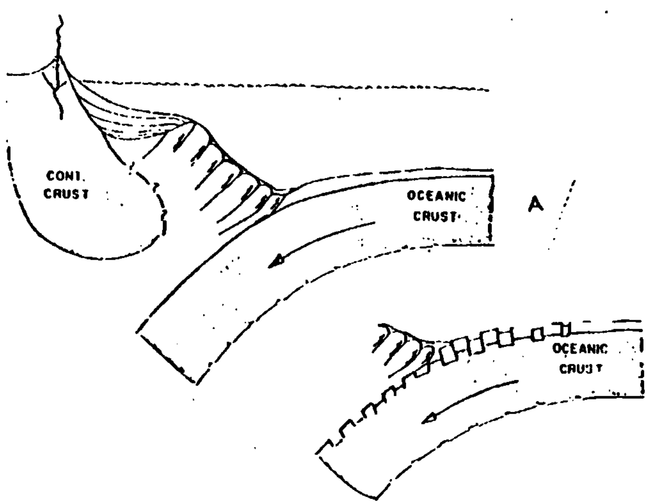


Figure 2.

FIGURE 3.

Distribution of graben fault structures within the subducting oceanic plates around the Pacific. Regions of thick trench axis deposits (where sediment volume exceeds graben volume) are also shown (preliminary).

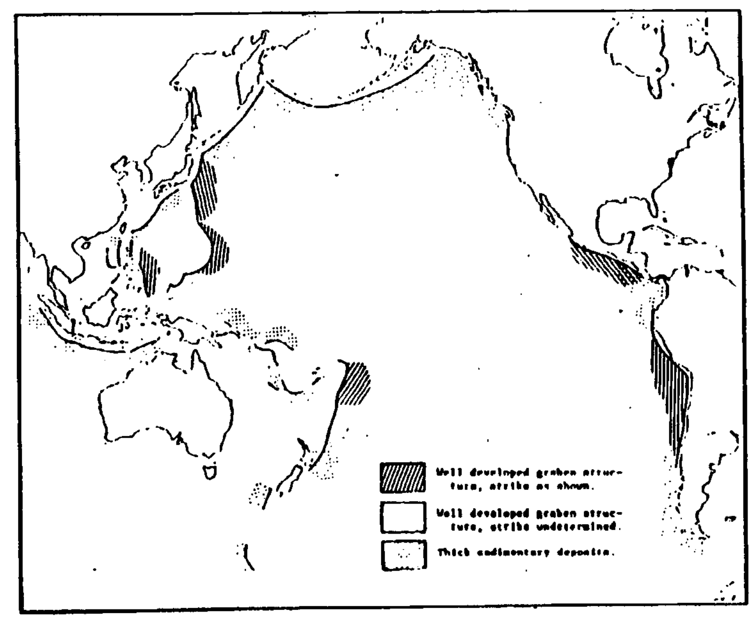


Figure 3

#27 (Cont)

A PROPOSAL

THE FEASIBILITY OF

NUCLEAR WASTE DISPOSAL BY SUBDUCTION

SUBMITTED TO THE

CENTER FOR ENERGY AND MINERAL RESOURCES
TEXAS A&M UNIVERSITY

BY

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INTRODUCTION

A major concern associated with the use of nuclear power to meet our future energy needs is what to do with the radioactive waste products that are produced in the process. If this problem can be solved and the solution convincingly demonstrated to society, nuclear power can almost certinaly provide for a major portion of our future energy requirements. Without the provision for essentially permanent waste disposal, and the development of pollution-free mining and safe power generation methods, society is likely to reject nuclear power as a means of providing for our future energy needs.

This proposal deals with one of these concerns, waste disposal. Presently, two broad catagories of sites are under consideration for nuclear waste disposal. These are 1) isolated, massive rock or salt bodies on land, and 2) sedimentary sections in remote regions of the deep ocean basins. Sending nuclear waste off into space has apparently been rejected, at least for now, as a viable option. This leaves the problem squarely within a geologic perspective. Although significant progress has been made in evaluating the above two catagories of potential waste disposal sites, it is my contention that a third type of site, which could prove to be far more desirable in many respects, has been prematurely excluded from proper consideration. These sites are the deep ocean trenches, where the earth's crust is being subducted into the deep interior of the earth. If it can be demonstrated that nuclear waste can be placed into subduction zones, without leakage, they offer something that other sites cannot--permanent disposal.

The reason that trenches have not previously been given serious consideration as disposal sites is because of a lack of knowledge of the actual structures, composition of rocks and processes in these zones. They are tectonic zones and intuitively it was assumed that all tectonic zones were regions where earth movements would make long term, secure containment of nuclear waste impossible. Based on an improved knowledge of the structures, rocks and processes in subduction zones, it now appears that they may be highly desirable sites for nuclear and other types of waste disposal, particularily for any large volumes of waste.

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LITERATURE REVIEW

Two, thus far separated, subject areas need to be considered in this study: 1) the general geological conditions for secure, long-term waste isolation, and 2) the detailed geology, structure, tectonic processes and environmental stability of deep-sea trenches and shallow (0-50 kms) portions of subduction zones.

General Geologic Conditons

Since some of the nuclides synthesized in reactors have half lives of over 10^6 years (iodine-135, 1.6×10^7; cesium-135, 2.3×10^6; neptunium-237, 2.1×10^6), the time constants of isolation must be long (Fyfe, 1980). The geological conditions needed to provide this isolation are generally considered to be 1) rock masses of low porosity that are free of fractures, 2) rocks in environmental conditions with little or no fluid transport and that inhibit metal transport, 3) low native radioactivity and minimal heat flow, 4) mineral compositions of the rock that are good for ion exchange or absorption processes, 5) rocks that are resistant to thermal stress, and 6) rocks that are plastic rather than brittle. Additionally, the host rock should not be desirable for other societal needs. Suggested depths of burial vary from 500 m to 15 km based both on technical and societal concerns. The essential point is that nuclear waste must be isolated from the biosphere (Aikin et al., 1977; Bredehoeft et al., 1978; Fyfe and Haq, 1979; Fyfe, 1980; Giletti et al., 1978; Hammond, 1980; Ringwood, 1980; Smith and Roy, 1978; Uffen, 1977; Weinburg, 1980).

Clays and zeolitic volcanic sediments are considered to be among the best sedimentary rocks, on land or in the oceans, in several respects for isolation of nuclear waste; ion exchange or absorption characteristics, plasticity and low porosity. In the oceans, salt water presents a problem because interstitial fluids with high salt concentration will compete with ion exchange on mineral surfaces. Various massive igneous rock bodies are considered on land, which meet some of the above requirements. However, of serious concern is the degree of rock fracture and ground water circulation, which on continents is linked to human and general biosphere consumption. Almost all igneous rocks are fractured to some degree.

Methods presently under consideration for nuclear waste packaging and placement in disposal sites include containerization in glass, inert metals, sintered corundum, natural materials (such as bentonite clays or brucite) and placement by drilling, in mines, or in filled pits (Boulton, 1978; Ringwood, 1980; Fyfe, 1980). If expense and volume were ignored there really would be no problem in building containers that could provide isolation for 10^7 years or longer. However these factors are not being ignored. Therefore method and geological environment of placement, to be determined on both technical and societal grounds, become very important considerations. Recent geological and geophysical studies of subduction zones suggest that these regions may offer better geological sites for nuclear waste disposal than either of the two broad catagories of sites presently being evaluated. Based on recent findings it would seem prudent to undertake an evaluation of subduction zones for their desirability and potential for nuclear waste disposal.

Subduction Zones

The outer rigid shell of the solid earth, called the lithosphere, is broken into several large plates which are in relative motion about the circumference of the earth. Oceanic lithosphere is in the order of 70-100 km thick, and composed of rocks that are more dense than continental rocks. Continental lithosphere is thought to be much thicker, possibly a few 100 kms (An excellent review of the earth's structure and dynamics is contained in LePichon et al., 1973). Where lithospheric plates are in motion toward each other (converging), one of the two plates descends beneath the other, at angles of $\sim 30^\circ$ to vertical, into the earth's mantle below the lithosphere (Isacks and Barazangi, 1977). This process is referred to as subduction (Uyeda, 1982). The two converging plates may both be continental (i.e. India and Asia), one oceanic and one continental (such as along the Peru-Chile Trench), or both oceanic (such as along the Bonin, Mariana and Tonga Trenches). For trenches and extensive subduction to develop, at least one of the two plates must be oceanic. Based on earthquake seismicity we observe that these plates descend to depths in the mantle of as much as 700 km (Isacks and Barazangi, 1977). The rates of plate convergence and subduction range from

#27 (Cont)

a few cms/yr to greater than 10 cm/yr (Minster et al., 1974; Fitch, 1972; Uyeda, 1979). It is at these convergent plate boundaries, where subduction is taking place, that deep-sea trenches are formed.

The possibility of using deep-sea trenches and subduction zones for waste disposal underwent a brief debate about one decade ago (Bostrom and Sherif, 1970; Frances, 1971) and was rather summarily rejected (Silver, 1972). At that time and until four years ago, it was believed that as plates converged at trenches the sediments in trenches were scraped off the descending or subducting plate and transferred to the leading edge of the over-riding plate, with an accompanying great amount of deformation (Karig, 1974; Karig and Sharman, 1975). It was, therefore, concluded that subduction zones were very poor sites for waste disposal. However, my research has shown that in most of the world's trenches the oceanic and trench deposits are not tectonically transferred to the over-riding plate but that these deposits are carried, much of them undeformed, into the deep interior of the earth with the subducting plate (Hilde and Sharman, 1978; Hilde, 1981).

As an oceanic plate bends downward into a subduction zone its upper surface undergoes extensional stress and it is broken by normal faults into horst and graben structures (Hilde and Sharman, 1978; Jones et al., 1978; see Figure 1). This faulting starts when the oceanic plate first starts to bend downward, well seaward of the deep-sea trench and before it begins to be subducted beneath the over-riding plate. In many trenches, by the time the down-going plate reaches the trench axis, displacement on the faults exceeds 500 m and the grabens within the surface of the subducting plate are 500 m to 1 km deep (Hilde and Sharman, 1978; Hilde and Fisher, 1979; and Hilde, 1981). Other typical dimensions of the grabens are 5 to 10 km in cross-section, extending several tens of km along their strike. It appears that in most trenches sediments in the grabens are subducted without being disturbed (Figure 2). As a graben descends beneath the over-riding plate the sediments from the leading horst block, having been temporarily compressed and piled up, are dumped into the graben and cover the sediments that were originally there (Figure 1). This apparently occurs where the volume of the grabens exceeds the volume of the available sediments, which is the case in most trenches (Hilde, 1981). A key point in this process that has particular significance for potential use of the grabens for waste disposal by subduction is that the plane of motion between the subducting and over-riding plate appears to be that defined by the plane connecting the basement surfaces of the horst blocks (see Figure 1). Below this plane (in the grabens) the rocks and sediments are subject to little disturbance. It is quite plausible that waste materials could be placed in a graben just before it starts to be covered with sediment from the leading horst block, that the waste would be sealed with the sediments pushed into the graben and thereafter be carried into the earth's interior with the subducting plate.

OBJECTIVES

The overall objective is to evaluate deep-sea trenches and the subduction process for potential use in the disposal of nuclear and other waste materials. Using existing seismic reflection profiles and bathymetric data the structure and sediment distribution of several circum-Pacific trenches will be evaluated for evidence of the nature and degree of sediment disturbance as trench sediments are initially subducted. This effort will be concentrated on sections of the Mariana, Bonin, Tonga and Peru Trenches for which we have suitable data sets for an initial evaluation. New mapping will be done of the structures in the Mariana Trench, in an E-W corridor between 17°30'N and 18°N, where we have a particularly high density of data and where grabens within the subducting plate are very well developed.

These studies should allow the determination of potential isolation dimensions of hypothetical waste placed within the grabens; amounts of sediment encasing the waste below the plane of subduction, above the igneous basement floor of the grabens and to the normal faults defining the edges of the grabens.

Analysis of sediment samples from these trenches (Deep Sea Drilling Initial Reports, and Shepard, 1981) will be reviewed for composition and physical characteristics that are either desirable or undesirable for sealing

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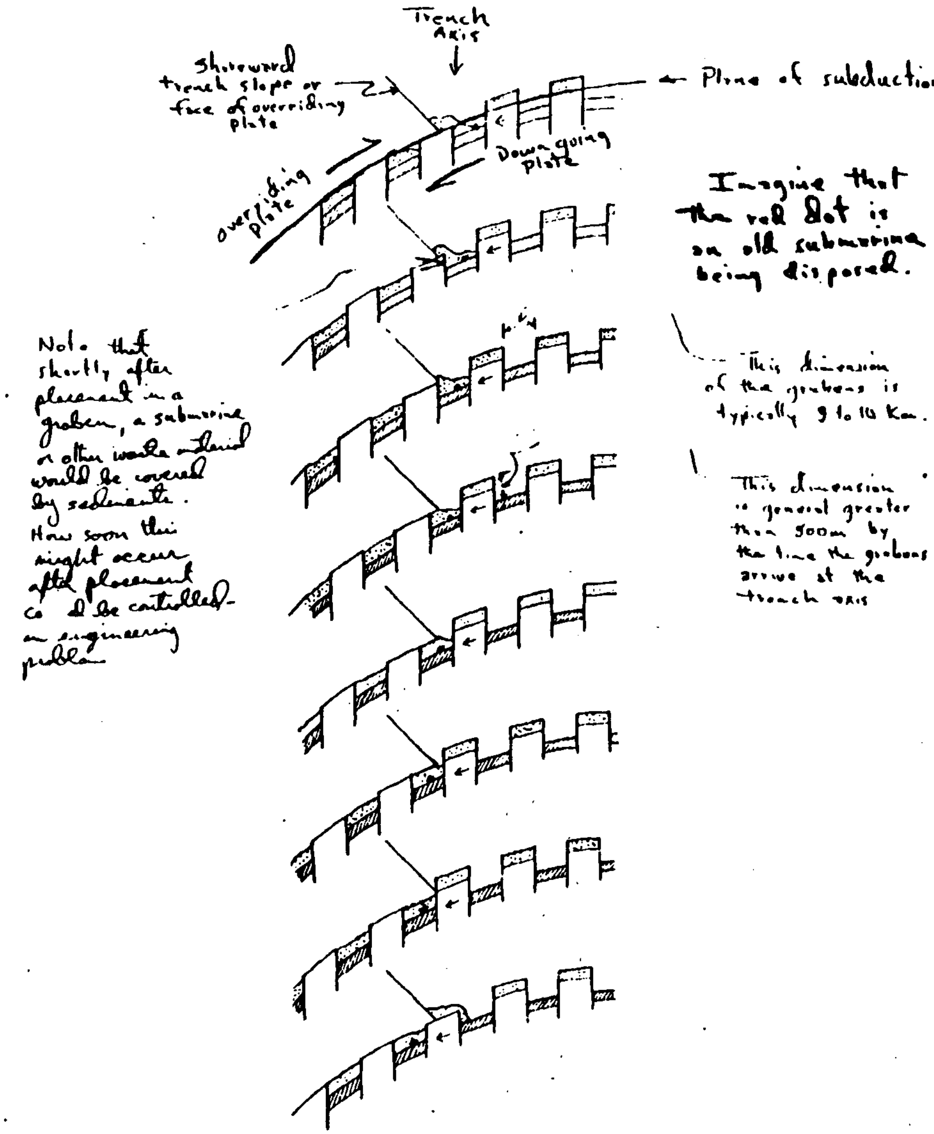

Figure 1. Sequence of trench cross-sections showing progressive subduction (from top to bottom) of an oceanic lithospheric plate that has been broken into graben and horst structures due to bending of the plate into the subduction zone. White area of subducting plate is igneous oceanic basement rock. Sediments on the oceanic plate are shown by dotted and slashed patterns. The different patterns are used not to indicate different type of sediments, but to indicate positions of sediments in the grabens and on the horsts before and after subduction. Note that sediments in the grabens remains undisturbed and that sediments on the horsts are scraped off by the leading edge of the over-riding plate and dumped into the trailing graben. The plane of motion (or subduction) between the subducting and over-riding plate is that which connects the basement surface of the horst blocks. The grabens are protected below that plane.

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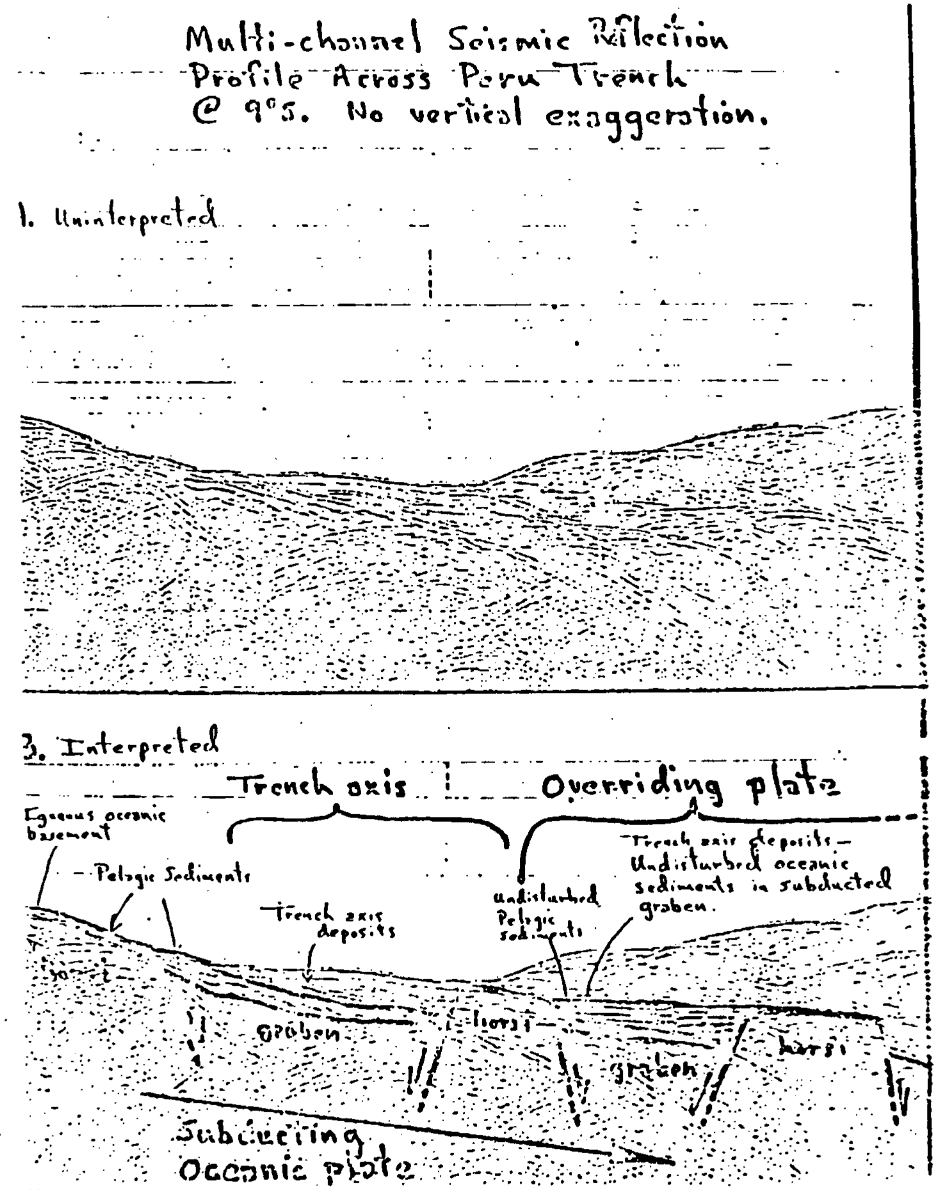

Figure 2. Multi-channel seismic reflection profile across Peru Trench at 9°S showing subducted graben containing undisturbed sediment fill. Sediments in graben were deposited when graben was previously at trench axis.
a) uninterpreted profile.
b) interpreted profile.
Note flat, undisturbed nature of reflectors in the subducted graben.

#27 (Cont)

nuclear waste. It is anticipated, for example, that in certain trenches (such as the Mariana Trench) the sediments will be found to contain large percentages of desirable clay and zeolitic volcanic components.

Environmental aspects of these trenches, such as ocean bottom-water characteristics will also be evaluated for relevance for nuclear waste disposal. Several aspects of the deep-sea are known to have generally stable and desirable characteristics for waste disposal. Deep-sea trenches are regions of the lowest heat flow on earth (Watanabe et al., 1977) and bottom-water temperatures in trenches are around 1°C or less (Reid, 1965), for example. However, while the Pacific Ocean Basin bottom-water residence time is known to be in the order of 1000 - 1500 years (Drake et al., 1978), residence time of bottom-water in trenches may be considerably longer and existing data needs to be evaluated in this regard.

It is anticipated that this study will demonstrate that a more extensive investigation of subduction zones for waste disposal is warranted. The findings from this study will be used as a basis for discussions with relevant government agencies concerned with nuclear and other waste disposal problems and the preparation of proposals for further research. Preliminary discussions have already been held with the National Oceanic and Atmospheric Administration, the U.S. Geological Survey and Sandia Laboratories. The Office of Naval Research (ONR) will be contacted during the early phases of this study to acquaint them with the project. Earlier discussions with officials of ONR revealed a Navy need for the permanent disposal of entire outdated nuclear powered vessels. Placement within grabens of subducting plates may be a solution to their problem. The possibility exists for Navy funding to carry out high resolution bathymetric and geophysical studies of the Mariana Trench in 1981.

SIGNIFICANCE

This research may provide a solution to the problems of nuclear and other waste disposal, including almost any volume of waste imaginable. At subduction rates of 10 cm/yr, a 5 km wide graben would be completely subducted in 50,000 yrs. This is a long time in terms of the needs of present-day society. However, by selecting grabens for waste disposal that are just beginning to subduct, the waste could be instantaneously covered by inducing (an engineering problem) the slumping into the graben of the temporarily accumulated sediment at the base of the over-riding plate (shoreward trench slope). Once this is done the waste would be disposed of and eventually carried deep within the earth.

PROCEDURES

Seismic reflection profiles from the Mariana, Bonin, Tonga and Peru Trenches will be interpreted for cross-sectional distribution of disturbed and undisturbed sediments and their position relative to the grabens in the subducting plate. This will be done for the trench axis regions and the shallow regions of subduction (where the subducting plate has just descended beneath the over-riding plate), to the limits of the reflection data penetration.

In the Mariana Trench, along the corridor mentioned earlier, topographic features will be mapped by compilation and contouring of a high density set of existing echo-sounding data. The contours will then be used, in conjunction with existing seismic reflection data, to identify the distribution of grabens and sedimentary structures along the trench axis. It is anticipated that various stages of convergence and sediment graben filling will be defined in this way.

Sediment and environmental data for these trenches will be compiled from existing reports and analyzed for relevance to acceptable nuclear waste disposal environmental conditions. Sediment samples from the Mariana Trench (DSDP, both shoreward and seaward flanks) will be analyzed for composition and physical properties. Estimates will be made of the radioactive absorption properties of these sediments, possibly including on-campus laboratory radiation experiments.

#27 (Cont)

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#27 (Cont)

BUDGET
one year (1982-1983)

A.	**Salaries**	
	Principal Investigator 1 month	$3,640
	Graduate Research Assistant (Ph.D.) 12 months at 50%	$8,242
	Subtotal	$11,882
B.	**Materials and Supplies**	
	Xeroxing and office supplies, drafting and laboratory materials, and photography	$3,000
C.	**Computer Time**	
	1 hour at $720/hour (2nd shift)	$720
D.	**Communications and Shipping**	$500
E.	**Travel**	
	Two trips to ONR (Bay St. Louis, Mississippi) at $500/trip	$1,000
	Two trips to Washington, D.C. at $1000	$2,000
	Subtotal	$3,000
	TOTAL	$20,102

BACKGROUND OF INVESTIGATOR IN PROPOSED AREA

Please note on the following resume the number of publications dealing with trench-arc-back arc systems and subduction processes. These are indicated by an "+". Most of the principal investigator's research over the last several years has been on the tectonics of convergence and the structure of trenches. It is probably reasonable to state that the principal investigator (P.I.) is one of the world's leaders in this area of research. Indication of this is the number of national and international meetings on this subject for which the P.I. has served as convenor, and the special publications on this subject for which the P.I. is editor (see resume).

More than three years accumulated time has been spent at sea doing marine geophysical field work on trench-arc-back arc problems.

The P.I. was the first scientist to use long-range side-scan sonor for studies of trench structures.

#27 (Cont)

BIOGRAPHICAL DATA

HILDE, Thomas Wayne Clark

Associate Professor, Oceanography & Geophysics
Leader, Geodynamics Research Program

PERSONAL:

Home Address:

Home Telephone:

Professional Address:

Office Telephone:

Social Security No.:

Health:

Birthdate:

Birthplace:

Marital Status:

EDUCATION:

B.A., Geology, San Diego State University, 1963
D.Sc., Geophysics, University of Tokyo, 1973

EXPERIENCE:

Laboratory Assistant, Scripps Institution of Oceanography, 1959-1964
Principal Engineering Aid, Scripps Institution of Oceanography, 1964-1967
Oceanographer, U.S. Naval Oceanographic Office, San Diego, 1967-1969
Supervisory Oceanographer, U.S. Naval Oceanographic Office, San Diego, 1969-1970
Scientific Consultant for Oceanographic Development, National Science Council, Republic of China, and Visiting Marine Geophysicist and Lecturer, Institute of Oceanography, National Taiwan University, 1970-1973.
Visiting Marine Geophysicist, Earthquake Research Institute, University of Tokyo, July-December, 1973

HILDE, Thomas Wayne Clark

EXPERIENCE: (Continued)

Consultant for Marine Geology and Geophysics, CCOP, United Nations Bangkok, Thailand, April-October, 1974
Senior Marine Geologist/Geophysicist, CCOP, United Nations, Bangkok, Thailand, March 1975-July 1976
Independent Consultant, San Diego, California, August 1976-June 1977
Associate Professor of Oceanography and Geophysics, and Leader, Geodynamics Research Program, College of Geosciences, Texas A&M University, College Station, Texas, July 1977-present

TEACHING EXPERIENCE:

Texas A&M University, 1977-present
Institute of Oceanography, National Taiwan University, Taipei, Taiwan, 1970-1972
Lectures in Oceanography, Navy ASW Reserve Training School, San Diego, California, 1964-1966

PROFESSIONAL INTERESTS:

Marine geophysics; oceanic, island arc and marginal seas tectonics; research administration

PROFESSIONAL AFFILIATIONS:

The Geological Society of America
American Geophysical Union
American Association for the Advancement of Science
American Geological Institute
Oceanographic Society of Japan
Geological Society of China
Geological Society of Malaysia
Geological Society of Thailand

PROFESSIONAL SERVICE ACTIVITIES:

Member, Western Pacific Working Group and co-chairman, Study Group 1, Inter-Union Commission of Geodynamics, 1974-1980
Member, Ocean Crustal Dynamics Committee, JOI, Inc., 1978 1980
Editor, Western Pacific Final Report, Geodynamics Project, Inter-Union Commission of Geodynamics, present
Member, Gulf Coast Working Group, U.S. Geodynamics Commission Continental Margins Transects Program, 1979-present
Chairman, Commission on Marine Geophysics, and advisor to the Executive for Co-ordination, International Association for the Physical Sciences of the Ocean, 1979-present
Member, JOI Site Survey Planning Committee, 1979-1981
Editor, "Convergence and Subduction", Special Issue, Tectonophysics, in preparation, 1981
Associate Member, Commission for Marine Geology, International Union of Geological Sciences, 1980-present
Corresponding Member, Working Group 8 - Subduction, Collision and Accretion, Inter-Union Commission on the Lithosphere, 1981-present

#27 (Cont)

PUBLICATIONS:

Magnetic profiles across Gulf of California: Amer. Assoc. of Petroleum Geol., Memoir No. 3, p. 122-125, 1964.

Topography of the Ninetyeast Ridge, Eastern Indian Ocean: Geol. Soc. Amer. (abstract); March, 1967.

*Age, composition and tectonic setting of the granite island, Hon Trung Lon, off the coast of South Vietnam: (with C. G. Engel), Geol. Soc. Amer. Bull., v. 78, 1, p. 1289-1294, 1967.

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*Preliminary results-Sea of Japan: (with J. M. Wageman, W. T. Hammond), Ocean. Soc. Japan (abstract); October, 1968.

*The structure of Tosa Terrace and Nankai Trough off southeastern Japan: (with J. M. Wageman, W. T. Hammond), Deep-Sea Res., v. 16, p. 67-75, 1969.

*Sea of Japan structure from seismic reflection data: (with J. M. Wageman, W. T. Hammond), 50th Annual meeting Amer. Geophys. Union (abstract); April, 1969.

*Cretaceous Tertiary events in Southeast Asia: (with C. G. Engel), Geol. Soc. Amer. Bull., v. 80, p. 1887-1888, 1969.

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Structural framework of the East China Sea and the Yellow Sea: (with J. M. Wageman, K. O. Emery), Bull. Amer. Assoc. Petroleum Geol., v. 54, n. 9, p. 1611-1643, 1970.

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*Evidence of oceanic crust beneath the shoreward slope of the Japan Trench from magnetic and seismic reflection data: (with A. D. Raff), 51st Annual Meeting Amer. Geophys. Union (abstract); 1970.

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Geophysics and oceanography, East China and Yellow Seas: (with J. M. Wageman, J. H. Osterhagen), U.S. Naval Oceanographic Office, Spec. Pub., 100 p., 1972.

*Structure and origin of the Japan Sea, in The Western Pacific: Island arcs, marginal seas, geochemistry, P. J. Coleman/Editor: (with J. M. Wageman), Univ. Western Australia Press, p. 415-434, 1973.

Geologic Structure of the offshore region northeast of Taiwan from geomagnetic data: (with Cheng-sung Wang), Sci. Report, Nat. Taiwan Univ., Acta Oceanographica Taiwanica, no. 3, 1973.

Mesozoic Sea-floor spreading in the North Pacific: D. Sc. Thesis, University of Tokyo, Tokyo, Japan, 1973.

Evolution of Pacific Plate: Penrose Conference, Geologic Interpretation of Magnetic Data (abstract); 1974.

*Mesozoic Sea-floor spreading in the North Pacific: (with N. Isezaki, J. M. Wageman, J. G. Sclater), International Woollard Symposium (abstract), December, 1974.

A Revised Time Scale of Magnetic Reversals for the Early Cretaceous and Late Jurassic: (with R. L. Larson, Jour. Geophys. Res., v. 80, no. 17, p. 2589-2594, 1975.

*Mesozoic Sea-floor Spreading in the North Pacific: (with N. Isezaki, J. M. Wageman) AGU Geophysical Monograph 19, p. 205, 226, 1976.

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*Tectonic History of the Western Pacific: (with S. Uyeda, L. Kroenke) in C. L. Drake, Ed., Geodynamics: Progress and Prospects, AGU Spec. Pub., p. 1-15, 1976.

*Evolution of the Western Pacific and its Margin: (with S. Uyeda, L. Kroenke), Tectonophysics, v. 38, p. 145-165, 1977.

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PUBLICATIONS: (continued)

*Fault Patterns in Outer Trench Walls and their Tectonic Significance: (with G.H. Jones and G.F. Sharman), International Geodynamics Conference, Western Pacific and Magma Genesis (abstract), Tokyo, March, 1978.

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*Fault Structure of the Descending Plate and its Influence on the Subduction Process: (with G.F. Sharman) AGU (abstract) EOS, v. 59, No. 12, p. 1182, 1978.

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Subduction versus Accretion: The Fourth CSK Symposium, (abstract), February 1979.

Reconstruction of the Philippine Sea: (with S. Uyeda and Y. Matsubara) (abstract) IUGG symposium on "Quantitative Methods of Assessing Plate Motion", Canberra, December, 1979.

*Graben Structure and Axial Zone Tectonics of Tonga Trench, Southwest Pacific: (with R.L. Fisher) (abstract) IUGG symposium on "Tectonics of the Southwest Pacific Margins", Canberra, Dec. 1979.

Okinawa Trough: Origin of a Back Arc Basin: (with C.S. Lee, G.G. Shor, L.D. Bibee and R.S. Lu) Marine Geology, 35, p. 219-241, 1980.

Northern Gulf of Mexico Topographic Features Study: (with various authors on topography and structure), R. Rezak and T. Bright, Editors, BLM Final Report, v. 1-6, 1980.

*GLORIA Long-Range Side-Scan Sonar Survey of the Peru Trench: (with R. Searle and W.E.K. Warsi), AGU (abstract) EOS, v. 61, no. 46, p. 1122, 1980.

Central Basin Fault Revisited: (with C.S. Lee), AGU (abstract) EOS, v. 61, no. 46, p. 1106, 1980.

'GLORIA' Side-Scan Sonar in the East Pacific: (with R.C. Searle, T.J.G. Francis et al.) EOS, v. 62, no. 12, p. 121-122, 1981.

A Suggestion Regarding our Marine Geology and Geophysics Data Center: in A.M. Hittleman, Ed., Proceedings, "Frontiers in Data Storage, Retrieval and Display" NGSDC, NOAA, p. 138, 1981.

*indicates first author on multi-authored publications.

PUBLICATIONS: (continued)

Seismic Stratigraphic Characteristics of Upper Louisana Continental Slope: An Area East of Green Canyon: (with A. H. Bouma, H. H. Feeley, J. L. Kindinger and C. E. Stelting), Offshore Technology Conference Proceedings, 1981, p. 283-291.

Structural Features of the Bonin Arc: Implications for its Convergence History: (with W. Bandy), Geodynamics Symposium, TAMU (abstract), 1981.

Convergence Structures of the Peru Trench between 10°S and 14°S: (with W. Warsi and R. Searle), Geodynamics Symposium, TAMU (abstract), 1981.

Sediment Subduction vs. Accretion around the Pacific: Geodynamics Symposium, TAMU (abstract), 1981.

*Subduction Induced Rifting of the Nazca Plate Along the Mendana Fracture Zone: (with W. Warsi), AGU (abstract) EOS, v. 63, no. 18, p. 444.

Transect across Deep Gulf of Mexico Basin from Onachita Mountains to Yucatan: (with R. T. Buffler and others), GSA (abstract), 1982 Annual Meeting.

Age and Evolution of the Western Philippine Sea: A New Interpretation: (with C. S. Lee), Geodynamics Symposium, TAMU (abstract), 1982.

*Depth, Age, Rate Relationships of Pacific and Back-arc Region Trenches: Contrasts and Significance: (with S. Uyeda and R. Carlson), Geodynamics Symposium, TAMU (abstract), 1983.

#27 (Cont)

RECENT AND PLANNED MEETINGS:

International Meeting on Geodynamics of the Western Pacific, Yuzhno-Sakhalinsk, Sakhalin, USSR, 28 May - 6 June, 1981, presentation: "Convergence Tectonics".

OMD Workshop for Synthesis of Region VI, Peru Trench; Hawaii, June 22-27, 1981, presentation: "Peru Trench Axis Tectonics".

OJI International Seminar on Accretion Tectonics; Tomakomai, Hokkaido, Japan, September 10-16, 1981 invited paper. Did not attend. Paper delivered by S. Uyeda: "The relationship between Trench Depth and age of subducting plates" by Hilde and Uyeda.

JOA (Joint Oceanographic Assembly), Halifax, N.S. August 2-23, 1982. Co-convener of Session A-5, "Active Continental Margins" sponsored by SCOR, IAMAP and ILP.

Probably - December 1982 AGU meeting, San Francisco.

PAPERS IN PREPARATION, SUBMITTED OR IN-PRESS:

"Graben Structure and Axial Zone Tectonics of Tonga Trench, Southwest Pacific", T. Hilde and R. Fisher, submitted to International Geodynamics Program, Working Group 1 Final Report, Editor, T. Hilde, (to be jointly published by AGU and GSA).

"Subduction vs. Accretion around the Pacific", T. Hilde, in preparation for a Special Issue of Tectonophysics, Editors, T. Hilde and S. Uyeda.

"Convergence Structures of the Peru Trench Between 10°S and 14°S", W. Warsi, T. Hilde and R. Searle, (same as #2), in preparation.

"Structural Features of the Bonin Arc: Implications for its Convergence History", W. Bandy and T. Hilde, submitted, (same as #2).

"Convergence along the Panama Trench", T. Hilde and R. Searle, in preparation for Geology.

CURRENT PRINCIPAL RESEARCH PROJECTS:

"Peru Trench OMD Synthesis"; extension, from OMD/JOI/NSF, for 1982, $30,947, T. Hilde, 2 students.

"Subduction vs. Accretion"; in preparation for ONR, for 1983, approximately $100,000, T. Hilde, 2 students.

PREVIOUS FUNDED RESEARCH AT TAMU:

"Gulf of Mexico Topographic Feature Study, Subsea Mapping"; BLM, 1 August 1978 - 1 March 1980, $101,702, T. Hilde, R. Rezak and T.K. Treadwell, 3 students.

"Geophysical studies of the Western Pacific"; ONR, Jan. - Dec. 1979; $35,000, T. Hilde and G. Sharman, 2 students.

"Geophysical studies of the Western Pacific"; ONR, Jan. - Dec. 1980; $42,000, T. Hilde and G. Sharman, 2 students.

"Peru Trench OMD Synthesis"; Co-principal investigators D. Hussong, L.D. Kulm and D. Crouch. This research was funded at $173,264 for 1981 by OMD/JOI/NSF ($43,577 to Texas A&M, 2 students).

#28

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
Rockville MD 20857

FEB 10 1983

Captain Edward F. Wagner, USN
Office of Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

The National Center for Devices and Radiological Health staff has reviewed the Draft Environmental Statement (DES) on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants dated December 1982. Primarily our effort has been directed to an evaluation of the public health and safety impacts associated with the proposed disposal alternatives. We have the following comments to offer:

1. The discussion in Chapter 2 for the land and sea disposal options has provided adequate assurance that the proposed disposal technology would (1) meet State and Federal radiation safety criteria for land burial of radioactive waste, (2) meet international limits on ocean disposal of radioactive waste, and (3) result in radiological exposures that would have little impact on individuals or the population.

2. The environmental exposure pathways identified in Appendix C, Section III, for land disposal and Appendix J, Section III, for ocean disposal adequately cover all possible emission pathways whereby radionuclides could be transferred from the land or ocean burial site to man. The dose computational methodology and models used in the estimation of the dose commitment to individuals and to populations have provided the means to make reasonable estimates of the dose commitments associated with the land and sea disposal of defueled, decommissioned submarine reactor plants. Results of the calculations are summarized in Table 4-11 for the total body exposures and confirm that such exposures are well within current radiation protection standards.

3. The environmental effects of possible accidents incident to land disposal are discussed in Chapter 4, Section I-B. These effects and the calculated doses in Appendix C, Section X, indicate that the immediate and delayed total body exposures to individuals and populations are adequate assessments of the potential health impact. The results are summarized in Table 4-11, and show minimal total body individual and population exposures that are within current radiation protection standards.

The environmental effects of possible accidents incident to the sea disposal option discussed in Chapter 4, Section II-B, together with the exposure estimates presented in Appendix J, Sections III-B, III-C, and III-E are adequate assessments of the potential health impact. The results are summarized in Table J-21 and Table 4-11, and show a minimal radiation dose commitment to individuals and the population that is within current radiation protection standards.

The DES does not contain any specific information on emergency planning and coordination with the States that may be impacted in the unlikely event of an accident. Even though the potential doses are small, it is believed that a section should be added to Chapter 4 that presents the scope of plans and coordination that would be implemented depending upon the disposal option selected. This is of particular importance at this time in view of the concern of the public and State agencies regarding potential exposure to low levels of radiation. N.10

In Chapter 2, Section I-F and Appendix K, Section III, it is stated that the environmental monitoring program for the land disposal option would be the same as those currently conducted by the Department of Energy at the Savannah River Plant and the Hanford Site. These programs have been described in the respective environmental impact statements for waste management operations at the above sites. We have previously reviewed these statements and concluded that the pathway monitoring and analysis for specific radionuclides were sufficiently inclusive to measure the extent of emission from waste disposal activities. Thus, we believe the monitoring program would also be adequate to document any releases to the environment related to the land disposal option.

In Chapter 2, Section II-F and Appendix K, Section IV, it is stated that environmental monitoring would be performed before, during and after the period of disposal in accordance with the requirements established by the EPA based on U.S. and international laws and treaties. The description of the monitoring program presented in Appendix K, Section IV, is considered to be an adequate program for assessing any potential releases of radionuclides to the marine environment that could subsequently make their way to man via the exposure pathways described in Appendix I, Section III, and shown in Figure I-1. We would appreciate receiving copies of the monitoring data collected during the active disposal period, as carried out in accordance with the program outlined in Appendix K, Section IV-B. These data should be capable of documenting the source term applicable to the environmental pathways to man, and of verifying that the dose commitment to individuals and populations meets the current radiation protection standards.

It appears from our review of this DES that the conclusion in Chapter 4, Section IV, which states "Because of these very low radiation related impacts, it is concluded that either option would be acceptable, and that the choice of options should not be based on radiological considerations." is valid from a public health and safety viewpoint and is justified by the technical assessment.

Thank you for the opportunity to review and comment on this Draft Environmental Statement.

Sincerely yours,

John C. Villforth
Director
National Center for Devices
and Radiological Health

Transcript of Proceedings

of

PUBLIC HEARINGS HELD IN COLUMBIA, S. C.,

on February 17, 1983,

at 9:00 a.m., 1:30 p.m.
and 7:45 p.m.

RE: NAVY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS.

Held by:

CAPTAIN EDWARD WAGNER, Hearing Officer,
Office of the Deputy Chief of Naval Operations
for Submarines, Washington, D. C.

PRESENTATION BY: MR. JAMES MANGENO, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program.

Court Reporter: Ms. Jewel B. Crawford
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Representing:

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Official Reporters
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New York, N. Y. 10038
(212) 962-5167

I N D E X

(The hearing opened at 9:00 a.m., February 17, 1983.)

CPT WAGNER (HO): I am Captain Edward Wagner. I work in the Office of the Deputy Chief of Naval Operations for Submarines. I have been appointed the Navy's Hearing Officer for this morning's public hearing. Here with me to present an opening briefing is Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program. Also present is Mr. James Gaver, Assistant to the Manager for Public Affairs, the Savannah River Operations Office, Department of Energy.

This public hearing is being held to receive comments on the Navy's Draft Environmental Impact Statement evaluating alternatives for disposal of nuclear powered submarine reactor plants after the fuel has been removed and the ships are no longer needed. The Navy has conducted studies on the feasibility of burying the defueled reactor plants in government-owned land disposal sites or placing them on the deep ocean bottom.

On December 22, 1982, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, or DEIS, on the disposal of decommissioned, defueled Naval submarine reactor plants. The DEIS contains the results of the Navy's studies of the alternatives available. On the registration table are copies of the Summary of the DEIS. Anyone in the audience who would like a complete copy of the DEIS should leave their name and address on the sheet of paper provided at the registration table, and a copy will be mailed to you.

The Navy's Federal Register announcement also scheduled public hearings at various locations which are convenient to the people with an interest in this matter, in order to provide them with an opportunity to present their views. I am here today to conduct one of these scheduled public hearings. The purpose of this hearing is to take testimony regarding the Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case nor to engage in debate. It is my responsibility to receive comments so that they can be considered in preparing the Final Environmental Impact Statement.

I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established for this hearing. As set forth in the announcement of the hearing, individual speakers are to limit their testimony to five minutes each, and organizational spokesmen are limited to ten minutes, unless additional time had been scheduled in advance. Time cannot be relinquished from one speaker to another.

In order to ensure all who desire to speak are given an opportunity, each person should fill out a registration card which is located on the registration table as you enter, and provide it to the person at the registration table.

All testimony will be recorded so that it can be considered in the development of the Navy's Final Environmental Impact Statement.

If you desire to submit written comments, rather than speak, that is acceptable. You can provide written comments to me, or you may leave them at the registration table. If you desire to provide written comments at a later date, let me give you my address, and then you can mail that to me at a later time. My address is:

Captain Edward F. Wagner
U. S. Navy
Office of the Chief of Naval
  Operations (OPNAV-22)
Washington, D. C. 20350

You should provide your written comments by March 31, 1983, which, as stated in the Federal Register Notice, is the cut-off date for submitting comments.

Before we begin receiving testimony, I would like to introduce Mr. Mangeno of the Naval Nuclear Propulsion Program, who will provide a general overview of the issue the Navy is addressing and the content of the Draft EIS.

Mr. Mangeno.

MR. MANGENO: Today's hearing is being conducted as a part of the decision-making process required by the National Environmental Policy Act. Under this law, the Navy must prepare an Environmental Impact Statement for any action which could have a significant environmental impact or which might be subject to controversy over the environmental effects. The Environmental Impact Statement must include the environmental impacts for all reasonable alternatives.

The Navy's Draft Environmental Impact Statement, or DEIS, on this subject provides the basis for these hearings, and the slides that follow are from the DEIS. It describes the alternate ways the Department of the Navy, in cooperation with the Department of Energy, is considering for permanently disposing of defueled nuclear-powered submarines after they are no longer needed. The practical choices are: Bury the radioactive part of the submarine at an existing DOE land disposal facility at the Hanford Site in the state of Washington, or the Savannah River Plant in South Carolina; or place the entire submarine on the bottom of the ocean in water more than 2.5 miles deep. In both choices there would be no nuclear fuel left in the submarine because all of it would be removed before disposal. Nevertheless, there would be some low-level radioactive materials left within the submarine.

Preparation of this Draft Environmental Impact Statement does not mean that the Navy has already decided to dispose of nuclear submarines. The Navy currently has about 120 nuclear-powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases, as shown in this slide, it is evident that a disposal plan must be prepared for use sometime in the future. This DEIS has been prepared now so that all interested agencies, organizations, and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

The submarines are constructed with the nuclear power plant enclosed within a single section of the ship called the reactor compartment. This slide shows a typical submarine with the location of the reactor compartment identified.

Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the uranium and all of the fission products. The removed fuel is handled according to established procedures and is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, to the metal structure surrounding the fuel, to the reactor vessel, and to other equipment in the reactor compartment, where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by the hull of the submarine and by the reactor vessel and coolant piping. In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel, or other metal atoms in the reactor plant. These

atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation of the nuclear reactor and the number of curies of each radionuclide at that time. A curie is a measure of the amount of radioactivity present, but it is not an indication of the possible effect on man or animals. The amounts and kinds of radioactive atoms present are described in detail in Chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the Federal Government disposal facilities already used for such low-level radioactive waste at the Hanford Reservation in the state of Washington, or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the compartment free from the remainder of the submarine, and weld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal, and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant sites. Other government-owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable waterways, so that transportation of the reactor compartment to those sites would be impractical. The Hanford and Savannah River burial grounds are described in Chapter 3.

A transporter of the sort shown in this sketch could then be used to haul the compartment over land to the burial location. There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial, or after burial. This is because radiation outside the compartment would be well below Federal limits and the reactor compartment would have been welded shut at the shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low-level radioactive wastes. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burials and would result in no significant additional environmental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the body. More than 200 years would pass before the reactor compartment bulkhead

could be penetrated by corrosion (rust). Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time, exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean is another practical alternative. The maximum radioactivity would be less than the limit specified by international criteria; and the triple containment provided by the submarine reactor compartment, by the reactor vessel and piping, and by the radioactive atoms being a part of the metal itself, would be an extremely strong and effective disposal containment package.

Locations for possible ocean disposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U. S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site-specific public hearings would be required and the permit process is not part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 190 miles west of Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry, and marine biology for very deep ocean locations. The depth of the water in these areas is between 4000 and 5000 meters (13,000 to 16,000 feet). The scientific information and measurements collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that the environmental impacts could be calculated using realistic data.

Preparations for ocean disposal would be made at one of the shipyards normally servicing nuclear-powered Naval vessels. Following defueling, the reactor vessel and the reactor compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping, and, of course, the metal itself completely intact. Most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping or free the atoms from the thick metal.

A comparison of the possible effects on the environment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100

submarine disposals for the year of greatest exposure for both options. This table shows that the radiation exposure would be very small and could have little impact on individuals or the population. These levels are also many times less than any limits established by U. S. regulations or international limits. They are much smaller than the normal fluctuations in annual average background radiation exposure for U. S. residents.

A perspective on radiation exposure can be gained by examining the exposure a person would receive from natural cosmic background radiation if he flew round trip from New York City to Los Angeles. That person would receive approximately 2 millirems more radiation than if he had not made the trip, because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one half millirem.

Other environmental impacts are similarly small for both options. The effects on animal life would be small and localized in either case. Land burial of 100 reactor plants would require only about 10 acres of land, and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square 10 miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land disposal would cost about 40% more (about two million dollars per submarine more) than sea disposal.

The "no-action" alternative is to place submarines in floating protective storage for an extended period, commonly called "mothballing." However, this would only temporarily delay disposal, because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods, and the estimated radiation exposures for the general public would be very small for all available courses of action.

Thank you.

CPT WAGNER: Thank you, Mr. Mangeno.

May we have the lights, please.

(The lights have been lowered in order to show the slides during Mr. Mangeno's presentation.)

Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing.

At this time -- we did not previously have any speakers registered for testimony. I understand we do have some speakers registerrd. Would you please bring them forward?

We will proceed right into testimony, and as soon as I receive the registration cards, we will call those people registered.

*Other issues discussed by Mr. Jackson are side barred in Exhibits 15 and 37b.

Simply to establish an order for the statements, I intend to ask individuals representing state government organizations to speak first, in alphabetical order of the speakers' last names, followed by individuals representing local government organizations, private organizations, and then private citizens, and, again, in alphabetical order by last name.

If your statement is so long that it cannot be given in the time allotted, either five or ten minutes, you may summarize in the five or ten minutes, and the entire statement will be included in the record if you submit the statement in writing.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, proceed to and be seated at the testimony table here in front of me. State your name and organization, if any. All comments are to be addressed to me.

Our first registered speaker, then, is Mr. Thomas C. Jackson, representing the Oceanic Society.

Mr. Jackson.

MR. JACKSON: Good morning, Captain Wagner. It is nice to see you again.

CPT WAGNER: Good morning.

MR. JACKSON: I would once again like to thank the Navy for giving us this opportunity to speak about the options for disposal of decommissioned, defueled submarines. #15a

I am Thomas C. Jackson, Vice-President of the Oceanic Society, a 60,000 member national marine conservation organization which publishes OCEANS magazine as part of a global research, education and conservation program. The Society's principal offices are in Stamford, Connecticut, and San Francisco, California. We have Oceanic Society Chapters in San Francisco, Los Angeles, San Diego, Dallas/Fort Worth, and the Long Island Sound region.

This morning, I am speaking on behalf of the Oceanic Society's 60,000 members to address an inadequate Draft Environmental Impact Statement, and argue against the sea disposal of obsolete nuclear
*W.1 submarines. A prime fault with the ocean alternative for worn out subs stems from the irretrievability of these ships once they have been sunk on the deep ocean floor. This alone is sufficient cause under federal law to reject the proposal.

The draft environmental assessment holds four significant defects:

L.7 First, the cumulative impacts of incremental increases in radioactivity entering the marine environment from these submarines are not considered in the DEIS;

J.76
I.13 Second, the monitoring program proposed in the DEIS is inadequate for either the sea or land disposal;

Third, effects of accidental sinking of the submarines
L.57 on the Continental Shelf are not adequately considered; and

Fourth, the disposal alternative which minimizes corrosion
H.3 and, hence, the release of radioactivity is not even considered

in this document.

Based on our consultations with scientists around the country, it appears the most assessible option is to place reactor compartments in an arid or semi-arid environment. In this alternative, the submarine's reactor compartment would be placed in a trench or left on the ground. Unlike the land alternative considered by the DEIS, the compartment would not be buried. H.3

Scientists believe that by not burying the reactor compartment, corrosion of the submarine's hull and bulkhead would be minimized. Clearly, a compartment which is left exposed to dry air will rust at a much slower rate than one which is buried in the earth. A submarine sunk in the salt water will, as shown in the DEIS, corrode at a much faster rate than either of these land disposal options.

I should make it clear at this point that, by definition, it appears the Savannah River site is inappropriate for either the land disposal option considered in the DEIS or the suggestion that we are making today. The amount of rainfall mentioned in the DEIS attending this land site indicates this is truly not an arid or semi-arid site. E.12

We must remember that we are speaking here of placing the entire reactor compartment on the land. The reactor compartment is a section of the hull which stretches between two water-tight bulkheads to provide significant containment to contain radioactivity.

*Other issues discussed by Mr. Jackson are side barred in Exhibits 15 and 37b.

In revising the DEIS, the Navy must consider this modification of the land disposal alternative. The current text contains neither mention of this option nor any reason for discounting it as a viable solution to the Navy's radioactive waste disposal problem. This inadequacy in the DEIS is just one of our prime concerns.

Both a lower continental-rise area and a Hatteras abyssal plain area off the North Carolina coast have been considered in the DEIS. J.28 Published scientific research at one of these sites suggests a more complete investigation by the Navy will find bottom currents which are for the deep ocean considered significant. In revising the DEIS assessment of the oceanographic data, J.8 the Navy officials must make clear the weight to be given to site selection guidelines developed by Doctors Charles Houktross (phonetics) Hollister and G. Ross Heath. They are reported in Appendix E of the environmental assessment.

L.55 The DEIS must also be revised to fully consider the artificial reef effect scuttled subs are expected to have on deep ocean ecology. Experience with radioactive waste dump sites, oil platforms, and ships sunk for fishing reefs, has established that at least on the Continental Shelf, any such structure attracts and holds new and more abundant communities of fish and invertebrates. Whether the subs will serve as an attractive nuisance, attracting new communities of life to the deep sea bottom, must be considered in the DEIS. Estimates of exposure to humans must also reflect this artificial reef effect.

The DEIS plan must also be expanded to provide case-line descriptions of fish and other forms of wild life that inhabit the abyssal plains off these Middle Atlantic States. J.9 Data on trace metals, radionuclides and metal sequestering proteins should be addressed. Specific attention must be paid to the species like Grenadier, a fish recognized in the DEIS as the most abundant large organism at these depths and one which has the potential to serve as a mechanism for horizontal and vertical transport of material released from these submarines.

Sea disposal for radioactive waste is a complex issue. If the Navy really expects informed public comment on this topic, specifically the DEIS, it should not have scheduled this hearing in only two months after the document was released, and specifically should not have limited the comment period to only 90 days.

This DEIS, which was released a few days before Christmas, is a thick and imposing document, containing a summary, four chapters of explanatory text, twelve appendices, and more than 400 pages. A volume of equal size contains scientific studies compiled to support the DEIS and its conclusions. Both volumes cite an impressive list of references from a myriad of sources. While some of these references are available, other, such as a State Department press release, are not easily accessible to citizens, conservationists, or elected officials. Despite the complexity of this issue and the depth of the DEIS, the Navy allotted only 90 days for public comment.

Many conservation groups, including the Oceanic Society, have written the Navy to request expanded comment periods and a delay in these hearings. As we noted in our request to Secretary of the Navy John Lehman, it is difficult to assess, let alone promote, informed public consideration of this draft environmental assessment within the time allotted.

The Oceanic Society has been concerned about the risks of radioactive waste disposal since 1978. We've held public policy forums, published books, and worked with scientists throughout the country, yet we have found it very difficult to analyze and to involve the public in an informed discussion about this issue on the Navy schedule.

Our analysis of this DEIS centers on an independent committee of scientific individuals who met February 3d and 4th to review the document. Our committee report will not be complete until the end of this month. Clearly, we cannot utilize this independent scientific evaluation to help citizens comment on these hearings.

Recent actions at the U. S. Environmental Protection Agency have done little to allay our concerns. The current administration has transferred the man who was in charge of drafting this DEIS for the Navy and placed him in charge of the EPA office, charged with regulating sea disposal of radioactive waste, and incidentally in charge of reviewing this DEIS for that agency. This administrator's refusal to allow any EPA staff to assist in our review

of the DEIS further weakens the agency's credibility as a regulatory agency which protects the public. Rarely has the Reagan Administration provided a clearer example of inviting the fox in to guard the hen house.

In revising the DEIS, additional attention must be paid to the twin problems of cumulative impact and monitoring. Neither the DEIS nor scientific research cited in support of that document consider the disposal of decommissioned nuclear submarines within the context of cumulative sources of radioactivity. This is a significant omission which makes it difficult, if not impossible, to adequately consider incremental increase in radioactivity entailed in land or sea disposal of decommissioned nuclear submarines. Revision of the DEIS must incorporate adequate data, information, and discussions to address this issue.

In considering the sea disposal option, consideration of cumulative impacts should begin with development of a comprehensive register of all radioactivity known or reasonably expected to enter the marine environment. This global inventory should include, but not be limited to, past, present and potential levels of radioactivity from weapons testing, historic U.S. and foreign radioactive waste operations, accidental losses of nuclear material, sea disposal of low level waste under the London Dumping Convention, other U. S. and foreign proposals for waste disposal in the marine environment. L.7

This assessment must include an estimate of the marine environment's capacity to assimilate radioactivity without damage. This estimate must be based on sound science and will, in all probability, require additional research. Assessment of cumulative impacts should include descriptions of past, present and projected efforts, effects, both in terms of human health and specific components of the marine ecosystem.

Consideration of cumulative effects must be complemented by a comprehensive monitoring program. We believe the marine monitoring programs considered in the DEIS are inadequate to gauge environmental affects on either land or sea disposal options. Absence of a comprehensive monitoring program prohibits sea disposal of nuclear submarines. In revising the DEIS, the Navy must consider and describe in detail the scope and cost of long-term monitoring of submarines on the deep ocean floor. Specific attention must be given to locating monitoring stations within 25 meters of the reactor compartment and in a network of sites where the plume of radioactivity from a submarine can be monitored. Details of plans for biota sampling, sediment sampling use of submersibles, and development of <u>in situ</u> monitoring equipment must be considered. Costs and assured sources of funds must be clarified.

The best estimate for corrosion described in Appendix G of the DEIS suggests the reactor compartment would be penetrated within a hundred years and that bottom currents would begin

flowing through the reactor within 400 years of disposal. This estimate is used in Figure G-2 to show release of radioactivity to the environment as occurring in more or less than one hundred and four hundred years. The comprehensive monitoring programs data must extend beyond the short-term studies envisioned in the DEIS, to include monitoring of these projected releases. Unfortunately, the monitoring program described in Appendix K of the DEIS proposed only a nine million dollar budget for monitoring before, during, and after the period of active disposal. Under Section 4c, the DEIS states the frequency of post-disposal monitoring will be determined by measured results, results from a period when the DEIS predicts no release of radioactivity to the marine environment.

The DEIS must also consider institutional impediments to conducting monitoring programs for very long -- I mean, periods of hundreds of years. Experience from the past three decades has demonstrated the difficulty in retaining records, let alone continuing environmental programs, of nuclear waste placed in the marine environment. To a significant degree, records of more than 100,000 curies of radioactive waste dumped in the sea by the United States from 1946 to 1970 are missing today. Research in monitoring of the storage sites is virtually nonexistent, and, in fact, has been cut back by the current administration -- which it is now proposing to do with the sea disposal of radioactive waste. J.79

The effects of accidental sinking of a submarine while

L.57 L.61 the ship is being towed to the sea also merits additional consideration. The DEIS predicts that .3 subs will be sunk for every sub disposed. However, this figure is based upon national statistics. It has not considered the hazardous weather

L.58 conditions proved to be valid off Cape Hatteras and Cape Mendocino.

Neither the DEIS nor the scientific studies cited in support of this document justify selection of the sea disposal option

W.1 over land disposal. Our inability to retrieve complete submarines from the deep ocean floor combined with the institutional im-

J.76 possibility of guaranteeing support for long-term environmental monitoring make the marine environment an unsuitable site for disposal of this waste.

These factors should combine to compel the Navy to withdraw this DEIS for extensive revision. Concerns expressed at this and the other hearings should be considered and reflected in a New Draft Environmental Impact Statement. That assessment must be written in clear language and use consistent terms of reference to allow citizens a fair opportunity to understand and comment upon this issue.

Release of a Revised Draft Environmental Impact Statement should be preceded by public education efforts which allow citizens in states like North and South Carolina, California, and Washington, to question the scientists whose works establish, support, the Navy assessments. Then, and only then, will the Navy have met the requirement for informed public participation

which is inherent in democracy.

Land disposal appears to offer a safer and more sensible solution to the dilemma now facing the Navy. If nothing less, the land alternative insures the submarine will not be sent out to sea, out of sight, and out of mind.

Thank you for this chance to talk again on this issue.

CAPT WAGNER: Thank you for your comments, Mr. Jackson.

Ladies and gentlemen, I know there are a few of you who have parking meter problems. You had to park in a place that has an hour limit. At this time I intend to take a recess so that you can solve that problem, and then we'll come back and resume testimony.

For those of you who would like to testify and have not yet registered, you may do so during the recess.

If you could turn that light off, please, I could see the clock and will set the time for reconvening the hearing.

We'll recess and reconvene at ten minutes of 10:00 -- at 10:00 o'clock. We'll meet at 10:00 o'clock. Thank you.

(The public hearing recessed at 9:50 a.m. and reconvened at 10:00 a.m., 17 February 1983.)

CAPT WAGNER: We are still receiving testimony from persons from organizations, and our next registered speaker is Mr. Michael F. Lowe, who is representing Palmetto Alliance, Incorporated. #29

Mr. Lowe, Please.

MR. LOWE: Good morning, Captain Wagner. I pronounce my name Lowe.

CAPT WAGNER: Excuse me.

MR. LOWE: I appreciate the opportunity for Palmetto Alliance to present its views here for the Navy today.

My name is Michael F. Lowe. I am the Director of Palmettc Alliance. We are a safe energy organization incorporated in South Carolina as a non-profit organization, to promote energy issues, particularly, nuclear waste issues.

Palmetto Alliance opposes ocean dumping of nuclear submarines for reasons so clearly outlined by Mr. Jackson of the Oceanic Society. And I won't go into detail of that.

E.12 Palmetto Alliance also opposes land disposal of these submarines at the Savannah River Plant. The high rainfall rate here relative to the alternative site at Hanford would risk corrosion and leaching of radioactive materials to the environment.

E.13 The location of the plant over the Tuscaloosa-Acquifer in the Southeast also is disadvantageous. We feel Savannah River Plant should never have been located in that position at any rate.

I.8 The fact that the plant is located in a Class III Earthquake Zone should also eliminate the Savannah River Plant as a disposal site for nuclear submarines.

And, finally, the amount of the radioactive waste already at the Savannah River Plant and already at commercial facilities in South Carolina would make it politically unwise for the Navy to choose Savannah River Plant as the site to dispose of nuclear submarines. South Carolinians have already done their part so far as the nuclear program, both commercial and military, for this country. And it is politically unwise, unfair, and unjust to ask us to tolerate more radioactive waste in this state.

I thank you for your time.

CAPT WAGNER: Thank you, Mr. Lowe.

The next registered speaker is Ms. Joyce Rosenthal, representing Greenpeace Association.

MS. ROSENTHAL: Good morning, Captain Wagner.

CPT WAGNER: Good morning.

MS. ROSENTHAL: Thank you very much for this opportunity to testify here today.

My name is Joyce Rosenthal. I will testify here today on behal of Greenpeace USA, in the capacity of Campaign Coordinator to the issue of Ocean Dumping. #13a*

Greenpeace is an international environmental organization whose sole purpose is the promotion of environmental protection over the long term. Our campaigns are designed to foster awareness of the threat of environmental degradation through research, educational efforts, and non-violent direct actions, to prevent destruction of endangered species and critical ecosystems.

Since Greenpeace's beginnings in 1971, the oceans have been a central concern of the organization. Largely due to our efforts to protect marine life and the ocean environment, Greenpeace presently has over 270,000 contributing members in the United States and more than one million worldwide.

I am here to address the Navy's examination of the ocean dumping option for the disposal of irradiated nuclear submarines, as outlined in their Draft Environmental Impact Statement, released December 22, 1982. Although the Navy maintains that they

*Other issues provided by Ms. Rosenthal are side barred in Exhibit 13b.

have not yet selected a preferred method of submarine disposal, environmentalists, fishermen, scientists, policy-makers, state governments, and citizens around the country, and in other nations, have been concerned over the possible resumption of ocean dumping of radioactive waste.

Greenpeace opposes the ocean disposal of radioactive waste. In approaching the question of nuclear waste disposal, we assume the objective goal is to insure the protection of public health and the environment over a very long term. The activity of isotopes present in all categories of nuclear waste, and present in the irradiated reactor compartment, pressure vessel, and steam generator of decommissioned submarines, guarantee that levels of radioactivity will persist for thousands of years.

*L.6 To pursue ocean disposal at this time would mean resuming a practice before the impacts on public health and the marine environment of past radioactive waste ocean dumping are understood.
W.1 Once dumped, these submarines would be irretrievable. This is a critical drawback that land based storage does not have.

A review of past radioactive waste ocean dumping in this country in comparison to the Navy's proposal elucidates part of our concern. The DEIS estimates that one defueled submarine reactor plant contains about 62,000 curies of radioactivity, which is approximately one-half the entire amount of radioactivity that has been calculated to have occurred in dumping operations off the United States coasts between 1946 and 1970. The isotopes

in the induced radioactivity in each sub contains: Cobalt 60, Nickel 63, Cesium 137, Nickel 59, and Niobium 94. There are 16 different radioactive nuclides in the initial 62,000 curies, with half-lives ranging from 5.26 years for Cobalt 60 to 80,000 years for Nickel 59. With over 100 nuclear submarines scheduled for disposal over the next 30 years, choosing the ocean dumping option would result in sea disposal of quantities of radioactive materials that dwarfs the previous U. S. dumping program by comparison.

In the over 100,000 containers of nuclear waste and one submarine reactor vessel dumped into the Atlantic and Pacific Oceans within the 24-year period of ocean dumping was approximately 120,000 curies of radiation. These are the recently revised calculations on the magnitude of past dumping by the Environmental Protection Agency, which has been largely unsuccessful in determining the full extent and location of past dumping.

The Navy's DEIS has not considered the precedent setting nature of this ocean dumping option. A formal request to the EPA to dump radioactive submarines into the ocean would constitute the most formidable pressure to reverse a twelve-year *de facto* ban on the multi-practice of ocean dumping. The practice was halted in 1970 when the Council on Environmental Quality issued a report which concluded that ocean dumping of any radioactive waste presented a very serious and growing threat to the marine environment. F.8 L.9

*Other issues provided by Ms. Rosenthal are side barred in Exhibit 13b.

I think the recent Anderson Amendments to the Ocean Dumping Act, which place a two-year moratorium on issuance of new ocean dumping permits pending a more detailed study of their environmental consequences, reflects the spirit of the constituency around the country that is opposed to renewed nuclear waste dumping into the ocean.

A new policy of considering nuclear waste dumping on a case by case basis, by necessity, would have to replace the present two-year moratorium, without developed EPA guidelines.
L.5 There are also no existing EPA regulations or a national policy
for radioactive waste ocean dumping. If the Navy pursues the
F.8 ocean dumping option, that represents an undeniable policy shift
that has implications far beyond the specific proposal. The
Navy's DEIS should have assessed the cumulative impacts of ocean
L.7 scuttling in the context of other past and proposed ocean dumping
and other sources of radioactivity in the marine environment.

Despite recognition of its needs by international maritime organizations, a complete inventory of radionuclides entering the marine environment has never been created.

The Navy in its proposal is breaking ground for a great variety of radioactive waste that could be dumped into the ocean if the EPA permits this practice on a case by case basis. Evidence of this is the February 1st notice by the Department of Energy that the ocean dumping option is being studied for disposal of FUSRAP soils, wastes from the Manhattan Project currently being stored in New York.

Politically, the resumption of dumping nuclear waste into the ocean is bound to be increasingly unpopular with a growing number of nations that are opposed to this practice, including Pacific Island nations and the European nations opposed to the current dumping by the U.K., Belgium, and Switzerland, into the Northeast Atlantic. Clearly, the U. S. role in influencing global decision making must be given more consideration. In the past two years, we have unfortunately seen the United States relinquish its leadership role in marine protection international to leading the battle cry for a small band of dumping nations.

Ocean dumping is currently subject to review by the more than 50 member nations that have signed a treaty called the "International Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter," better known as the London Dumping Convention. This is an appropriate week to consider the international aspects of the Navy's scuttling plans, as it marks the seventh meeting of the London Dumping Convention, where the LDC nations will consider a proposal by the Pacific Island nations to ban radioactive waste ocean dumping as an amendment to that treaty.

In light of the current unanswered questions regarding the biological transport pathways of radionuclides, oceanic currents, and the cumulative effects of past and current dumping operations, we hope that the LDC nations will recognize the risks of continued ocean dumping at this time, and support a ban on its practice.

Japan and other nations are closely watching the development of the U. S. policy on this issue in consideration of their own plans for radioactive dumping. Greenpeace is represented at the LDC meeting as a non-governmental organization and is supporting the proposed ban on all radioactive waste ocean dumping.

These policy implications of the scuttling plan are why we have to examine the entire issue of ocean dumping in judging them, including the under-researched effects of past dumps in this country. Scientific studies contracted by the United States EPA have revealed evidence of radionuclide biocumulation into
U.9 the marine food chain. Specifically, I refer to Dr. William Schell's study of Americium 221 contamination of the rattail fish otherwise known as the grenadier, off the coast of New Jersey and New York, and that is a great cause for concern, especially in light of the almost complete absence of the EPA radioactive waste dumpsite monitoring. Given the current status of the EPA programs, we find that the monitoring plans as outlined for both the ocean and land disposal options in the DEIS are not credible.

Time constraints in preparation of this testimony following the release of the DEIS do not permit me to engage in a technical review of the Navy's supporting scientific studies on the ocean disposal option, or to review the Navy's study of possible land burial sites at Hanford, Washington, and Savannah River, South Carolina. The 90 day commentary period provided by the Navy is not sufficient for the public to analyze the bulk of technical

data and considerations in the scope of this DEIS. Greenpeace has submitted a request as part of a coalition of environmental organizations requesting a 90-day extension of public commentary time. We hope the Navy agrees to this for the benefit of the public, that North and South Carolina have barely had time to obtain a copy of the DEIS, much less analyze this 400-page technical document.

We would also like to note that in addition to not spelling out monitoring plans for land-based disposal, the DEIS did not L.13
take into account the artificial reef effect that nuclear submarines will have on the marine environment. The EPA has found
out that in the deep sea, metal drums used for radioactive waste L.55
disposal in the past produces a reef effect, actually attracting organisms, since the metal containers provide one of the few hard substances to attach to on the ocean floor.

Careful consideration must be given to today's testimony by the Oceanic Society, the Palmetto Alliance, and others, as they critique the DEIS on technical grounds. These people have pointed to unacceptable gaps of essential information that would
be used to predict the transport or fate of radioactivity in the L.1
marine environment.

Returning to the question of how to dispose of obsolete submarines, Greenpeace proposes that the Navy should continue to G.2
maintain irradiated submarines in protective storage in the

naval shipyards where they are decommissioned, to allow for the anticipated early rapid decay of short-lived radioisotopes.

We have presently asked a technical expert to evaluate data on decay of radioactivity in the subs and hope to present findings that pinpoint the earliest optimum time for shipping from protective storage to land-based storage. Information in the DEIS indicates that a proper time-frame for shipment would be from twenty to fifty years.

Supporting this recommendation is a statement in the DEIS: "Nuclear submarines can also be placed into storage for a long time without risk to the environment. The submarines would be kept in protective storage. About every twenty years each ship would be taken out of the water for an inspection and repainting to assure continued storage."

Questions we must ask ourselves after that time to assess the differences between land disposal options include:

E.23 What is the shortest, safest transportation route for these radioactive wastes to the land burial site, or land disposal site? Recognizing that shipment is the weakest link in the disposal process, due to the possibility of accidents and public exposure, great consideration must be given to the shortest and safest route.

L.62 L.57 What are the chances of a barge-towing accident in case the shipment transverses deep or shallow salt water or rivers? The DEIS must consider these possibilities.

What environmental concerns have been raised by the public near the two land disposal sites that the DEIS does not cover? Are there more appropriate burial sites not covered in the DEIS? E.28

Can there be monitoring plans for a land-based disposal site? I.13

In conclusion, I note the Savannah River Plant's relative high rainfall, 47 inches a year. Corrosion is greatly accelerated by moisture, and corrosion is the process by which these radionuclides get into the environment from the reactor compartment. This environment is a factor which would make the Savannah River Plant an unattractive site for these radioactive wastes. E.12 I.9

I also note in conclusion the problems that every nuclear nation around the world has had in disposing of their radioactive wastes. We must examine our policies carefully to determine whether it's acceptable to society to continue producing materials for which there exists no environmentally sound disposal practice.

Thank you, Captain Wagner.

CAPT WAGNER: Thank you, Ms. Rosenthal.

The next registered speaker is Ms. Mary T. Kelly, representing the League of Women Voters in South Carolina. #30

Ms. Kelly.

MS. KELLY: Thank you, Captain Wagner. I appreciate the opportunity to speak.

I don't have a prepared statement, and I would like to reserve the right to submit one at a later date. I just want to go on record for the League as being greatly concerned by this question of both ocean dumping and possible land disposal at the Savannah River Plant. Though, the League of Women Voters is very concerned about the many issues concerning nuclear waste and everything to do with nuclear in South Carolina. Because we are a state excessively impacted both because we have the Savannah River Plant; we've got the Naval Base in Charleston; we have more than the average number of power reactors in this state; we've got a third of the nations high-level waste disposals; we have one of three low-level waste sites. Just from the standpoint of fairness of actually what has happened in South Carolina, it seems to be something that should be considered in this disposal option.

However, we would like to urge you to take into careful account the points that have been raised here since they are
L.1 extremely valid, the many unknowns concerned with deep ocean
L.7 disposal, possible mixing impacts, the cumulative impacts of
J.76 radioactive materials getting into the ecosystem, and the long-range monitoring. The fact that these submarines will be irre-
W.1 trievable is certainly a matter of tremendous importance.

We are also concerned about disposal at the Savannah River Plant because -- we're always concerned about the Savannah River Plant, for the simple reason that long ago when it was sighted -- in hindsight --when we doubt that we'd ever be placed in an area with the geological characteristics of the Savannah River Basin.

That area is in a Class C-3 seismic zone, but we've had a major I.8
earthquake in this state in the past; the possibility of ground
water contamination if this submarine corrodes as we expect it I.9
to. All those are factors that enter in.

We also are a little perturbed at the fact that the time-frame allowed for comment has not really been adequate. I think that governmental organizations really do not comprehend how citizens groups and private citizens operate. We don't have full-time staffs and experts. It takes us a while to come to grips with these things, and we do need more time. We would appreciate that.

Thank you.

CAPT WAGNER: Thank you, Ms. Kelly. We would be pleased to receive your written comments later.

I have no further registrations for people desiring to provide testimony. Is there anyone registered to provide testimony whose name I have not called?

(No response)

CAPT WAGNER: Additional public comments for consideration in the final statement may be sent to me at the address that I announced previously.

I would like, on behalf of the United States Navy, to thank all of you for attending this morning, particularly, those of you who provided testimony.

This hearing is adjourned.

(The morning hearing adjourned at 10:20 a.m., February 17, 1983.)

(The afternoon session of the public hearing convened at 1:33 p.m., February 17, 1983.)

CAPT WAGNER: Ladies and gentlemen, I would like to call this hearing to order.

Is there anyone here this afternoon who did not attend our morning hearing?

(No response)

CAPT WAGNER: I have no registrations for our hearing scheduled this afternoon. Is there anyone in the audience who would like to register and would like to provide testimony?

(No response)

CAPT WAGNER: Then, I will remind everyone that we have a hearing scheduled at 7:30 this evening. We will adjourn at this time and hold a hearing at 7:30 in the evening. Thank you.

(The hearing adjourned at 1:35 p.m., February 17, 1983.)

(The night session of the public hearing convened at 7:45 p.m., February 17, 1983, in Columbia, South Carolina.)

CAPT WAGNER: Good evening, ladies and gentlemen, this hearing is called to order.

I am Captain Edward Wagner, and I work in the Office of the Deputy Chief of Naval Operations for Submarines. I have been appointed the Navy's Hearing Officer for this evening's public hearing. Here with me to present an opening briefing is Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program. Also present is

Mr. James Gaver, Assistant to the Manager for Public Affairs, the Savannah River Operations Office, Department of Energy.

This public hearing is being held to receive comments on the Navy's Draft Environmental Impact Statement evaluating alternatives for disposal of nuclear powered submarine reactor plants after the fuel has been removed and the ships are no longer needed. The Navy has conducted studies on the feasibility of burying the defueled reactor plants in government-owned land disposal sites or placing them on the deep ocean bottom.

On December 22, 1982, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, or DEIS, on the disposal of decommissioned, defueled Naval submarine reactor plants. The DEIS contains the results of the Navy's studies of the alternatives available. On the registration table are copies of the Summary of the Draft Environmental Impact Statement. Anyone in the audience who would like a complete copy of the DEIS, should leave their name and address on the sheet of paper provided at the registration table, and a copy will be mailed to you.

The Navy's Federal Register announcement also scheduled public hearings at various locations which are convenient to the people with an interest in this matter, in order to provide them with an opportunity to present their views. I am here today to conduct one of these scheduled public hearings. The purpose of this hearing is to take testimony regarding the Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case nor to engage in debate. It is my responsibility to receive statements so that they can be considered in preparing the Final Environmental Impact Statement.

I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established for this hearing. As set forth in the announcement of the hearing, individual speakers are to limit their testimony to five minutes each, and organizational spokesmen are limited to ten minutes, unless additional time had been requested in advance. Time cannot be relinquished from one speaker to another.

In order to insure all who desire to speak are given an opportunity, each person should fill out a registration card and provide it to the registration table. All testimony will be recorded so that it can be considered in the development of the Navy's Final Environmental Impact Statement.

If you desire to submit written comments rather than to speak, that is acceptable. You can provide written comments to me or leave them at the registration table. If you desire to provide written comments at a later date, my mailing address is:

Captain Edward F. Wagner
U. S. Navy
Office of the Chief of Naval
Operations (OPNAV-22)
Department of the Navy
Washington, D. C. 20350

You should provide your written comments by March 31, 1983, which as stated in the Federal Register Notice, is the

cut-off date for submitting comments.

Before we begin receiving testimony, I would like to at this time introduce Mr. Mangeno of the Naval Nuclear Propulsion Program, who will provide a general overview of the issue the Navy is addressing and the content of the Draft EIS.

Mr. Mangeno.

MR. MANGENO: Today's hearing is being conducted as a part of the decision-making process required by the National Environmental Policy Act. Under this law, the Navy must prepare an Environmental Impact Statement for any action which could have a significant environmental impact or which might be subject to controversy over the environmental effects. The Environmental Impact Statement must include the environmental impacts for all reasonable alternatives.

The Navy's Draft Environmental Impact Statement, or DEIS, on this subject provides the basis for these hearings, and the slides that follow are from the DEIS. It describes the alternate ways the Department of the Navy, in cooperation with the Department of Energy, is considering for permanently disposing of defueled nuclear-powered submarines after they are no longer needed. The practical choices are: Bury the radioactive part of the submarine at an existing DOE land disposal facility at the Hanford Site in the state of Washington, or the Savannah River Plant in South Carolina; or place the entire submarine on the bottom of the ocean in water more than 2.5 miles deep. In both choices there would be no nuclear fuel left in the submarine because all of it would be removed before disposal. Nevertheless, there would be some low-level radioactive materials left within the submarine.

Preparation of this Draft Environmental Impact Statement does not mean that the Navy has already decided to dispose of nuclear submarines. The Navy currently has about 120 nuclear-powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases, as shown in this slide it is evident that a disposal plan must be prepared for use sometime in the future. This DEIS has been prepared now so that all interested agencies, organizations, and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

The submarines are constructed with the nuclear power plant enclosed within a single section of the ship called the reactor compartment. This slide shows a typical submarine with the location of the reactor compartment identified.

Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the uranium and all of the fission products. The removed fuel is handled according to established procedures and

is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, to the metal structure supporting the fuel, to the reactor vessel, and to other equipment in the reactor compartment, where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by the hull of the submarine and by the reactor vessel and coolant piping. In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel, or other metal atoms in the reactor plant. These atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation of the nuclear reactor and the number of curies of each radionuclide at that time. A curie is a measure of the amount of radioactivity present, but it is not an indication of the possible effect on man or animals. The amounts and kinds of radioactive atoms present are described in uetail in Chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the federal government disposal facilities already used for such low-level radioactive waste at the Hanford Reservation in the state of Washington, or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the compartment free from the remainder of the submarine, and weld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal, and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. Other government-owned disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable water, so that transportation of the reactor compartment to those sites would be impractical. The Hanford and Savannah River burial grounds are described in Chapter 3.

A transporter of the sort shown in this sketch could then be used to haul the compartment over land to the burial location.

There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial, or after burial. This is because radiation outside the compartment would be well below federal limits, and the reactor compartment would have been welded shut at the shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low-level radioactive wastes. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burials and would result in no significant additional environmental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the body. More than 200 years would pass before the reactor compartment bulkhead could be penetrated by corrosion. Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time, exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean is another practical alternative. The maximum radioactivity would be less than the limit specified by international criteria; and the triple containment provided by the submarine reactor compartment, by the reactor vessel and piping, and by the radioactive atoms being a part of the metal itself, would be an extremely strong and effective disposal containment package.

Locations for possible ocean disposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U. S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site-specific public hearings would be required and the permit process is not a part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 190 miles west of Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry, and marine biology for very deep ocean locations. The depth of the water in these areas is between 4000 and 5000 meters (13,000 to 16,000 feet). The scientific information and measurements collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that the environmental impacts could be calculated using realistic data.

Preparation for ocean disposal would be made at one of the shipyards normally servicing nuclear-powered Naval vessels.

Following defueling, the reactor vessel and the reactor compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping, and, of course, the metal itself completely intact. Most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping or free the atoms from the thick metal.

A comparison of the possible effects on the environment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100 submarine disposals for the year of greatest exposure for both options. This table shows that the radiation exposure would be very small and could have little impact on indivduals or the population. These levels are also many times less than any limits established by U. S. regulations or international limits. They are much smaller than the normal fluctuations in annual average background radiation exposure for U. S. residents.

A perspective on radiation exposure can be gained by examining the exposure a person would receive from natural cosmic background radiation if he flew round-trip from New York City to Los Angeles. That person would receive approximately 2 millirems more radiation than if he had not made the trip, because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one-half millirem.

Other environmental impacts are similarly small for both options. The effects on animal life would be small and localized in either case. Land burial of 100 reactor plants would require only about 10 acres of land, and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square 10 miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land disposal would cost about 40 percent more (about two million dollars per submarine more) than sea disposal.

The "no-action" alternative is to place submarines in floating protective storage for an extended period, commonly called "mothballing." However, this would only temporarily delay disposal, because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods, and the estimated radiation exposures for the general public would be very small

for all available courses of action.

Thank you.

CAPT WAGNER: Thank you, Mr. Mangeno.

Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing. I will now proceed with public testimony.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, please proceed to and be seated at the testimony table in front of me. State your name and organization, if any. All comments are then to be addressed to me.

Our first registered speaker is Ms. Ruth Thomas from Columbia, South Carolina, representing Environmentalists, Inc. #31.

Ms. Thomas.

MS. THOMAS: Thank you, Captain Wagner.

I appreciate this opportunity of being here.

Oh, I should repeat my name: Ruth Thomas with Environmentalists, Incorporated, a Columbia educational organization which has been in existence for over ten years.

I wanted to thank you, too, for holding three sessions, although I didn't know you were going to hold it for me, but I did have two other conflicts. I had a conflict this morning and this afternoon, so I was glad that there was one this evening.

I did receive, or our organization did receive, a copy of the Draft Environmental Impact Statement on the disposal of decommissioned Naval submarine reactor plants, and in looking

this over and in listening to the presentation, I still have
some questions, for example, in relation to the National Environ-
mental Policy Act. It seems as though there are a number of other
H.3 alternatives which have not been included. For example, it would
seem that disposal in an area which is very dry and arid should
be considered.

Another thing is that some of the information appears to
conflict with some factual data. I was surprised, too, that
the National Academy of Scientists reports on radioactive wastes
I.11 were not included as references, or at least I did not find these
as references. For one thing, the National Academy of Science
in their 1966 report indicated that the Savannah River Plant was
not a good area to have radioactive material, and in support of
this they cited the climate, the moist climate, and the water
table which is quite near the surface, and some other problems
with the area.

Of course, with the disposal at sea you are going to have a
lot more water than we have in South Carolina, and the corrosion
problems are a concern, and since this would be the method by
which the radioactivity would be released, I think, too, that we
have to consider that in the future we may be making different
L.36 uses of the ocean than we do now, for more food, and that this
could be a problem having the radioactive material buried at sea.

I.14 I also have with me, which I will leave a copy of, a
report from the U. S. Department of Interior, the geological

survey, and they point out problems at the Savannah River Plant
in relation to having radioactive material and nuclear activity I.14
there. They also point out that monitoring doesn't necessarily
pick up a leaking radioactivity, that the radionuclides can
by-pass monitoring walls and move undetected into a site. And
they point out that if this happens with long-lived radioactivity
that it could be impossible or impractical to take remedial action.

I noticed in the talk that it was mentioned that this would
be classified as low-level radioactive wastes, but as I understand
it, this low-level radioactive waste can include materials that
are radioactive for very long periods of time.

I understand, too, through a study done by Roderick Poole,
that the operation of a nuclear reactor brings about the long-
lived radionuclides, and I believe some of these are mentioned --
I think Lead 59 is one. I couldn't find that report before com-
ing tonight, but I do mention that report and the information
that is contained in that.

The presentation referred to a natural radiation and radia-
tion that we receive from other sources, and since the effects
of radiation are cumulative, it is a concern to think that we
are having this added to the harm that we already receive from
natural radiation. I think we are inclined, because it has been
around so long, to think that maybe natural radiation isn't
harmful, but of course we know that it is.

So, I would like to submit in writing, and I'm sorry that
I didn't have something this evening, but I will do that at a future

date, and I believe by March 31st -- was it?

CAPT WAGNER: That's correct.

MS THOMAS: So that I can refer exactly to the documents that I spoke of and for the basis of our Environmentalists, Inc., recommending that other considerations be given besides those that are included and that we do feel that we would not like to see the disposal at sea, and also would not like to see it buried at the Savannah River Plant. We feel like we have enough there.

Thank you.

CAPT WAGNER: Thank you, Ms. Thomas. We will be happy to receive your written comments when you submit them.

I have no further registrations. So, is anyone registered to speak that I have not yet given them an opportunity?

(No response)

CAPT WAGNER: I would like to again add that the written comment can be mailed to me at the address that I mentioned earlier.

I would like to thank Ms. Thomas for her comments tonight on behalf of the Navy and myself. We appreciate that. And at this time I would like to adjourn the hearing.

(The scheduled night session of the public hearing in Columbia, South Carolina, was adjourned at 8:12 p.m., February 17, 1983.)

CERTIFICATE

March 9, 1983

I hereby certify that the foregoing transcript consisting of 49 pages plus index constitutes a complete and verbatim report of the Public Hearings held on February 17, 1983, at 9:00 a.m., 1:30 p.m., and 7:45 p.m., in Columbia, South Carolina, RE: NAVY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS, reported and transcribed by me.

Jewel B Crawford
JEWEL B. CRAWFORD
Court Reporter &

Notary Public for and in the
State of South Carolina.

My Commission Expires: May 13, 1991

#13b*

GREENPEACE U.S.A.

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June 29, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-45)
Department of the Navy
Washington D.C. 20350

Dear Captain Wagner:

Please accept this as Greenpeace U.S.A. comments on the Navy's Draft Environmental Impact Statement.

Thanks very much.

Sincerely yours,

Joyce E. Rosenthal

Joyce E. Rosenthal

REGIONAL OFFICES CALIFORNIA GREAT LAKES
HAWAII NEW ENGLAND ROCKY MOUNTAINS SEATTLE

COMMENTS
on the
DRAFT ENVIRONMENTAL IMPACT STATEMENT
ON THE
DISPOSAL OF DECOMMISSIONED, DEFUELED
NAVAL SUBMARINE REACTOR PLANTS

By
Marvin Resnikoff, PhD.
Council on Economic Priorities

Prepared for Greenpeace U.S.A.

The Draft Environmental Impact Statement (DEIS) by the Department of the Navy examines the environmental implications of the Navy's plan to dispose of 100 nuclear submarines. Two alternatives are seriously considered: sinking the defueled submarines in the deep ocean and burying the nuclear reactor compartment in near-surface burial grounds at Hanford, Washington and Savannah River, South Carolina. The deferred action alternative preferred by environmental groups, to dispose of the pressure vessel plus radioactive internals in deep underground repositories after a 25 to 50 year storage period is briefly mentioned by the Navy and dismissed.

The Navy DEIS is an ambitious undertaking. It must consider the short and long-term implications of both surface land and deep ocean disposal. However, the DEIS is fatally flawed in its estimates of the initial radioactivity present in the reactor taken out of service. These incorrect estimates lead the Navy to incorrect conclusions about the hazards and method of disposal.

The Navy DEIS understates the curies of cobalt-60 and niobium-94 present in the reactor pressure vessel plus internals. Based on the radioactivity hazard of cobalt-60, submarine reactors should be stored 25 to 50 years, then disposed of in deep underground land repositories rather than in a surface burial ground. Further, the projected occupational exposures in decommissioning a submarine reactor are unsubstantiated and seriously underestimated in the DEIS. Allowing the submarine to remain in safe storage for 25 to 50 years before dismantlement will result in less radiation exposures than if the submarine is immediately dismantled, yet the DEIS holds the opposite. The long-lived gamma radioactivity due to niobium-94 rules out surface burial. These points are discussed in much greater detail below. G.7*

*Other issues provided by Ms. Rosenthal are side barred in Exhibit 13a.

#13b (Cont)

Specific Comments:

A.10

1. The Navy DEIS underestimates the levels of radioactivity of certain radionuclides remaining in a defueled submarine nuclear reactor. This radioactivity is due to the irradiation of the reactor metals by neutrons escaping from the reactor core. We calculate the correct numbers in this section by scaling the levels in a commercial PWR down to the smaller submarine reactor. An exact calculation is impossible because the basic data, such as the power level, capacity factor, geometry and metals (including contaminants) of the submarine reactor are not specified in the DEIS, presumably because of security reasons.

For a rough estimate of the radioactivity in a submarine reactor, we assume that the average submarine reactor has maximum power levels of 125 MW(e) and a capacity factor or 60% for a 30 year period. On average, submarines are at sea 90% of the time, though not operating continuously at full power. The total energy produced is one key parameter determining the radiation levels. Energy is directly proportional to the number of fissions and therefore to the total number of neutrons, a fraction of which escape the reactor core and irradiate the metals. The curie content can then be estimated by linearly scaling the results for a commercial power PWR, as shown in Table 1. We expect that this method underestimates the activation products in a submarine reactor since smaller reactors have a greater fraction of "lost" neutrons, i.e., neutrons which do not interact with uranium-235 and escape the core.

As seen in Table 1, the levels of nickel-59 and -63 estimated by us and the Navy are identical. However, the levels of cobalt-60 estimated by us are greater by a factor of 6; the levels of niobium-94 are greater than the Navy DEIS by a factor of 100. Unless the metals in a Navy reactor are radically different from a commercial PWR, the Navy's estimates for the different radionuclides are inconsistent. Since the NRC values, upon which our projections are based, have been well substantiated in NUREG/CR-0130, we employ them, rather than the Navy's, in further discussions. The Navy has not substantiated its numbers for cobalt-60 and niobium-94 in the DEIS. To do this, it needs to document the contamination levels of Co-59 and Nb-93, the precursors of Co-60 and Nb-94, respectively, and needs to document the total neutron fluence. A.10

These two underestimates by the Navy radically alter the disposal options. Because Co-60 emits penetrating γ radioactivity, higher Co-60 levels imply higher occupational exposures in the case of immediate dismantlement and argue for continued storage, on the order of 25 to 50 years. Higher Nb-94 levels argue for deep underground disposal rather than surface disposal because Nb-94 is also a strong γ emitter and has a 20,000 year half-life. We discuss these points next.

2. Based on projected commercial PWR radiation levels after shutdown, we can estimate radiation levels for the submarine reactor. These are not calculated in the Navy DEIS. Our calculations are shown in Table 2. At reactor shutdown, the radiation levels in the submarine reactor are expected to range as high as 41,500 R/h, due to Co-60 alone. These levels decline to 40.5 R/h, 53 years after sub reactor shutdown. At 1,000 years after reactor B.7

#13b (Cont)

B.7

shutdown, we project the γ radiation levels at the reactor shroud to be 150 mr/h, due almost entirely to Nb-94. These levels exceed the NRC levels for unrestricted release, 2 mr/h, or if a person were continuously present at the reactor for a full year, 0.02 mr/h (170 mr/y). These radiation levels due to Nb-94 necessitate deep underground disposal rather than land surface disposal. Since the half-life of Nb-94 is 20,000 years, these radiation levels will persist for a long period of time. The DEIS claims that the radiation levels will decline to 0.1 mr/h after 53 years (p.1-6) are based more on wishful thinking than the law of physics.

G.6

3. Because of the presence of cobalt-60, the longer the nuclear reactor is stored before dismantlement, the lower will be the worker radiation exposures. For a commercial PWR, with much higher radiation levels, the NRC estimates a 30-year storage period before reactor dismantlement. There appears to be no major reduction in occupation exposure in waiting longer than 30 years (Table 2.8-1, NUREG/CR-0130). The greatest occupational exposures come from immediate dismantlement. Unless submarines have certain design characteristics or methods of dismantlement differing greatly from a commercial PWR, we expect this approximate time period of 30 years to hold for submarines as well. Yet the Navy DEIS comes to a different conclusion.

G.6

4. The Navy opposes interim storage and eventual removal of the reactor pressure vessel, preferring instead to scuttle the entire reactor. It opposes interim storage for two reasons: a) submarine maintenance will be required ever 20 years, and b) there is no reduction in occupational exposures to warrant keeping the submarines in storage.

If submarines are placed in storage, the hull must be maintained every 20 years. The implication in the Navy DEIS is that the hull is corroding. Since the Navy downplays the effects of corrosion if the submarine is sunk, the necessity for maintenance is peculiar. The Navy cannot have it both ways. The Navy claims that once the sub is sunk, thousands of years must pass before water can enter the submarine compartment. G.6 L.23

The Navy claims that the radiation exposures incurred in mothballing a submarine, then burying it in surface burial ground (20 person-rems) is greater than immediate land disposal (17 person-rems). This makes no sense. During a 20-year period, cobalt 60 decays by a factor of 15 and therefore the radiation exposures at the time of dismantlement should be greatly reduced. The DEIS claims that protective storage does not lessen radiation exposures to the public (p. 5-13), yet it does lessen exposures to workers. G.6

5. Because of the longevity of Ni-59 and Nb-94, submarines should neither be buried at sea nor in surface land disposal. According to the EPA interim standards, dose rates should be calculated as if no institutional safeguards were present after 100 years. The Navy did not use this procedure in the DEIS. The presence of Co-60 and Nb-94, in greater amounts than predicted by the Navy DEIS, indicates that the exposures to the public will be greater than calculated by the Navy. Rather than burying the entire reactor compartment in a surface burial ground, it may be preferable to bury the submarine reactor itself in a deep underground repository. The option of deep underground disposal is not considered in the DEIS. This should be remedied in the Final EIS. P.13 A.10 G.7

#13b (Cont)

K.14 G.7

6. Transportation aspects are not properly considered in the DEIS. The barge accident rate should be higher implying that the number of accidents in transporting the reactor compartment to surface land disposal will be greater. According to NUREG-0056 on floating nuclear power stations, the number of accidents per million miles is 9.3. The Navy claims only 5.8. In any case, there is no need to transport the entire reactor compartment, weighing 1000 tons. Only a small component of this 1000 ton mass is radioactive, the reactor pressure vessel plus internals. The difficulties in transporting the reactor compartment up the Savannah River are unnecessary. The reactor itself should go to the final repository, which is not the Savannah River facility.

N.3

7. The costs of deep underground disposal would be considerably greater than for surface land disposal or seabed disposal. Nevertheless, the costs are a small fraction of the full construction and operation costs of a submarine reactor, just as the costs of decommissioning a commercial nuclear reactor are a fraction of the construction and operation costs. The Navy should accept this cost as the commercial sector has for power reactors.

A.10 B.7

8. The DEIS claims that because of radioactive decay, after 100 years there will be no external exposures (p.S-10). This neglects the presence of Nb-94. The DEIS should be revised in light of Table 2 which predicts radiation levels on the order of 143 mr/h.

B.1

9. The population dose commitment does not appear to be correctly evaluated. The Navy definition does not evaluate the radiation exposures over the full hazardous life of these materials. The total number of cancers should be calculated from the total dose to the population over all time.

This concept of dose commitment has been consistently employed by the EPA and should be adopted by the Navy as well.

F.8 L.7

10. Because of the precedent of ocean disposal by the United States and its ramifications on the actions of other countries, it is quite possible that other signatories to the London Dumping Convention will begin to dispose of low level waste by ocean dumping. The Navy should consider the effect of many countries disposing of low level waste and not just the effect of 100 submarines being sunk. This is a reasonable effect of the preferred alternative which the Navy, according to NEPA, must consider.

E.10 E.30

11. The Navy does not consider the full implications of barging the reactor compartment to Savannah River and Hanford. At Savannah River, about 7800 cubic yards of a swamp must be dredged to construct a barge slip. The swamp on the Savannah River is also laced with cesium from the L-reactor. The start-up of the L-reactor would bring more Cs to the swamp. At the Hanford site, the Yakima Indian Nation is opposed to the continued radioactive contamination of the federal preserve. Neither of these two concerns appear in the DEIS.

Table 1. Radionuclides in a Commercial PWR and Submarine Reactor

Radionuclide	Commercial PWR (Ci)[b]	Submarine Estimated (Ci)[c]	Submarine DEIS (Ci)[a]
Cobalt-60	1.84E+6	1.36E+5	2.2E+4[d]
Nickel-59	1.63E+3	1.21E+2	1.2E+2
Niobium-94	9.29	6.88E-1	6.3E-3
Nickel-63	2.43E+5	1.8E+4	1.8E+4

Notes:

[a] From Table 1-1, Navy DEIS, six months after reactor shutdown.

[b] From NUREG/CR-0130, assuming a 3500 MW(t) PWR, operating 40 years at 75% capacity factor. Levels at time of reactor shutdown.

[c] Numbers in Col. 1 multiplied by ratio $\frac{60\% \times 30y \times 125\ MW(e)}{75\% \times 40y \times 1175\ MW(e)} = 1/13.5$

[d] $2.2E+4 = 2.2 \times 10^4 = 22,000$

Table 2. Projected Submarine Exposure Rates*

Radionuclide	One-half year after reactor shutdown (R/h) Shroud	Inner Wall	Fifty-three years after reactor shutdown (R/h) Shroud	Inner Wall	One thousand years after reactor shutdown (R/h) Shroud	Inner Wall
Cobalt-60	4.15E+4	4.00E+1	4.05E+1	3.91E-2	-----	-----
Nickel-59	6.74E-3	1.19E-5	6.74E-3	1.19E-5	6.74E-3	1.19E-5
Niobium-94	1.48E-1	1.26E-2	1.48E-1	1.26E-2	1.43E-1	1.22E-2
Nickel-63	β emitter		β emitter		β emitter	

*Exposure rates obtained from NUREG/CR-0130, scaled down to size of submarine reactor.

#13b (Cont)

GREENPEACE U.S.A.

2007 "R" St. N.W.
Washington, D.C. 20009

Tel (202) 462-1177
Tlx 89-2359

QUOTES FROM PERSONS INVOLVED IN OVERSIGHT OF RADIOACTIVE DUMPSITES

"After each dump, a thorough inspection is made of the dump area to ascertain that all containers have sunk. In the rare event of a floating radioactive waste container, it is sunk by gunfire."**
-- U.S. Naval Radiological Defense Laboratory

"First, let us destroy myth that the only materials the United States dumped in the ocean were low-level radioactive wastes...There were over 48,000 radioactive waste containers dumped in the Pacific Ocean, EPA saw approximately 200, and examined the sediment around even fewer... One reason their samples may not be representative is the EPA expeditions never look in the right place."** -- Congressman Glenn M. Anderson 11/20/80

"We never go directly to a dumpsite, some of those places have been in all kinds of use for very long periods of time...it could be deadly dangerous."
-- NOAA official as quoted in "New England Outdoors" Sept '81

"It should be clearly recognized that the information we have collected is not encyclopedic. It does represent a pioneering first step in developing general monitoring programs for both abandoned and active dumpsites, but more information is desireable from a scientific and public health point of view... It is my view that market place, dumpsite, and baseline monitoring should all be done." ** -- Roger J, Mattson,Office of Radiation Programs EPA 11/20/80

"We do not have sufficient data to estimate the level of activity (curies) remaining in the waste after years of radioactive decay." **
-- John F. Ahearne, Nuclear Regulatory Commission 10/1/81

"I feel there ought to be additional monitoring there mainly because ... the fact is that I am not sure we have sufficient information as to what exactly was in those containers... In the absence of the kind of information essential to making a judgement in this area, the Congress should strongly oppose any further resumption of waste dumping in our ocean beds."*
-- Congressman Leon E. Panetta 10/7/81

"It is imperitive that we determine the exact location of these barrels, what kinds of wastes were buried, and what levels of radioactivity was involved." * -- Congressman Robert J. Logomarsino 10/7/81

"...between 1946 and 1970, the AEC issued liscenses for ocean dumping of both low and high-level radioactive waste materials off the Atlantic and Pacific coasts; due to faulty and fragmented record keeping; and an incomplete innacurate monitoring system, it is impossible for us to know the precise location, contents, and amounts of radioactive waste which have been dumped in our oceans. This lack of knowledge poses a threat to the health and safety of our citizens."* -- Congressman Anthony C. Beilenson 10/3/80

"On the question of the need for research and monitoring, we have been frustrated in our attempts to better grapple with the impacts of dumping by the lack of scientific evidence on critical features of the marine environment, and the effects upon it of radioactive materials."**
-- Leslie H. Brown, Bureau of Oceans, Dept.of State 11/20/80

#32

Feb. 12, 1983
Beverly Roberts
Box 1162
Willits, Cal. 95690

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

Thank you for the copy of the Navy's Draft Environmental Impact Report. I have studied it and would like to respond to it as a citizen
*J.76 of Mendocino County. My main concern is the lack of solid information
reguarding monitoring of Radioactive waste sites. I am aware of the 1980 Scientific Advis ory committee with John Burton which stated that radioactivity had entered the food chain from Nuclear waste dumped off the Farrallon Islands near San Francisco. Also, the Environmental
U.9, Protection Agency studied in the 70's data collected on fish which
L.36 shows a direct pathway of radioactivity to humans from Nuclear waste at the Hudson Canyon dumpsite. No study has been made on an artificial reef
L.55 caused by dumped subs that would attract fish and sea life. As to whether life exists at the bottom of the sea, I have seen photographs of the proposed area, 160 miles off the coast of Cape Mendocino which clearly showed sea cucumber, starfish, Rattail fish (grenadeers), and tracks of sea life on the ocean bottom. The D.E.I.S. states there
J.12 is no significant fishing in the area but two independent tests show that albacore caught in the proposed area numbered highest in one test and second highest in the other. The navy sites cost as a factor in ocean disposal, however after removing the reactor core and welding the sub back together, the cost is similar for both land and sea. Another major
W.1 concern is the lack of retrievability if the subs are sunk into the sea. Without strict testing of this method, untold damage could be done to future generations of humans with no way to correct the mistake. The U.S. Government admits that Radioactive waste is dangerous to life and

*Other issues discussed by Ms. Roberts are side barred in Exhibit 32a.

it is a National problem as to what to do with dangerously radioactive L.53
substances. Mendocino Counto 5th District Supervisor Norman DeVall said, "this is the richest fishing in the world, as 20% of fish protein is caught within the U.S. 200 mile limit. It is obsurd that the U.S.
would consider trashing this area. Fishing is the second largest economic L.14
factor in the County with 400 boats in the Ft. Bragg harbor and a home for all boats from Alaska to San Diego." The U.S. Government must do something about its Nuclear waste build up, and as Supervisor John Cimolino states, "The ocean is not the place to put this waste. We must defeat it and defeat it soundly." Please, Captian Wagner, please consider the future of life to be healthy and free from contamination. It is our Constitutional right to have clean air, safe uncontaminated food, and a healthy Non-Nuclear ocean. Thank-you,

Sinserely,

Beverly Roberts

#33

February 9, 1983

TO: The Honorable John Lehman

Secretary of the Navy
U.S. Department of Defense
The Pentagon Building
Washington, D.C. 95814

REF: Comments regarding the Public Hearing, February 24, Draft EIS, California Water Resources Building, Sacramento, Ca.

SUBJ: Permanent Disposal of Decommissioned Nuclear Submarines in waters off Cape Mendocino.

Dear Mr. Lehman:

As a resident of the North Mendocino Coast I would like to state my opposition to any proposal to dispose of nuclear powered vessels in ocean waters. My reasons are as follows:

1. Local Issue:

a. On-shore, the Mendocino coastal citizens are concurrently dealing with three State mandated projects: State acquisition of private property for public purposes, updating the Mendocino County General Plan (Draft), and certification of the Local Coastal Plan.

b. A review of the respective goals and policies formulated by these projects will serve to point out that the highest priority and maximum commitment is given to the long-term management and protection of our natural environment.

F.8 F.11 | c. As our off-shore waters are a part of the aggregate of surrounding things which we call our natural environment I find that the proposal to dump nuclear wastes off Cape Mendocino is not consistent with the goals and policies cited in para. b., above.

2. National Issue:

F.8 | a. I firmly believe that it is in the best interests of our nation that we preserve the pristine nature of our off-shore waters. Our nation now has the opportunity to set an example for the other nuclear nations to follow, by enacting a permanent moraturium on ocean dumping of Nuclear wastes.

b. A review of the current data available indicates that the on-shore permanent means of disposal of Nuclear wastes is enviromentally acceptable, as compared to ocean dumping methods, which in my judgment is not.

J.15 | I support the fair and reasonable proposals made by our elected representatives that hearings regarding this important issue should be held in the Mendocino North Coast Area.

Sincerely,

D. Paul De Mayo

D. Paul De Mayo
26900 North Highway 1
Fort Bragg, Ca. 95437

#34

ALBEMARLE COMMISSION
Regional Planning and Development

POST OFFICE BOX 646
512 SOUTH CHURCH STREET
HERTFORD, NORTH CAROLINA 27944

TELEPHONE
(919) 426-5753

SCH # 83-E-0000-5113 DATE: 18 Feb. 1983

PROJECT: Draft EIS Submarine Reactor Plants

APPLICANT: U.S. Dept. of the Navy

We have received the "Notification to Clearinghouse of Intent to Apply for Assistance" for the above project, and a review has been completed. The basis of our review of the submitted information is to determine the project's compatibility with Regional goals and objectives. Therefore, the following determination is assigned to the project.

____ The Region R Clearinghouse finds the project to be in keeping with Regional goals and objectives.

____ The Region R Clearinghouse finds the project to be in keeping with Regional goals and objectives; however, the attached comments should be noted.

XX The Region R Clearinghouse finds the project to be in conflict with Regional goals and objectives and/or a duplication of current efforts.

This letter may be used as the official Region R comment to be attached to your application and signifies approval from the Region R Clearinghouse only. The U. S. Official Management and Budget Circular A-95 requires that approval also be obtained from the State Clearinghouse.

Sincerely,

Clearinghouse Coordinator, Region R

/cd

cc: State Clearinghouse

LEAD REGIONAL ORGANIZATION FOR
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A-95/Form #4 5/81

#34 (Cont)

ALBEMARLE COMMISSION
Regional Planning and Development

RECEIVED
FEB 1983

POST OFFICE BOX 646
512 NORTH CHURCH STREET
HERTFORD, NORTH CAROLINA 27944

TELEPHONE
(919) 426-5751

TO: PROJECT REVIEWER — ARPDC, Hertford, N.C.

A-95 CLEARINGHOUSE PROCESS — SCH# 83-E-0000-5111

FROM: Stephen F. Davenport, Clearinghouse Coordinator, Region R SED

SUBJECT: Draft EIS- Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

DATE: 2 February, 1983

For A-95 Clearinghouse purposes, please review the attached notification and indicate your response below. If you or your agency require additional information, contact the applicant directly or refer your request to this office.

Please return this response to my attention at the above address by 16 Feb., 1983. If you do not respond by this date, I will assume you have no comment.

RESPONSE: This notification has been reviewed and appropriate response(s) checked below:

____ This project is consistent with local and/or regional goals and objectives and does not duplicate or counter other efforts. (Please note additional comments below).

____ Potential problem areas have been identified. (Please describe below).

____ Applicant has been advised of problem area(s).

____ Problem has been resolved as of ____________ (date).

____ Problem has not been resolved and respondent requests that Clearinghouse arrange a meeting with the applicant.

COMMENTS: (see other side)

For additional comments, use reverse side.

Reviewed by: Dorothy B. Lippert (Name) Clearinghouse Committee member (Title)

/cd
cc: State Clearinghouse

LEAD REGIONAL ORGANIZATION FOR
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plugged vessels be placed into protective storage for following reasons.

1) Until some future less hazardous method of disposal is discovered or developed | G.2

2) That there may be a need for these ships at some future time. Recommissioning of the ships would be faster and more economic than the building of entirely new vessels. | G.3

#34 (Cont)

FEB 16 1983
A.R.P.D.C.
Hertford, N.C.

ALBEMARLE COMMISSION
Regional Planning and Development

A.R.P.D.C.
Hertford, N.C.

POST OFFICE BOX 646
512 SOUTH CHURCH STREET
HERTFORD, NORTH CAROLINA 27944

TELEPHONE
(919) 426-5753

TO: PROJECT REVIEWER
A-95 CLEARINGHOUSE PROCESS SCH# 83-E-0000-5113

FROM: Stephen E. Davenport, Clearinghouse Coordinator, Region R SED

SUBJECT: Draft EIS- Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

DATE: 2 February, 1983

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XX Potential problem areas have been identified. (Please describe below).

___ Applicant has been advised of problem area(s).

___ Problem has been resolved as of ________ (date).

___ Problem has not been resolved and respondent requests that Clearinghouse arrange a meeting with the applicant.

COMMENTS:

L.53 The Board of Commissioners and staff see potentially negative and irreversible impacts that may hinder the Town's efforts to develope and maintain an environment conducive to tourism.

For additional comments, use reverse side.

Reviewed by: William E. Collins (Name) Planning & Development Director (Title)

/cd
cc: State Clearinghouse

LEAD REGIONAL ORGANIZATION FOR
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ALBEMARLE COMMISSION
Regional Planning and Development

FEB 4 1983
A.R.P.D.C.
Hertford, N.C.

POST OFFICE BOX 646
512 SOUTH CHURCH STREET
HERTFORD, NORTH CAROLINA 27944

TELEPHONE
(919) 426-5753

TO: PROJECT REVIEWER
A-95 CLEARINGHOUSE PROCESS SCH# 83-E-0000-5113

FROM: Stephen E. Davenport, Clearinghouse Coordinator, Region R SED

SUBJECT: Draft EIS- Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

DATE: 2 February, 1983

For A-95 Clearinghouse purposes, please review the attached notification and indicate your response below. If you or your agency require additional information, contact the applicant directly or refer your request to this office.

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X Potential problem areas have been identified. (Please describe below).

___ Applicant has been advised of problem area(s).

___ Problem has been resolved as of ________ (date).

___ Problem has not been resolved and respondent requests that Clearinghouse arrange a meeting with the applicant.

COMMENTS:

County interests would be better served by selection of land disposal method. Feel ocean storage may have unforeseen long-term ecological effects. L.39

For additional comments, use reverse side.

Reviewed by: Barbara K. Hopes (Name) Development Coordinator (Title)

/cd
cc: State Clearinghouse

LEAD REGIONAL ORGANIZATION FOR
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#34 (Cont)

FEB 4 1983

A.R.P.D.C.
Hertford, N.C.

ALBEMARLE COMMISSION
Regional Planning and Development

Post Office Box 646
512 South Church Street
Hertford, North Carolina 27944

TELEPHONE
(919) 426-5753

TO: PROJECT REVIEWER

A-95 CLEARINGHOUSE PROCESS SCH# 83-E-0000-5113

FROM: Stephen E. Davenport, Clearinghouse Coordinator, Region R SED

SUBJECT: Draft EIS- Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

DATE: 2 February, 1983

For A-95 Clearinghouse purposes, please review the attached notification and indicate your response below. If you or your agency require additional information, contact the applicant directly or refer your request to this office.

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RESPONSE: This notification has been reviewed and appropriate response(s) checked below:

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__✓__ Potential problem areas have been identified. (Please describe below).

_____ Applicant has been advised of problem area(s).

_____ Problem has been resolved as of __________ (date).

_____ Problem has not been resolved and respondent requests that Clearinghouse arrange a meeting with the applicant.

COMMENTS:

I personally prefer land disposal as a permanent method as opposed to ocean alternative, despite costs projected. Problem with [illegible] in ocean is lack of [illegible]. Currituck Board has taken no position

For additional comments, use reverse side.

Reviewed by: [illegible] (Name) County Manager (Title)

/cd
cc: State Clearinghouse

LEAD REGIONAL ORGANIZATION FOR

Camden • Chowan • Currituck • Dare • Gates • Hyde • Pasquotank • Perquimans • Tyrrell • Washington
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Nags Head • Plymouth • Roper • Southern Shores • Winfall

A-95/Form #1 5.

ALBEMARLE COMMISSION
Regional Planning and Development

Post Office Box 646
512 South Church Street
Hertford, North Carolina 27944

TELEPHONE
(919) 426-5753

TO: PROJECT REVIEWER

A-95 CLEARINGHOUSE PROCESS SCH# 83-E-0000-5113

FROM: Stephen E. Davenport, Clearinghouse Coordinator, Region R SED

SUBJECT: Draft EIS- Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

DATE: 2 February, 1983

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RESPONSE: This notification has been reviewed and appropriate response(s) checked below:

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__X__ Applicant has been advised of problem area(s).

_____ Problem has been resolved as of __________ (date).

_____ Problem has not been resolved and respondent requests that Clearinghouse arrange a meeting with the applicant.

COMMENTS:

The disposal of defueled decommissioned nuclear submarines could have a negative impact on the tourist and fishing industries of KDH and Dare County. L.53

For additional comments, use reverse side.

Reviewed by: Ray Sturza (Name) Town Planner (Title)

/cd
cc: State Clearinghouse

LEAD REGIONAL ORGANIZATION FOR

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A-95/Form #1 5/

#35

Neuse River Council of Governments

P.O. Box [illegible] New Bern, N.C. [illegible]

REGIONAL A-95 CLEARINGHOUSE REVIEW STATEMENT

Date: February 16, 1983

SCH # 83-E-5113 Decommissioned Submarine Proposal
Project Title/County

N/A (estimated) N/A
Funds Requested Funding Agency

Please attach this form to your application before submitting it to the funding agency.

Applicant: Dept. of the Navy

Project Description:

The Dept. of the Navy and Dept. of Energy have submitted a Draft Environmental Impact Statement for review regarding the disposal of decommissioned, defueled naval submarine reactor plants by land and sea disposal.

REGIONAL REVIEW OF THIS PROJECT IS COMPLETE. The project has been reviewed by and through the Regional A-95 Clearinghouse with comment(s) as follows: (You should proceed to complete formal application for submission to appropriate agency. This statement and its attachments MUST be attached to your formal application.

( ) 1. Project is consistent with regional and local goals, policies, programs, and fiscal resources and is recommended for further development.

( ) 2. Project is recommended for further development with attached recommendations for strengthening it.

( ) 3. Project is recommended for further development if attached specific and major changes are incorporated into project by funding agency.

(X) 4. Project is not recommended for further development based on attached comments.

( ) 5. Project has been waived from A-95 review.

NOTE TO FUNDING AGENCY:

The review and comments for this project are valid until 2/16/84. If the project is considered for funding after this date, please resubmit the application for an additional 30 day review.

cc: Chrys Baggett

Joshua H. Schypies
Areawide A-95 Clearinghouse Supervisor

[illegible]

A 95 Local Review and Comment Form

INSTRUCTIONS FOR LOCAL REVIEW AGENCIES

A 95 is a procedure for coordinating federally-assisted programs and projects with each other and with state, regional and local plans and programs.
Please review the proposed project in light of its consistency with your governmental unit or agency's goals and activities, and return this card by date shown below or waive your review and comment opportunity.

Project Title: Disposal of Decommissioned Submarines

Date Mailed: 2/2/83 Project No. 83-E-5113

Card to be Returned to NRCOG by This Date 2/15/83
OR Comment is waived

LOCAL COMMENTS

The Notification of Intent to Apply for Assistance or the Application for the above project has been received and we

☐ Find the proposed project consistent with local adopted plans, programs and policies. (Conditions, comments or suggestions are OPTIONAL and may be written below or attached.)

☐ Find the project inconsistent with local adopted plans, programs and policies (reason given below IN WRITING or attached.)

☐ Waive the opportunity for review and comment. (No Comment)

COMMENTS: SEE Attached Letter

Typed Name: HENRY E. DICK Date: 2-10-83

Signature: Henry E. [signature]

Title: County MANAGER (Craven)

Telephone:

Please Complete Above.

#35 (Cont)

L.39

County of Craven

County Manager

Henry E. Dick

1712

February 10, 1983

Mr. Don Eggert
Neuse River Council of Governments
P.O. Box 1717
New Bern, North Carolina 28560

Dear Don:

Craven County is in receipt of your A-95 Review Form for Project No. 83-E-5113, Disposal of Decomissioned Submarines, and make the following observations concerning this proposal.

While this proposal is neither consistent nor inconsistent with any locally adopted plans, programs or policies since there have not been any such programs, plans or policies adopted concerning this type of activity, it is the opinion of Craven County, however, that insufficient information is available concerning any possible long-term negative impacts. As such, it is impossible for the County Commissioners to take a specific position on this proposal.

Based on the above, it is the opinion of Craven County that this proposed project is not consistent with the needs or welfare of Craven County based on information available at this time. I remain,

Sincerely,

Henry E. Dick
County Manager

HED:alf

Enclosure

405 Middle Street New Bern, NC 28560 (919) 637-3338

A 95 Local Review and Comment Form

INSTRUCTIONS FOR LOCAL REVIEW AGENCIES

A 95 is a procedure for coordinating federally-assisted programs and projects with each other and with state, regional and local plans and programs.

Please review the proposed project in light of its consistency with your governmental unit or agency's goals and activities, and return this card by date shown below or waive your review and comment opportunity.

Project Title: Decommissioned Submarine Disposal

Date Mailed: 2/2/83 Project No. 83-E-#113

Card to be Returned to NRCOG by This Date: 2/15/83 OR Comment is waived.

LOCAL COMMENTS

The Notification of Intent to Apply for Assistance or the Application for the above project has been received and we:

☐ **Find the proposed project consistent with local adopted plans, programs and policies. (Conditions, comments or suggestions are OPTIONAL and may be written below or attached.)**

☒ **Find the project inconsistent with local adopted plans, programs and policies (reason given below IN WRITING or attached.)**

☐ **Waive the opportunity for review and comment. (No Comment)**

COMMENTS:

Typed Name: Jim Rickards **Date:** 2/8/83

Signature:

Title: Co. Mgr. (Craven)

Telephone:

Please Complete Above

124

#35 (Cont)

A 95 Local Review and Comment Form

INSTRUCTIONS FOR LOCAL REVIEW AGENCIES

A-95 is a procedure for coordinating federally-assisted programs and projects with each other and with state, regional and local plans and programs

Please review the proposed project in light of its consistency with your governmental unit or agency's goals and activities, and return this card by date shown below or waive your review and comment opportunity

Project Title: Disposal of Decommissioned Submarines

Date Mailed: 2/22/83 **Project No.** 83-E-5113

Card to be Returned to NRCOG by This Date: ________
OR Comment is waived

LOCAL COMMENTS

The Notification of Intent to Apply for Assistance or the Application for the above project has been received and we.

- ☐ Find the proposed project consistent with local adopted plans, programs and policies. (Conditions, comments or suggestions are OPTIONAL and may be written below or attached.)
- ☒ Find the project inconsistent with local adopted plans, programs and policies (reason given below IN WRITING or attached.)
- ☐ Waive the opportunity for review and comment. (No Comment)

L.39 **COMMENTS:** Potential hazards to marine life and environment.

Typed Name: R. G. Leary **Date:** 2-14-83

Signature: R G Leary

Title: County Manager (Onslow)

Telephone: 347-4717

Please Complete Above.

BEFORE THE

UNITED STATES

DEPARTMENT OF THE NAVY

PUBLIC HEARING

ON

DRAFT ENVIRONMENTAL

IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED,

DEFUELED NAVAL SUBMARINE

REACTOR PLANTS

AUDITORIUM

OFFICE BUILDING NO. 2

STATE CAPITOL

OLYMPIA, WASHINGTON

9:00 A.M.

TUESDAY

FEBRUARY 22, 1983

IN ATTENDANCE:

On behalf of the U.S. Department of the Navy:

CAPT EDWARD WAGNER, USN, Hearing Officer
MR. JAMES MANGENO, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program

On behalf of the U.S. Department of Energy:

MR. FRANK STANDERFER, Assistant Manager for Defense and Energy Programs, Richland Operations Office

I N D E X

P R O C E E D I N G S

9:15 a.m.

CAPT WAGNER: Please take your seats. This hearing is called to order.

I am Captain Edward Wagner and I work in the Office of the Deputy Chief of Naval Operations for Submarines.

I have been appointed the Navy's Hearing Officer for this morning's public hearing.

Here with me to present an opening briefing is Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program. Also present is Mr. Frank Standerfer, Assistant Manager for Defense and Energy Programs, Richland Operations Office, Department of Energy.

This public hearing is being held to receive comments on the Navy's Draft Environmental Impact Statement evaluating alternatives for disposal of nuclear-powered submarine reactor plants after the fuel has been removed and the ships are no longer needed.

The Navy has conducted studies on the feasibility of burying the defueled reactor plants in government-owned land disposal sites or placing them on the deep ocean bottom.

On December 22nd, 1982, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, or DEIS, on the disposal of decommissioned, defueled Naval submarine reactor plants. The DEIS contains the results of the Navy's studies of the alternatives available. On the registration table as you entered the auditorium, you will find copies of the Summary of the Draft Environmental Impact Statement. Anyone in the audience who would like a complete copy of the DEIS should leave their name and address on the sheet of paper provided at the registration table and a copy will be mailed to you.

The Navy's Federal Register announcement also scheduled public hearings at various locations which are convenient to people with an interest in this matter in order to provide them with an opportunity to present their views. I am here today to conduct one of these scheduled public hearings. The purpose of this hearing is to take testimony regarding the Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case nor to engage in debate. It is my responsibility to receive statements so that they can be considered in preparing the Final Environmental Impact Statement.

I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established for this hearing. As set forth in the announcement of the hearing, individual speakers are to limit their testimony to five minutes each, and organizational spokesmen are limited to ten minutes, unless additional time had been requested in advance.

Time cannot be relinquished from one speaker to another.

In order to ensure all who desire to speak are given an opportunity, each person should fill out a registration card and provide it to the registration table. All testimony will be recorded so that it can be considered in the development of the Navy's Final Environmental Impact Statement.

If you desire to submit written comments rather than speak, that is acceptable. You can provide written comments to me or leave them at the registration table. If you desire to provide written comments at a later date, my address is as follows: Captain Edward F. Wagner, U.S. Navy, Office of the Chief of Naval Operations, OPNAV-22, Department of the Navy, Washington, D.C., Zip Code 20350.

You should provide your written comments by March 31st, 1983, which as stated in the Federal Register notice is the cutoff date for submitting comments.

Before we begin receiving testimony this morning, I would like to introduce Mr. Mangeno of the Naval Nuclear Propulsion Program who will provide a general overview of the issue the Navy is addressing and the content of the Draft EIS.

Mr. Mangeno.

MR. MANGENO: Today's hearing is being conducted as a part of the decision-making process required by the National Environmental Policy Act. Under this law, the Navy must prepare an environmental impact statement for any action which could have a significant environmental impact or which might be subject to controversy over the environmental effects. The environmental impact statement must include the environmental impacts for all reasonable alternatives.

The Navy's Draft Environmental Impact Statement, or DEIS, on this subject provides the basis for these hearings, and the slides that follow are from the DEIS. It describes the alternate ways the Department of the Navy, in cooperation with the Department of Energy, is considering for permanently disposing of defueled nuclear-powered submarines after they are no longer needed. The practical choices are: bury the radioactive part of the submarine at an existing DOE land disposal facility at the Hanford Site in the State of Washington or the Savannah River Plant in South Carolina; or place the entire submarine on the bottom of the ocean in water more than 2.5 miles deep. In both choices there would be no nuclear fuel left in the submarine because all of it would be removed before disposal. Nevertheless, there would be some low-level radioactive materials left within the submarine.

Preparation of this Draft Environmental Impact Statement does not mean that the Navy has already decided to dispose of nuclear submarines. The Navy currently has about 120 nuclear-powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases,

as shown in this slide, it is evident that a disposal plan must be prepared for use sometime in the future. This DEIS has been prepared now so that all interested agencies, organizations and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

The submarines are constructed with the nuclear power plant enclosed within a single section of the ship called the reactor compartment. This slide shows a typical submarine with the location of the reactor compartment identified.

Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the uranium and all of the fission products. The removed fuel is handled according to established procedures and is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, to the metal structure supporting the fuel, to the reactor vessel and to other equipment in the reactor compartment, where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by the hull of the submarine and by the reactor vessel and coolant piping. In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel, or other metal atoms in the reactor plant. These atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation of the nuclear reactor and the number of curies of each radionuclide at that time. A curie is a measure of the amount of radioactivity present, but it is not an indication of the possible effect on man or animals. The amounts and kinds of radioactive atoms present are described in detail in Chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the Federal Government disposal facilities already used for

such low level radioactive waste at the Hanford Reservation in the State of Washington or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the compartment free from the remainder of the submarine, and weld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal, and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. Other government-owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable waterways so that transportation of the reactor compartment to those sites would be impractical. The Hanford and Savannah River burial grounds are described in Chapter 3.

A transporter of the sort shown in this sketch could then be used to haul the compartment overland to the burial location. There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial, or after burial. This is because radiation outside the compartment would be well below federal limits and the reactor compartment would have been welded shut at the shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low level radioactive wastes. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burials and would result in no significant additional environmental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the body. More than 200 years would pass before the reactor compartment bulkhead could be penetrated by corrosion. Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time, exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean is another practical alternative. The maximum radioactivity would be less than the limit specified by international criteria and the triple containment provided by the submarine reactor compartment, by the reactor

vessel and piping, and by the radioactive atoms being a part of the metal itself would be an extremely strong and effective disposal containment package.

Locations for possible ocean disposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U.S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site-specific public hearings would be required and the permit process is not part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 190 miles west of Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry and marine biology for very deep ocean locations. The depth of the water in these areas is between 4,000 and 5,000 meters, about 13,000 to 16,000 feet. The scientific information and measurements collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that the environmental impacts could be calculated using realistic data.

Preparations for ocean disposal would be made at one of the shipyards normally servicing nuclear-powered naval vessels. Following defueling, the reactor vessel and the reactor compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping, and, of course, the metal itself completely intact. Most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping or free the atoms from the thick metal.

A comparison of the possible effects on the environment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100 submarine disposals for the year of greatest exposure for both options. This table shows that the radiation exposure would be very small and could have little impact on individuals or the population. These levels are also many times less than any limits established by U.S. regulations or international limits. They are much smaller than the normal fluctuations in annual average background radiation exposure for U.S. residents.

A perspective on radiation exposure can be gained by

examining the exposure a person would receive from natural cosmic background radiation if he flew round-trip from New York City to Los Angeles. That person would receive approximately two millirems more radiation than if he had not made the trip because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one-half millirem.

Other environmental impacts are similarly small for both options. The effects on animal life would be small and localized in either case. Land burial of 100 reactor plants would require only about ten acres of land and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square ten miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land disposal would cost about 40 percent more, about two million dollars per submarine more, than sea disposal.

The "no-action" alternative is to place submarines in floating protective storage for an extended period, commonly called mothballing. However, this would only temporarily delay disposal because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods and the estimated radiation exposure for the general public would be very small for all available courses of action.

Thank you.

CAPT WAGNER: Thank you, Mr. Mangeno.

Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing. I will now recess briefly to establish an order for persons who wish to provide testimony. For those people who would like to testify and have not yet registered, you may do so at this time.

We will recess the hearing and reconvene in five minutes and commence testimony at 9:40.

(Short recess.)

CAPT WAGNER: Ladies and gentlemen, if you would please resume your seats, we will reconvene the hearing.

Simply to establish an order for the statements, I intend to ask individuals representing state government organizations to speak first, in alphabetical order of the speakers' last names; followed by individuals representing local government organizations, in alphabetical order by last name of the speakers; and then private organizations; and finally private citizens, also in alphabetical order by last name of the speaker.

I request your cooperation in providing comments within the time limit so that we may be certain all who wish to speak have an opportunity to do so. Once again, that is five minutes for individuals and ten minutes for organizational spokesmen. If your statement is longer than that and it cannot be given in the time allotted, you may summarize in the five or ten minutes and the entire statement will be included in the record if you submit it in writing.

The procedure for public testimony will be as follows. I will announce each registered speaker. When called, proceed to the microphone here in front of me, in the front of the auditorium, and state your name and organization, if any. And even though I announce your name first, please state your name so that our recorder gets that properly for the record.

For those of you who have already registered and you know you are going to be speaking, I encourage you to come down to the front couple of rows here that are reserved for you so we minimize the time coming and going to the microphone.

All comments are to be addressed to me, please.

Our first registered speaker is Ms. Anne Bringloe from Bainbridge Island, Washington. Ms. Bringloe is representing the Sierra Club.

VOICE: Sir?

CAPT WAGNER: Yes.

VOICE: Did you just state that government organizations would go first?

CAPT WAGNER: Yes, if we have government organizations.

VOICE: There are no government organizations?

CAPT WAGNER: I have none registered.

Is Ms. Bringloe here?

#36

MS. ANNE BRINGLOE: Thank you. My name is Anne Bringloe. I am the Conservation Chairman for the Cascade Chapter of the Sierra Club, which is essentially the State of Washington. We have approximately 6,000 members, whose main concern is protecting our environment and using it in a responsible fashion.

The Sierra Club is concerned about several points in the EIS. I think that the main idea that I would like to present is that there is a gamble in assuming that nuclide decay in the reactor compartment will coincide with corrosion rates in the material surrounding the reactor. L.20

Now, if everyone has studied the EIS, they will see that there is some information about the presumed corrosion rates. What we are concerned with is that because of the ionizing radiation's effects on materials such as surround these reactor compartments, the schedule that the Navy EIS suggests may not in fact be what actually happens. If in fact the schedule suggested is different in reality, we may find Q.13

dangerous materials entering the ocean environment much sooner than thought.

Disposing of submarines in the ocean, although it appears to be the most cost-effective plan, it is the embodiment of the idea of dump something and forget about it, because there is not much opportunity for monitoring what is happening after these submarines are disposed of in the ocean. J.76

The Sierra Club would prefer that an option is selected that would make available monitoring. We do not think that disposal in the ocean is the proper choice.

We would hope that the Navy would investigate dry land disposal at some site, not necessarily the Hanford site. The possibility of dry land disposal in a desert environment would hope to be an alternative to ocean dumping. And if the corrosion problem could be minimized by covering of these reactor bodies, it is assumed that it would be a safer substitute. The reactor compartments could be monitored and there would always be the option to dispose of them in some other manner at a future time.

We hope that the Section of the EIS dealing with land burial will be updated and improved and expanded and that this option of land disposal with its monitoring possibilities will be more thoroughly considered.

And I would like to state again that we feel that dumping in the ocean with no possibility of monitoring and no J.76 W.1

possibility of retrieval is not the responsible thing to do in this case. If the Navy cannot come up with a more responsible method for disposing of submarines, perhaps they could consider their submarine building program and really understand the costs of building these submarines when the disposal costs, the real cost to the environment, are added in.

Thank you.

CAPT WAGNER: Thank you, Ms. Bringloe.

The next registered speaker is Dr. Michael J. Herz from San Francisco, California. Dr. Herz is representing the Oceanic Society.

*#37

DR. MICHAEL J. HERZ: Thank you. My name is Dr. Michael J. Herz, Executive Vice President of the Oceanic Society, a 60,000 member non-profit organization devoted to protection of the marine environment. The Society has headquarters in San Francisco and Stamford, Connecticut, and has active chapters along both coasts.

*N.15

Before I begin my testimony, I really must protest the manner in which you public noticed incorrectly this hearing, with no attempt to correct the location. There should have been signs set up in order to have people who went to the first building so that they would find this building correctly. A number of people have gone to the wrong location. There has been no information there. I similarly find that the address listed in the Federal Register announcement for the San

Francisco hearing is incorrect, as well. I would hope that there would be an attempt made to correct in advance that information so people don't have to go to the trouble of wasting a half hour finding the correct hearing place. It just is wrong.

The Oceanic Society is concerned overall with the issue of nuclear waste disposal in the oceans. Although we view with alarm the possibility of the Navy disposing a hundred nuclear submarines in the ocean, it's as much because of the precedent setting nature of this action as it is because of our concern over the potential impact of 6.2 million curies of radioactivity that would ultimately be added to the oceans if these subs are disposed there. L.9

It should be noted that in addition to the Navy's reactor disposal program, the Department of Energy has spent approximately 20 million dollars since 1976 to investigate the use of the seabed off Hawaii as a disposal site for high level nuclear waste. Fuel rods from nuclear power plants. In addition, the Department of Energy is also considering the ocean alternative for the disposal of nuclear waste from the Manhattan Project that produced the first atomic bomb. I should note here too that the so-called FUSRAP Program, the formerly utilized sites remedial action program that is going on right now, was in the Federal Register on February 1st with the hearings being held at the Niagara Falls site on the end L.9

*Other issues discussed by Dr. Herz are side barred in Exhibits 37a, 37b, and 37c.

of last week, hearings being held in Niagara, scoping hearings at the same time as your hearings were being held on the submarine program, at the same time as the London Dumping Convention was meeting. We feel that that is unfortunate because there are a limited number of people in this country who are available to critique these programs and to evaluate the science involved in them, and to have three sets of things happening at the same time is, to say the least, extremely unfortunate because there should be an opportunity for those qualified to comment on these government programs to attend all of the hearings.

The comment period on this Department of Energy Program closes the 25th, the day after the San Francisco hearings on the submarine, making it extremely difficult for people concerned and organizations concerned to track these issues.

Our role, the Oceanic Society's role in evaluating the potential impact of the proposed activities on the marine environment and on land, is to assess science and technology that are presented in support of such proposals. In early February the Oceanic Society convened a scientific committee made up of experts from a variety of disciplines to review the adequacy of the Navy's DEIS and the supporting oceanographic studies. The points raised in the testimony that follows are based on the conclusions from the committee's deliberations.

First of all, it was the committee's conclusion that

the Navy's Draft Environmental Impact Statement is one of the poorest environmental documents any of those committee members had ever reviewed. It is filled with significant information gaps and technical deficiencies and raises a great many issues requiring much additional information. These will be considered and discussed below. But by and large the document reflects poor scholarship, as demonstrated by its author's failure to consider large bodies of pertinent information regarding a number of issues and by the use of old information when significant new information was readily available.

In addition, the DEIS and its oceanographic support documents indicate -- review of it indicates that there are numerous internal inconsistencies, places where the summary of the DEIS misrepresents data presented in the body of the DEIS, and the DEIS and oceanographic studies misrepresent information -- or the summary of the oceanographic study misrepresents information from the total body of the studies. J.21

The most serious deficiencies, though, have to do with the DEIS's consideration of the ocean disposal alternative and the way in which it considers the availability of radioactivity and the possible pathways through which radioactivity might reach humans. The issues that were not addressed or inadequately presented include the following.

First, we feel that there is much additional information required to fully assess the significance of the CRUD

A.12 A.11 J.64 J.34

deposits in the reactor cooling system. The CRUD are the deposits that form on the inside of the cooling pipes because radioactive water has flowed through the cooling system of the reactor. Data from CRUD collected at land-based reactors suggests that this may be one of the most serious sources of radioactivity which can easily become available to the marine environment. Further data on Alpha emitters and CRUD from wrecked and decommissioned nuclear subs is needed. Missing details on sampling sites relative to the location of the reactors from the Thresher and Scorpion accidents makes it impossible to evaluate the Navy's claim that such subs pose no threats to the marine environment or to humans. Sediment, water and organism samples should also be collected from the site of the Soviet sub which the U.S. Government attempted to raise with the Glomar Explorer.

Q.13

We are also concerned because we feel that the projections in the DEIS fail to take into consideration the possibility of galvanic effects, the manner and rate of corrosion at external weld locations and the manner in which the lattice breakdown in the radiated stainless steel will affect corrosion. I might also add the interactions of pressure, the high temperature that the reactors have been subjected to, and the great depths at which disposal would take place do not appear to have been adequately considered in the DEIS.

L.36

Of greatest concern with any disposal alternatives are the potential pathways in which radioactivity might reach

U.9 U.5 L.35

humans. There exists a significant body of literature concerning the migration of radionuclides from waste forms to the water column sediments and to organisms that appears to have been totally ignored in the preparation of the DEIS. The pathway issues that have not been adequately addressed include, first, the studies conducted by the Environmental Protection Agency and others demonstrating possible pathways such as benthic organisms to rattail fish which should serve as a warning that other pathways exist and further investigations are warranted.

L.6

It should be pointed out here that in the late '70s the Environmental Protection Agency collected a great deal of data at the low-level dump sites off of San Francisco at the Farallon Islands and from the Hudson Canyons right off of the East Coast. There were some 13 studies that were released by the EPA in October of 1980 following a great deal of pressure that was applied by a congressional oversight committee. And in fact the strongest of these studies, the one that shows the best evidence of transport from the waste drums into the bottom -- into benthic organisms that live on the bottom and from thence into fish, has not yet been released by the Environmental Protection Agency. None of these were referred to in the DEIS and I cannot understand why.

L.55

Also not considered was the artificial reef effect which has not been investigated in the deep ocean at all, but

L.55 the settling by marine organisms on the subs appears likely and should be investigated, particularly in terms of how it might serve as a pathway in an accident scenario, both at the disposal site or on the continental shelf.

Q.12 Also there was failure to consider the possible role of bacteria in the mobilization of radionuclides. L.57 There also is the feeling that the potential effects of accidents have not been adequately addressed. The Navy estimates .1 accidents per hundred subs scuttled at sea. Because this is a, quote, reasonable probability, unquote, the potential impact of such L.61 an accident on the continental shelf from both an intact sub and from an exposed reactor compartment should be discussed in detail, especially in terms of possible exposure levels of three rems to a population of 30,000 people. A determination on whether this is an acceptable exposure rate should be provided in the DEIS.

U.21 There was feeling by our committee that the worst case calculations in the DEIS are confused and appear to be off by as much as nine orders of magnitude. U.19 Further, the use of EPA standards for drinking water seem to us to be misleading and inappropriate, especially since the correct calculation using the Navy's own data, come to within .1 of that standard.

J.12 The data presented in the DEIS on albacore catches in the vicinity of the proposed Mendocino site are based on 13- to 23-year old information, while more current available

data readily available from the same source, that is, Scripp's Institute of Oceanography, suggest a much more significant fishery in that area. J.9 In addition, there is no information presented on catches on the East Coast, near the East Coast sites.

R.24 There is a lack of consistency throughout the DEIS in terms of worst case and average case scenarios. In order to make discussions of exposure overdoses resulting from accidents a uniform approach to terminology and calculations should be adopted in order to make presentations meaningful.

S.25 A very serious deficiency as perceived by our committee throughout the DEIS is the fact that none of the measurements presented are accompanied by error terms, making it impossible to determine the level of precision or the range or variability of the data presented.

J.9 Although the DEIS states that the location for possible ocean disposal has not been selected, the stated site selection standard suggests that at least the lower continental rise area and possibly the Hatteras abyssal plain area, as well, might be eliminated based on data presented in the oceanographic studies, Volume 2. J.2 It should also be noted that the Cape Hatteras site is outside the U.S. economic zone, outside the 200-mile area, and therefore, I think, will probably not be able to be considered as a dump site.

In addition, through talking with the principal

J.2 investigators at Oregon State University who did the site selection for the generic sites on the West Coast, it appears unlikely that any locations other than the Cape Mendocino area could be found on the West Coast that meet the required selection criteria. J.9 Obviously, if the ocean alternative is chosen, more site-specific data will be required before an evaluation can be made, J.2 but it certainly appears from all the information available that the sites are going to be within the generic sites, and to say that the sites have not been selected, I think, is not totally accurate.

As presented in the DEIS, the monitoring plans for either land or ocean alternatives are inadequate. I.13 With the land alternative the assumption is made that monitoring will be conducted as part of the current and continuing programs at Hanford or Savannah River sites. However, the cost of monitoring is not reflected in estimates presented. There are no cost breakdowns, at least. The sea disposal monitoring presentation is also clearly inadequate, based on inadequate record keeping and the failure of the U.S. Government to conduct any but the most rudimentary monitoring or research at L.6 any of the ocean sites used for disposal of nearly 100,000 curies of waste during the 1946 to '70 period, the program and site documentation must be included as part of the DEIS.

Although the document doesn't contain a cost breakdown, the total amount listed for monitoring appears totally

J.76 inadequate. The committee, our committee, felt that without an adequate monitoring program being presented in the DEIS, the sea disposal option shouldn't receive any further consideration.

W.1 By far the most serious problem with the sea disposal alternative, though, as presented in the DEIS is that F.2 once scuttled the submarines are, by the Navy's admission, irretrievable. Indeed, the Anderson amendment, recently signed into law by the President, requires that radioactive wastes disposed of in the ocean must be retrievable.

Because there are significantly more gaps, deficiencies, unanswered questions and uncertainties regarding the sea disposal alternative, the Oceanic Society's committee concluded, based on the existing information, that a land disposal option is far preferable. Land disposal would minimize corrosion, the principal mechanism producing available radioactivity, and would greatly simplify the monitoring process.

I should point out that the suggestion that was just made or put forth by one of the members of our committee, Dr. Ruth Weiner, who will be testifying following me, but it was her suggestion and it was not considered in the DEIS that the solution, the alternative that would end up with the least amount of radioactivity becoming available to the environment, would be in these reactor compartments on dry land in an arid environment and totally reducing the corrosion to an absolute minimum.

Thank you.

CAPT WAGNER: Thank you, Dr. Herz.

The next registered speaker is Mr. James Puckett from Seattle, Washington, representing Greenpeace.

#38

MR. JAMES PUCKETT: I'm Jim Puckett with Greenpeace Northwest.

Included in the record here today will be technical analyses of data and conclusions. But there are some fundamental questions often lost in technical discussions that deserve full attention.

I would like to focus on the big picture, the political and moral implications of radioactive waste dumping at sea. I testify here on behalf of Greenpeace Northwest as campaign coordinator for the issue of ocean dumping.

Greenpeace is an international environmental organization whose sole purpose is long-range protection of the biosphere, a thin fragile shell around our globe on which all life, present and future, must depend. Seventy-one percent of of this living surface consists of ocean, the womb of all organisms and the great provider of protein for much of the world's human population. About human beings and the ocean, Jacques Cousteau has said, "Each one of the cells in our bodies is a miniature ocean. Poisoning the sea will inevitably poison us."

Greenpeace has long stood for the protection of the

ocean environment. Our continuing success with international treaty organizations such as the International Whaling Commission and efforts to prevent the extermination of marine species is well documented and accounts for our 250,000 members in this country and over a million members worldwide. Greenpeace has become famous for the protection of marine mammals, organisms at the top of the oceanic food chain. It is an obvious step for us to be concerned with the entire food chain of the sea within which we humans are inextricably bound.

Greenpeace opposes all ocean disposal of radioactive wastes. We oppose the U.S. Navy's most recent plans to dispose of over a hundred decommissioned radioactive submarines by sinking them in United States coastal waters. We oppose the United States Environmental Protection Agency's recent advocacy role on the international question of radioactive waste dumping at sea. Opposing all these things, be reminded, we are simply proponents of life and health. The sea disposal of a single submarine cannot be viewed as insignificant. The 25 years of radioactive dumping practiced in this country already represents 95,000 curies of radiation. A single nuclear submarine, minus the core, represents 50,000 curies of radiation from at least 16 different isotopes. But apart from the damage these isotopes would create, apart from the multitude of unanswered questions, crucial to consideration

F.8

of scuttling a single submarine, we are especially concerned over the insidious precedent that would be created by the resumption of U.S. ocean dumping of nuclear waste. Following only the dictates of economy and convenience, the Navy would like to reverse our 13-year defacto dumping ban. If approved, the tyranny of this small decision viewed in a historical perspective could oppress us for a long time to come. Consider the enormous quantities of high-level and low-level radioactive wastes created in this country each year. Hanford Nuclear Reservation last year alone accepted 50,000 cubic meters of radioactive waste. Could the EPA, or anyone, justify granting the Navy dumping permits while disallowing all the other nuclear waste generators? When one considers the entire nuclear world, we are talking about a multiplication of the Navy's Environmental Impact Statement that will make this plant's vast ocean resources look suddenly very small.

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Worldwide concern over widespread ocean dumping was demonstrated last week when the London Dumping Convention, an international treaty organization, voted 19 to 6 to outlaw the ocean dumping of radioactive waste. The United States, represented by Reagan's EPA, was, in a major policy shift, part of the minority that attempted to block a moratorium. Since January 1st, by a vote of Congress, it is now illegal to dump radioactive waste in U.S. coastal waters. In light of this

fact, Greenpeace seriously questions legality of the EPA in presenting a policy in the international forum that is a direct contradiction of U.S. law. There is good reason to believe that the Navy's sub disposal option was the real hand that voted in London, as it is the only formal proposal, as yet drafted, that would reverse current U.S. practices. The EPA-Navy connection is made more obvious when we follow the career of Glenn Sjoblom, one of the authors of the Draft Environmental Impact Statement we are reviewing today. Glenn Sjoblom, formerly a Navy employee, is now in charge of the department of the EPA that would approve or deny the Navy's dumping permit application under the Marine Protection, Research and Sanctuaries Act. This appears to be more than a conflict of interest involving Mr. Sjoblom, but rather a blatant conflict of interest within the EPA itself which it seems has hired another fox to guard another hen house.

If the Environmental Protection Agency does ignore the London Dumping Convention's moratorium, if the Navy is granted permission to eventually dump over a hundred radioactive submarines, in the eyes of the world the United States will not only be cast as one of the small band of agressive, irresponsible nuclear nations, but as a world leader could be a deplorable yet influential example, opening the doors to other economically competitive nations to act irresponsibly. Countries like Japan, Belgium and South Africa are now watching

F.8 the U.S. closely to see if we intend to ignore and belittle what is now international law.

Although the Navy acknowledges the presence of at least 16 different radionuclides in the irradiated vessels slated for disposal, the Department's reports consistently refer to a single isotope, Cobalt 60, half-life 5.26 years. L.46 Often overlooked are the isotopes Niobium 94 with a half-life of 20,000 years, Nickel 59 with a half-life of 80,000 years, or Technetium 99 with its half-life of 212,000 years. All of these are also radioactive ingredients of decommissioned nuclear submarines that will remain active for hundreds of thousands of years.

The submarines, once dumped, would be irretrievable. W.1 Repeated attempts by both the EPA and the Navy have failed to locate the hulk of the only nuclear submarine deliberately scuttled to date. The Sea Wolf was dumped off the coast of J.85 New Jersey in 1959. Recently, after repeated dives with a research submersible, EPA personnel called off the search for the missing Sea Wolf. The still radioactive submarine could not be found. Ocean dumping of radioactive wastes must be W.1 considered permanent disposal.

If later studies indicate that radioactivity is entering the food chain in significant quantities, there will be nothing we can do. No amount of future monitoring to which the EPA would be committed could reverse the poisoning. The

ocean, once contaminated, could not be cleaned up.

In their Draft Environmental Impact Statement, the authors attempt to make light of the effects of low-level radiation. They define the unit of millirems in terms of the energy required to lift mosquitoes one centimeter. Or the energy necessary to raise body heat two billionths of a degree X.1 centigrade. I would like to remind all present that what we are concerned with today is the manner in which radioactive energy wreaks havoc within living cells and bio-accumulates in the food chain. We are not losing sleep over the possibilities of being crushed by mosquitoes or slowly parboiled.

There has never been a determination of the truly safe level of radioactivity. The standards of yesterday are now considered unsafe and as the long-term cancer statistics are tabulated, experts such as Lowen Mendelsohn of Lawrence-Livermore Laboratories are again questioning the radiation dose limit standards. As the likelihood of exposure to multiple sources of additional radioactivity continue to multiply, L.7 it will become increasingly important for all individuals to avoid all sources of radioactivity that would increase exposure to above-normal background levels. Bio-accumulation, L.36 the process by which radioactive elements are concentrated as they move up the food chain, has been well documented since L.37 the 1950s. And recent investigations by Dr. William Schell,

U.9

contracted by the EPA, have already revealed alarming evidence of radionuclide migration from past ocean dump sites into edible fish. So given that the radionuclides within a decommissioned nuclear submarine will be active for thousands of years, given that the submarines, once dumped, would be irretrievable, and given that the cumulative biological dangers are known but not fully understood, how can we, as part of the human race responsible for creating this dilemma, knowingly pass on to countless future generations the lethal legacies of irreversible radioactive contamination of the biosphere? We today are grossly outnumbered by those of the future. We simply do not have the right under any system of ethics to make such a decision.

G.7

Therefore, Greenpeace requests, first, that we never again dump nuclear waste at sea. We propose that the Navy continue to maintain the irradiated submarines in protective storage in naval shipyards for 25 to 50 years which according to Dr. Marvin Resnikof of the Council of Economic Priorities would be the proper time to allow for the early decay of the short-lived radionuclides. In support of this recommendation I quote from the DEIS. Nuclear submarines can be placed into storage for a long time without risk to the environment. Questions we must ask ourselves after that time to assess the best land disposal options include, are there any unforeseen land disposal alternatives? Recognizing that shipment is the

E.23

weakest link in the land disposal process, subject to accidents and public exposure, what is the shortest, safest route in that all river shipments must traverse deep salt water and run the risk of towing losses, preference must be given to an all land shipment, if feasible. We do not wish to see a precedent of rivers such as the Columbia becoming nuclear highways.

H.3

The subs should be stored in an area with a minimal corrosive environment and adequately monitored. Finally, Greenpeace opposes any water shipment of spent fuel or high-level radiation products. If, after 25 to 50 years, water transport of submarines proves to be the safest method of transport, may this never be interpreted as an endorsement of water shipment of high-level radiation products.

In closing, I would like to quote from Admiral Hyman Rickover, father of the nuclear navy, who recently made the following statement. "Until about two billion years ago it was impossible to have any life on earth. That is, there was so much radiation on earth you couldn't have any life, fish, or anything. Gradually, about two billion years ago the amount of radiation on this planet and probably in the entire system reduced and made it possible for some form of life to begin. It started in the seas, I understand. Now when we go back to using nuclear power we are creating something that nature tried to destroy to make life possible. And I think the human race is going to wreck itself. Therefore, it is important that we get control of this horrible force and try to eliminate it."

Today, we are creating radioactivity, not eliminating it. It is of utmost importance that we, in this uncertain age, act with caution and take seriously our responsibility for handling the threat of radioactivity. By setting a short-sighted international example and precedent, the Navy's plans could send large amounts of lethal radiation back to the sea, the cradle of evolution. If accepted, the Navy's plans to sink their troubles could sink us all.

Thank you.

CAPT WAGNER: Thank you, Mr. Puckett.

Our next registered speaker is Dr. Ruth Weiner from Seattle, Washington, representing the Sierra Club.

#39

DR. RUTH WEINER: I'm Ruth Weiner, I live at 6837 51st Avenue, Northeast, Seattle. I am currently a visiting professor in the Program for Social Management Technology at the University of Washington. And I am here representing the Washington Environmental Council, a statewide organization of approximately 1,100 members at large and 80 organizations. I am chairman of their Radioactive Waste Committee. And the Cascade Chapter of Sierra Club, I am the chair of the Cascade Chapter.

In general we support the position of the Oceanic Society of America and I would like to add a few perspectives to the statements made by Dr. Michael Herz. I would also like

to second Dr. Herz's objection to the foul-up in the place where the hearing was. I was told several times the hearing was in the General Administration Building. The least you could have done was to put signs on the door saying it is not in the General Administration Building. And the fact that the same problem will doubtless occur in San Francisco -- in fact, I have one thing to add. I'm not sure why you are having this hearing in Olympia. It is the state capitol but there is a federal facility in Seattle where plenty of federal hearings are held. If you are going to have it on-site, you should have it in Bremerton, that's where the submarines are. The reason for putting this 60 miles from the population center, forcing people who are interested, many people who are interested, to drive here if they can get here, I just don't understand. N.15*

The Navy has considered three options for disposal of the decommissioned reactor plants. Deep ocean disposal at 4,000 meters, land burial on the low level waste site at Hanford or Savannah River, and leaving the subs moored where they are essentially, or in protective storage.

The nuclides which are of absolutely major concern in this disposal venture, because of the combination of half-life and the amount that each submarine produces are, of course, Cobalt 60, Nickel 63 which has a half-life of 92 years, Iron 55, those three because there is more than 18,000 curies per

*Other issues discussed by Dr. Weiner are side barred in Exhibit 39a.

sub. Nickel 59 and Carbon 14, the last is clearly of concern because it is extremely labile in the environment.

For a hundred submarines, I would like to point out that that is 220,000 curies of Cobalt 60 alone. A curie is a great deal of radioactivity. A curie is 37 billion disintegrations per second. The table from which I have taken these numbers, Table 1.1, goes on to list those nuclides present in less abundance. But even one ten-thousandth of a curie is a lot. You are putting a great deal of radioactive maaterial wherever you put it.

In suggesting ocean disposal the Navy is taking a calculated gamble that the nuclides will have decayed sufficiently by the time the material of the reactor compartment has corroded and sort of dispersed and found its way into the food chain. And by the time that happens you would then no longer have radioactive nuclides. For the nuclides listed above, in particular for Carbon 14, the gamble is that they will never reach the food chain at all. As the Oceanic Society statement has pointed out, combined uncertainties in corrosion rates and dispersion rates make this gamble something much less than an educated guess. Ionizing radiation is known to damage crystal and glass structures. I might add parenthetically that 20 years ago I did my doctoral dissertation on damage to single crystals from ionizing radiation and in particular using Cobalt 60 as a source. So that is not new information. Moreover, the accumulated CRUD in the reactor plants

is just about ignored in the DEIS. The material is far more labile in the environment than the metal of the reactor plant itself.

The Oceanic Society statement points out the uncertainties in the Thresher and Scorpion data. It is also unclear why data from the Glomar Explorer attempt to raise the Russian submarine was not included. This last provides a real case of radioactive material in a submarine in the marine environment. It differs from the Thresher and Scorpion data in that we know where the Russian submarine is. If you look at the data from Thresher and Scorpion in the DEIS, there is only a vague idea of whether they are there at all.

In sum, the marine environment is exceedingly corrosive. Eventual corrosion and dispersion, as the Navy has pointed out, are a certainty, and will in some fashion contribute to the radioactive loading of the ocean. Disposal in the ocean is the alternative with the most uncertain future. Moreover, retrievability is out of the question and monitoring poses enormous problems. The DEIS fails to consider the cumulative effects of old ocean dumps, the FUSRAP program as was mentioned by Dr. Herz, ocean dumping now done or contemplated by other nations. It can be argued that you are dealing with a very large volume in the Atlantic and Pacific Oceans but it can also be argued that we are talking about hundreds and even thousands of years. The comparisons which the DEIS does make to other processes that put radioactive material into the

L.29

environment are often spurious. For example, Table 4-7 of the DEIS compares activity from the reactor plants with activity naturally washed by rivers into the ocean. How natural that process can now be said to be, considering current uranium and coal mining activity, is anybody's guess, of course. But even if it is, this is an apples and oranges comparison. Uranium-234 and 238 and Thorium-232 are compared in the table with Nickel-63, Nickel-59 and Carbon-14. The chemical and biochemical behaviors of the latter three nuclides is completely different from that of the former. This is just another one of those spurious comparisons that we see in all environmental impact statements regarding radioactive waste that you can summarize by saying you are always being told it is no more radioactivity than you are exposed to naturally. It is different. It may not be more or less, that is not the point.

U.6

I would like to make a comment aside now. When are we going to get away, now that we have lots and lots of different radionuclides, from simply considering total activity. The chemical behavior of the radionuclides is the key factor in whether they are incorporated into the human food chain, where they go in the human food chain, what happens to them chemically, what happens to them physically, and so on. We cannot continue to lump uranium with nickel, with carbon, with tritium and hope that we are going to make any sense at all. I didn't really expect the Navy to step out in front on this

and use a specific activity approach in the study of radionuclides but I would hope at some point we could at least get away from this kind of comparison and consider how nuclides that are put into the environment by any given process, these particular nuclides compare with their presence in the natural environment, other things with similar chemical behavior, and so on.

There is not nearly an adequate data base for the costs represented. The Oceanic Society has commented on the costs of marine disposal. I question the cost estimates of the land disposal option, as well, by the way, as other features of the discussion of the land burial option. In particular, the discussion of the Hanford site. The Navy's assessment of that site is based on a 1975 environmental study. At that time the commercial low-level waste site, which I suppose is adjacent to the Department of Energy site that is discussed in the DEIS, was receiving 1,000 cubic meters a year. In 1976 the rate of burial began to increase exponentially and today the rate of burial at the commercial site is about 50,000 cubic meters a year. And it is still going up. Hanford is the only unlimited commercial low-level radioactive waste site in the United States today. Hopefully, by 1986 when the Federal Low-Level Waste Act of 1980 really begins to take effect, the amounts coming to Hanford will be limited by compact but they are not limited now. There are several bills currently pending in the State Legislature, one of which asks for an updated environmental study considering the environmental impact of the current waste storage practices at Hanford, what has gone on between 1976 and now. In addition, of course, the basalt underlying the Hanford site are being considered and are a very good candidate for the first high-level radioactive waste disposal site in the United States. We have just learned that there is a high-level site at Hanford that is leaking 200,000 gallons a day of radioactive liquid and that this has been going on for years. The environmental conditions have changed since 1975, they are changing all the time, and in an environmental impact statement those conditions must be considered as nearly as they can be assessed at the present time. You can't keep on assessing them but you can at least do it now. I might point out with this regard that there is no comprehensive detailed discussion of what kind of continuing monitoring there would be on the Hanford site if that were in fact used as a land burial site.

The estimated costs of land burial are so vaguely addressed that it is impossible to judge whether recent activities have been taken into account or not. The state, for example, now charges a 30 percent burial tax, if you will, on commercial sites. I don't know whether there will be any negotiation with the Federal Government over the submarines or not. Transportation accidents are not adequately addressed.

The Columbia River bar at Astoria is a notorious navigational hazard and an accident in the Columbia could bring radioactive material at least from the CRUD into the food chain immediately. We still fish in the Columbia River.

Section 3, Page B-4, which purports to consider other land burial sites, is particularly vague and sloppy. The sites are barely mentioned and receive no serious consideration at all. Hanford and Savannah River, as usual, are considered because they are already being used as low-level waste sites, or because they are or have ever been particularly suited for that purpose. We keep talking about Hanford as a site because Hanford was the federal reservation that was established during the war, during World War II, and people started storing radioactive waste there. There has never been a study that says Hanford is better or worse than many, many other sites with the same geographic, topographic, geologic and meteorological characteristics.

The Navy has failed to consider, finally, an obvious and quite sensible alternative, disposal above ground in a desert. The Federal Government owns plenty of such land besides Hanford in military reservations: China Lake is one example. The Nevada test site and Alamogordo are two other possibilities. Above ground disposal, possibly covering the plants with plastic sheets that we worry are going to last hundreds of years anyway, in a region of less than eight inches of rainfall a year would minimize corrosion. In this particular instance, we are not dealing with the sort of low level waste that is normally dumped into the Hanford commercial site. This is not material that if you don't bury it and cover it and put it in drums is just going to disperse. This is material, most of which, except the CRUD, will be released by corrosion. So you look at the alternative that gives you the lowest corrosion rate. Above ground storage poses the best situation for both monitoring and retrieval. We are not making an argument for this option at the present time but it must be considered as an alternative in the EIS. Savannah River, I might point out, is clearly not suitable for such an option. And sites in addition to Hanford must also be considered. Also, those sites must be considered from the point of view of transportation difficulties in getting there. I would like to echo Mr. Puckett's statement that we would rather not see the Columbia River become a highway for radioactive waste, although in some senses it already is.

It is easy for environmental groups in other coastal states to make a strong argument against the ocean disposal option and not address land burial. This is not easy or even possible for residents of Washington or South Carolina. The Navy is telling us in Washington that if the reactor plants don't go into the ocean they will go to Hanford, thus leaving us with a Hobson's choice. However, we recognize that reactor

plants must be dealt with and our recommendation on the Environmental Impact Statement is two-fold:

First, revise, update, improve and expand the section of the EIS dealing with land burial, and correct the inadequacies in the current DEIS.

Second, add a thorough discussion and investigation of the above-ground disposal option.

And, I might add, third, once that has been done then I think a second series of public hearings should be held to discuss this option, since it wasn't even addressed.

We support the Oceanic Society's position. We would also like to see the Navy consider its future submarine construction program in the light of the difficulty of disposing of the decommissioned plants.

And, finally, I would like to point out that we do in fact recognize that something has to be done with this material. For my organization, and for myself, I really don't see much point in protected storage for another 50 years. This is a situation where if the short half-life stuff decays it is not going to be corroded out by then anyway. I can't see any other option being made scientifically available over the next 50 years and it is probably going to take some time to work out the actual option, in any case. There is no point in leaving these things in a corrosive environment which the marine environment is. And there really is a point in strongly questioning how many more of them we are going to end up with, anyway.

Thank you, very much.

CAPT WAGNER: Thank you, Dr. Weiner.

I have no further registrations for people representing organizations. Is there anyone registered representing organizations whose name I have not called?

(No response.)

CAPT WAGNER: At this time we will proceed to testimony by individuals. Again, let me stress, please stay within the five minute time limit so everybody has an opportunity to speak.

In order to save some time from people walking back and forth, I am going to announce three individuals at a time. When your name is called, please come forward, have a seat close to the microphone, and then I will announce each speaker to come to the microphone, so we will have three at a time kind of moving in, so that we can give everybody a chance to speak.

The first three individual speakers, then, will be Ms. Kay Bollinger, Mr. Richard Fabry, Mr. Cricket Feringer.

The first of the three, again, Ms. Kay Bollinger, from Seattle, Washington.

#40

MS. KAY BOLLINGER: Hello, I am Iron-55. I have a half-life of 2.6 years. I am easily absorbed into the marine plants and from there into fish. I expect there will be a lot

L.14

of fish and plants around the sunken submarine because any large object in the ocean creates an artificial reef to which organisms are attracted. L.55

CAPT WAGNER: Thank you, Ms. Bollinger.

#41

Mr. Richard Fabry of Seattle, Washington.

MR. RICHARD FABRY: Hi. I am Technetium-99. Talk about long life. My half-life is 212,000 years. Do you know how long 212,000 years is? If people are still around by the time I die out, it won't be thanks to me. I am radioactive and I intend to stay that way (laughing).

CAPT WAGNER: Mr. Cricket Feringer from Seattle, Washington.

#42

MR. CRICKET FERINGER: Today I am also representing Niobium-94. I have a half-life of 20,300 years. According to the recent work of Dr. Marvin Resnikof my presence has been underestimated by a factor of 100. My persistent characteristics will enable me to outlive the reactor chamber. When the corrosive powers of the sea cause the sub's metal to rust away, then my time will begin. I will escape and find a clear pathway through the marine environment into the oceanic food chain. Thank goodness the Navy is not thinking ahead. Their short-sighted thinking will allow me to carry out my long life and demonstrate my destructive potential.

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L.36

CAPT WAGNER: Thank you, Mr. Feringer.

The next three speakers will be Mr. Pete Hayes and

Mr. Harold Hoey and then Mr. John Hylinger. First, Mr. Pete Hayes from Olympia, Washington.

#43

L.36

MR. PETE HAYES: I don't have a lot to say other than the fact that I am really distressed by the proposal. I think that it is very dangerous to dispose of nuclear waste in the ocean. For the reasons that were given by the previous speakers, I would strongly advocate further considerations of other options, for the same reasons.

I represent a lot of people who couldn't come today, students and other people who have things to do. I don't know if I can say that I represent them, but I would like to think so.

Thank you.

CAPT WAGNER: Thank you, Mr. Hayes.

The next speaker is Mr. Harold J. Hoey, I believe it is. And you will have to announce your location, I can't read the city, sir.

#44

MR. HAROLD HOEY: That's Harold Hoey. I live out here at Lacey.

O.10

I think there is a lot of hysteria in this disposal thing. I can't see dumping these submarines out in the ocean because you are going to lose a lot of valuable material and it may cost the government quite a bit to dismantle these things. But this material will go back into the -- and be remanufactured or the components will be taken out and

installed in ships. I think Hanford is the logical place to put it. We have got the biggest scrapyards in the world in Portland, Oregon and no doubt that it would benefit the economy of Portland and rest of the State of Washington.

Most of the equipment in these submarines is readily reusable, the equipment, most of the equipment in these submarines is reusable without further manufacture. And as far as polluting the Columbia River, it looks to me like there isn't enough radioactive material in these submarines to really bother. All you have to do is bury the things out there in the Hanford desert and put a roof over it so that the moisture can't get to them and they are there forever.

Thank you.

CAPT WAGNER: Thank you, Mr. Hoey.

The next registered speaker is Mr. John Hylinger from Puxuallup, Washington.

MR. JOHN HYLINGER: Puyallup.

CAPT WAGNER: Excuse me.

#45

MR. HYLINGER: I have heard a lot here today about why we can't do this and why we can't do that. So long as we have nuclear energy we are going to have nuclear waste to contend with. It seems to me that nobody has ever come up with a viable nuclear waste dump and I think if we have got one, we have never really used it. In fact, we have got a couple. One is to take nuclear waste in space and fire it into the

H.4

sun. But that is economically unfeasible. So the next closest thing we have got is a container that would live the life of the nuclear waste.

During the '60s -- I think it was the '60s -- we did a lot of underground nuclear testing in the Nevada test facility down near Nellis Air Force Base in Las Vegas. From what I understand, the caverns caused by those nuclear explosions are some 200 feet in diameter and are lined with approximately three feet of what they say is low-grade glass. And they will be there for eons. And why the Navy and the nuclear industry and the Atomic Energy Commission, why they just don't core drill into those with a hole of approximately maybe one foot, maybe six inches, and take your nuclear submarine core and manufacture what I would consider a giant belt sander in an enclosed building and literally grind this nuclear submarine core up into powder and then squeeze the powder into, oh, a ball-shaped object of about the size of a baseball or grapefruit and just drop them down into this cavern. You could do the same thing with nuclear-spent rods. Just make a facility down there and get rid of the high-level nuclear waste in something that is already radioactive as the dickens to begin with.

A.16

Putting it in the ocean has definite disadvantages. If you ground it up into a powder and spread it all over the ocean you would still have the problem. If you sink your

submarines you have still got your problem. The only viable way I can see is either like Dr. -- I don't know what her name was -- she said put it above ground so they don't corrode as fast. But I think if you put them in a glass-lined chambers of the underground nuclear explosions that we had down there, I think that would live just about as long as mankind is going to live around here.

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One thing I would like to say about some of the people that come up here is that they always say you can't do this and you can't do that. The Sierra Club is famous for that. I have heard so many people talk about the Sierra Club. They always come up with reasons why they can't do something. If they can't do it, why don't they come up with a little bit of viable alternatives, what we can do. They never seem to come up with that.

Thank you.

CAPT WAGNER: Thank you, sir.

Next three speakers will be Mr. Carl Deskins and Mr. Ted Mahr and Mr. David Schomer. Mr. Carl R. Deskins from Olympia, Washington.

#46

MR. CARL R. DESKINS: Pretty much that I feel that just a personal statement here, it is important to me because nuclear waste is going to be in my life because it already is, and in my children's life.

I don't understand why we haven't come up with a solution other than dumping it in a riverbed that has a large

H.3

population and a large eco-system. It seems that above ground nuclear storage is a viable solution, just for being able to check on the situation instead of putting it under the rug or under the ocean.

I'm just here to say that I don't appreciate what the Navy has been doing to the world. I have been part of the Navy, I don't appreciate what they do to humans in the Navy. I think that being subjected to military rule and having to be subjected to the dangerous situations and surroundings are wrong for mankind. And I think that the nuclear waste is wrong, also.

Thank you.

CAPT WAGNER: Thank you, sir.

Next registered speaker is Mr. Ted Mahr from Olympia, Washington.

#47

MR. TED MAHR: I want to thank the Navy and other state officials for allowing us citizens to attend this meeting.

However, one comment, sir, and that is, that the meeting really wasn't adequately publicized. I heard about the meeting in December and it was only from a KING Radio broadcast I heard it from. And they told me the meeting would be in the General Administration Building across campus. I went there and no one knew about the meeting. After much difficulty I finally found out it was here. If you do have another meeting in the future I would greatly appreciate it if

N.15

you could adequately publicize it and perhaps put a notice in the Daily Olympian, Seattle Times, Seattle P.I. papers, as well as perhaps holding the meeting at night when more people could participate. I work, I am taking time off work right now and I will have to make up some excuses for my employer when I get back, why I am not there.

Eventually, as to the plan, eventually this radioactivity is going to escape into the environment. There is really no way to keep this material, I believe, isolated for 10,000 or more years from now, the time needed to make sure it is really safe. As a perspective, 250 years ago the United States didn't even exist. And 10,000 years ago we were just entering from a hunting and gathering society into an agriculturally-based society. 10,000 years from now I question whether the United States or really any civilization might exist in order to safeguard the wastes and keep it isolated from the environment.

L.20

What will the ocean be like if the Navy dumps these subs in the Pacific? Well, the Federal Government -- I think we already have a glimpse of what happened -- what might happen. The Federal Government dumped barrels of radioactive waste into the Pacific off San Francisco from the late '40s until 1967. As a result of that dumping, radioactive material is now seeping into the fish and food chain and there is a new species of radioactive sponge as high as this ceiling now

L.36
L.14
L.6

living off the California coast, off the Farallon Islands.

California is attempting to do some studies now as to whether that radiation is seeping into the environment. Unfortunately, they don't have really the budget, the federal funds have been cut by Congress and President Reagan so they can't determine that.

Both alternatives, land and sea burial, are bad but I think the land alternative is much better. But you have to remember because I think it will take much longer for the radiation from these submarines to enter into our food chain and environment.

The real issue is not so much dumping of these subs, whether in the sea or the land, but is to eradicate from the face of the earth forever nuclear weapons and nuclear power reactors. Now, I know in the Navy the job is defense but on the other hand there comes a point when we have got, I think, too much defense.

N.12

Another question you might want to consider is what are we going to do 30 or 40 years from now when the present Trident subs will have to be scuttled. Again, we will have to face the same issue all over again.

Thank you for your time.

CAPT WAGNER: Thank you, sir.

The next registered speaker is Mr. David Schomer from Seattle, Washington.

#48

MR. DAVID SCHOMER: Hi. I'm Dave Schomer and normally I'm a fairly meek and mild-mannered individual, but today I'm Cobalt 60 and that means I'm hot stuff, okay? And that means I'm going to say some pretty hot things because I'm pretty pissed-off.

N.15

Okay, the fact is that the meeting here was very hard to find; I don't find that a mystery at all. The Navy has a long history of ignorance and greed and trying to get things within a budget, do things cheaply without any concern to the public at all, so I'm not surprised. But, as Cobalt 60, I'm the isotope with the most total curies of radiation that will be present in the submarines considered for dumping.

A.10

Still, according to Dr. Marvin Resnikof, the counsel on economic priorities, the levels of my abundant radiation have been underestimated by a factor of six, okay?

G.2

I emit highly penetrating energetic gamma radiation. However, my half-life is relatively short, so I have a small suggestion: If you can keep the subs on a dryland storage or something like that for 30 years until I've done my thing, you'll be a little bit better off.

Thank you.

CAPT WAGNER: Thank you, sir.

Final two registered speakers I have -- and please correct me on this one if I'm wrong -- Swaneagle is the name, following by Mr. Greg Vinson.

Mr. Swaneagle from Colville, Washington? Is that correct?

VOICE: I'm very concerned because --

CAPT WAGNER: Excuse me, ma'am. Would you please state your name properly for the record.

SWANEAGLE: Oh, Swaneagle from Colville.

CAPT WAGNER: Thank you.

#49

SWANEAGLE: I'm very concerned because as of now, my children don't have a healthy future and I feel this situation jeopardizes it even further and it really concerns me that the people that are responsible for such hideous waste are going to leave it to future generations to deal with.

I feel we can do things like make it to the moon, but we can't communicate or find viable solutions for such a horrible situation and I don't see it getting better and I feel we need to concentrate our energy on solutions and on getting along with people all over the planet who do care about their children.

CAPT WAGNER: Thank you.

Next registered speaker is Mr. Greg Vinson from Bellevue, Washington.

#50

MR. GREG VINSON: Hi, I'm Greg Vinson, and I'm today representing Nickel 59.

I emit x-rays and I'll be doing that for quite a while, quite a few generations, as a matter of fact. I've got

a half-life of 80,000 years. The Navy repeatedly ignores my presence, but I'm not going to go away. Not for hundreds of thousands of years. So, pass out the wet blankets and have pleasant dreams. L.46

Thank you.

CAPT WAGNER: Thank you, sir.

I have no further registrations. Has anyone registered in the audience whose name I have not called?

(No response.)

CAPT WAGNER: Ladies and gentlemen, additional public comments for consideration in the final statement may be sent to me at the address that I announced earlier.

I'd like to remind everyone that we have two more scheduled hearings today, one at 1:30 this afternoon, the second at 7:30 this evening. I'd like to thank everyone for their time and particularly for their testimony and comments this morning.

On behalf of the United States Navy, thank you very much.

This hearing is adjourned.

(Whereupon, at 10:50 a.m., the hearing was concluded.)

154

BEFORE THE

UNITED STATES

DEPARTMENT OF THE NAVY

PUBLIC HEARING

ON

DRAFT ENVIRONMENTAL

IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED,

DEFUELED NAVAL SUBMARINE

REACTOR PLANTS

AUDITORIUM

OFFICE BUILDING NO. 2

STATE CAPITOL

OLYMPIA, WASHINGTON

1:00 P.M.

TUESDAY

FEBRUARY 22, 1983

IN ATTENDANCE:

On behalf of the U.S. Department of the Navy:

CAPT EDWARD WAGNER, USN, Hearing Officer
MR. JAMES MANGENO, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program

On behalf of the U.S. Department of Energy:

MR. FRANK STANDERFER, Assistant Manager for Defense and Energy Programs, Richland Operations Office

I N D E X

P R O C E E D I N G S

1:45 p.m.

CAPT WAGNER: This hearing is called to order.

I am Captain Edward Wagner and I work in the Office of the Deputy Chief of Naval Operations for Submarines.

I have been appointed the Navy's Hearing Officer for this afternoon's public hearing.

Here with me to present an opening briefing is Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program. Also present is Mr. Frank Standerfer, Assistant Manager for Defense and Energy Programs, Richland Operations Office, Department of Energy.

This public hearing is being held to receive comments on the Navy's Draft Environmental Impact Statement evaluating alternatives for disposal of nuclear-powered submarines after the fuel has been removed from the reactor plants and the ships are no longer needed.

The Navy has conducted studies on the feasibility of burying the defueled reactor plants in government-owned land disposal sites or placing them on the deep ocean bottom.

On December 22nd, 1982, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, or DEIS, on the disposal of defueled, decommissioned Naval submarine reactor plants.

The DEIS contains the results of the Navy's studies of the alternatives available. On the registration table are copies of the Summary of the Draft Environmental Impact Statement. Anyone in the audience who would like a complete copy of the DEIS should leave their name and address on the sheet of paper provided at the registration table and a copy will be mailed to you.

The Navy's Federal Register announcement also scheduled public hearings at various locations which are convenient to people with an interest in this matter in order to provide them with an opportunity to present their views. I am here today to conduct one of these scheduled public hearings.

The purpose of this hearing is to take testimony regarding the Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case, nor to engage in debate. It is my responsibility to receive statements so that they can be considered in preparing the Final Environmental Impact Statement.

I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established for this hearing. As set forth in the announcement of the hearing, individual speakers are to limit their testimony to five minutes each and organizational spokesmen are limited to ten minutes, unless additional time had been requested in advance. Time cannot be relinquished from one speaker to another.

In order to assure all who desire to speak are given an opportunity, each person should fill out a registration card and provide it to the person at the registration table. All testimony will be recorded so that it can be considered in the development of the Navy's Final Environmental Impact Statement.

If you desire to submit written comments rather than speak, that is acceptable. You can provide written comments to me or leave them at the registration table. If you desire to provide written comments at a later date, my mailing address is as follows: Captain Edward F. Wagner, U.S. Navy, Office of the Chief of Naval Operations, OPNAV-22, Department of the Navy, Washington, D.C., Zip Code 20350.

You should provide your written comments by March 31st, 1983 which, as stated in the Federal Register notice, is the cutoff date for submitting comments.

Before we begin receiving testimony, I would like at this time to introduce Mr. Mangeno of the Naval Nuclear Propulsion Program who will provide a general overview of the issue the Navy is addressing and the content of the Draft EIS.

Mr. Mangeno.

MR. MANGENO: Today's hearing is being conducted as a part of the decision-making process required by the National Environmental Policy Act. Under this law, the Navy must prepare an environmental impact statement for any action which could have a significant environmental impact or which might be subject to controversy over the environmental effects. The environmental impact statement must include the environmental impacts for all reasonable alternatives.

The Navy's Draft Environmental Impact Statement, or DEIS, on this subject provides the basis for these hearings and the slides that follow are from the DEIS. It describes the alternate ways the Department of the Navy, in cooperation with the Department of Energy, is considering for permanently disposing of defueled nuclear-powered submarines after they are no longer needed. The practical choices are: bury the radioactive part of the submarine at an existing DOE land disposal facility at the Hanford site in the State of Washington or the Savannah River Plant in South Carolina; or place the entire submarine on the bottom of the ocean in water more than 2.5 miles deep. In both choices there would be no nuclear fuel left in the submarine because all of it would be removed before disposal. Nevertheless, there would be some low-level radioactive materials left within the submarine.

Preparation of this Draft Environmental Impact Statement does not mean that the Navy has already decided to dispose of nuclear submarines. The Navy currently has about 120 nuclear-powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases,

as shown in this slide, it is evident that a disposal plan must be prepared for use sometime in the future. This DEIS has been prepared now so that all interested agencies, organizations and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

The submarines are constructed with the nuclear power plant enclosed within a single section of the ship called the reactor compartment. This slide shows a typical submarine with the location of the reactor compartment identified.

Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the uranium and all of the fission products. The removed fuel is handled according to established procedures and is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, to the metal structure supporting the fuel, to the reactor vessel and to other equipment in the reactor compartment, where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by the hull of the submarine and by the reactor vessel and coolant piping.

In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel or other metal atoms in the reactor plant. These atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation of the nuclear reactor and the number of curies of each radionuclide at that time. A curie is a measure of the amount of radioactivity present, but it is not an indication of the possible effect on man or animals. The amounts and kinds of radioactive atoms present are described in detail in Chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive

material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the Federal Government disposal facilities already used for such low-level radioactive waste at the Hanford Reservation in the State of Washington or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the compartment free from the remainder of the submarine, and weld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. Other government-owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable waterways so that transportation of the reactor compartment to those sites would be impractical. The Hanford and Savannah River burial grounds are described in Chapter 3.

A transporter of the sort shown in this sketch would then be used to haul the compartment overland to the burial location. There is little risk of radiation exposure to any-one in the general public during movement to the burial ground, actual burial or after burial. This is because radiation out-side the compartment would be well below federal limits and the reactor compartment would have been welded shut at the shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low-level radioactive waste. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burials and would result in no significant additional environ-mental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the body. More than 200 years would pass before the reactor com-partment bulkhead could be penetrated by corrosion. Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time, exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean is another practical alternative.

The maximum radioactivity would be less than the limit specified by international criteria and the triple containment provided by the submarine reactor compartment, by the reactor vessel and piping, and by the radioactive atoms being a part of the metal itself would be an extremely strong and effective disposal containment package.

Locations for possible ocean disposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U.S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site specific public hearings would be required and the permit process is not part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 190 miles west of Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry and marine biology for very deep ocean locations. The depth of the water in these areas is between 4,000 and 5,000 meters, 13,000 to 16,000 feet. The scientific information and measure-ments collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that the environmental impacts could be calculated using realistic data.

Preparations for ocean disposal would be made at one of the shipyards normally servicing nuclear-powered naval cessels. Following defueling, the reactor vessel and the reactor compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping and, of course, the metal itself, completely intact. Most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping or free the atoms from the thick metal.

A comparison of the possible effects on the envionment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100 submarine disposals for the year of greatest exposure for both options. This table shows that the radiation exposure would be very small and could have little impact on individuals or the population. These levels are also many times less than any limits established by U.S. regulations or international limits. They are much

smaller than the normal fluctuations in annual average background radiation exposure for U.S. residents.

A perspective on radiation exposure can be gained by examining the exposure a person would receive from natural cosmic background radiation if he flew round-trip from New York City to Los Angeles. That person would receive approximately two millirems more radiation than if he had not made the trip because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one-half millirem.

Other environmental impacts are similarly small and localized in either case. Land burial of 100 reactor plants would require only about ten acres of land and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square ten miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land disposal would cost about 40 per cent more, about two million dollars per submarine more, than sea disposal.

The "no-action" alternative is to place submarines in floating protective storage for an extended period, commonly called mothballing. However, this would only temporarily delay disposal because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods and the estimated radiation exposure for the general public would be very small for all available courses of action.

Thank you.

CAPT WAGNER: Thank you, Mr. Mangeno.

Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of the hearing. I will now recess briefly to establish an order for persons who wish to speak. For those people who have not yet registered and wish to make a statement, you may register at this time.

We will take a recess of five minutes and reconvene the hearing at ten minutes after two.

[Short recess.]

CAPT WAGNER: We will reconvene the hearing.

I do not have any registered speakers for organizations. I mentioned the ten-minute timeframe for organizational spokesmen. Is there anyone who has not registered or

maybe who has registered who I've missed that would like to speak for an organization?

[No response.]

CAPT WAGNER: Then we'll get right into testimony by individuals. The procedure for your public testimony will be as follows. I will call your name. Please come to the microphone right here at the head of the auditorium. Even though I've mentioned your name, I'd like you to please, first of all, state your name in case that I mispronounce it, state your name and then address your comments directly to me.

#51

Our first registered speaker is Mr. Gary DeGraff from Seattle, Washington. Mr. DeGraff.

MR. GARY DeGRAFF: Thank you for your presentation, Captain Edwards -- Captain Wagner, I'm sorry.

I wish to point out that --

CAPT WAGNER: Excuse me, sir. Would you please state your name.

MR. GARY DeGRAFF: Oh, I'm sorry. Gary DeGraff, Seattle, Washington.

CAPT WAGNER: Thank you.

MR. GARY DeGRAFF: I wish to address the fact that here in he United States that us being a superpower, that we're looked upon so much as a nation to set precendents and in some of the literature that I received today, some from the Navy, some from various environmental groups, statements were made here where Japan is prepared this year to make large nuclear waste dumps in the occnas and, in my opinion, Japan relies greatly on the ocean for their survival.

Now, in my years of concern over the whaling issue, Japan has totally ignored the wishes of the International Whaling Commission which is an international organization for the good of huanity and Japan has ignored these things.

F.8

Now, I feel that in this literature where it states that the United States was one of the first -- or, was the first nation -- to form rather a ban on nuclear waste disposal that was very vital to this London Committee for nuclear waste, and I feel that our reversal of our precedences that we have set on this matter, that the amounts or statistics on the amounts of radiation released by our disposed nuclear submarines, that in reality, when this sets a precedent for other nations to say, "Well, the United States, they dump their old nuclear submarines and claim that low-level nuclear wastes are not harmful to the food chain," that here in America where we can speak up on these matters, that's one thing, but what's going to happen with these other countries such as the Soviet Union where citizens are not able to stand before their defense administration and address these matters?

So I feel strongly that, being a citizen of the United States, I wish to voice that I think it's vital that

we set precedents on these kind of things and that since we've created them, let's dispose of them on the land, on our own soil, and I see that a lot of economic issues are raised over this matter and at this present time where the economy could use a little revival, this disposal of removing the reactor out of the submarine, this is in my field of trade, I am presently unemployed, I would like to see some of this work become available, so I wish to just state that I believe in safety, first. Setting precedents for other countries to flllow the examples that we set and, as far as the economic factor, we can use a little work and when it comes to who pays for that work, the Department of the Navy, it says here that people feel that it's the Navy's responsibility, well, my tax dollars is how the Navy exists and myself being a single person and working seven days a week, many hours a day, I get taxed to the hilt, but I'm more concerned with safety, first, even if it does cost me extra dollars and this money factor where safety gets disregarded, I feel that' it's something that we as human beings should really realistically address.

N.3

Thank you, sir.

CAPT WAGNER: Thank you, sir.

The next registered speaker is Mr. Riede Wyatt from Olympia, Washington. Mr. Wyatt.

MR. RIEDE WYATT: Hi. My name is Riede Wyatt.

#52

N.15

This is a public hearing, correct? So why is it that so little effort has been made to inform the public that this hearing is taking place? And, why was the little information given to the public about this hearing false pertaining to location and time of hearing?

Existence of nuclear submarines in the first place stems from the war-like mentality of the United States military. They are built to destroy. So, why should the Navy be concerned with human life and the environment when it comes to dumping old radioactive subs?

That's all I have to say.

CAPT WAGNER: Thank you, sir.

Ladies and gentlemen, I have no further registrations for speakers. Has anyone in the audience registered to speak and I have failed to announce your name?

[No response.]

CAPT WAGNER: Again, I'd like to add that additional public comments for consideration in the final statement may be mailed to me at the address that I gave to you earlier.

I'd like to thank those in the audience for your interest and for the people who provided testimony this afternoon.

Also, I'd like to again re-emphasize that we do have a hearing this evening scheduled for 7:30. Anyone who would like to attend that hearing or if you haven't made

a statement and you would like to consider making one at that time, you're welcome.

On behalf of the United States Navy, I'd like to thank you again for your interest today. This hearing is adjourned.

[Whereupon, at 2:15 p.m., the hearing was concluded.]

BEFORE THE

UNITED STATES

DEPARTMENT OF THE NAVY

PUBLIC HEARING

ON

DRAFT ENVIRONMENTAL

IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED,

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REACTOR PLANTS

AUDITORIUM

OFFICE BUILDING NO. 2

STATE CAPITOL

OLYMPIA, WASHINGTON

7:30 P.M.

TUESDAY

FEBRUARY 22, 1983

IN ATTENDANCE:

On behalf of the U.S. Department of the Navy:

CAPT EDWARD WAGNER, USN, Hearing Officer
MR. JAMES MANGENO, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program

On behalf of the U.S. Department of Energy:

MR. FRANK STANDERFER, Assistant Manager for Defense and Energy Programs, Richland Operations Officer

I N D E X

P R O C E E D I N G S

7:45 p.m.

CAPT WAGNER: Good evening, ladies and gentlemen. This hearing is called to order.

I am Captain Edward Wagner and I work in the Office of the Deputy Chief of Naval Operations for Submarines.

I have been appointed the Navy's Hearing Officer for this public hearing.

Here with me to present an opening briefing is Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program. Also present is Mr. Frank Standerfer, Assistant Manager for Defense and Energy Programs, Richland Operations Office, Department of Energy.

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You should provide your written comments by March 31st, 1983 which, as stated in the Federal Register notice, is the cutoff date for submitting comments.

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about 120 nuclear-powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases, as shown in this slide, it is evident that a disposal plan must be prepared for use sometime in the future. This DEIS has been prepared now so that all interested agencies, organizations and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

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Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the uranium and all of the fission products. The removed fuel is handled according to established procedures and is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, to the metal structure supporting the fuel, to the reactor vessel and to other equipment in the reactor compartment, where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by the hull of the submarine and by the reactor vessel and coolant piping.

In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel and other metal atoms in the reactor plant. These atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation of the nuclear reactor and the number of curies of each radionuclide at that time. A curie is a measure of the amount of radioactivity present, but it is not an indication of the possible effect on man or animals. The amounts and kinds of radioactive atoms present are described in detail in Chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless

of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the Federal Government disposal facilities already used for such low level radioactive waste at the Hanford Reservation in the State of Washington or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the compartment free from the remainder of the submarine, and weld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. Other government-owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable waterways so that transportation of the reactor compartment to those sites would be impractical. The Hanford and Savannah River burial grounds are described in

Chapter 3.

A transporter of the sort shown in this sketch could then be used to haul the compartment overland to the burial location. There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial or after burial. This is because radiation outside the compartment would be well below federal limits and the reactor compartment would have been welded shut at the shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low level radioactive waste. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burials and would result in no significant additional environmental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the body. More than 200 years would pass before the reactor compartment bulkhead could be penetrated by corrosion. Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time, exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean is another practical alternative. The maximum radioactivity would be less than the limit specified by international criteria and the triple containment provided by the submarine reactor compartment, by the reactor vessel and piping, and by the radioactive atoms being a part of the metal itself would be an extremely strong and effective disposal containment package.

Locations for possible ocean disposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U.S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site-specific public hearings would be required and the permit process is not part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 190 miles west of Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry and marine biology for very deep ocean locations. The depth of the water in these areas is between 4,000 and 5,000 meters, 13,000 to 16,000 feet. The scientific information and measurements collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that the environmental impacts could be calculated using realistic data.

Preparations for ocean disposal would be made at one of the shipyards normally serving nuclear-powered naval vessels. Following defueling, the reactor vessel and the reactor compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping and, of course, the metal itself, completely intact. Most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping or free the atoms from the thick metal.

A comparison of the possible effects on the environment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100 submarine disposals for the year of greatest exposure for both options. This table shows that the radiation exposure would be very small and could have little impact on individuals or the population. These levels are also many times less than

any limits established by U.S. regulations or international limits. They are much smaller than the normal fluctuations in annual average background radiation exposure for U.S. residents.

A perspective on radiation exposure can be gained by examining the exposure a person would receive from natural cosmic background radiation if he flew round-trip from New York City to Los Angeles. That person would receive approximately two millirems more radiation than if he had not made the trip because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one-half millirem.

Other environmental impacts are similarly small for both options. The effects on animal life would be small and localized in either case. Land burial of 100 reactor plants would require only about ten acres of land and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square ten miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land disposal would cost about 40 percent more, about two million dollars per submarine more, than sea disposal.

The "no-action" alternative is to place submarines in floating protective storage for an extended period, commonly called mothballing. However, this would only temporarily delay disposal because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods and the estimated radiation exposure for the general public would be very small for all available courses of action.

Thank you.

CAPT WAGNER: Thank you, Mr. Mangeno.

Ladies and gentlemen, Mr. Mangeno's presentation concludes our formal portion of tonight's hearing. I will now recess briefly to establish an order for persons who wish to speak. For those people who would like to testify and who have not yet registered, you may do so at this time.

We will recess and reconvene the hearing at ten minutes after eight and start testimony at that time.

VOICE: Will there be an opportunity for questions?

CAPT WAGNER: No, this is a testimony period. As I said earlier, it's not a question-and-answer, it's not a debate session.

[Short recess.]

CAPT WAGNER: Ladies and gentlemen, we'll resume our hearing.

For the gentleman who asked the question on will we have questions and for those of you who might have questions, we do have a lady at the front table who represents the Chief of Naval Information. Her name is Ensign Laurie Ramp. If you have a specific question that you find that the information that we've provided at the registration table does not answer, you may leave that question with her and she will either answer it at the time, if she's able to, or she will find the answer for you and get it to you at a later time.

Simply to establish an order for the statements, I intend to ask individuals representing organizations to speak first. We will do that in alphabetical order by the last name of the speaker. Then we will follow the organizational spokesmen with testimony by individuals, again in alphabetical order by last name of the speaker.

I request your cooperation providing comments within the time limits that we've established so that we may be certain that all who wish to speak have an opportunity to do so.

Once again, that's five minutes for the individual speakers and ten minutes for organizational spokesmen.

If your statement is so long that you feel it cannot be given in the five or ten minutes allotted, then you may submit the entire statement in writing. It will be then entered in the record and you can summarize your entire statement in the five or ten minute period.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, please proceed to the microphone that we have here in the front of the auditorium, state your name and organization, if any, then address all comments to me, please.

I want to re-emphasize, even though I announce your name, please for the record state it. I might mispronounce it and you can then correct it for the record when you start.

Our first registered speaker is Mr. John Schubert from Tacoma, Washington, who is representing the Tahomans for a Healthy Environment.

#53

MR. JOHN SCHUBERT: Thank you, Captain Wagner. My name is John Schubert. I'm a resident of Tacoma, Washington, and my training is in environmental sciences and policy and I'm presenting my views tonight as a representative of Tahomans for a Healthy Environment, or T.H.E.

T.H.E. is a Tacoma citizens' group dedicated to achieving a healthy environment for all people who live and work in Tacoma, yet our concerns extend broader than that from time to time, such as the situation tonight.

I am here to express our opposition to the disposal

of decomissioned and defueled nuclear submarines at sea. My reasons are simple and I believe unassailable. You simply don't put toxic wastes where you can't get at it unless you know it will do no harm and you know you'll never want access to it again. Neither of these conditions are knowable at this time for disposal at sea of radioactive wastes.

W.1

L.39

Too many times we have had passed out of sight and out of mind pollution disposal policies that come back to haunt us. We're in Tacoma unfortunately faced with quite a few of these problems. We've been listed among the top ten toxic waste sites in the country and we're facing very difficult problems in figuring out how to resolve these problems because we put things on the bottom of Commencement Bay, we put things in all sorts of places where there was no ready access to them, now that it's times to do something with it that we never expected to have to do.

As for disposal of these submarines on land, though undesirable in its own right, I believe this option is preferrable. Not only does disposal on land allow retrieval, if necessary or desirable at a future date, but sites in our own back yard such as Hanford and Savannah River serve the public and government well as ever-present reminders of the need to minimize the production of toxic wastes in the first place.

Thank you very much for the opportunity to comment.

#54

CAPT WAGNER: Thank you, sir.

The next registered speaker is Stuart Robert Smith from Olympia, Washington. Mr. Smith is representing the Concerned Citizens of Cooper Point.

MR. STUART SMITH: My name is Stuart Smith and I represent the Concerned Citizens of Cooper Point. The statement here has been quickly drawn up and is not well organized, but I think the points I make are fairly well taken, Captain Wagner.

N.15

One thing I notice was that the public hearing advertisement had the wrong address on it. In the Olympia paper, The Daily Olympian, the address given was the General Administration Building and this, as we know, isn't the General Administration Building; so perhaps there would be more people here if the address was correct.

Secondly, I notice that these public meetings are only taking place in four communities across the entire country: in Sacramento, in Olympia, in Raleigh, North Carolina and Columbia, South Carolina; not well distributed, I'm afraid, and I think perhaps more people would become involved in public meetings if more effort was made to distribute their addresses.

I am a student, I study genetics, and one of the things that I've recently learned about in genetics is something called mutation. Mutation is a change in the structure of a

chromosome which is the basic unit of inheritance in reproduction of animal tissue of humans, eventually. I noticed in looking through the summary of the Draft EIS that you mention millirems and talk about millirems in terms of lifting mosquitoes and I was just wondering if your Department of the EPA ever considered millirems in terms of destroying chromosomes and how much energy it takes to dissociate an active human chromosome.

X.1

I don't have the budget that the Navy does, obviously, to provide a slide show, but I did make some photocopies of human mutations that are not very pretty. They're not as slick as the Navy presentation, I'm afraid, but they do cause one to stop and think very seriously in terms of numbers of millirems or exposure to any radiation at all, not so much in terms of watching television or riding on the airlines, as the Navy chooses to see it, but more in terms of potential biological concentration of mutagens, radioactive nucleotides in the ocean waters that unfortunately can never be removed and we'd have to filter the entire ocean. Once we've polluted these waters, we certainly can't unpollute them.

L.43

L.20

W.1

In fact, Dr. William Schell from the EPA has revealed alarming evidence of radionucleotide migration into edible shellfish from past dump sites. Now, I know that this particular Environmental Impact Statement is not addressing previous dump sites or anything like that, but I think it's something that we might consider, is cleaning up previous waste dumping.

U.9

Now, I know this may seem irrelevant, but in terms of watching television and riding in airplanes, it doesn't seem particularly irrelevant to mention that there is several other ships in the Navy nuclear fleet, for example, the -- oh, let's see, there's the Enterprise, the Kennedy and the Nimitz, which are large carriers I'm sure you're familiar with and the Frigate Long Beach, these are the few that I could come up with, there are cargo ships and many other nuclear ships. For example, the Sea Wolf, which has been sunk off my home state of New Jersey -- at least that's where I was raised; now I'm a resident of Washington -- apparently the Sea Wolf has never been found, which I think is sort of an interesting idea.

I.85

I mean, in one sense, it could be a good argument for the Navy considering that the level of radiation is so low that they've never been able to find it, but in another sense I think it's rather frightening that we can never find out exactly what the effects of the Sea Wolf sinking as our only example of a dumping ocean sunk nuclear vessel.

Anyway, I guess the most frightening thing to me about the Navy wanting to potentially dump spent reactors in the open ocean is that apparently last week the London Dumping Convention, which is I believe an international organization, voted 19 to 6 to outlaw ocean dumping of radioactive

F.5

waste and I think that if the Navy is considering breaking an

international law in dumping nuclear waste in the ocean, that's something -- it's not setting a good precedent for the rest of the world. F.8

I guess I would also mention that the other -- in the Summary Draft Environmental Impact Statement, there is no mention of the potential extent that the radioactive isotopes involved -- talked in terms of half-lives, how long these things will be around. Obviously, they'll be released very slowly into the ocean or into the atmosphere around the land dumping site or anywhere. Technetium-99 was the one that I was particularly impressed by. That's a 212 thousand year half-life, which means half of whatever -- well, half of whatever technetium-99 has produced will be gone after a quarter of a million years. It seems pretty impressive. If any of it is around at all, I imagine it going to be for quite some time.

I guess my main concern is that it seems as if these proceeedings, the EIS proceedngs and Environmental Impact Statement, which of course was drawn up by -- apparently drawn up by an ex-military -- an ex-Navy man, let's see, I have his name here, Sjoblom -- I'm sorry, sir, wherever you are -- who drew up the EPA document, a Navy personnel person, but I guess what I'm most concerned about is the best possible things we could do at this point, I think, is to wait, is to keep the ships in drydock. It seems to be G.2

the least expensive procedure at this point, compared to the others. It adds 3.2 million to a potential 16 million, the most expensive of the procedures. We're not at all sure what the total effects of environmental radiation can be as far as the mutagenic effects and in terms of potential birth defects in our own species and in terms of not fully understanding the storage -- the deep sea dumping procedures that have happened in the past based -- apparently is already leaking out of containment vessels that we were convinced were safe and is already entering our food supply.

L.6

I guess you could just say that I'm concerned. I'm a concerned citizen. And, I certainly hope that the Navy is not whitewashing over their decision to dump the containers, these reactor vessels into the ocean because it's the least expensive thing to do. I'm not someone who has vast credentials or vast experience. I'm young, I'm inexperienced, but I am concerned and that's something that I feel I have a responsibility to represent my children, my grandchildren, your children, your grandchildren here by considering the possible effects of ocean dumping and of land storage and of drydocking.

N.3

Well, I think I've covered most of the points that I wanted to mention. I guess the only thing left to say would be that I certainly hope that you can consider these proceedings very carefully and I certainly hope that you will

*Other issues discussed by Mr. Baird are side barred in Exhibit 55a.

hold public meetings in other communities besides just Sacramento and Olympia and Raleigh, North Carolina and Columbia, South Carolina. I hope it's not too late for the rest of the nation to become aware of what the Navy's plans are. And, I certainly hope that we can undo the damage that we've already done.

J.15

Thank you very much.

CAPT WAGNER: Thank you, Mr. Smith.

(Applause.)

CAPT WAGNER: Ladies and gentlemen, I have no more registrations for organizational spokesmen.

VOICE: I'm here as a representative of the Tatoosh Group of the Sierra Club.

CAPT WAGNER: We had the Sierra Club represented earlier today, so I will give you an opportunity alphabetically with the public. In fact, Mr. Baird -- if you're Mr. Baird, you'll be first. But, the remainder of the cards are alphabetized now with the individual speakers. The same procedure will be used in terms of calling you up to the microphone and I encourage you to please make your comments directly to me, try to stay within the time frames so that we can get everybody who I have listed here tonight an opportunity to speak.

The first individual is Mr. Brian Baird from Tacoma, Washington.

MR. BRIAN BAIRD: My name is Brian Baird. I represent

#55

the Tatoosh Group of the Sierra Club. I'm a conservation chairperson for that organization.

A couple of interesting comments I'd like to begin with. One is I first learned about this meeting quite by accident, actually, although I've been interested in the subject for a couple of years. I happened upon a legal notice in the classified advertising section, which I'm sure you're familiar with the size of those and the frequency with which they're read.

It seems that on something of this magnitude a greater effort could be undertaken to notify the press and the public that something like this is happening. I took it upon myself to call our local newspaper and say, "Hey, did you know this meeting was coming up?" and they were kind enough to publicize it in a slightly larger article, but I have little doubt that many people would be interested in this had the matter been publicized more.

*N.15

Secondly, it has caused some consternation for me to attend the scheduled meeting site and find a notice that the meeting location had been changed, no assistance, particularly, as to how to find the new meeting site, it is raining outside, we came early so as to have a chance to peruse any documents you might have provided for us, ended up getting here about five minutes late after having circumnavigated every building in the nearby vicinity.

*Other issues discussed by Mr. Baird are side barred in Exhibit 55a.

The kinds of minds that are expected to plan disposal of nuclear wastes and nuclear submarines at sea might be expected to provide a map or a better description of the location of a meeting site.

Well, I like to think -- and perhaps it's unjust so because the generations to come might be quite different than these -- but I like to think we're here speaking for people who can't speak because they don't yet exist and, as the gentleman mentioned earlier, that would be my grandchildren and your grandchildren and on for literally thousands of generations who will have to live with whatever we do here today.

I also like to believe that humans are capable of learning from our experience and from our mistakes, but time and again that belief gets challenged by our recurrent stupidity.

The proposal to dump more deadly garbage at sea is another case in point. It exemplifies not only our stupidity, but our arrogance and our short-sightedness. As a resident of Tacoma, like Mr. Schubert, I've seen the effects of short-term solutions to long-term problems. There was a time when industries of Tacoma thought it was perfectly acceptable to dump literally hundreds of thousands of tons of chemical waste in the Bay. Today we're just beginning to see that that works its way up through the food chain and we eat it and it has effects long, long after the actual actions undertaken.

In this case, the waste of concern are only a couple hundred feet deep. Yet, if you attend any of the meetings about how to get those things out or what to do with them, you'll find that it's an incredibly perplexing problem. Certainly it will cost more to eliminate them from the environment where they lay now than it would have to have properly disposed of them at the time.

At any rate, I'm not certain that we'll ever come up with a thoroughly satisfactory solution to that problem, but that's only in a couple hundred feet of water. My understanding is that the proposal for the submarines is in a couple miles deep of water.

W.1

O.26

I'd ask you to really ask yourself seriously -- and I've seen no mention of it in the Environmental Impact Statement -- what if our grand designs and our best-laid plans of mice and men go awry and something happens down there to those reactor vessels? What happens then? How do we get them out? I see no cost estimates for that in the EIS, no even feasibility studies for whether or not that would be possible. The experience at Commencement Bay and hundreds of other sites suggest that that would be a prudent thing to include in any EIS considering ocean dumping sites.

The basic message, as was mentioned earlier, is if

W.1

something's going to be poisonous for an awful long time, you don't dump it where you can't get back at it. But again, I don't think we learn our lessons very well.

I'd like also to make kind of an observation about environmental impacts of the past. There's some questions in addition to the one I just mentioned that might be asked. My observation from the scientific literature that I've had access to which hasn't been vast in this area, but generally there seems to be a great question mark, in fact, that you often read in these studies, so little is known about this area as of yet. We're just beginning to study it. More research is needed.

L.1

J.9

Some questions that I don't think have been adequately addressed include just what organisms are there down there? This is pretty deep water we're talking about and I don't think it's been adequately surveyed. Perhaps I'm mistaken on that. You've already addressed some of the things about long-term effects of the saltwater. I would venture to guess that when the rather rosy picture of possible worst-case -- I won't say "worst-case" because you didn't -- but the possible rosy picture of millirems and how comforting it was to see that in my trip to New York I'll be exposed to more millirems does not consider the worst case incident. If I'm mistaken in that, I'd appreciate correction, but I would certainly guess that if that was the worst possible case of exposure, we wouldn't be having this meeting at all.

The gentleman mentioned earlier that we're talking about half-lives of 20, 30, in some cases hundreds of thousands of years for these things. Again, that was not mentioned in the slide show.

It hearkens back to the time when we were first considering nuclear power and people said, "Hey, this is plenty safe stuff" and at the time we didn't have any real appreciation for the significance of reactor core brittling, we didn't understand the effects of neutron bombardment of some of the vessels, and we went ahead making decisions that really in the long term we're seeing is not particularly appropriate.

So, I'd like to ask just one kind of question, I suppose, in conclusion. We're making decisions that will affect people 20,000 years from now with possibly exposing them to extremely toxic stuff and I would ask just who the hell we think we are. I recognize that that may be viewed by some as an obscenity, but to be frank, I view this proposal to dump things at sea without adequate knowledge as a far greater obscenity and that obscenity is far less, I fear, than the contempt that our progeny may hold for us if we go ahead with that kind of plan.

L.39

Thank you.

CAPT WAGNER: Thank you, Mr. Baird.

(Applause.)

CAPT WAGNER. The next speaker is, I believe, Mr. Scott Elliott -- I might have the first name wrong -- from Olympia, Washington.

#56

MR. SCOTT ELLIOTT: My name is Scott Elliott. I'm a resident of Olympia, Washington.

I believe, pursuant to NEPA, the environmental and scientific data presented is not fully documented within the Environmental Impact Statement. This meeting was not properly publicized. There are insufficient meetings for all members of the public interested to attend. And I think a special area lacking within the EIS pursuant to the NEPA is the social aspects of this that have not been considered.

First of all, the options have not been considered fully with regard to employment. There will be substantially greater employment benefits as a result of land-based disposal. O.11

Secondly, this cannot be considered fully in a vacuum. There are social impacts beyond merely employment, including international law aspects that will impact upon the environment. F.8

One such similar case currently that the United States is involved in is the acid rain controversy involved in the Eastern United States with Canada. That's currently in litigation before the International Court of Justice and that has not been addressed within the Draft Environmental Impact Statement.

F.8

Second is the issue of sovereignty. This will have an effect upon sovereignty and that was not addressed at all in the Draft Environmental Impact Statement. Whenever a government has sovereignty over an area, it can control the environmental impacts that occur there. This will impact sovereignty.

F.8

Third, the international social and legal aspects beyond just sovereignty. Once we start dumping, it will be very hard to stop others from dumping and other nations do not necessarily have the full environmental review processes that we do. Once we set a precedent, that will allow others potentially to dump very high levels of radioactive materials that we will have no control over, we'll not be in a position to comment internationally, and our sovereignty could be potentially violated in the same way as the acid rain situation.

I think it's important that mitigation has not been fully considered, either, as pursuant to NEPA. There are many possible ways of reducing our radioactive contamination of the environment such as immediately decommissioning all nuclear ships. Second, fully decommissioning all nuclear power plants. These are mitigating measures that could be taken if we were to dispose of these at sea.

Another portion of mitigation is land-based disposal could be further improved by processing these further, not just simply welding them shut and dumping them in holes.

E.5

They can be sealed better, they can be processed down. These issues were not properly dealt with in NEPA. Under NEPA you're required to fully consider all the possibilities and all reasonable mitigating measures. I consider slight improvements in the burial processes to be important, significant and economically feasible and they were not dealt with. The Draft Environmental Impact Statement does not meet NEPA. It needs to be fully rewritten, more hearings held at more places, better publicized before a Final Environmental Impact Statement should even be considered.

E.5

My recommendations are beyond just those, that land-based burial be the only option and that full mitigating measures should be taken.

Thank you.

CAPT WAGNER: Thank you, sir.

(Applause.)

CAPT WAGNER: I have two registration cards from Mr. Joe Morin. If we have two people by that name here, let me ask the first man to come up and then --

#57

MR. JOSEPH MORIN: No, they registered once for me. Can I speak --

CAPT WAGNER: Yes, sir. From Olympia, Washington, Mr. Joe Morin.

MR. JOSEPH MORIN: My name is Joseph Morin. I'm a registered voter in the City of Olympia and a citizen of the United States and I came to add my small voice in this Government basement to urge you not to -- to strongly reconsider your proposals to dump nuclear submarines in an ocean site. It would seem rather foolish and perhaps even arrogant that we would lightly make a decision that could affect generations and generations of our families which is not a thing that we should take very lightly.

I'm pleased to see that the Navy has a Draft Environmental Impact Statement, but it doesn't seem to be perhaps as clear as an issue of such vital importance should be before we make such a large decision.

So, basically, I'd just like to add that for the record and strongly urge the Government to take its responsibilities for properly disposing of its waste and not pass that burden on to future generations.

Thank you.

CAPT WAGNER: Thank you, Mr. Morin.

(Applause.)

CAPT WAGNER: The next registered speaker is Mr. Jim Skutt, I believe it is, S-k-u-t-t, --

MR. JAMES SKUTT: You got it.

CAPT WAGNER: -- from Olympia, Washington.

MR. JAMES SKUTT: Good evening. My name is James Skutt and I live here in Olympia. This evening I'm here to offer my comments on the U. S. Navy plan to scuttle spent

nuclear submarines in the ocean.

Earlier today and earlier this evening, you were presented with testimony from a number of environmentally-oriented groups and individuals who pointed out the flaws in the Navy plan and the many ways in which it endangers the existence of the ocean environment.

We also have heard about the dangerous precedent the Navy plan would set in regard to world wide ocean dumping.

I do not feel that I have any further comments to offer that would be of great scientific help. However, I would like to tell you about the way this Navy plan is affecting my impression, my view of the amount of care the Navy and the Government, in general, has for the earth. I'm rapidly getting the impression that the Navy views the ocean as simply a medium for floating their war ships. The earth is the only real world there is. If we continue to poison it, it will die. If it dies, we die, whether we come from America or anywhere else. The earth will not play favorites, the earth will not be selective. The earth, when angry, will be incredibly powerful. Even the Navy higher-ups and the members of the executive branch who are running the united corporation of America will not be able to escape. If the earth's vengeance doesn't come in the form of floods, earthquakes, drastic weather alterations or other spectacular forms, it will come in more insidious and man-caused forms such as radiation in the air and water.

Captain Wagner, you probably find this constant barrage of opposition a bit difficult. Of course, we can't tell because you are trained not to reveal your emotions. But, you have only begun to hear the voice of the people who will be affected by this plan.

The plan to dump nuclear subs in the ocean will lead the way for a new attack on the environment which is, in effect, our mother, and rather than lead the way into oblivion in yet another way, the United States could take action that would, perhaps, be able to lead the world away from darkness. I do not expect the United States Government in its present form to take this action, but, nevertheless, I hope for it.

Thank you for this opportunity.

CAPT WAGNER: Thank you, sir.

(Applause.)

CAPT WAGNER: The next registered speaker is Mr. Eric Simmons from Olympia, Washington.

#59

MR. ERIC SIMMONS: Hello. My name is Eric Simmons and I'm from Olympia, as well. I'd like to comment upon the following falsehood in the DEIS; I quote: "The animal life on or near the sea floor in these study areas is very sparse. None of the animals are used by man or form part of a food chain know to lead to man."

The Prophet Isaiah said, "All flesh is grass" and he was making a point about the transitory nature of life, but in fact he was also stating the basic law of biological communities. The ultimate source of all human and energy upon this planet is the green plant which alone can use the sun's energy to synthesize organic compounds. Plants are not only the primary producers of our world, but also generate the oxygen we breathe. It has been estimated that the free-floating plants of the sea, the phytoplankton, represent 80 percent of the world's annual production of plant material. 80 percent.

Like most plants, phytoplankton require four principal materials to grow. These are water, carbon dioxide, sunlight and certain inorganic nutrient salts such as nitrates and phosphates. In the productive sunlight surface areas, carbon dioxide, sunlight and water are readily available. The limiting factors are the nutrient salts. The vast majority of phytoplankton are unable to fix nitrogen out of the atmosphere. The nitrogen becomes available only through the decomposing done by bacteria. Bacteria turn organic compounds into inorganic, water-soluble nutrients that are suitable for uptake by plants.

This was recognized as long ago as 1865 by Louis Pasteur. Quote, "Life could not exist on earth without not only death, but decomposition." We can see, in crude terms -- I only have five minutes -- the constant recycling of a relatively unchanging amount of nitrogen in the ocean ecosystem. Marine bacteria show a characteristic pattern of vertical distribution in the open waters of the ocean. In the sunlit surface waters, there are relatively few bacteria. Much higher levels are found immediately below the thermocline and the thermocline is the level at which most plant production ceases. It's too dark. The numbers then fall off sharply as one goes deeper, and the intermediate depths of 500 feet and more are relatively devoid of bacteria. By far the greatest numbers of bacteria are found a few centimeters above and within the bottom deposits of the ocean. It is true that most of the bacteria essential to the nitrogen cycle are found. These decomposers are at all depths in all oceans. The nitrates formed are recycled by upwelling and by winter turbulence.

T.24

J.31

You might see the pictures in the EIS of the sea floor, just blank mud, sterile, cold-looking, but should this blank mud, this function cease its activities, the available nitrates would be used up in one bloom of phyto-plankton, that's less than three months.

L.55

Eighty percent of all green plant production on this planet would cease immediately. No animal would survive.

This scenario is probably impossible in nature. However, it must be made very clear to everyone that we are not discussing the extinction of the Snail Darter or some

equally obscure critter that got itself killed by economic considerations. We're talking about the life breath of the planet. Incredibly, no mention has been made of the effects of this dumping on benthic decomposers. You must understand how basic and essential this ocean cycle is. It cannot be ignored.

T.24

L.13

The dumping of only 100 nuclear subs into the sea floor may or may not choke us or starve us. The point is the sea floor is not and must not be considered as a safe place to dump toxants. If you must put them somewhere, put them at Hanford. Do not set such a precedent as this. The interactions in the sea are complicated and very little understood, but the planet's life breath may be more fragile than any of us suspect.

L.9

F.8

L.39

CAPT WAGNER: Thank you, sir.

(Applause.)

CAPT WAGNER: Next registered speaker is Starwater from Colville, Washington.

#60

STARWATER: Thank you, Captain. My name is Starwater. I live in Colville, Washington. And, I honor and respect your position and I would like to believe that the Navy is looking for the best possible solution to this problem. I share the concern in handling these wastes safely and effectively.

Submarines use the ocean; they share it with plant and animal life that live in these waters. We must work together efficiently to serve both the Navy and the ocean life. We cannot dump these deadly poisonous wastes into our living waters. I suggest that before a final decision is made that we continue to look for a beter alternative.

Thank you.

CAPT WAGNER: Thank you.

(Applause.)

CAPT WAGNER: Next registered speaker is Mr. Marcus Tengesdal of Olympia, Washington.

#61

MR. MARCUS TENGESDAL: I am Marcus Tengesdal. I do live in Olympia..

Although saying no without having a viable alternative might seen a little shallow to you, people who aren't technically trained in the area of radioactive disposal need to speak out for what isn't right. Due to the very scanty amount of publicity given for these hearings, I didn't know they were happening until two days ago, which is hardly enough time to do justifiable research into alternatives to ocean disposal.

N.15

Whether planned or not, your tactics of keeping these hearings very low-key and changing buildings at the last minute seem to have succeeded in keeping the public at bay.

Even if your estimates of the maximum amount of radiation levels were correct, who has the right to determine

how many rems we, as living beings, can be exposed to? To say there is no impact on the environment certainly must be an ignorant statement. What about the food chain, to have one example of how it will eventually get to us, even, let alone the animals that are exposed to it immediately? L.36 L.14

When the subs are scuttled, you say they will go down and rest gently on the bottom; how do you know what they're going to do when they get down there? You will be able to watch them? The ocean is the life support system of many cultures and certainly our culture relies upon many products from the sea. How will this radiation be carried by currents throughout the world? J.76 L.53

From going over the DEIS and from testimony heard, I don't see any other option at this point but to dispose of these submarines on the land somewhere in a dry climate. But, at this point, I also haven't heard of a proper mode to do that in and it seems to me the best thing we can do is to wait and someone just may have a better idea and until that point, I think we should just sit tight and leave them where they are. G.2

Thank you.

CAPT WAGNER: Thank you, sir.

(Applause.)

CAPT WAGNER: The next registered speaker is Mr. John Wood of Olympia, Washington.

#62

MR. JOHN WOOD: Good evening, Captain Wagner. My name is John Wood. I'm from Olympia.

The Draft EIS summary in this meeting kind of distressed me. We've heard from about probably twelve people tonight and maybe two this afternoon and four this morning, I believe. That's about eighteen people and eighteen times four is maybe -- we'll call it eighty people across the U. S. who might have said something concerning this disposal of low level nuclear waste. I think that's kind of a sad thing because we will be making decisions that -- you know, this stuff is going to be around for a long time and I think that perhaps in the future -- and I don't know whether this is deliberate or not -- there could have been a bit more planning to make these meetings, one, more accessible and, two, perhaps a bit broader-based because I doubt there's anyone from Hanford here and part of the policy of -- certainly part of this EIS was concern with a land-based disposal system and Hanford was considered and I have a feeling the people in Hanford would have liked to have known about this. And, it seems your minds are already made up.

The summary of the EIS, which I read this afternoon, contained only one single-sentenced paragraph. It was the next to the last paragraph. The sentence read, and I quote, "Sea disposal would seem to be the least costly method.", unquote. Perhaps that should have been the title of the

Draft EIS.

Aren't there other considerations? The report fails to address the need for a national comprehensive policy on the disposal of low level and also high level nuclear waste. Wouldn't that be a good idea? Rather than scatter our waste in areas, and I quote from the Draft EIS again, "cold, dark and tranquil with a sparse population of organisms", end quote, we should develop adequate disposal sites now, disposal sites which incorporate the needs of the future as well as the demands of the present. And, of course, I'm leaving moot the point that perhaps in the future the Navy and perhaps other powers across the world should consider investing in alternative sources of energy for ships, submarines power plants, et cetera. It requires so much time and energy to dispose of and so little time and energy to get started. Most people talk about how little energy is required once things are operating. Well, that's great, but there's so many manhours spent to get rid of the stupid things, it seems as though perhaps we could think a bit more in terms of the future instead of so much in the present. N.3 N.12

That's all I have to say. Good evening.

CAPT WAGNER: Thank you.

(Applause.)

CAPT WAGNER: That concludes the registered people that I have. Is there anyone in the audience who would like to speak who has not registered?

Yes, sir.

VOICE: Yeah.

CAPT WAGNER: I would like you to fill out a registration card for the record if you would, sir, so that we can make sure that we have that.

VOICE: Can I do that on my way out?

CAPT WAGNER: Pardon?

VOICE: Can I do that on my way out?

CAPT WAGNER: Yes, you may.

#63

MR. RICHARD BECK: My name is Richard Beck, and I'm from Olympia, and I just had one thing to say, and that was that so far everybody here tonight has been opposed to dumping them at sea and probably has grave reservations about dumping -- dumping them on the land, too. I mean, there's really nothing to do with these things and we keep making them, but I think that if this has been pretty much the percentage of people that have been opposed to dumping them at sea, that if they go ahead and dump them at sea, it's going to give us a lot of reservations about the whole system for public input, so I just wanted to make that comment on it.

CAPT WAGNER: Thank you, Mr. Beck.

(Applause.)

CAPT WAGNER: Is there anyone else who has not

had an opportunity to speak who would like to do so?

(No response.)

CAPT WAGNER: I'd like to then finally add that additional comments, as I said earlier, may be provided to me at the address that I gave you earlier. If you'd like to make a longer comment, I invite you to do so, and those comments will be considered, as well as those oral comments tonight, in the development of the Final Environmental Impact Statement.

On behalf of the United States Navy, I'd like to thank all of you for your time tonight and particularly for your public testimony.

Thank you very much. This hearing is adjourned.

(Whereupon, at 8:55 p.m., the hearing was concluded.)

#55a*

February 22, 1983,

Public comment regarding disposal of nuclear submarines by the U.S. Navy.

To the hearings officer:

I wish to state at the outset that my comments are offered out of concern for all of the present and future human inhabitants of this planet who may be effected by the proposed disposal of nuclear reactors at sea. Although the proposed project if carried out will likely effect everyone on the planet, not everyone will have the opportunity to express their views about it. Indeed, if past experience is a guide, far more people will come to know of it after the fact, when it is too late to stop the project, and too difficult to remedy it.

I would like to believe that humans are capable of learning from our mistakes, but time and time again that belief is challenged by our recurrent stupidity. The proposal to dump more deadly garbage at sea is another case in point. It exemplifies not only our stupidity, but our arrogance and shortsightedness as well.

As a resident of Tacoma WA. I have seen the effects of short term solutions that have unfortunate long term consequences. There was a time when the industries of Tacoma considered Commencement Bay to be a bottomless toilet, capable of absorbing whatever was dumped into it and in any amount. Over the course of fifty years or so hundreds of thousands of tons of waste products were purposefuly dumped in the bay. The consequences are just beginning to be seen, in diseased fish and other organisms, possibly including humans.

The unfortunate but instructive aspect of the Commencement Bay pollution is that its location makes remediation extremely difficult, if not impossible. Even if it is possible to somehow remove the chemicals from the environment, the cost is likely to be extreme, and almost certainlky will far exceed what it would have cost to dispose of the wastes on land, where it could be more readily accessed.

*W.1 The lesson I hope we could learn is, don't put dangerous things where
they can harm you for years and where you can't do anything about it once they
are there.

That is the lesson I hope we learn, but along comes the Navy with the
A.16 idea that we should dump nuclear submarines at sea, reactor cores and all.

I recognize that there have been environmental impact studies done, but I
J.201 also am aware that the knowledge in this area is exceedingly sparse in
comparison with what we need to know to make a decision of this magnitude.

Just how does the area of the sea in question change over the course of
L.39 tens of thousands of years during which the material will still be dangerous?
Just what organisms live in those locations and what role do they play on
Q.13 other levels of the food chain? What are the long term effects of salt water
and extreme pressure on the submarine and reactor core? Is there any way we
A.16 could remove the material if we find out that it indeed is causing important
damage? How much would that cost? Is it possible that by disposing of the
W.1 material in this way we are unwittingly precluding future use of an area that
may have unique and valuable features?

These are just a few questions to be asked. I am aware that the answer
J.9 will come in the form of best available evidence, but I contend that this is
not yet adequate for a decision of this magnitude. The area of the ocean
floor that is being considered, has been studied very little. In spite of the
EIS and Navy suggestion to the contrary, scientific research studies of the
area consistently contain sugestions that further study is needed and our
knowledge to date is sparse. In view of this is seems far better to store the G.2
material on land than to rush ahead and permanently contaminate an area for
the sake of short term political and economic expediency.

Twenty five years ago, the "best available evidence" did not predict the extent of reactor core brittling that we are finding today, nor was it anticipated that the radioactivity of certain reactor core parts would be higher than is allowable for less costly disposal. These are costly and dangerous mistakes that resulted from our excessive and unnecessary haste. We may not be replicating the specific mistakes with this proposal, but we will certainly be following the same illthought decision procedures, and misplaced priorities that led to them.

If this hearings proposal really has an impact, which I am admittedly not confident that it does, it is difficult to imagine that the submarines will be dumped at sea. I think the public has gradually realized that the ocean is not a toilet, even if the U.S. Navy has not.

Before concluding I would like to note that the public hearing procedure for this EIS was a mockery of the intent of the law. Only four, poorly publicized hearings were held, in locations not necessarily proximal to those which the proposal would impact. Moreover, at the Olympia WA. hearing, the hearing site was changed with exceedingly poor notice regarding the new location of the hearing site. It gave those of us who attended a distinct impression that the Navy did not really want public input into the process.

The EIS itself is, in my judgement, highly inadequate, in the areas
mentioned above, and also in its disregard for worst case scenarios including O.26
costs and consequnces if the plans for this disposal are in error, as
experience has shown they so often are. There should by a new EIS conducted, G.2
or the disposal should be delayed and the submarines mothballed.

In concluding these comments I would like to ask the decision makers who might be inclined to support the dumping at sea proposal, just who in the hell they think they are. What gives them the right to saddle thousands of generations with a potentially deadly threat that they cannot feasibly eliminate. The impression gained at the hearing was that the navy is hell bent on the sea disposal proposal, damn the public input, full speed ahead.

At the Olympia hearing which I attended, the public input was unanimously in opposition to sea dumping. If public input is really important, as a democratic society and NEPA suggest it must be, then there seems to me to be no way the Navy can justify its dumping at sea. The only acceptable course is mothballing, or land disposal. Sea dumping would demonstrate a blatant disregard, not only for the environment and the future, but for the principles of citizen participation in government. The Navy is commissioned to uphold those principles, not circumvent or undermine them.

Thank you for your attention:

Brian N. Baird

Brian Baird
2612 North Union,
Tacoma, WA. 98407

*Other issues discussed by Mr. Baird are side barred in Exhibit 55.

#64

Please return to attendant when completed.

NAME [illegible] DATE [illegible]

MAILING ADDRESS 1200 [illegible]

CITY Olympia STATE WA ZIP [illegible]

SPEAKING AS: (Check one)

- [ ] Individual
- [ ] Representing a Non-Government Organization
- [ ] Representing a Local Government Organization
- [ ] Representing a State Government Organization
- [ ] Representing a Federal Agency or Organization

NAME OF ORGANIZATION OR AGENCY [illegible]

MAILING ADDRESS

CITY STATE ZIP

Written comments may be provided on the other side.

The debate over where to dump nuclear waste, highlights the fundamental anarchy which is at the core of the nuclear industry as a whole. Information about the effects of radiation on all living things is readily available to both the public + the military. Lack of knowledge of these disastrous effects is not the issue. Decisions are made not in ignorance of information but in blatant contradiction to that information – to the facts. The reason for such seemingly [illegible] behavior is cost + profit. Facts are manipulated and misconstrued to deceive the public in order to benefit a minority. The public wishes to be dealt with honestly + fairly. Continued resistance to public need and desire will only increase the pressure. A shift in values and perspective is a prerequisite to rational, safe decision making policy re: nuclear waste.

N.3

Testimony at the Public Hearing

on the

Draft Environmental Impact Statement

on the

Disposal of Decommissioned Nuclear Submarines

Thursday, February 24, 1983

Department of Water Resources
1416 9th Street
Sacramento, California

Morning Session

Reported By: Theresa French, CSR No. 5750
Ida Ruth Lundsten, CSR No. 5751

Sacramento, California

February 24, 1983

--oOo--

CAPTAIN EDWARD F. WAGNER: Ladies and Gentlemen, if you would please take your seats, we will convene this hearing.

Good morning, ladies and gentlemen. This hearing is called to order. I am Captain Edward Wagner, and I work in the office of the Deputy Chief of Naval Operations for Submarines. I have been appointed the Navy Hearing Officer for this morning's public hearing.

Here with me to present an opening briefing is Mr. James Mangeno, Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program.

This public hearing is being held to receive comments on the Navy's Draft Environmental Impact Statement evaluating alternatives for disposal of nuclear powered submarine reactor plants after the fuel has been removed and the ships are no longer needed. The Navy has conducted studies on the feasibility of burying the defueled reactor plants in government-owned land disposal sites or placing them on the deep ocean bottom.

On December 22, 1982, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement or DEIS on the disposal of decommissioned, defueled nuclear powered submarines. The DEIS contains the results of the Navy's studies of the alternatives available. On the registration table, as you entered this auditorium, you'll find copies of the Summary of the Draft Environmental Impact Statement. Anyone in the audience who would like a complete copy of the DEIS should leave their name and address at the registration table on the sheet of paper provided and a copy will be mailed to you.

The Navy's Federal Register announcement also scheduled public hearings at various locations which are convenient to people with an interest in this matter in order to provide them with an opportunity to present their views. I am here today to conduct one of these scheduled public hearings. The purpose of this hearing is to take testimony regarding the Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case nor to engage in debate. It is my responsibility to receive statements so that they can be considered in preparing the Final Environmental Impact Statement.

I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established for this hearing. As set forth in the announcement of the hearing, individual speakers are to limit their testimony to five minutes each, and organizational spokesmen are limited to ten minutes unless additional time had been requested in advance. Time cannot be relinquished from one speaker to another.

In order to insure all who desire to speak are given an opportunity, each person should fill out a registration card and provide it to the registration table. All testimony will be recorded so that it can be considered in the development of the Navy's Final Environmental Impact Statement.

If you desire to submit written comments rather than speak, that is acceptable. You can provide written comments to me or you may leave them at the registration table. If you desire to provide written comments at a later date, you may mail those comments to me at the following address: Captain Edward F. Wagner, W-a-g-n-e-r, U. S. Navy, Office of the Chief of Naval Operations, OPNAV-22, that's O-P-N-A-V dash 22, Department of the Navy, Washington, D.C., zip code 20350.

You should provide your written comments by March 31st of 1983, which as stated in the Federal Register notice is the cutoff date for submitting comments.

Before we begin receiving testimony, I would like at this time to introduce Mr. Mangeno of the Naval Nuclear Propulsion Program who will provide a general overview of the issue the Navy is addressing and the content of the Draft EIS.

--o0o--

CAPTAIN WAGNER: Mr. Mangeno?

JAMES MANGENO,

Deputy Director of Nuclear Technology for the Naval Nuclear Propulsion Program.

Today's hearing is being conducted as a part of the decision-making process required by the National Environmental Policy Act. Under this law, the Navy must prepare an environmental impact statement for any action which could have a significant environmental impact or which might be subject to controversy over the environmental effects. The environmental impact statement must include the environmental impacts for all reasonable alternatives.

The Navy's Draft Environmental Impact Statement or DEIS on this subject provides the basis for these hearings and the slides that follow are from the DEIS. It describes the alternate ways the Department of the Navy, in cooperation with the Department of Energy, is considering for permanently disposing of defueled nuclear powered submarines after they are no longer needed. The practical choices are bury the radioactive part of the submarine at an existing DOE land disposal facility at the Hanford Site in the State of Washington or the Savannah River Plant in South Carolina, or place the

entire submarine on the bottom of the ocean in water more than 2.5 miles deep.

In both choices there would be no nuclear fuel left in the submarine because all of it would be removed before disposal. Nevertheless, there would be some low-level radioactive materials left within the submarine.

Preparation of this Draft Environmental Impact Statement does not mean that the Navy has already decided to dispose of nuclear submarines. The Navy currently has about 120 nuclear powered submarines in operation and five submarines already in protective storage. However, as the number of submarines reaching 25 to 30 years of operation increases, as shown in this slide, it is evident that a disposal plan must be prepared for use sometime in the future.

This DEIS has been prepared now so that all interested agencies, organizations and private citizens can have their views on the available courses of action factored into the Navy's decision. Because this statement has been issued well in advance of any action, there is adequate time for such consideration prior to implementation of any decision.

The submarines are constructed with the nuclear power plant enclosed within a single section of the ship called the reactor compartment. This slide shows a typical submarine with the location of the reactor compartment identified.

Before a ship is taken out of service, the fuel is removed from the submarine in a process called defueling. This defueling removes all of the uranium and all of the fission products. The removed fuel is handled according to established procedures and is not discussed in the DEIS because it would not be included in the disposal of submarines. This defueling removes most of the radioactivity from the ship.

The next slide shows a simplified picture of the nuclear power plant inside the reactor compartment. During operation of the ship, some of the neutrons travel from the fuel, which is installed inside the high-strength steel reactor pressure vessel, the metal structure supporting the fuel to the reactor vessel, and to other equipment in the reactor compartment where they are captured in the metal and cause it to become radioactive. The radioactive atoms which were formed in the metal structures in the reactor compartment would be contained by the hull of the submarine and by the reactor vessel and coolant piping.

In addition to these containments, the radioactive atoms are an inseparable part of the metal and are chemically just like the rest of the iron, nickel or other metal atoms in the reactor plant. These atoms can only be released from the metal by the slow process of corrosion, like the rusting of common iron or steel.

This slide shows the important radionuclides which would remain in the ship six months after the final operation

of the nuclear reactor and the number of curies of each radionuclide at that time. A curie is a measure of the amount of radioactivity present, but it is not an indication of the possible effect on man or animals. The amounts and kinds of radioactive atoms present are described in detail in Chapter 1 of the DEIS.

As shown in this slide, the amount of radioactivity in each submarine will constantly decrease with time, regardless of the method chosen for disposing of the submarine.

One way to permanently dispose of the radioactive material remaining after the fuel is removed would be to bury the metal components inside the reactor compartment at one of the Federal Government disposal facilities already used for such low level radioactive waste at the Hanford Reservation in the State of Washington or at the Savannah River Plant in South Carolina.

The best way to accomplish this would be to leave the radioactive equipment installed in the reactor compartment, cut the compartment free from the remainder of the submarine and weld the reactor pressure vessel and the reactor compartment shut. This would provide an excellent container for permanent disposal and it would avoid the radiation exposure to shipyard personnel that would otherwise be associated with removal of individual parts.

The compartment would be loaded onto a barge and towed to a river landing near the Hanford or the Savannah River Plant site. Other government-owned land disposal sites have been considered for reactor compartment burial, but all except the Hanford and Savannah River Plant sites were eliminated from consideration, primarily because the others were too far from navigable waterways so that transportation of the reactor compartment to those sites would be impractical. The Hanford andSavannah River burial grounds are described in Chapter 1.

A transporter of the sort shown in this sketch would then be used to haul the compartment overland to the burial location. There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial or after burial. This is because radiation outside the compartment would be well below federal limits and the reactor compartment would have been welded shut at the shipyard to prevent entry.

These compartments could be buried in accordance with existing requirements for burial of low level radioactive wastes. The reactor compartments would be physically larger than packages currently being buried at these locations, but the amounts of radioactivity would be consistent with current burial and would result in no significant additional environmental effects.

Because the radioactive atoms are a part of the structural metal itself, they cannot be readily taken into the

body. More than 200 years would pass before the reactor compartment bulkhead could be penetrated by corrosion, rust. Following the penetration of this exterior containment, the reactor pressure vessel inside would remain intact for a long time exceeding several thousand years. Corrosion of the metal inside the reactor vessel could only then slowly release the remaining radioactive atoms.

Disposal of the reactor plants by sinking the entire submarine into the deep ocean is another practical alternative. The maximum radioactivity would be less than the limit specified by international criteria and the triple containment provided by the submarine reactor compartment, by the reactor vessel and piping, and by the radioactive atoms being a part of the metal itself would be an extremely strong and effective disposal containment package.

Locations for possible oceandisposal have not been selected. If ocean disposal were selected by the Navy, a separate process would be required to obtain a permit from the U. S. Environmental Protection Agency. Part of that permit process would include the selection of ocean disposal sites. Separate site-specific public hearings would be required and the permit process is not part of this DEIS.

However, two study areas in the Atlantic Ocean about 200 miles east of Cape Hatteras, North Carolina, and another in the Pacific Ocean centered approximately 190 miles west of

Cape Mendocino, California, have been used to perform extensive research on currents, sediments, geology, chemistry and marine biology for very deep ocean locations. The depth of the water in these areas is between 4,000 and 5,000 meters, that's 13,000 to 16,000 feet. The scientific information and measurements collected in these areas have been used to make technically well-founded estimates of the potential effects of ocean disposal. The study areas in the Atlantic and Pacific Oceans were also selected to be typical of any site that might be chosen under existing international rules for ocean disposal so that environmental impacts could be calculated using realistic data.

Preparations for ocean disposal would be made at one of the shipyards normally servicing nuclear powered naval vessels. Following defueling, the reactor vessel and the reactor compartment would be filled with water to prevent crushing during sinking and sealed.

Research and analyses have shown that the submarine would reach the deep ocean floor with the containments provided by the hull, the reactor vessel and piping and, of course, the metal itself completely intact. Most of the radioactive atoms imbedded within the metal would have changed to nonradioactive atoms before corrosion could penetrate the hull and piping or free the atoms from the thick metal.

A comparison of the possible effects on the

environment associated with ocean and land disposal has been presented in Chapter 4 of the DEIS. This slide shows the conservative estimates of the possible radiation exposure to a person from 100 submarine disposals for the year of greatest exposure for both options. This table shows that the radiation exposure would be very small and could have little impact on individuals or the population. These levels are also many times less than any limits established by U. S. regulations or international limits. They are much smaller than the normal fluctuations in annual average background radiation exposure for U. S. residents.

A perspective on radiation exposure can be gained by examining the exposure a person would receive from natural cosmic background radiation if he flew round trip from New York City to Los Angeles. That person would receive approximately two millirems more radiation than if he had not made the trip because there is more cosmic radiation at higher altitudes where the atmosphere is less dense.

Another perspective is that the exposure to an individual watching television two hours each day for a year would be approximately one-half millirem.

Other environmental impacts are similarly small for both options. The effects on animal life would be small and localized in either case. Land burial of 100 reactor plants would require only about ten acres of land and disposal at sea would actually occupy about the same area, with the submarines arranged over approximately a square ten miles on a side.

The costs for disposal of a submarine have been estimated and are shown in this slide. The least expensive method for land disposal would cost about forty percent more, about two million dollars per submarine more, than sea disposal.

The "no-action" alternative is to place submarines in floating protective storage for an extended period, commonly called "mothballing." However, this would only temporarily delay disposal because it does not provide a permanent solution and permanent disposal would eventually be required. Protective storage would increase the costs. Since potential exposure to the public would be so small for the other alternatives, there is no advantage to be gained.

In summary, there would be no significant environmental impact from any of the disposal methods, and the estimated radiation exposures for the general public would be very small for all available courses of action.

Thank you.

CAPTAIN WAGNER: Thank you, Mr. Mangeno.

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CAPTAIN WAGNER: Ladies and Gentlemen, Mr. Mangeno's presentation concludes our formal portion of this morning's hearing. I will now recess briefly to establish an order for persons who wish to speak. For those people who would like to testify and who have not yet registered, you may do so at this time.

We will now take a ten-minute recess, and we'll reconvene the hearing at 9:45 and start testimony.

(Brief recess)

CAPTAIN WAGNER: Ladies and Gentlemen, if you will please be seated, we will reconvene the hearing.

Ladies and Gentlemen, this hearing is going to reconvene. If I could have your attention, I will explain the order for testimony.

Simply to establish an order for the statements, I intend to ask individuals representing State government organizations to speak first in alphabetical order of the speakers' last names followed by individuals representing local government organizations, also in alphabetical order by last name of the speaker and then private organizations and private citizens in alphabetical order by last name of the speaker.

I request your cooperation in providing comments within the time limits established so that we may be certain all who wish to speak have an opportunity to do so. Once again, that's five minutes for individuals and ten minutes for organizational spokesmen. If your statement is so long that it cannot be provided within those time limits, then you may summarize in the five- or ten-minute period, and the entire statement will be included in the record if you submit it in writing.

The procedure for public testimony will be as follows: I will announce each registered speaker. When called, please proceed to and use the microphone here in the front of the auditorium. We're going to use the one microphone for the convenience of the press this morning. State your name and organization, if any. Even though I announce your name, I'd like you to state it properly for the record and your organization, if any. All comments are to be addressed to me, please.

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CAPTAIN WAGNER: I'm honored this morning to announce as our first speaker the Honorable Leo McCarthy, Lieutenant Governor, State of California.

LEO T. McCARTHY,

Lieutenant Governor, State of California.

Thank you, Captain Wagner, and I'm very appreciative first of all of your being here to hold this hearing. Am I at a microphone?

CAPTAIN WAGNER: Yes, sir.

MR. McCARTHY: All right. I'm appreciative of being here to -- that you're even holding this hearing so that those of us in elective office and other citizens of California can give our views on a very critical issue, and you indicated the first capacity in which I appear as Lieutenant Governor of California. I'm here as a co-author of Senator Barry Keene's 1982 resolution in which the legislature directly asked the President and the Congress to ban the dumping of radioactive wastes, specifically including the scuttling of nuclear submarines, in our coastal waters.

It's difficult to approach today's hearing without somehow feeling that we're the targets of an aggression by our own federal representatives. It's difficult to -- and I also find it difficult to accept that those who insist on what

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I perceive as a kind of deadly nuclear littering as cost effective as clear public policy thought. It's not difficult to understand the thinking of Congress when it recently voted with bipartisan support for a two-year moratorium on ocean dumping, this after nearly 50,000 barrels of radioactive waste had already been dumped off California's coastline. That two-year moratorium is barely started, and yet here we are seriously discussing plans to go ahead and commit an act of national litterbugging and deliberate disregard of the known and unknown dangers that I think it might cause us, and with all due respect, this is not a decision really to be made just by the United States Navy or in the corridors of the Pentagon. The responsibility must fall where it belongs, on the President and the members of Congress, our elected civilian policy makers. It was to them last year that California's Legislature addressed Senator Keene's resolution which urged no more dumping of radioactive waste off our coast until it has been proven safe by valid and reliable scientific studies. So far, no such studies have been conducted that are known to us. To the contrary, each passing year reveals more evidence seriously questioning the scientific basis for believing ocean dumping to be safe.

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There were promises that there would be monitoring of the 50,000 barrels of nuclear waste already sitting off our shores. Those promises I don't think have been kept because

the Environmental Protection Agency has changed its program priorities.

So we are told it is cost effective to dump nuclear submarines into the ocean where their radiation can so easily affect the sea life upon which this hungry world depends. And we are also told that it isn't a high priority to check up and see what that radiation is doing.

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L.6

This is clearly another of the growing problem of toxic waste in our society, a danger from which politicians, including me, are supposed to be protecting the public or trying to protect them. If the United States Government can respond so promptly to public concerns over dioxins in Missouri, surely this issue is important enough to warrant some prompt and serious attention by the President and by the members of Congress.

The Navy says its plan to scuttle 100 nuclear subs off the Northern California coast is perfectly safe yet it has chosen an area quite close to geographic fault lines which pose enough of a threat to us on their own without the added ability to unleash a wave of radioactivity along with the next earthquake. They're quite common here as you know.

J.19
F.22

We know there are alternatives for handling decommissioned nuclear submarines. Land disposal of the radioactive elements is one option, not a happy one, but a better option than this one we're considering. Mothballing the submarines for possible

G.2, G.3 later use or later disposal is another option. I suggest to you that this plan is really not an option we should be seriously pursuing.

L.22 Given current evidence that leaking radioactivity does not harmlessly disperse in ocean water but instead it sinks to L.36 be absorbed into the bottom sediment there to become part of the food chain, this ocean disposal is many things. I see it as foolhardy, it's high risk, perhaps ultimately self-destructive. I do not consider it a reasonable option.

The danger of this procedure, in my view, is not eliminated merely by moving it offshore. It is merely disguised, and that may make it all the more dangerous.

J.9 The day may come when scientific research indicates a way to safely use the ocean depths for disposal sites, a day W.1 when we are so certain that we can afford to set a course which is almost irreversible. I don't see that day as having arrived.

The day which has arrived is this one when so many of us are here to deliver to you, in respect, the same message. We will not willingly accept further designation of our coastline as a nuclear garbage disposal. We will not willingly N.3 accept the risk which we are being asked to take in the name of cost effectiveness.

Our message is simple and please listen to us and carry it back. I will represent the responsibility of communicating directly with the President and the members of Congress.

Thank you very much for your courtesy.

CAPTAIN WAGNER: Thank you, Mr. McCarthy.

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CAPTAIN WAGNER: I am pleased to announce our next registered speaker, Ms. Susan Wade from the U. S. House of Representatives Merchant Marine and Fisheries Committee. Ms. Wade is speaking for Congressman Douglas Bosco and Congresswoman Barbara Boxer.

SUSAN O. WADE

Thank you, Captain Wagner. My name is Susan Wade, and I'm on the staff of the U. S. House of Representatives Committee on Merchant Marine and Fisheries. Our committee maintains legislative jurisdiction over the Marine Protection Research and Sanctuary Acts which governs ocean dumping including low level nuclear waste on the Navy submarines. It is in the capacity of committee observers that I'm attending the hearing today. However, additionally, because they cannot be here, two members of our committee also California Representatives, have requested that I read the testimony which they have prepared for today's hearing. I am pleased to do so. The first will be on behalf of Congresswoman Barbara Boxer. The second on behalf of Congressman Douglas Bosco.

It reads, "Statement for Testimony at U. S. Navy Hearings in Sacramento, February 24, 1983, on Draft Environmental Impact Statement Regarding Disposal of Nuclear

Submarines.

"Nuclear waste disposal is one of the most critical and sensitive issues of our time. The process by which we confront the difficult decisions surrounding this issue has ramifications today and for generations to come.

"Whether we are talking about Cobalt 60 with a half-life of 5.2 years or Plutonium with a half-life of 22,000 years, the issue must be addressed as a whole. Whether we talk about 47,500 fifty-gallon drums which were dumped off the Pacific and Atlantic coasts in the years between 1946 and 1970, or about 100 nuclear submarines each of which would equal fifty percent of all nuclear waste dumped in the sea prior to the present ban, the issue is the same: Where is the safest possible place to store radioactive waste?

"We are treading down a path upon which errors, poor decision-making, inadequate data gathering or dangerous precedent setting would prove most unforgiving in the future. The history of toxic waste disposal -- nuclear or otherwise -- is already rife with examples of bad planning, insufficient monitoring, ill informed decision-making, and consequent health and safety impacts.

"As we prepare to step further down the necessary decision-making path on the nuclear waste disposal issue, the public would like to feel secure in the knowledge that the appropriate steps all have been taken, that all the facts and pieces of the puzzle are in hand before we proceed.

"After review of the DEIS on the proposed ocean alternative for nuclear submarine disposal, I find it inadequate in the following respects:

J.76 "No. 1, the monitoring program proposed in the DEIS

I.13 is inadequate for either sea or land disposal of nuclear submarines.

L.7 "No. 2, cumulative impacts of incremental increases in radioactivity entering the marine environment from these submarines are not considered in the DEIS.

H.3 "No. 3, the disposal alternative which minimizes corrosion and hence release of radioactivity has not been considered in this document. A monitored land disposal option which considers placing the reactor compartments in the least corrosive terrestrial environment -- namely, placing the compartments on land, unburied -- should be considered.

J.76 W.1 "No. 4, placing submarines on the seabed makes monitoring extremelty difficult. Retrieval, if problems arose, would be virtually impossible, according to the Navy's DEIS.

"No. 5, California is home to a multi-million dollar

L.53 fishery. Any potential leakage of radiation and consequent uptake by the flood web could have catastrophic impacts on the economy and potentially on human health.

"No. 6, finally, and of paramount importance, the DEIS states that the key questions and information regarding

L.1 bioaccumulation and ecological transport are still unanswered. Until the scientific community and all the public have all the information on what potential marine impacts and social and biological costs may be, no decision can be made. Fundamental biological answers are the key to decision-makers' questions, and we don't have them.

"In summation, the combined concerns and data gaps as indicated in my testimony bring me to speak against the sea disposal option as presented." Barbara Boxer, Member of Congress.

Miss Boxer invites you to contact her with any questions at her Washington address: 1517 Longworth Building, Washington, D.C. 20515, phone number 202-225-5161.

Now I will read the statement prepared by Honorable Douglas H. Bosco, Representative in Congress from the State of California.

"I appreciate the opportunity to comment today on the Navy's Draft Environmental Impact Statement on the disposal of nuclear submarines. The many serious questions raised by the DEIS demand thorough public review and scrutiny.

"From the outset, however, I wish to express my concern

J.15 over the Navy's refusal to hold public hearings on the DEIS in either Fort Bragg or Eureka, California. Council on Environmental Quality regulations for DEIS preparation state the need to quote, 'describe the environment of the area to be affected or created by the alternatives under consideration.'

"With the designation of an area off Cape Mendocino for generic scientific studies, the residents of the North Coast of California are obviously concerned over the future of their environment. Who is in a better position to describe the many facets of their environment than these residents? They should be afforded the ample opportunity to comment on the ocean disposal option, and the impact such disposal may have on the North Coast.

"As stated in a formal request by all twenty eight Democratic members of the California Congressional delegation, both the time and location of these hearings may prevent access to many concerned citizens. I would hope the Navy reverses its position and expands these hearings for the citizens of Mendocino, Humboldt and Sonoma Counties.

L.9 "Beyond this, I would like to address two basic concerns: the precedent that low-level radioactive waste disposal could set, and the counterproductive nature of this DEIS in alleviating public concerns over ocean disposal.

"As the Navy has stressed, all nuclear fuel and its accompanying uranium and fission products will be removed from each submarine before ocean disposal. The DEIS estimates the radiation exposure to people from remaining materials would be less than natural background radiation. An important variable in this 'low-risk' disposal option, however, is careful site selection. State and local government, as well as

individual citizens, are concerned that conditions making an area acceptable for low level waste disposal will later be viewed as conducive to future high-level waste dumping as well.

"Actual ocean conditions making areas off Cape Mendocino preferable for generic scientific studies or low-level waste disposal will still exist should the Navy or some other governmental department deem further dumping necessary in the future. Unless it is dealt with responsibly, the controversy over the ocean dumping proposal could also result in increased public opposition to alternative means of disposal in the future. L.9

"The unique and delicate nature of California's natural resources is the lifeblood of its major industries. The residents of this area are obviously opposed to making the California coast a dumping ground for national problems. This natural concern of North Coast residents has been exacerbated by several factors associated with the DEIS. It has actually increased fears about offshore dumping rather than allay them.

"First, a detailed environmental impact statement is required for federal actions significantly affecting the quality of the human environment. Yet in defining the very basis for an EIS, the Navy overtly states its bias against very real environmental concerns of the public. The foreword to the DEIS indicates the need for study of the submarine disposal options because of 'anticipated high interest rather than the expectations that either option would significantly affect the quality of the human environment. Potential dangers associated with any release or dispersal of radioactivity place a premium on insuring that all environmental and economic considerations are carefully weighed. Publicly defining the government's expectations before a nonbiased, scientific appraisal of the options can be made does not engender much public confidence in the conclusions reached.

"Also, the highly technical nature of the generic scientific studies used to support the DEIS are difficult for the non-scientist to assess adequately. The selection of areas off Cape Mendocino for generic studies entails technical analysis regarding currents, temperature and geochemistry. Allowing just sixty days for public consumption, analysis and comment will only add to the concerns of many who feel the Navy is not soliciting sufficient local input. With so much at stake, it is important that local government and residents not feel shut out from the impact assessment process because of strict time constraints.

"All involved interests would greatly benefit from well-considered and thorough comments from the public. I would urge that the request of seventeen environmental and citizen organizations be granted in extending the comment period on the DEIS for ninety days to June 10th, 1983. Lack of

sufficient time for public review and comment could seriously jeopardize the Navy's attempt to obtain the cooperation of state and local interests.

"Furthermore, Section 1502.14 of CEQ regulations states the need to present alternatives in the comparative form. The DEIS should define the alternatives in detail, providing a 'clear basis for choice among options by the decisionmaker and the public.'

"While I do not wish to lay claim to any advanced scientific knowledge, detailed analysis appears absent from certain aspects of the ocean dumping alternative. There is certainly inadequate data and analysis, for instance, on possible effects on ocean food chain pathways. Leakage of concentrations of radioactive material into the food chain could have profound and unforeseen consequences. L.36 L.20 There is also insufficient analysis of the abundant marine life located near the Cape Mendocino site where studies were undertaken. J.9 These and other shortcomings in the Navy analysis of ocean dumping cannot be perceived as providing a clear basis for comparison with land disposal. I remain concerned that the 'easiest' and 'cheapest' way to dispose of aging submarines may not be the most environmentally sound. N.3

"In conclusion, I wish to urge the Department of the Navy to consider these factors in evaluating the DEIS on the most appropriate means of disposal. The [illegible], [illegible] and

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environmental way of life of hundreds of coastal communities may be at stake in your decision."

That concludes Congressman Bosco's statement. He too has invited you to contact him with any questions at 1330 Longworth Building, Washington, D.C. 20515, area code 202, 225-3311.

Thank you.

CAPTAIN WAGNER: Thank you, Ms. Wade.

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CAPTAIN WAGNER: The next registered speaker is the Honorable Barry Keene, California State Senator.

#67

SENATOR BARRY KEENE

I want to thank you for receiving my testimony today which is really a petition for redress of grievances both past and proposed. Under the Constitution of the United States, in discussing technicological safety, and I hope it won't be regarded as a cheap shot, but I couldn't fail to notice that the system, the sound system in this room was so far from fail-safe this morning at this important hearing at the most -- at the Capitol of the most populace state in the union that it almost drove all these people away, that I want to assure you that for every person out there now there are 100,000 people in California that are equally concerned about this issue. We Californians are very much a Pacific people. Every Californian lives near the shores of the Pacific Ocean. We visit it; we swim in it; we sail on it; we eat seafood from it; we earn our livelihood from it; we depend upon it fully. We're concerned about the fact that the Draft Environmental Impact Statement makes clear that the Navy plans to scuttle its decommissioned nuclear submarines still very highly radioactive probably off of Cape Mendocino in the area that I represent and the area that Congressman Bosco represents

***Other issues discussed by Senator Keene are side barred in Exhibit 67a.**

and the area that other congresspeople represent and the area that the Lieutenant Governor is so concerned about.

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The conclusion that it's preferable that sea disposal is preferable to burying submarines on land is a very questionable one, and there is the more practical alternative of storing them at land sites where the radioactive reactor vessels can be studied, monitored, and if necessary, retrieved.

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And as concerned as we are about the more than 100 out-moded nuclear submarines, we are more concerned about the additional radioactive garbage that would be dumped in the new Pacific Coast dump site if the Navy initiates dumping there.

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We know that once one federal agency such as the Navy begins dumping at Cape Mendocino or any other site, other federal agencies will follow suit. But worse still, so will other nations, and if that occurs, the same history that will now not let us forget things like the internment of Japanese-Americans in World War II, will not forgive and forget the fact that Americans led the way to making the oceans a nuclear dumping ground, a nuclear sewer, and we can't let that happen because we're too proud of ourselves.

L.7

In the language of federal law, we are concerned about the cumulative impact of all past and future radioactive pollution of the Pacific from the South Pacific nuclear weapons tests, fallout from nuclear explosions around the world, past dumping by this country and other countries, other future

dumping. We're concerned about natural background radiation and all other radiation sources. We're concerned that together they could raise specific ocean radiation to very, very harmful levels.

L.7

A year ago, on February 18th, 1982, I wrote to you, Captain Wagner, to call your attention to the fact that the annotated outline of this report failed to consider the cumulative impact as required by the Federal Council and Environmental Quality Regulations that implement NEPA, a National Environmental Policy Act. The response assured me that the report would "include a consideration of cumulative impacts of action in compliance with the Council on Environmental Quality Regulations."

However, as far as I can tell, that consideration does not appear in this report. In passing Senate Joint Resolution 27 last year, the California Legislature opposed dumping of radioactive wastes in the Pacific until and unless future scientific studies proved it to be safe. This report does not prove that the cumulative impact is safe. It doesn't even try. We cannot comment on its data and its conclusions about the cumulative impact because it presents none. We can only comment on its data and conclusions about the facts of scuttling the more than 100 nuclear submarines that the report does discuss.

Independent scientists who have studied the report

*Other issues discussed by Senator Keene are side barred in Exhibit 67a.

are best qualified to comment on the quality of its research. Some of them will testify later today, Dr. Michael Herz, for example. A biologist with the Oceanic Society will present evidence suggesting that the report relies on skewed data on the rich commercial albacore catch at the Cape Mendocino site.

Other scientists still are conducting their studies of the report and intend to submit written comments before the deadline. I've asked and I ask again now that the deadline be extended until June 30th to allow them to prepare and submit the most useful comments possible on this important question. Commercial fishermen who fish the Cape Mendocino site are best qualified to comment on the data and conclusions about what fish are found at the site and what concentrations; about whether there is significant upwelling that would bring radiation to the surface quickly; about which way and how fast the prevailing currents could carry that radioactive pollution; and about vessel traffic in the area.

J.15 Some of the fishermen will testify later today. More will testify if you grant the request that I and many others have made, and then I repeat now for local public hearings in Fort Bragg and Eureka, the two major fishing towns nearest the Cape Mendocino site.

I do wish to note one more flaw in the data that the report presents to support its conclusion on what the Navy considers the key factor, the turning point on this issue, and

that's dollar cost. In the abstract on the title page and throughout the rest of the report, it concludes again and again that the only reason to prefer scuttling over land burial is its lower cost. The report even fails to consider the exorbitant cost of the eternal monitoring of the scuttle submarine that would be required under existing federal law, J.76 and incredibly the report fails to present any data or calculations to support its conclusion about dollar savings. O.2

Finally, I will also note one other major flaw in the data and conclusions on what I believe to be the key factor, retrievability or the lack of it. The report ambiguously states that retrievability would not be possible with current technology. Now, if you look at those words, the conclusion is very ambiguous. It's undocumented in the first place, but W.1 what does it mean? Does it mean on the one hand that the submarines might become retrievable with some future new technology? If so, we should be able to be informed because we wish to be an informed public in assisting in this decision. We need to know what that new technology is that is contemplated and how much it will cost and add to the cost of ocean dumping. If not, the report should state honestly that the submarines, once sunk, will be irretrievable. We should say clearly that if scuttling later proves to be a mistake, it will be an uncorrectable one and the submarines will be out there emitting radiation into the Pacific Ocean for thousands and thousands of years.

In concluding, let me simply state, and we must remind ourselves of this from time to time, I do, others must, government is charged with protecting, protecting the lives and safety of its people, not creating risks to them. The words of Lincoln -- the words of Lincoln always come to mind. He said it was a government of the people, by the people, for the people, and not a government against the people.

Thank you very much.

CAPTAIN WAGNER: Thank you, Senator Keene.

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CAPTAIN WAGNER: Our next registered speaker is Mr. Peter Douglas representing the California Coastal Commission.

#68*

PETER DOUGLAS

Thank you, Captain Edward. My name is Peter Douglas. I'm Chief Deputy Director of the California Coastal Commission, and for the record, I want to indicate that we will be submitting written comments on the Draft Environmental Impact Statement to you within the deadline that exhaustively goes over the various points concerned to us.

The California Coastal Commission is responsible for implementing the California Coastal Act of 1976. This statute is the main component of the California Coastal Management Program which has been approved by the Federal Government for carrying out national coastal policies as well as State coastal policies, and under federal law, the Coastal Zone Management Act, enacted in 1972 -- in fact, a month before the citizens of California passed Proposition 20 -- the Federal Government may not conduct activities which directly affect California's coastal zone unless the federal agency undertaking that activity first determines that the activity would be consistent with the maximum extent practicable with the California Coastal Management Program, and then that determination must be submitted to the California Coastal Commission which would

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*Other issues discussed by Mr. Douglas are side barred in Exhibit 68a.

either concur or not concur in that determination.

If the Coastal Commission disagrees with the determination of consistency, the activity may not take place unless the federal agency is prohibited by some other federal law from complying with that state law, and I think that's a very important point to make because I notice that there has been no mention made that the State of California does have a vehicle, a handle, through which to review this proposed activity.

The Coastal Commission staff, based on the information that we have been able to review to date, is of the opinion that the activity proposed, the scuttling of nuclear submarines off the coast of California would directly affect California's coastal zone, and that, therefore, a federal consistency determination would have to be made and that consistency determination would have to come to the Coastal Commission for review.

The Coastal Act of California calls for the maintenance, enhancement and restoration of marine resources. Under the Coastal Act, uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healthy populations of all species of marine organisms adequate for the long-term commercial, recreational, scientific and educational use of the people.

The effects of any ocean dumping of radioactive wastes would have to be measured against these and other Coastal Act provisions.

I think the main concerns that we have, and I'm not going to go over all these. I have this statement in writing and will submit it to you, but we are concerned about the bio-accumulation of radionuclides through the marine food chain; we're concerned about radiation in marine waters that can affect the fecundity of fish, most especially currently over-exploited fish species; direct and in part perceived in terms of what the impact of the disposal of radioactive materials offshore California would be.

If the consumer knows or feels that fish and shellfish are coming from coastal waters where radioactive wastes have been recently dumped, the purchaser is quite likely to avoid fisheries' products from California. Consumer avoidance or rejection of fisheries' products due to potential radiation damage would devastate coastal fisheries in California.

We think that kind of an impact must be considered and is a direct impact.

The cumulative effects of a disposal of radioactive wastes in the Pacific Ocean must be carefully assessed. Nuclear wastes have been dumped at several locations off the California coast and numerous other places in the Pacific, and accurate records have not been kept. Some monitoring of

NOTE: The issues discussed by Mr. Douglas are side barred in Exhibit 68a.

existing dump sites has been done, but these studies and this monitoring has been quite cursory. Little definitive information has been generated about the fate and effects in the ocean and on the ocean of the various specific types of radioactive wastes that have been dumped.

The Navy's consideration of scuttling nuclear subs off the Mendocino coast is the most immediate and alarming proposal to reestablish the use of California's ocean waters offshore California as a radioactive waste receptacle. One of the most significant issues that has to be addressed, as Senator Keene pointed out, is the retrievability. If serious problems are discovered after the marine disposal of the radioactive wastes, it would be nearly impossible, if not actually impossible, to take any corrective action at that point.

In reviewing a future federal consistency to scuttle nuclear submarines off the California coast, the Coastal Commission would have to consider several -- would expect that several issues be adequately addressed through the provision of adequate information, thorough information that would give us answers about certain -- about these following points: ocean currents, for example. We need a detailed assessment of current conditions and a model projecting the maximum movement of radionuclides dumped where they are dumped. The movement, potential movement of those wastes, is going to be very important to know.

The geology of the earth. What is the seismic history of the area? What is the likelihood of major seismic activity? What effect would an earthquake have on the dumped material?

As to living marine resources, we would need a detailed survey of the plants and animals which inhabit or pass through the dump site. An accurate mapping of all fish breeding and spawning areas is also necessary. This data must be carefully correlated with water movement data to determine potential effects on fishery stocks. How do these particular radionuclides react in seawater? What are the potential synergistic effects? The question of bioaccumulation must be addressed in detail.

Dumping of nuclear wastes in California's ocean waters would certainly affect the public's acceptance, if not the direct productivity and vitality of fisheries offshore. So the fishery, the impact on the fisheries must be addressed.

And then I think one of the most important aspects of it, and that is the precedential effect of such an activity and the cumulative effect of dumping radioactive waste off the shores of California.

In conclusion, the California coastline is the gateway to the Pacific Ocean for millions of visitors from throughout the world. The Pacific is a rich source of food for mankind and an important element in the California and national economy. It is critical to the well-being of California, the nation and the world that the biological health and productivity of ocean waters along the coast be vigorously protected and preserved. The vitality of this rich environment should not be jeopardized by a quick fix solution to the long-term problem of nuclear waste disposal.

Thank you.

CAPTAIN WAGNER: Thank you.

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CAPTAIN WAGNER: The next registered speaker is Wesley Chesbro from Humboldt County.

#69

WESLEY CHESBRO

Captain Wagner, as you said, my name is Wesley Chesbro. I'm a member of the Humboldt County Board of Supervisors, and today I am representing a unanimous position of the Board of Supervisors that probably doesn't agree unanimously on anything else. I think you're going to hear perhaps an expert soon from the Mendocino County Board of Supervisors, and I think they could say the same thing, they too are unanimous on this issue.

First of all, thank you very much for the opportunity to present our board's views on the subject of nuclear submarine disposal. Although we appreciate any opportunity to have input, we feel that the Navy is missing out on a full and accurate representation of viewpoints by not holding a hearing on the North Coast where this submarine graveyard is to be proposed. The Humboldt County Board of Supervisors joined with other local governments up and down the coast in asking for hearings in Mendocino and Humboldt Counties. Today we once again formally request that you come to the North Coast and sample the opinions of those who will be most directly affected by this proposal.

J.15

On March 2nd, 1972, the Humboldt County Board of

Supervisors unanimously voted to ask the Federal government to permanently ban the dumping of all nuclear waste, including decommissioned nuclear submarines off of the coast. I have included a copy of that resolution with this testimony which I gave to your reporter. You will note that we based our opposition at that time, and it continues on this basis, to be on the following:

L.53 First, Humboldt County's economic dependence on offshore waters for commercial and recreational fisheries; L.6 and second, past record of radioactive contamination to ocean sediments and the marine environment.

W.1 J.76 Since that time, we have become alarmed at several other aspects of the proposal: the physical inaccessibility of the ocean dump site for both monitoring and for retrieval should problems develop; the failure by the Navy thus far to adequately address the questions of monitoring and retrieval; O.34 and the economic impacts on the tourism and fishing industries of public perception that a hazard exists.

F.22 We are also concerned that the Navy has underestimated the potential for radioactivity resulting from loss of containment due to seismic activity.

I will deal with these points one at a time. First of all, the offshore fishery is a critical element in our local economy. Our economy has been hard hit by the recession in our largest employment sector, the timber industry. And the

fishing industry has been hard hit on a number of fronts, not the least of which is government action and regulation.

Our fishermen are for the most part independent business people who are struggling along in an extremely adverse economic climate to put food on America's dining table. The fisherman does not need, and thus America does not need, for the habitat of this important resource to be threatened by disposal of the Navy's castoff radioactive garbage. You may think that you are considering a proposal to throw these subs away, but let me assure you that there is no "away." What we put down there will come back to haunt us. L.20

The albacore catch data shown on page E-11 of the Draft Environmental Impact Statement is out of date and does not properly reflect the current importance of the proposed dump area to the albacore fishery. J.12 The data is 13 to 21 years old. Substantial changes in the fishing fleet have occurred since then, and the capability of more modern vessels has dramatically increased the importance of the area directly overlying this Pacific Ocean study site to the albacore fishery.

In addition, the grenadier is a fish species that has exhibited uptake of radioactive materials. And the grenadier or rattail fish as it is also known, and I believe it's referred to in the EIS, is commercially important. U.9 Eighty thousand pounds were landed in Humboldt Bay last year. The DEIS fails to discuss this biological pathway, a pathway which T.19 T.20

could substantially increase the availability of radioactivity to the populace.

F.12 There is a bank of data and research on the migration of radionuclides from waste forms to the water column, sediments and to marine life. The DEIS has neglected to cite this important information in its consideration of pathways to humans.

The next major concern that we have is the physical inaccessibility of an ocean dumping ground for monitoring or retrievability. The DEIS states that there is no significant difference between the land disposal option and the ocean disposal option.

Such a statement neglects the obvious, that a land disposal option would allow for a much greater degree of monitoring and mitigation should safety or health threatening situations arise. The DEIS states that 20 years of protective storage or mothballing would reduce the quantity of radioactive material by a factor of four, yet considers this to be no significant advantage. G.2 From the standpoint of public assurances, such storage would seem to be far preferable to immediate disposal.

W.1 It is clear that once these subs are down there, there is no cost effective way to bring them back up should problems develop. This fact alone renders the idea of ocean disposal to the realm of complete nonsense.

Another concern on the north coast is the impact on the economy of our area that will result from the failure of public confidence in the safety of our natural environment and the desirability of one of our most important export products, seafood. These concerns are reflected in the opposition to this proposal by two important north coast business groups: the various associations of commercial fishermen on the one hand and the Redwood Empire Association which is the north coast's leading tourism industry association on the other. And I believe you have received written opposition to the proposal from those organizations, and you'll probably be hearing testimony later today.

From an economic standpoint, public perception among tourists and purchasers of seafood that a hazard exists will be just as bad as the actual exposure. All it takes is for the question to be raised in the mind of the consumer or the traveler for them to reject the north coast and its seafood products in favor of an alternative.

On the question of accidental release of radioactivity, the worse case anlaysis presented in the EIS considers immediate loss of containment from the accidental sinking of one submarine. It is quite conceivable, however, that loss of containment by multiple vessels could occur at the disposal site should the area be subject to some ground-shaking stress. F.22

An estimate of such stresses are shown in the attached

U. S. Geological Survey Open File Report which I have included with the written version of my testimony. The Draft EIS does not contain information to determine whether or not such estimated stress would cause any disruption at the Pacific Area Site, and the final EIS should be amended to include such a discussion and should include a worst-case scenario for loss of containment that might occur due to such an event.

We would recommend adding to the list of disposal site criteria the following: that the site not be subject to J.19 ground-shaking stresses of a magnitude that could trigger sea flow disruption or loss of vessel integrity over the critical period of radioactive decay. We would also recommend adding to the list of pre-site selection monitoring, that seismographic sea floor monitoring be conducted in order to accurately determine the ground-shaking stresses of the site.

L.53 In conclusion, this is a dangerous proposal which threatens our fishing and our tourism industries. There are L.1 many unanswered questions, and the greatest problem with ocean disposal is that it is quite literally an irretrievable act. Once the subs are down there, should the answers to these W.1 questions begin to emerge as threats to the environment and public health, there will be no cost effective way to either assess or mitigate the danger.

Humboldt County does not want to be part of this dangerous experiment. Thanks, but no thanks.

I also have, for the record, a representation from a group that to my knowledge hasn't taken a political stand in years that voted this week to oppose this proposal, and I'd like to submit it for the record.

"Dear Secretary of the Navy Lehman:

"Freshwater Grange #499, P.O. Box 6153, Eureka, California 95501, at their regular meeting on February 22nd, 1983, with a membership of one hundred and forty-nine members, is opposed to any dumping of nuclear submarines off the Northern California Coast."

I'd like to submit that for the record, and I have additional copies of my testimony should they be required.

Thank you very much.

CAPTAIN WAGNER: Thank you, sir.

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#70

CAPTAIN WAGNER: The next registered speaker is Mr. John Cimolina representing the Mendocino County Supervisors.

JOHN CIMOLINA

Good morning. My name is John Cimolina, and I represent the Fourth District in Mendocino County which is from Fort Bragg to the Humboldt County line, so you know that Cape Mendocino is on my doorstep.

Later on today the Chairman of our board, Dan Hamburg, will be making a formal presentation on our board position, and also Norman deVall who represents the south coast will also be making a more detailed presentation. Mine is a more personal message. All of the people in my district: fishermen, loggers, men, women, children, tourists, sportsmen, are unanimously opposed to any ocean dumping, period.

I am a life-long resident native of Fort Bragg. As a boy I lived a quarter of a mile from the ocean. When I got married and left the homestead, I moved another quarter of a mile east, so I lived in Fort Bragg exactly one-half mile from the ocean.

As a boy I played on the old wharf down where they used to load the tramp steamers with lumber and talk to sailors, and I spent quite a bit of time on the fishing boats at Noyo. I believed the fishermen and I believe them now when they tell

me that whatever you dump into the ocean, sooner or later she will cough it up.

The Navy has put together some of the finest research and development teams in the world. They are proud of these teams and rightly they should be. But the direction of the research of these teams has been directed towards the development of more and better and more sophisticated weaponry.

In the DEIS, what is not addressed and the message that I want you to bring back to your commander in chief is that you redirect the direction of these research development teams towards the development of a safe, permanent method of disposing of nuclear subs and/or radioactive waste so that you won't have to dump in the ocean where it will create a potential for disaster forever.

Thank you.

CAPTAIN WAGNER: Thank you, Mr. Cimolina.

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CAPTAIN WAGNER: The next registered speaker is Miss Judith Evered, representing Isla Vista Recreation and Park District.

#71

JUDITH EVERED

As you said, Captain Wagner, my name is Judith Evered, and I have come from Isla Vista, Santa Barbara County to voice our opposition to any more pollution of the ocean or the land. We traveled overnight Monday night to be at the hearings against Diablo -- PG&E's permit to dump radioactive water into the Pacific.

And we at the Isla Vista Recreation and Park District oppose any pollution of this coastline. We have the information now that the ocean is polluted. There was a spill at Humboldt County, PG&E Nuclear Power Plant in about 1975 where 2,000 or more gallons of radioactive water containing cadmium -- which is a cadmium, which is a carcinogenic material was dumped into Humboldt Bay.

L.6 | We know that the barrels of radioactive waste at the Farallon Islands, thirty-five percent of them are leaking.

A.19 | This heat in the ocean attracts fish, especially striped bass fish. And this is a staple diet of people along this coastline.

Off the Santa Barbara Coast are the Islands Channel Islands, Anacapa, and Semequl (ph.) And from the

years of '46 to '51, the Navy dumped waste there.

The manager of our park district went to these islands to try and find out what was happening to this waste. He couldn't find out. We still have to seek this information. We don't know at Santa Barbara if it's safe to swim in the ocean there. We don't know that it's safe to eat the fish that are caught off the coastline.

There are many activists in Santa Barbara. If you should try to put the subs off the Santa Barbara, you would meet just as much opposition as you are getting from the northern states.

And we are here today to speak against the subs being dumped because that would be an irretrievable and irremediable problem for the future. | W.1

We ask for the action of mothballing so that the technology can catch up. | G.2

We are also opposed to Diablo. And I have a -- very personal knowledge of the damage that low radiation can effect because in England, my first son was -- I had an x-ray before he was born -- that was in 1956, and that was just the year that the information was coming out about the bad effects of x-rays before birth. My son died at six years of age from cancer. And we really attribute this to low-level radiation of one x-ray. That's how little it took. So I didn't find this out until after I was a blockader. I was arrested twice in the 1981 blockade of Diablo. That's how strongly I knew and felt that radiation was no good for people.

We will -- I'm on the Defense of Necessity trial. We've a month-long testimony of San Luis Obispo and experts from all over this country came to testify against nuclear power plants. It's all the same problem. Once you get radioactive materials and energy, you have problems. People are going to die. You're committing to death a certain number of people, and you don't know who.

And the unconstitutionality of this is that those people who will be affected by this have no voice and no knowledge of what you're going to do or propose to do. We've already had deaths from nuclear power in this country. We don't know who and we don't know we can't prove that this causes this.

But I ask for a stay of this action until you have incorporated into your testimony works of John Gofman, Ernest Sternglass, Michiokaku, and Dr. Helen Caldicott from Australia, the country of my birth.

We know now that radiation is extremely hazardous. We know that we have a right to live in a safe environment, and we insist that you wait.

And I -- I am also a part of a process which is going to -- in this state called the Public Right to Know. And it's before the Santa Barbara Supervisors now as an

ordinance. And many areas in this state have passed these ordinances, which just means that the public has a right to know of the pollution against this earth.

If you would take note of this book. It's called "Nuclear California, an Investigative Report." It's the truth about the development of nuclear sites, nuclear weapons, nuclear transportation, nuclear dumping, nuclear power plants in this state.

You know, we might think that they have the problems in the east; the commercial fish are already tainted in the east. It's like Russian roulette if you should eat fish over there. Well, it's going to be the same here I'm sure. U.9

The problem is that the research has not been done to find out about the effects of nuclear materials in the ocean here. So I would just like to repeat that the public must be told. The public has a right to a voice. L.1

And I'm very appreciative, Captain Wagner, of your close attention today and the fact that you're taking this testimony and that it will have some impact on the decision makers.

There's a researcher at the University of California Santa Barbara by the name of Adrian Gleena (ph), and he has done research on crabs at San Onofre. And they're finding that the fertility of crabs has been greatly lowered by the fact that the San Onofre nuclear generating plant is admitting radioactive materials into the sea, even though they have a more advanced technology than what is proposed at Diablo Canyon because they have a closed circuit offshore cooling system whereby the radioactive water doesn't supposedly come into contact with the sea.

Now, Diablo Canyon has an open cooling system whereby the water is filtered through the plant and back into the sea. So therefore, Diablo Canyon Nuclear Power Plant is more antiquated in design than San Onofre -- San Onofre nuclear generating plant.

All I can say is first the fish -- first the filter feeders like the zoo plankton, the algae, the mussels who feed by filtering the materials at the bottom of the ocean and then the fish that we feed on feed on those. So it goes up the biological chain to humans. And eventually the humans will be tainted. So we really don't know what's going to happen. And I implore that you -- that more research be done and that you put a hold on every kind of nuclear dumping in the sea. And I'm sure that a lot of it originally was done in ignorance, but it was also done in secrecy.

L.36

And I am very grateful today for all the people that are here and for the government representatives who are voicing opinions of the people. And I begin that the tide is -- is really turning today. And this is an extremely exciting meeting for all of us here. If only -- this last Tuesday we had meetings

here in this same room. There were about a dozen people, and they were talking about the permit for the Diablo Canyon to dump 2.7 billions of water each day into the ocean, some of which will contain the worst pollutants known: mercury, nickel, cadmium, copper, PCBs and so on into the ocean. And people don't know.

So I'm very grateful today that we have had this opportunity and that we're learning what this -- the deleterious effects and the desecration of the ocean could be.

Thank you for your attention.

CAPTAIN WAGNER: Thank you, Miss Evered.

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CAPTAIN WAGNER: The next registered speaker is Assemblyman Dan Hauser from the California Assembly.

UNIDENTIFIED SPEAKER: Someone said Dan Hauser, representing the north coast, has been momentarily detained on the Assembly floor and will be here shortly to testify.

CAPTAIN WAGNER: We will proceed with the next registered speaker then; that's Mr. Dan Hamburg, Mendocino County, Chairman of the Board.

*#72

DAN HAMBURG

Thank you. The Mendocino County Board had hoped that we could hold a hearing similar to this up in Mendocino County. We made repeated requests for such a hearing in Fort Bragg. I know the Humboldt County Board wished that a hearing might be held in Eureka. However, we are glad to have this opportunity to address you. We hope that before this thing is over, we will be able to hold some public hearings on our home turf. [*J.15]

I come before you today as the Chairman of the Mendocino County Board of Supervisors, and I'm representing that Board of Supervisors in its position of unanimous opposition to disposal of nuclear wastes in the Pacific Ocean. There is very little comfort for us in the statement that we were sent in a written correspondence from Chapman B. Cox of

the Navy Logistics Section which said that Cape Mendocino has been selected only as a representative study area which may be subsequently designated as the West Coast disposal site. [J.2] We fully realize there are few locations other than Cape Mendocino which would meet the required selection criteria which the Navy and the EPA have outlined.

Beyond our parochial interest that radioactive material not be dumped off our coastline, without our fishery, is the [L.53] larger issue of whether such dumping should occur anywhere off the coast of the United States or any other country's coast. Surely the Navy and the Environmental Protection Agency do not expect the counties and the states located on coastlines to accept this Draft Environmental Impact Statement as evidence of the Federal Government's commitment to a sound nuclear waste disposal program.

I need only draw your attention to the October 1981 General Accounting Office report which admits, and I quote: [L.6] That the Federal government has no complete and accurate catalogue of information on how much, what kind and where low-level radioactive waste has been dumped. End of quote. [L.7]

With this type of record to point to, there should be no surprise in the fact that the Federal government is not trusted to carry forth such a broad and delicate program as the one you propose.

It is the position of the Mendocino County Board of

***Other issues discussed by Mr. Hamburg are side barred in Exhibits 72a and 72b.**

J.20 L.35 L.1

Supervisors unanimously that this DEIS does not adequately address the issue of migration of nucleotides from waste forms to the water column to sediments and organisms.

The critical issue of pathways of radioactivity to humans must be considered in full detail. We note with great

J.12

concern that the data presented in the DEIS on albacore catches in the vicinity of the Mendocino site are based on 20 year-old information; while current data suggests a much more significant fishery in that area.

The Mendocino County Board stands united with our neighboring city councils and board of supervisors, as well as with scores of state and federal elected officials and with millions of citizens across this nation who are opposed to the profligate use of our precious ocean resource as a garbage can for the Federal government and its military establishment.

At this point I want to offer some testimony as an individual supervisor, which goes a bit beyond the position of our Board. I believe the matter before us today is a -- of far greater importance than simply which ocean gets this garbage, whose fishery is polluted, or even whether ocean or land disposal ultimately becomes your preferred option.

The discussion in the DEIS is centered on what to do over the next few years with 100 radioactive submarine hulls. These subs represent only a tiny fraction of the total amount of nuclear waste for which there is no planned disposal method.

This tremendous tonnage of nuclear waste represents only a fraction of the overall problem of waste disposal in this nation.

Of grave concern to me is the message that I'm receiving from the high officials of the Reagan administration that environmental protection in general -- and nuclear and toxic waste disposal in particular -- are being neglected under the guise of deregulation. This administration appears to me to believe that what is good for the military and what's good for the major corporate interests of this country is necessarily good for America. Indicative of this administration's stance that the very agencies which are responsible for environmental protection and for the stewardship of our resources are pushing hard to open our continental shelf to the oil rig and our fishing grounds to the obsolete radioactive sub. Perhaps it is what we might reasonably expect from an administration that dubs its latest multimegaton nuclear weapon "The Peace Keeper."

It's enough to make one believe that your Orwellian nightmare has arrived, and here a full year ahead of schedule.

It is appalling to me that what we have -- ostensibly are doing here is try to figure out how to dump the Polaris in order to make room for the Trident. Does it not occur to this administration in its adherence that is the path of folly? In fact, it is pure arrogance; the worst kind of folly because it threatens the very survival of humankind as species. First we construct weaponry capable of massive unprecedented death and destruction, and then in discarding this weaponry in order to construct ever more potent death machines, we risk tremendous ecological damage. Where is the plan of the Navy and EPA to dispose of the Trident when it's time for burial to come? And what of the kilotons of the other spent weapons and obsolete power plants that litter the earth and spread their radioactive menace? N.12

I believe it's time for an overview. It's time to take stock and redirect our efforts into harmony with other living things on this planet because the earth will digest only so much of our shamelessness before it lays waste to the wastemaker.

Thank you.

How many copies of this did you want?

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CAPTAIN WAGNER: The next registered speaker is Mr. Lawrence Espinoza from the California Department of Fish and Game.

Is Mr. Espinoza here?

(Speaker not present.)

CAPTAIN WAGNER: Then we'll proceed with the next registered speaker, Mr. Norman de Vall. Mr. de Vall is representing the Mendocino County Supervisors.

#73

NORMAN de VALL

Mr. Chairman and members of the hearing panel. I had hoped there would be more of you.

Obviously, I support the Mendocino County position, which is a unanimous five-zero position. I'm sorry that there are not more of your colleagues here.

Before I read my brief testimony, I would like to say that I think the Reagan administration and the Navy will regret it is not following the law as passed by the Anderson Amendment to the gas tax which called for a two-year moratorium on this proposal to dispose of spent nuclear submarines in the Pacific Ocean. I think that on a political note that there will be nothing more that will unify and cause people to register and create an issue for the 1984 campaign. F.2

When the administration does not hear the people and when Congress is thwarted in its full efforts to try and support what the people have to say, we will come forward at the grass-root level and we will band together. We will form coalitions, and we are going to stop this proposal.

L.53 The proposal to dispose of spent nuclear submarines within the American Fishery Management Limit or anywhere in a nation's waters or international waters is both foolhardy and incompetent. It puts at risk an existent and viable industry L.36 and jeopardizes the food chain of future generations for an untold period of time.

Very simply, the Government should not design or build that which it will not dispose of safely. Your nuclear submarines fall into the same sphere as nerve gas, dioxanes, and the waste from Three Mile Island.

Under the guise of national security, the proposal to dispose of spent nuclear submarines on the seabed is a harbinger of proposals to come; a disposal plan for other atomic waste that admittedly need a disposal site and method. But that site and method must be safe beyond doubt. Your proposal, sir, is not.

L.53 The DEIS is rift with inconsistencies, incomplete data and skewed statistics. It negates the fact that the Mendocino Escarpment is one of the richest fishing areas known in the world. It is for that reason that Russians, Poles, Germans, Japanese and others as well as Americans choose to

fish there.

The damage being done by this proposal to this industry is phenomenal. It is not understood by your administration. It is not understood by the Navy. It is understood by the people.

Your current data is not yet known satisfactorily by the U. S. Coast Guard. Any of their -- search pattern has a risk factor built into it; the risk to our economy is beyond doubt.

I again repeat, sir, you will contend with us in 1984 when we go to the polls again.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Assemblyman Dan Hauser, California Assembly.

#74*

ASSEMBLYMAN DAN HAUSER

Good morning. Thank you. I also apologize for being late. The legislature was in session this morning, and we just broke up. So --

I would like to address my comments also to the Draft Environmental Impact Statement and to the politics of the north coast. Many of those of us who live on the north coast of California have suspected for some time that one of the major reasons why the Navy has been so interested in our region for its radioactive waste dump site is our relatively sparse population and resultant relative lack of political power. However, it was not until October of last year when the Navy released the report by the Department of Energy Sandia (ph) Laboratories entitled "Oceanographic Study to Support the Assessment of Submarine Disposal at Sea" that we had the proof.

The Sandia report upon which this Draft Environmental Impact Statement is based states that the Cape Mendocino site is less impacted by shipping lines, offers less opportunity per a productive fishery, appears to be characterized by smoother topography and more uniform sedimentation and is a greater distance from major port activity and population centers

than the San Francisco site which was earlier considered and dropped.

I'm here today to tell the Navy that we are capable of generating opposition far beyond our numbers, and we intend to do so. With leaders and spokesmen such as Congressman Doug Bosco, State Senator Barry Keene, we intend to make it impossible for the Navy to turn the ocean that we love into a radioactive dump site.

The income of our entire region depends upon the commercial and recreational fishing industries and the seafood industry which is based in the Ports of Crescent City, Trinidad, Eureka, Fort Bragg, Albion, Port Arena and Bodega Bay. They also depend upon the timber industry which relies on the Port of Humboldt, northwest of Cape Mendocino, to ship many of its products to market. And they depend on the tourism industry, which also is based on the Pacific Ocean and its spectacular coastline. L.53*

This Draft Environmental Impact Statement underestimates and often simply ignores the impacts of radioactive waste dumping on the jobs of those who work in and around these industries. Even public fear of dumping could have a major economic impact; a fact that this DEIS fails to discuss at all. O.34

The California Legislature, however, is not ignoring these threats. Senator Keene and I have introduced Assembly Bill 138, directing the State agencies to use their full legal

***Other issues discussed by Mr. Hauser are side barred in Exhibit 67a.**

powers to prevent any dumping of radioactive waste into the Pacific Ocean unless it would have no adverse impact on the resources and environmental values of the California coast and would be conducted in accordance with all applicable state, federal, and international laws. The agencies directed to cooperate include the California Coastal Commission, which administered the Federal Coastal Zone Management Act in California; the Attorney General's office; the Department of Health Services; the Department of Fish and Game; and the Legislature's Joint Fisheries and Aqua-Culture Committee.

The Navy may think that its sketchy report and contradictory data are enough to roll over the north coast, but the Navy is wrong. The jobs and the health of our people are too important for us to allow that to happen unless it can be proved that it's safe; no one has -- at this point no one can. And we don't intend to allow the dumping to occur.

Thank you.

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CAPTAIN WAGNER: Has Mr. Lawrence Espinoza appeared in the hall yet?

(Speaker is not present.)

CAPTAIN WAGNER: Ladies and Gentlemen, I intend to continue with nongovernmental agencies.

Mr. Espinoza is the last registered governmental organizational spokesman, and we will work him in when he does arrive and I have received word that he is here.

The next registered speaker then is Ms. Pat Agnello, representing Redwood Alliance.

PAT AGNELLO

#75

Sorry, I don't appreciate the title too much, but --

CAPTAIN WAGNER: I will make mistakes, and as I said, please repeat your name correctly and it will be proper for the record.

PAT AGNELLO: My name is Patrick Agnello, I'm here representing the Redwood Alliance. We are located up in Arcata, California, on the north coast. We are a group dedicated to educating the public on nuclear issues. We're quite active in the north county. And I'm here to speak for the 1700 or so members that we have. We certainly hope that you listen to the concerns of the north coast constituents, our Congressman Doug Bosco, our State Senator Barry Keene, and

J.15

Dan Hauser our Assemblyman who just spoke and to hold hearings on the north coast. Though we have already had two hearings -- and you weren't present at either one -- we hope that maybe you can be coming up there pretty soon.

The concerns we have are many. First, our major concern is that your desire is to scuttle submarines sold to us as low-level waste off our coast is an effort to circumvent the legal responsibilities of seeking stronger environmental safeguards and injecting a greater degree of accountability in all aspects of radioactive waste dumping.

J.76
L.6

The lack of monitoring procedures and lack of strong commitment to study existing ocean dumps is not consistent with this statement issued by the Environmental Protection Agency. It is a shame that the Reagan administration has withheld the funds for developing monitoring procedures and monitoring studies for ocean dumps. I wonder if the Navy will do the same.

Since 1974, the Federal government has spent only $250,000 studying existing ocean dumps, while spending nearly 10 million dollars to study the sub-seabed and sub -- and the seabed disposal of high-level radioactive waste.

J.76

We have our doubts that the Navy can scientifically monitor these subs at the depth of 15,000 feet. We feel that the Government should spend the extra 250 million dollars required over the next 30 years for the land disposal so that our country will

learn from monitoring and study of these wastes. Our scientists are probably the best in the world and should be given the opportunity to get us out of this radioactive crisis that we are currently facing.

Remember just 200 years ago we were still inventing nice, dandy farm equipment that will help us to, you know, proceed in the future. And now we have 200 years hence in front of us. I think we can probably develop something on the land and try and get rid of this problem.

Our second concern is that with the scuttling of these subs, this is the first penny in the well for the military. These nuclear waste problems far outglow that of the commercial nuclear industry. Once the first sub is sunk followed by the 99 or so others, the rest of the old nuclear navy will likely follow; followed by the waste from the Rocky Flats, followed by Livermore, et cetera.

L.9

And as we sit here today calmly discussing low-level waste, the Defense Department is injecting high-level liquid radwaste into the sub-seabed off the coast of the Marianas in the Pacific. Yet they have failed to file an EIS or address the public. And how long can we depend on you to come to us when you want to dispose of radioactive waste? And how many deals will be made by the commercial nuclear industries with the Government to dispose of their waste also as a secret, easy way out? This is not what we deserve, and it is not what we want, certainly.

Thirdly, we have -- we are concerned by the facts that our friends around the world will follow our lead in dumping their waste into the ocean. Although Norway, Iceland, Canada, Austria and Sweden see the danger of ocean dumping -- and their voices in the London Dumping Conference Convention aren't as strong as those of Britain, the Japanese, the French and the Americans who dump most of the waste. We should become the world leader in radwaste technology, not the world leader in a quick-fix boondoggles.

F.8

Lately -- lastly, I should say, we are concerned that the Draft EIS does not take into account the accidents in dumping that could occur when one sub is sunk by mistake on the body of another sub. This is not addressed in the DEIS.

F.23

The contact that could occur -- though the Navy doesn't feel that such a mishap is possible -- could expose the unit hulls of the sub; that's increasing the corrosion factor. There is no study of any accident or any kind of procedure to remove one sub from another sub if this accident does occur.

We doubt that there is also a ninety-nine percent success rate that the Draft EIS takes into account. You only think that there is only sub -- one mishap that could possibly happen as a worst case scenario. If any agency, the government or otherwise, had a ninety-nine percent success rate, that would be truly a miracle. We would like that you

F.22

show us some reality and responsibility by providing us a scenario of this possible or probable disaster.

On behalf of the Redwood Alliance and our constituents on the north coast, I thank you for the opportunity to provide the input at this public hearing. Thank you.

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CAPTAIN WAGNER: The next registered speaker is Dr. Jackson Davis, representing the Santa Cruz County Board of Supervisors.

#76

JACKSON DAVIS, Ph.D.

Captain Wagner, members of the press and concerned people, my name is Jackson Davis. I'm a professor of biology at the University of California at Santa Cruz. I'm here to testify on behalf of the Board of Supervisors of Santa Cruz County and also the Farallon Foundation for whom I have analyzed from a scientific standpoint the Environmental Impact Statement prepared by the Navy.

I would like to begin by placing the proposed submarine scuttling program into the context of other past and proposed programs of radioactive waste dumping in the oceans. The Navy said it wants to scuttle 100 submarines between now and the year 2000; each containing 62,500 curies of residual radioactivity. What the Navy does not mention in its DEIS is that it is continuing to manufacture nuclear submarines, each of which will also require scuttling when it wears out.

N.12

In other words, we are talking here about a potentially open-ended dumping program, which if allowed to begin, will continue into the indefinite future for as long as nuclear submarines and other nuclear weapons are manufactured.

The magnitude of this program is staggering. It would involve hundreds of times more radioactivity than past dumping programs. What the Navy is here proposing is by far the largest program ever considered for ocean dumping of radioactive wastes. The Navy has considered -- has suggested that these unprecedented quantities of radioactivity will not harm people because the wastes are bound up in the metal walls of the reactor vessel. But let us look forward in time just one century, by which time even the Navy's calculations indicate that container will be breached. The Navy says that by this time each submarine will contain 10,000 curies of radioactivity; times four submarines per year equals 40,000 curies per year.

R.3

In other words, to proceed with this program, Captain Wagner, is the equivalent of dumping 40,000 curies annually of unpackaged radioactive wastes directly into our grandchildren's laps.

Captain Wagner, I respectfully suggest that this is not a legacy that the people of this state will willingly leave their grandchildren simply because the U. S. Navy says we should.

Let us examine the issues of safety as raised in the DEIS. One of the criterias stated by the Navy in its preliminary scientific evaluation is that "sites should be away from areas containing active geological phenomena such as volcanos."

But according to the Navy's own studies, the Northern

NOTE: This testimony was also submitted (June 28, 1983) as a document which appears in Exhibit 707.

J.19 California dump site lies less than 50 miles from one of the most geologically unstable areas of the sea floor known in any ocean on earth -- the Mendocino fracture zone.

According to the Navy's own data, the report in the preliminary studies, dozens of major earthquakes have been centered along this zone in the past century.

Also according to the Navy, the resulting bottom F.22 shears in the dump site area resulting from these earthquakes and the resultant effects on decayed submarines lying on the bottom are unknown.

Another criterion listed by the Navy as important in choosing a dump site is "sites should be away from areas such as submarine canyons which have a high rate of exchange of the deep ocean waters with surface layers."

But according to the Navy's own studies, there are powerful near-bottom eddy currents in the California dump site that reach velocities of 16 centimeters per second and stir the ocean bottom from top to bottom. Current velocities as J.29 low as 7 centimeters per second -- less than half -- would have been measured -- are capable of suspending and transporting radionuclides.

The Navy also documents a slower southerly current moving at a rate of one kilometer per day. This current could transport suspended radioactivity directly toward the major population of Marin County and the San Francisco Bay Area,

possibly in a matter of months.

The Navy has asserted that animal life in the dump site area is sparse; but when we examined the actual scientific data presented by the Navy in its preliminary scientific study, we find a much different picture. These studies show that all bottom cores from the study areas are "strongly burrow-molted," implying a very active bottom population. All photographs made by the Navy at the bottom in the dump site area show evidence of considerable bottom life.

As also acknowledged in the DEIS, animals are known to concentrate in dump site areas. In short, the dump site area contains abundant bottom life which could rapidly return the dump radionuclides to human beings through the ocean food chain.

The Navy claims that exposures of human beings to radiation dumped at sea would be so small as to be negligible. But it is worth examining how the Navy has arrived at this conclusion.

Their assertions of safety are based upon the use of extremely hypothetical models to calculate possible human exposure. The Navy has ignored all empirical studies of past and present radioactive dump sites, many of which have produced evidence of much higher radiation in seafood than the Navy suggests will occur. F.12

To illustrate: The British discharged 100,000 curies per year into the Irish Sea, resulting in fish that are so radioactive that members of critical consuming groups receive literally quadrillions of times more radioactivity than the Navy claims will result from the submarine scuttling program.

The Navy freely acknowledges the uncertainty inherent in its calculations. On page A-10 of the DEIS, we read the calculations of human radiation exposure by different methods yields different values of, quote -- and this is a quotation of the U. S. Navy -- "The indicated differences are not considered to be significant; rather the real difference is overwhelmed by the magnitudes of the uncertainties in the calculations."

In my considered judgment, Captain Wagner, it is not appropriate to base major public health decisions on hypothetical models and unknown and untested safety factors. The Navy has claimed that the proposed submarine dumping program is consistent with both domestic and international law. This claim was, of course, made prior to the recent domestic legislation facing a two-year moratorium on ocean dumping radioactive waste.

F.2

With respect to international law, I have just returned from the Seventh Consultative Meeting of the London Dumping Convention, which is the sole treaty organization that regulates the disposal of radioactive waste into the ocean.

In this convention, I served as a scientific and technical advisor to the Pacific Island nations on the issue of

radioactive waste dumping at sea. This meeting passed -- by an overwhelming majority, 19 to 6 -- a moratorium on radioactive waste dumping at sea, pending resolution of scientific questions which I and other scientists have raised.

Captain Wagner, I respectfully suggest that the legality of the Navy's proposed dumping program, if not at all established under international law, it would be a matter for all of the contracting parties to this convention to collectively decide at one of our consultative meetings.

F.5

As indicated by the recent vote in London, the nations of the world are not sympathetic to such proposals. The Navy's proposal to dump worn out submarines at sea would be more understandable if there were no alternatives, but there is an alternative; one that is safer, fairer, more cost effective and less politically contentious.

This alternative is the land alternative. Consider first the issue of exposure to human beings to radiation. The Navy's own calculations presented in the DEIS show that human exposure to radiation from sea dumping would be 3 to 40 times greater than the land alternative.

L.47

The Navy claims that these differences are small compared to the uncertainties in the calculations. But we may well ask in return if the uncertainties are large, are not also the inherent risks large?

Knowing as we do that any level of radiation exposure is harmful, it is clear from the Navy's own calculations that the land alternative -- although not without its own risks -- is many times safer than sea dumping.

The second advantage of the land alternative involves monitoring. The Navy has stated that the land burial sites are already monitored on a regular basis, and hence no new monitoring would be required. In contrast, the ocean alternative would require extensive monitoring before, during, and after scuttling operations.

J.76

The first and obvious question to ask is will such monitoring ever in fact take place? Many of us here today recall a congressional investigation on the Farallon nuclear dump site held in October of 1980, at which the U. S. Congress asked responsible federal agencies to monitor the Farallon dump site off of California. Three years have passed since that congressional order was issued. The Farallon site has still not been monitored. Funds to enable such monitoring have still not been allocated, and the people of the Western United States still do not know with certainty whether the seafood harvested at the Farallons contains radionuclides from the dump site there.

L.6

We are obligated to ask whether monitoring of the scuttled nuclear submarines is any more likely to occur.

The chief argument offered by the Navy for preferring the sea option is cost. Close examination of the economics,

however, reveals that the Navy has failed to include several expenses that in total would make sea dumping equally or more expensive than the land alternative. These unaccounted costs include accidents, monitoring, psychological impact, medical expenses, direct economic impact on fisheries and tourism, and the cost of the protracted political struggle which is certain to ensue if the Navy continues with this program.

L.57
O.26
J.76
L.53
O.34

Captain Wagner, there are 70 operational commercial power reactors in the United States at present and 70 more in various stages of planning. If this Navy reactor scuttling program is allowed to proceed, a precedent will be set for dumping worn-out commercial reactors in our coastal waters. I submit that there are too many uncertainties to justify even a small scale sea dumping program, and the nations of the world have agreed with this position in their recent vote. There are scientific uncertainties. There are public health uncertainties. There are economic, social, legal, political, and moral uncertainties. All of these uncertainties have combined to ignite the public's opposition to this proposed submarine scuttling program.

L.9
F.8
L.1

As just one indication of this opposition, the Board of Supervisors of Santa Cruz County has authorized me on behalf of the Farallon Foundation to deliver to this hearing their unanimous resolution opposing the scuttling of decommissioned nuclear submarines in California coastal waters.

As a scientist familiar with the technical issues, as the father of several wonderful children, as a representative of the Pacific Island people whose only natural resource is the sea, and as a representative of the people of Santa Cruz County, I respectfully request that the U. S. Navy immediately abandon this submarine scuttling program.

CAPTAIN WAGNER: Thank you, Dr. Davis.

--o0o--

CAPTAIN WAGNER: The next registered speaker is Mr. George Balding, representing the Fort Bragg Salmon Trollers Marketing Association.

#77*

GEORGE BALDING

Thank you, Mr. Wagner. My name is George Balding. I am a commercial fisherman from Fort Bragg, and I've been elected to the Board of Directors last year. And I was selected unanimously by the Board of Directors to represent the Salmon Trollers Marketing Association of Fort Bragg.

A lot has been said today, and I'm really happy to hear all the emotional quality of the speeches. I've been spending quite a bit of time in the last few weeks making emotional speeches myself to the Pacific Fishing Management Council and recently the legislature. And I'm happy to hear the legislators themselves getting up here and voicing strongly their opposition to this proposal of the earth.

We all -- as Normal de Vall and others have said already -- feel that the Government has a very great lack of concern and in fact a large disregard for the environment. And this environment directly affects our fisheries.

The administration that's currently in power, I think, is probably -- this is the only time that this could possibly happen that I've seen in recent years. Everything that's been -

***Other issues discussed by Mr. Balding are side barred in Exhibit 77a.**

that had been done in 1970 seems to be going backwards now, and we don't like it. Our seasons are being cut down, especially in salmon fishing. In regard to the environment -- the environmental damage being done on all species of fish is becoming irreversible, I would say. Striped bass numbers are down. Steelhead numbers are down, and we can't commercially fish these. Yet the salmon are decreasing at about the same rate, and we are being blamed and restricted from fishing the salmon because of other environmental dangers. And we can't afford any more environmental degradation.

For about six years now we have been under the guise of the Pacific Fishery Management Council, and we've been making input to have some authority given to these people for environmental control. Finally this year, they addressed the issue. They say one of their environmental goals is to use the marine environment in such a way that it will maintain a healthy population of all species. They ask that this happen. They have no authority to enforce this. And we haven't found very many people -- it doesn't seem to me that I've been addressing, including the Department of Fish and Game and others here that are willing to take the responsibility to enforce environmental controls.

Getting to your Draft Environmental Impact Statement. One section of it addressed the disadvantages of ocean disposal. It says the environmental aspects are more

controversial than the land disposal. We are very happy that you people can recognize a controversy when you see it.

You also say that the overwhelming body of scientific research and opinion shows that concerns over the potential public health and environmental consequences posed by past ocean dumping activity are unwarranted and overemphasized. I feel that this is an outright lie.

From what we have gathered from what people are saying here today, I would say that the overwhelming body of scientific research and opinion shows that it is definitely warranted. And we intend to emphasize it.

Mr. Davis just presented a little bit about the radiation getting into the food chain. We are not scientists, we are fishermen. And you yourself say that the submarines are going to produce artificial reefs. Well, anywhere there is a reef, there's a lot of fish activity. The submarines are going to be covered by bacteria, as I understand it. This bacteria will be fed on by other organisms. I don't think anybody here thinks that an organism living right on the submarine isn't going to remain unaffected. And this material is going to become incorporated -- this radiation is going to become incorporated in the food chain. There is no way around it.

I've been fishing for only nine years now, and I know that the ocean is one unit. It's a living organism in itself.

U.5*
L.55
L.36
L.14

*Other issues discussed by Mr. Balding are side barred in Exhibit 77a.

Anything that happens in any part of the ocean is going to somehow -- and possibly in some way it can be spread throughout the entire ocean. It's almost like you people are saying that you're going to put the submarines down there and nothing is going to happen with it; there won't be any interaction with the rest of the ocean. We don't believe that at all.

Very little is said about the socioeconomic effects of L.53 this. As fishermen, we realize that once the public becomes alarmed about having radiation in the fish, they'll stop buying O.34 the fish. That will be the end of the commercial fishing industry as we know it now. And that's going to be a really large financial impact. You're talking of millions of dollars every year, and yet you are worrying about the cost of disposing N.3 of submarines on land. There was no worry about the cost when they were built.

Another part of the Impact Statement that bothers me -- I suggest that the Navy can't even follow their own criteria set up for study guides of the study areas. You say that you will avoid areas of seafood production which is currently used by man. Well, thanks to Dr. Hertz of the Oceanic Society that came to Fort Bragg, I was given an address of the fellow who works for the National Oceanic Atmospheric Administration. It is a national marine fishery service. We got it from J.12 Script Institute 1974, 1976, '77, '78, '80 and '81. There was significant albacore catch directly above the area of the

proposed scuttling. Now, if you're so concerned with these J.12 criteria that you set up, you wouldn't even have considered this area. And it's also been shown by several speakers here J.19 that this is an active area; the fault runs right across there. F.22 Many fishermen who fish that area all their lives have told me that there are upwellings all the time along that fracture J.31 zone and around it caused by the fracture. It's a very productive fishing area. As it's been said before, one of the most productive fishing areas in the world.

I'm not trying to say that you shouldn't dump the nuclear waste in this area. We are just saying that we don't want it in any part of the ocean.

You're saying that you're going to monitor these; yet J.76 your past monitors have been very poor as already testified. L.7

There is, according to your own words -- at the current technology -- they will be unretrievable. You say W.1 that the pathways to humans are not known. You discuss corrosion; I don't think it's covered adequately. Q.13

Another one of my main concerns here has been the Navy's response to public sentiment and also response to politicians who have tried to present opinions and have been refused.

Senator Keene is one example I'm talking about who had the input; who had the backing of California, Oregon, Washington, Idaho, Alaska and Hawaii to represent the Pacific states at the

London Dumping Convention, and he was refused to be a delegate at the convention.

So we, you know, what's -- we feel like what's our input, a public person's input, if you are not listening to our representatives? We don't like that.

L.53

In conclusion, I would just like to say that the success of our industry is based on a quality habitat. The fishing resource is very valuable; it's too valuable to jeopardize it or destroy it. It's important on a worldwide basis. The ocean is used by all Californians for many purposes, and this radiation is going to affect it for tens of thousands of years.

I would just like to say finally that we don't want to have any radioactive waste put in any ocean.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Nat Bingham, representing the Pacific Coast Federation of Fishermen's Association.

#78*

NAT BINGHAM

Captain Wagner, I thank you for the opportunity to appear before you this morning.

I'm a commercial salmon fisherman. I have been a fisherman for 20 years on the north coast of California, and I fished many years in the particular area in question for dumping. I am President of the Pacific Coast Federation of Fishermen's Association, representing 8,000 commercial fishermen in California. I'm also on the Board of Directors in Salmon Trollers Marketing Association in McGeorge.

California's fishing industry was shocked in the autumn of 1981 to learn of the Navy's plans to dispose of 100 obsolete nuclear submarines in the Pacific Ocean, south and west of Cape Mendocino. The men and women of our fishing industry, a north coast economic mainstay, are especially concerned with the effect that dumping program would have on their livelihoods. More than a year has passed since the first terrifying news; a year in which the Navy might have substantially allayed the fears of our citizens of our coastal communities. Instead, the period has been consumed in a

*Other issues discussed by Mr. Bingham are side barred in Exhibit 78a.

desperate struggle for the information about the Navy's plan; a struggle that has been met with Government delays, denials, and silence.

To give voice to the concerns of Californians over the dumping, the fishing industry asked for the introduction of Senate Joint Resolution Number 27, which asked that the scuttling be delayed until valid, reliable scientific studies prove it's safe. With a quarter of the entire California Legislature joining as co-authors, the bill received virtually unanimous support from the Legislature. The Joint Legislature Committee on Fisheries and Agriculture has been assisted by some of California's top marine scientists in an effort to obtain and evaluate information concerning the dangers of dumping radioactive materials into the ocean, as well as regarding the proposed dump site off Cape Mendocino.

The difficulty these scientists have had in obtaining information concerning the Navy programs at times appeared insurmountable.

In June 1982, our north coast State Senator Barry Keene requested copies of specific studies completed by Oregon State University for the Navy; in some cases as early as 1978. He was finally forced to file a Freedom of Information Act request for these publicly-funded materials. It was not until 7 August 1982 that Rear Admiral J. H. Weber responded, claiming that studies had not been summarized and interpreted and would

not therefore be released.

It was October before we received a 686-page report -- Oceanographic Studies to Support the Assessment of Submarine Disposal at Sea.

Up to this point, those responsible for the Navy submarine disposal program have contended that no conclusions have been drawn nor choices made favoring sea disposal over viable sub reactors on land. Our analysis indicated, however, that our fears had been justified. The Oregon State study emphasized the distance of the Cape Mendocino site from major population centers. It downplayed the area's contribution to fisheries' harvest and mistakenly concluded that "no upwelling is present in the study area."

The presence of upwelling, the movement of water from great depths to the ocean's surface in the study area is well-known to north coast fishermen who view the area as a major producer of economically important fish, especially albacore.

I would like to state that I was an active participant in those albacore fisheries that George mentioned. I have been right over the site personally of the dump, and I have enjoyed many very successful days of harvesting albacore.

While albacore themselves are surface-feeding pelagic fish, they are in fact dependent on smaller fish such as needle fish and seriola, which in turn feed on plankton which is feeding T.20*

***Other issues discussed by Mr. Bingham are side barred in Exhibit 78a.**

on upwellings of inorganic and organic materials which come from deep within the water.

I have also participated in the salmon fishery just inshore from that area and have been astounded to catch fish which I don't know the name of because I haven't seen them in any books anywhere. I only know that to me they are sea monsters. They are things that come up from the deep. I have caught them myself; so as far as I am concerned, I am convinced of the unusual nature of the upwellings in this region.

It's not surprising, therefore, that the Navy's Draft Environmental Impact Statement on the disposal of decommissioned, deep-fueled naval submarine reactors, the subject of today's hearing, should prove inadequate developed as it was on an incomplete and in some cases erroneous information.

Let me list some of the deficiencies we see in the DEIS, and let me assure you we will provide more detailed concerns within the period allowed for written comments.

Lack of accumulative impact analysis. In his February 16, 1982 letter to you, Senator Keene specifically pointed out to the Federal Council on Environmental Quality Regulations, implementing the National Environmental Policy Act requires the Navy to analyze how the action proposes to carry out and attribute to accumulative impact of other such actions.

Part 1508.7 of the Federal Regulation defines cumulative

impact as the impact on the environment which results from the incremental impact which -- of the action when added to other past, present and reasonably foreseeable future actions, regardless of what agency undertakes any such action.

Accumulative impact regulations explained can result in individually minor but collectively significant actions taking place over a period of time. Senator Keene suggested this to me. The Navy must address the accumulation of radionuclides in the environment, including fallout from nuclear weapon testing, past dumping of radioactive waste by the United States and foreign countries' background radiations, other future disposal plans where anticipated and all other sources.

In your response, you stated that the Draft Environmental Impact Statement will also include a consideration of cumulative impact of action in compliance with the Council on Environmental Quality Regulations. No such consideration appears in the DEIS. Absence of accumulative impact analysis is in our view a grievous deficiency in the environmental documentation of this Navy's project.

Alternative disposal cost inadequately compare. The DEIS at page S-16 concludes: Sea disposal is seen to be the least costly method. Disposal at sea of entire submarines is priced at 5.2 million per ship; while the cost of land burial of each reactor compartment and sea disposal for the remainder of each sub is estimated to add 2 million to that figure.

Missing from both of these preprogram studies and from the project cost estimate are monitoring activities sufficient to determine the effect of the proposed dumping on the environmental health of the Pacific. Nothing is known of the present radioactivity of the site, and no commitment is made to determine how the actual corrosion rate of the abandoned submarines and the resulting escape of radionuclides in the ocean agri-system will compare with the estimates you used in justifying the Navy's position.

As a fellow boatman -- admittedly on a somewhat smaller scale -- I'm here to tell you that the only way you can keep a boat from falling apart in the ocean is to maintain it. If you let it sink, it's going to come apart. There is absolutely no way that you can keep a man-made object in one piece at the bottom of the ocean.

Were the costs of ocean wandering included, it would likely rule out the Navy's apparently preferred option of disposing entire submarines at sea.

Also missing are estimates of what the economic and social costs of the loss of the entire fishing industry of Northern California would be.

I would at this point suggest as a safe alternative a mothballing of these submarines. We don't want to dispose them on land. It's my conviction that these perhaps in the far

future or in the near future would be more usefully employed in peaceful pursuit, such as oceanographic research, transportation of sensitive materials, whatever. I can't believe that you haven't got any use for those submarines, outside of sinking them. If they are not safe to use -- if in fact they are leaking now, then you've got no business dumping them at the bottom of the ocean.

The DEIS presents estimates at Table 411 of the radioactivity exposure that the general public would experience and concludes that the figure shows no significant difference between the disposal options. In fact, the estimates suggest the public would suffer 42 times more radiation exposure were just one of the submarines slated for sea disposal involved in a handling accident. I refer you to the population exposure column at the table rows B2 and B1: proposed action not identified.

The document before us today is not in fact a Draft Environmental Impact Statement. The pertinent federal regulations clearly require at part 1502.14 that the DEIS identify the proposed action. The document before us, however, concludes that either option could be chosen. Essential purpose of environmental impact statement is that it allows the public to see how by what logic an agency arrives at the preferred alternative. The document which obscures from the public the agency's chosen option defeats the purpose of the DEIS process.

I am sure that the Council on Environmental Quality has this clearly in mind when it adopted Regulation part 1502.14.

I would like to turn from the defects in this specific environmental document to a brief discussion of how the Navy's ocean dumping program fits within the context of existing state and national law and policy. I might suggest at the outset the fit is not particularly natural nor logical. The points which I have to share with you was brought to the attention of the Joint Legislative Fishery Committee at its hearing on the Navy's plan held in San Francisco 7 August 1982.

The State of California has prepared and the Federal government has certified the California Coastal Management Program. The Federal Coastal Management Act prohibits any federal agency from conducting activities which directly affect California's coastal zone unless the federal agency first determines that they -- the activities are consistent with our management plan and the California Coastal Commission concurs in that determination.

The California Coastal Act, the heart of our management program, requires the uses of marine environment should be carried out in a manner that will sustain the biological productivity of the coastal waters and will maintain healthy population of all species of marine organisms adequate for long-term commercial, recreational, scientific and educational

purposes.

We are concerned frankly that radionuclides released by the Navy's dumping program could biocumulate through the marine food chain and cause real or publicly-perceived radiation damage to fish food species. Consumer rejection of California seafood products could devastate our industry and would clearly be inconsistent with our Coastal Management Program.

I would like to add my voice to those of California's congressional delegation, Honorable Lieutenant Governor McCarthy, and Senator Keene in requesting that additional hearings regarding this Draft Environmental Impact Statement be held in Fort Bragg and Eureka, California, in order that those people most directly impacted by the proposed dumping program have the opportunity to adequately express their concerns.

I would like to thank the Navy as it is concerned with the needs of California coastal communities as it is with more heavily represented Raleigh, North Carolina, and Columbia, South Carolina, where field hearings were held last week.

Finally, I would request that the Navy extend the period for receiving public comments on DEIS until at least June 30th of this year.

The effect on the health of our world's oceans from the sort of use proposed here by this Navy, which will make international outlaws of us, will continue for a long, long time. I would urge those responsible for the disposal program to make every effort to seek the best scientific information available to guide their decision. And I would plead with equal urgency that you listen carefully to the fishermen of our coastal communities; those whose health and livelihoods may be changed forever by what you decide in the few months ahead.

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CAPTAIN WAGNER: The next registered speaker is Bonnie Blackberry, representing the Citizens for Responsible Government.

#79

BONNIE BLACKBERRY

My name is Bonnie Blackberry, and I'm a resident of Humboldt County. And I came here to represent people that are concerned about the responsibility of their government.

This proposal of dumping the nuclear waste in the ocean is unacceptable. Creating the nuclear waste is unacceptable.

The President -- it appears that the President of this country believes that a nuclear war is a possibility, and they are planning for a nuclear war. Our county and every county in the nation is planning an evacuation plan so that they can respond to this proposed nuclear war.

I believe that -- that these nuclear subs -- that it's a real problem because there's 100 of them; and now they are too radioactive to use. So the proposal is to dump them in the ocean and bring on the Trident. We don't want the Trident. D.5

I would like to talk about Diablo Canyon. As I was here two days ago in this same building talking to the Water Quality Control Board about dumping toxic waste and radioactivity into the ocean.

The PG&E is planning to load the Diablo Canyon plant on .

March 31st, regardless of the environmental impact. Our agencies in the government have been unable to respond to protecting the water -- the quality of the water in our oceans from this. I am very concerned and everyone here is very concerned. And we as the people -- the real people of the United States -- are not going to allow this to happen.

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CAPTAIN WAGNER: Ladies and Gentlemen, I think this is a good time to take a break for lunch. What my intentions are -- we'll take a recess until 1:30. For those of you who have already registered, I will continue with testimony alphabetically with you who have registered this morning. We will continue with the nongovernmental organizations. When we complete that, we'll go into the five-minute time frame for individuals. And then, again, I will give priority to those who have registered already over those who might register this afternoon.

I would like to thank all of you; particularly those of you who provided testimony this morning for your testimony. We will reconvene -- and I would also like to thank you -- I should add -- for conforming to the time limits involved. This is a way of assuring that everybody with a representative view has an opportunity to speak.

At this time, we'll recess the hearing and reconvene the hearing at 1:30.

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Testimony at the Public Hearing

on the

Draft Environmental Impact Statement

on the

Disposal of Decommissioned Nuclear Submarines

Thursday, February 24, 1983

Department of Water Resources
1416 9th Street
Sacramento, California

Afternoon Session

Reported By: Theresa French, CSR No. 5790
Ida Ruth Lundsten, CSR No. 5791

CAPTAIN WAGNER: If you would please be seated, we will reconvene our hearing.

This hearing is reconvened. I would like to tell you a few things again that I said this morning for the benefit of some of the people that might not have been here this morning.

The purpose of this hearing is take testimony regarding the Draft Environmental Impact Statement on the disposal of the defueled, decommissioned nuclear power submarines. The purpose is neither to plead the Navy's case nor to engage in debate. It is my responsibility to receive statements so that they can be considered in the development of the Navy's final impact statement. I will afford an opportunity to those individuals and organizations who wish to provide oral or written statements to do so within the guidelines established in the hearing. We are providing five minutes time frame for testimony for individual speakers, and ten minutes for those persons representing organizations, unless additional time had been requested in advance. Time cannot be relinquished from one speaker to another.

If you have not filled out a registration card and wish to provide testimony, I ask that you fill out a registration card at the registration desk. And that card then will be added to our alphabetical list for testimony.

Due to the number of registrations this morning, we still have a large number to give an opportunity to speak. As I mentioned before we recessed, I intend to continue with this morning's registration list, and specifically those individuals who registered by 9:00 o'clock, I'm giving them priority. And we are still going through that list. We will continue with nongovernmental organizations that registered before 9:00 o'clock this morning. And from there, we'll move into individual testimony, alphabetically, for those people who registered before 9:00 o'clock this morning.

When we get through with that group, then we'll move on with later registrations.

For the procedure, again, for public testimony, I will announce each registered speaker. When your name is called, please proceed to and use our microphone over here. For the convenience of the press, we'll continue to use one microphone. State your name and organization, if any, even though I call you by name. I want to make sure that the record gets that name and organization correct, in case I mispronounce or whatever. All comments are to be addressed to me.

The next registered speaker is Mr. Lawrence R. Espinoza, who was not here this morning. I want to see if he is here at this time. Representing the California Department of Fish and Game.

Is Mr. Espinoza here now?

(Speaker not present.)

CAPTAIN WAGNER: Then we'll proceed. And the next registered speaker is Mr. Sam Camp from the Environmental Protection Information Center.

--o0o--

THOMAS O'NEIL

#80

I'm with the Environmental Protection Center, but I'm O'Neil, and he had to leave because his wife is sick.

May I speak in his place?

CAPTAIN WAGNER: Yes, Mr. O'Neil, you may. Please state your full name for the record.

MR. O'NEIL: Thomas D. O'Neil, with the Environmental Protection Center.

I would like to start off by saying 20 years ago President and General of the Army Dwight David Eisenhower in his farewell address said, "Beware of the military industrial complex."

I would like to proceed by saying that dealing with that -- this report I found -- I was able to read it. Most of the pertinent areas dealing with ocean dumping, I found it pretty holey in the sense of with holes; particularly lack of footnotes; like the difference with radiation. In other words, the difference in millirems from New York to Denver if you are flying -- which was given this morning in testimony. I don't know where these things came from. Also the terms "very conservative" and "realistic" were used in the report to derive the radiation. They said very conservative. I had the feeling reading it that it was conservative in the sense of the EPA and the Interior Secretary. I feel that conservatism begins with the earth and the planet; conserving the planet. And these terms are being misused, and it's kind of like new speak.

The statistic that was used in the report on page S12 of 0.00000000006 millirems per year exposure to a person most directly to be exposed seems by itself most infinite -- negative magnitude to be absurd and fly in the face of common sense; particularly compared to natural, quote, natural radiation from potassium 40 of 2.4 millirems per year.

It seems that dealing with radiation, the people are expected to take this by -- by faith. And this leap of faith is certainly valid for mystics and other spiritual people. But I don't feel it's valid for scientists and politicians.

I will keep my comments on sea disposal. However, in last week's Newsweek was published a satellite picture of South Carolina, very near where one of the proposed sites for the land dumping. And they are quoted as saying criss-crossed by creeks and rivers. And that's on page 52, Newsweek,

the 21st, 1983. I only hope that this has been taken into satisfactory account. And if you dump them there, that years afterwards reactors there do not become a toxic waste dump.

But even here if -- if these future "realistic" assumptions prove to be an error, it would seem to be possible to clean it up at relatively less cost. How about cleaning W.1
up toxic waste at 14,000 feet below the surface? Here it would seem to be prohibitively expensive.

And my concern -- one of my concerns is that in the future we might find that we might have to clean up this toxic waste dump, and we would have to pay for it. And it will be much more than 2 million dollars per submarine. In other words, O.26
it seems like it's a penny-wise measure but dollar foolish.

Two-thirds of all the radiation per sub is in cobalt 62, which has a half life of five and a fourth years, and nickel 61, which has a half life of ninety-two years. I'm particularly concerned with nickel 63 because it's one-third of the total curies involved in each submarine, and it's an internal exposure hazard.

In other words, it will affect you inside the body L.36
through eating of fish, for instance.

Another one -- and I hope the statistic was right in there -- is this nickel isotope 59, which has a half life of 80,000 years. And both of these seem prime candidates, if L.20
leaked into the oceans, to somehow get into the food chain.

It would seem to me that dumping 120 or more submarines would increase the marine life in the area by providing homes and L.55 cover for all sorts of marine life. We could be creating cities of marine life; especially when the containment walls are breached, probably within 100 years as it was said in the report.

Since most radiation is on the interior surface of the containment vessel when breached, they could become virtual pools of radioactivity where marine life would make their homes. Also would not the forms of life attaching themselves to the Q.13 hulls of submarines accelerate the process of corrosion? And this was never taken into account.

Seismic activity 40 miles away doesn't give me very much F.22 confidence. In the report there were at least, I think, only two to three lines dedicated to this, in very small print; which seems for 40 miles away to be negligence of some form.

Also that area, they mentioned one plate -- tectonic plate, the Gorda Juan de Paruca plate. But there are three plates that join right offshore there: the Juan Paruca plate, the Pacific plate and the North American plate. And of course, the San Andreas fault system is also very close to Cape Mendocino offshore. And very little information is given to the geology of the area relatively close to the dump site.

Incidentally, tectonic plate theories are only just about 20 years old; about the age of the submarines that we want to dump into there. Not much is known, particularly near

their boundaries. It could be found out, for instance, in the next 20 years that 40 miles away from a major fracture zone, instead of being "safe," could well be found to be quite dangerous. And we should leave ourselves open to that possibility.

On the map of page E-31 shows that the dumping site L.53 is less than 50 miles from one of the West Coast's prime fisheries; almost 500 catch per unit effort. Also the 127 degrees longitude eastern boundary -- and that's probably where the dump will take place because within 30 minutes of that you did the core samples. So -- also the map shows on this particular part that the grading goes from less than 10 catch per unit effort all the way up to 100 to 300 catch per unit. It's the only part in the map where you get such a discrete jump in catch areas. So I feel the report is kind of lacking in the research needed for that in the -- in the grading. We need a grading of the fishing. And since I eat the fish -- L.36 and the people I'm involved with eat most of our fish from Shelter Cove, it seems hardly pertinent to us to -- to make sure this is all checked out because I'm concerned about eating.

I'm also concerned about the currents. You have a south, southeast current at 29 meters above the ocean floor, J.28 at about one kilometer per day. It's rather slow, but within 100 days, radioactivity warmed by the current can move 60 miles. Very little is said about upwellings which is always J.31

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a possibility. There are two major current oceanic surface currents relatively near to the proposed site, and it is possible through upwellings that the radioactivity can be brought much closer to the surface.

One of these is the California current, which is a north-south current in the summer, and it moves pretty well right over that area. But in the winter, there is also a Davidson current, which is a warm water current that moves from south to north in the general area where the California current more closely out to sea. None of this is, of course, mentioned. I had to look into the National Atlas published in 1970.

L.9

If this site is approved, if submarines are dumped, then I feel a precedent will be set that hasn't been set before. And once these submarines are dumped in a 20- to 30- -- 25- to 30-year period, then I would presume that the new Tridents will also be ready to dump. And heaven only knows what the Navy has prepared for us after the Trident; I would imagine a floating Diablo Canyon. You know, one big Captain Nemo submarine with all of the destructive power of all the wars forever and ever. Unless -- Unless of course there is a nuclear war, and then all of that is of course moot, and then -- and so we go on ad infinitum on this nuclear arms race thing, and it all ties together.

And what I've seen here today is such unity of the

north coast area, the whole coastal area and in particular our area that a brother who was working with Mother Teresa in Calcutta called our area God's country. And I -- I think it's the -- to be using the Pacific for war-making materials is a --

UNIDENTIFIED SPEAKER: A sin.

MR. ONEILL: Yes, that's right.

And with that, the only thing that I feel is that if you go ahead with this, I really feel that you will be resisted politically, nonviolently. And I feel in the long run if you -- if we are not listened to that -- that forces could be set up where you might -- that we could have nonviolent direct action off the coast; which means you would -- each submarine would have to cost more than 2 million dollars just to alert the ships to post water hoses on them to keep the fishing boats away.

Thank you very much.

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CAPTAIN JAGGER: The next registered speaker is Garrett Connelly, representing Santa Barbara's People for Nuclear Free Future.

--oOo--

#81

GARRETT CONNELLY

Well, I have met an admiral in my life. I met an admiral in my life named Admiral Rickover who worked on submarines, and I had a long talk with the Admiral. And he explained to me exactly how radiation affects life. That the higher the level of radiation, the lower the level of life. It's as simple as that.

Now, you put more radiation in the water, the Santa Barbara -- the people of Santa Barbara, the people of California are not going to stand for it. So there's a problem; The radiation exists. I've read your book. I understand the logic that you're using. And I think we have to understand that this is California, and the people of California have a definite feeling for what life is all about; which is going to have to be understood by the Federal government.

And it goes something like this with regard to radiation: The NRC says that so many rems is so many rems.

And you fly in an airplane, and you get so many rems. You know, so you get your rems one way or you get your rems another way. It doesn't matter, you get your rems.

Well, we know more than that about the world. We've been accused here of being two generations ahead of science by our own Government. And none of us are scientists. We just have a feeling for what life is all about. It's as simple as that.

Now, when you get a rem -- when you get a rem it comes from carbon and that piece of carbon happens to be a hydrocarbon, it's part of your body; that's one kind of rem. And you get a rem flying in an airplane from general radiation out of the solar existence, and that's a general thing that happens day to day out, every way to Sunday.

So the Santa Barbara People for Nuclear Free Future and the people of California who are beginning to resist the constant pressure of absorbing the poisons that are generated by hateful warmongering all over the earth -- the Santa Barbara People for Nuclear Free Future feel that these things should be stored on the land somewhere very hard to reach from the ocean; Somewhere a long way away from a major river. Somewhere like up in the middle of Nevada. Somewhere very difficult; not on the Hanford River land site seven miles from the Columbia River, which is the alternate proposal. The radiation will have to go into the ocean eventually. The longer we can delay that path H.4

in our lifetimes is the best that we can do at this point in time.

N.3

The cost don't really bear in this. I have been in relationship with the Federal government on cost matters on several occasions. Once I saw the Federal government save 23 million dollars by allowing the NRC to give everyone in the country permission to burn all the radioactive rats, to throw all the radioactive shot givers -- hypodermic needles -- in the trash with the normal trash, to take all the radioactive aprons and radioactive pumps and all the radioactive things for another five millirems of specific radiation -- my objection was specific radiation -- as hydrogen and carbon.

So now we are all getting five millirems, an equivalent of a flight from here to New York of hydrogen and carbon; everyone here in this room -- and we are made out of hydrogen and carbon.

The basic attitude, the error, the reason the DEIS went wrong, where it missed the boat and where you'll never be able to convince the Californian that cares about the State is that you forgot to think about the relationship between the purely mechanical realm of pneutonian physics and the wonder of life. And life is magic. It's a magic thing that nobody understands, and you are in a realm here with radioactivity that is fooling with forces that are two generations ahead. You don't understand them. And you can't put it into the ocean

because you can't bring it back.

And so that's my objection from Santa Barbara, and I'll just tell you we are here. We put the Air Force on notice with the highest respect in a nonviolent heart, and the same goes for the Navy; the same goes for anyone that wants to hurt Mother Earth.

CAPTAIN WAGNER: Thank you, Mr. Connelly.

--oOo--

#82

CAPTAIN WAGNER: The next registered speaker is Ramona Crooks, representing Women Against Nuclear Proliferation.

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RAMONA CROOKS

I'm Ramona Crooks; I'm from Anchor Bay on the Mendocino County coast. I represent a small group called Women Against Nuclear Proliferation. We're very concerned about ocean nuclear waste dumping for one reason primarily: the lack of proven information on the effects it can have.

According to the Navy, the radiation exposure is expected to be negligible, but expectations have been wrong in the past.

Two hundred and fifty thousand servicemen participated in atmospheric nuclear testing in the past, and no one in the military expected them to develop a higher rate of cancer than normal. Civilians living downwind of the Nevada test sites in the '50's and '60's are now having health problems. The military didn't expect that to happen either because nobody knew about the dangers of radioactive iodine getting into the food chain from fallout. People should never assume anything

because assumptions are so often wrong. And this Draft EIS is full of assumptions. I will assume the military did not expect that American servicemen would be contaminated by Agent Orange in Vietnam. L.40

What assumption is the Navy making about submarine dumping now that may be proved false when it's too late? According to the Navy, the radiation exposure is expected to be negligible. According to John Gotman (ph), a past associate director of the Lawrence Radiation Lab and internationally known for his research on the effects of radioactivity on man and on his environment, "No amount of radiation has ever been proved to be safe."

To my group that means that there is no negligible amount of exposure to radiation. We are very concerned about what you don't know and about what you may be assuming.

Therefore, we are opposed to disposal of nuclear submarines or nuclear waste in any ocean, river, lake, pond or stream.

Thank you.

--o0o--

*#37a

CAPTAIN WAGNER: The next registered speaker is Dr. Michael J. Hertz. Dr. Hertz represents the Oceanic Society.

--o0o--

DR. MICHAEL J. HERTZ

Thank you. I'm Dr. Michael J. Hertz, Executive Vice President of the Oceanic Society, a 60,000-member nonprofit organization devoted to protection of the marine environment to the development of a constituency for the oceans. The society has headquarters in San Francisco and Stamford, Connecticut, and active chapters along both coasts. We have testified at all three of your previous hearings and have been working with states, cities, counties and citizens' groups on both coasts on this issue over the past several years. I'm also delivering this testimony in behalf of the Whale Center, a nonprofit concern for the protection of mammals located in Oakland.

The Oceanic Society has, since it began, been concerned with the issue of ocean disposal of nuclear waste. Although we view with alarm the possibility of the Navy disposing 100 nuclear submarines in the ocean -- it is as much because of the precedent-setting nature of this action as it is because

of our concern over the potential impact of 6.2 million curies of radioactivity that will be added to the seas by the sub. It should be noted that in addition to the Navy's reactor disposal program, the Department of Energy spent over 20 million -- actually closer to 30 million -- since 1976 to investigate the use of the seabed off Hawaii as the disposal site for high-level nuclear waste fuel rods from nuclear power plants.

In addition, the Department of Energy is also considering the ocean alternative for disposal of nuclear waste from the Manhattan project that produced the first atomic bomb. We are concerned that -- the scoping hearings on that project were held last Thursday at the same time as your hearings were held in Savannah, South Carolina, and the same time that the London Dumping Convention was going on, making it extremely difficult for individuals and organizations concerned with this issue to track and testify at all these hearings.

We are also concerned that one of the driving forces behind the Navy's desire to scuttle these subs is that the SALT agreements -- the Strategic Arms Limitations Treaty provisions -- limit the number of subs that any country can have. The alternative for keeping the subs in protective storage or keeping them any place other than scuttled at sea might limit the number of Tridents that could be launched in the coming years. | D.7 *

*Other issues discussed by Dr. Herz are side barred in Exhibits 37, 37b, and 37c.

The Oceanic Society's role in evaluating a potential impact of proposed activities on the marine environment is to assess the science of technology presented in support of such a proposal. In early February, we convened a scientific committee made up of experts from a variety of disciplines around the country to review the adequacy of the Navy's Draft Environmental Impact Statement and the supporting oceanographic studies.

It should be noted too that the title of the oceanographic studies was "Oceanographic Studies in Support of the Assessment of the Sea Disposal of Nuclear Reactors," which leads us to believe that -- that is pretty high on the priority list, and that we are not just looking at the two alternatives; that some decisions may have already been made.

The points raised in the testimony of the file that were based on deliberations of this committee, the final report of our scientific committee, will be completed within the week and will be submitted as written comments to the Navy and will be available for other groups to review.

By far the most serious problem with the sea disposal alternative as presented in the DEIS is once scuttled the submarines are -- by the Navy's admission -- irretrievable. And as has been indicated here by a number of previous speakers, the irretrievability is against the current law. And the Anderson Amendment says any nuclear waste that is put in the

ocean following the two-year moratorium is by law required to be retrievable.

As presented in the DEIS, the monitoring plans for either land or ocean alternatives are inadequate. With the land alternative, the assumption is made that monitoring will be conducted as part of the current and continuing programs of Hanford or Savannah River sites. However, the cost of monitoring is not reflected in estimates presented. The sea disposal monitoring presentation is also clearly inadequate. The adequate -- inadequate record keeping and the failure of the U. S. government to conduct any but the most rudimentary monitoring research at any of the ocean sites -- and there were 50 used for disposal of nearly 100 curies of waste during the '60's, around the '40's and '50's and '60's, does not inspire us with confidence; especially with the grossness around EPA in charge of the permit procedure. Although the Draft Environmental Impact Statement contains no cost breakdown, the total amount listed for monitoring appears to be totally inadequate for materials that will be available for marine environment for many, many millenium. Without that adequate monitoring program, our scientific committee agreed that the sea disposal option should not receive further consideration.

The most serious deficiencies in the DEIS consideration of the ocean disposal alternative concerns the availability of radioactivity and the possible pathways through which available contamination might reach humans.

Issues not addressed or inadequately considered include: Additional information is required to fully assess the significance of the radioactivity contained in the crud deposits in the reactor cooling systems. Data from the crud collected at land base reactors - and that is a technical term, that is crud. That is the material that lines the inside of the cooling pipes that cools the reactor. The data from land base reactors suggests that this might well be one of the most serious sources of radioactivity which can easily become available to the marine environment.

Further data on alpha emitters or crud from decommissioned submarines is also needed. Missing details on the sampling sites relative to the location of the reactors from the Thresher and Scorpion accidents make it impossible to evaluate the Navy's plan that such steps pose no threat to the marine environment or to humans. Sediment, water and organism samples should also be collected from the site of the Soviet sub which the U. S. Government attempted to raise with the Glomar Explorer.

J.42

J.43

J.34

Also we are concerned that the projections presented in the DEIS fail to consider galvanic effects, the manner and rate of corrosion at external well locations, and the manner in which the lattice breakdown in the radiated stainless steel which has been heated from operation of the reactor will

affect corrosion.

Of greatest concern with any disposal alternative are the potential pathways to which the radioactivity might reach humans. There exists a significant body of literature concerning the migration of radionuclides from waste forms to the water column sediments into organisms that appears to have been ignored in the preparation of the Draft Environmental Impact Statement.

Pathway issues not addressed or inadequately considered include: the studies conducted by the Environmental Protection Agency and others demonstrating possible pathways such as benthic organisms to rattail fish which serve as a warning that other pathways or potential pathways exist and that further investigations are warranted.

In that regard, the single most damaging study to the position that says there has been no harm from past dump sites is a study that was done by William Shell and his associates which demonstrated that in the case of the East Coast, the Hudson Canyon site, that migration of radioactivity -- the americium in this case -- has been traced from waste barrels in the bottom sediment in the benthic organisms and then to rattail fish.

You should watch tonight the 20/20 program which will be the first public airing of that set of data because the Environmental Protection Agency has refused to release that information. I think perhaps the Navy could get the information if they requested it.

The artificial reef effect has not been investigated in the deep ocean, but the settling of marine organisms on the subs appears unlikely and should be investigated; particularly in terms of how it might serve as a pathway in an accident scenario both at a disposal site or worse on the continental shelf itself.

Also there has been a failure to consider the possible role in bacteria in the mobilization of radionuclides as a beginning of another pathway to humans.

The potential effect of accidents has not been adequately addressed. The Navy estimates 0.3 accidents per 100 subs scuttled at sea. Because this is a, quote, reasonable probability, the potential impact of such an accident on the continental shelf from both an impact sub and exposed reactor compartment should be discussed in detail, especially in terms of possible exposure level of three rems to a population of 30,000. To determine whether this is an acceptable exposure rate should be provided in the Draft Environmental Impact Statement.

Worse case calculations are confused and appear to be off by as much as nine orders of magnitude.

Further, the use of EPA's standard for drinking water is misleading and inappropriate, especially since the correct

calculations using the Navy's data come to within .1 of that standard.

The data presented in the DEIS on albacore catches in the vicinity of Mendocino sites are based on 15- to 23-year-old information while the more current available data which are available from the same sources at Scripps Institution of Oceanography indicate that in some cases each year the albacore catch is among the highest recorded on the Mendocino Coast. And that data is just as available to the Navy as it is to us to find.

In addition, there is no information presented as to fish catches on the East Coast site. There's a lack of consistency throughout the DEIS in terms of the use of worse and average cases' scenarios. In order to make discussions of exposure doses resulting from accidents, a uniform approach to terminology and calculations should be adopted in order to make presentations more meaningful.

The committee felt that one of the most serious deficiencies throughout the Environmental Impact Statement is the fact that none of the measurements presented are accompanied by air terms, making it impossible to determine the level of precision or the range or variability of the data recorded and a practice that no scientist would use in anything that he attempted to publish.

A serious deficiency throughout the DEIS is the fact --

I'm sorry, I'm repeating myself.

Although the DEIS states that locations for possible ocean disposal have not been selected, the stated site selection standards suggest that the lower continental rise area might be eliminated or possibly be eliminated based on data presented in the Oceanographic Studies Volume 2. That is where it is shown that the currents are some of the fastest seen in the North Atlantic. I think it would be unacceptable in terms of potential for disturbing of the radioactivity. Also the other East Coast site, the Hatteras Plain site, will probably be eliminated because it's just outside the U. S. 200-mile economic zone. And I think our Government could not fly that much in the face of international opinion and dump submarines outside our territorial waters.

In addition, it appears unlikely that locations other than Cape Mendocino area could be found on the West Coast that keep the required selection criteria. Our discussions with Dr. Ross Bek (ph) who is in charge of the Oregon State University studies indicate that the Southern California site that was considered briefly and then discarded as being too close to habitation, fishing, and shipping was the only other site that was really reasonable to be -- to fall into or to meet most of the criteria required; and therefore it looks as if the Mendocino "generic" site is the most likely of the three sites that are covered in the Environmental Impact

Statement for use.

Obviously, more site specific data will be required before an evaluation of the impacts on delineated disposal locations can be made.

Overall, our committee felt that this Navy DEIS is one of the poorest environmental documents that any of the scientific committee members have ever reviewed. It is filled with significant information gaps and technical deficiency and raises a great many issues requiring much additional information.

By and large, the document reflects poor scholarship as demonstrated by its author's failure to consider large bodies of pertinent information regarding a number of issues and by the use of old data when significant new information was readily available.

Also the review of the DEIS in the supporting oceanographic study reveals numerous inconsistencies -- internal inconsistencies -- places where the summary of the DEIS misrepresents data presented in the body of the DEIS, and also where the DEIS and the oceanographic study summary misrepresents information from the oceanographic studies. J.21

Careful reading of the cost data on ocean versus land also indicates the interesting fact that if one looks carefully, the 2 million dollar difference -- the 2 million dollar more expensive land disposal presentation includes within

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it the cost of, after removing the reactor compartments, welding the submarines back together, making them watertight and then towing them out to the ocean. That doesn't seem to be

O.12

part of the ocean -- or the land disposal alternative to us. And if that difference, if that cost of that project is removed, I think that that may eat up much of the difference, leaving cost not one of the principal considerations.

N.3

Our feeling that human health and safety should in any case take precedence over cost.

Because there are significantly more gaps, deficiencies, unanswered questions and uncertainties regarding the sea disposal alternative, the committee concluded based on the existing information that a land disposal option is far preferable. Land disposal would minimize corrosion, the principal mechanism producing available radioactivity and greatly simplify the monitoring process. We do, however, recommend an alternative not presented in the DEIS land

H.3
H.4

disposal alternative discussion, and that is the possible use of something like the Nevada test site which is a very arid environment, leaving the reactor compartments above ground where they would be subject to much less corrosion and minimize the amounts of radioactivity released in the environment.

And finally, we would like to add our support -- and we've already requested it - for an extension of the comment period at least for another 90 days to give people sufficient

time to comment on this proposal.

Thank you very much.

CAPTAIN WAGNER: The next registered speaker is Jeff Hohensee. I'm going to not be able to give the correct organization -- the Alliance for Responsible Energy. And, Mr. Hohensee, would you please correct that organization.

UNIDENTIFIED SPEAKER: There's another speaker here for organizations who is probably going to talk later who's on the list. He came late this morning; I would like to move over to individual speakers --

CAPTAIN WAGNER: Excuse me, sir?

UNIDENTIFIED SPEAKER: -- representing an organization. There is a fellow Yorgos Savides who is going to talk for our organization, and I would like to move my name over to individuals.

CAPTAIN WAGNER: Fine.

UNIDENTIFIED SPEAKER: Thank you.

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252

CAPTAIN WAGNER: The next registered speaker then is Mr. Jim Le Cuyer.

MR. SAVIDES: Can I speak then at this point because I represent CARE, that is the organization that Jeff --

CAPTAIN WAGNER: That's fine. I'm sorry, sir.

--oOo--

#83

YORGOS SAVIDES

My name is Yorgos Savides. I represent CARE -- the Cahto Alliance for Responsible Energy. We are a member group of the Abalone Alliance located in Laytonville. And we represent the northernmost portion of inland Mendocino County. I trust that we would welcome a break from sort of the form that the hearing has been taking. I have a poem that offers testimony for our position against the dumping of submarines off the coast. It's entitled "Not Here, Not Anywhere."

"Not here, not anywhere should we meet like this
to discuss what to do with dead atomic submarines.
Not here, not anywhere.
I told them long ago it was a bad idea.
Sooner or later we would have to junk the things

because they would be too hot to handle.
I don't think anybody really cared about it
at that time.
It was just a brilliant new idea.
We were all blinded by the splitting of the
peaceful atom.
Dr. Frankenstein, meet Captain Nemo."

I learned all about the dangers of radiation in the 1950's. A film strip turtle taught me when I was a child in school. Being a turtle, he was very lucky, he could pull his head inside of his shell any time he wanted to escape from reality. He taught us to duck and cover. As soon as you see the blinding light, get under your desk. Clasp your hands on the back of your neck to protect it. Stay indoors and keep the windows closed until the cloud passes. Dump hot nuclear reactors in the ocean far, far away from the centers of population. Dilute them with enough seawater, and their leaking deadly radiation will be harmless. We were told lies then, and we are still being lied to.

And while we are obediently crouched under our desks, you know,I really did feel safe. I remember that as a child I really felt safe under my desk.

Innocent servicemen sat in open trenches in camp desert rock a few thousand feet from ground zero and watched the bones in their hands as if the flesh had melted away as white-coated AEC scientists studied their ability to field strip their M-1s moments after the blast. The green-clad guinea pigs today lie in hospital beds dying of leukemia while the VA turns a deaf ear.

Now, these old subs ain't going to hurt nobody if we can just get them far enough away.

B.4

When they were being built, the radiation from the submarines killed workers. Portsmouth Naval Shipyard, New Hampshire boasted a leukemia rate amongst shipyard workers 450 percent above the national average.

Admiral Rickover was not very eager to let folks know about that one.

The crews on the submarines most likely will fair no better. If they let these subs melt into the ocean floor, it's pretty certain we'll kill some more. I think the strange thing is our enemy may be a lot safer from these subs than we've ever been.

I am angry at America. I am angry at America's unleashed power greed. And I am angry at those who still blindly insist that radiation is a poison that can be diluted with the four sacred elements of our Mother. And that chromosomes will not notice the counterfeit. Those people who still insist this are either serving obscene self-interests or simply have had their heads in the sands of delusion so long they can no longer retrieve them.

We shouldn't be having this meeting. It is an insult to our children.

My neighbor's child contracted leukemia. I must speak from the heart as it is illuminated by the shadow of death.

When the submarines were built, they were dumped on the planet. We cannot dump them now. Not here, not anywhere. There are no hiding places left, and I still trust that we shall find the answers together.

I have a friend who is six years old, his name is Yaro Tager (ph). And he asked me to bring this and deliver it to the Navy today; a little sketch he did. And it's a picture of a submarine underneath the ocean, and a little boy standing on the shore. And I can't read all of it because some of it is written backwards, I think. But the kid's got a smile, and he's saying, "I can't swim." And the submarine has a big X through it.

Thank you for listening.

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CAPTAIN WAGNER: The next registered speaker is Mr. Jim Le Cuyer, representing Friends of the Earth.

--o0o--

#84

JIM LE CUYER

I'm Jim Le Cuyer, and I'm here to read a letter from Friends of the Earth, and joining with the Friends of the Earth in approval of that letter is the Marin Center for Peace, Marin Artists for Social Responsibility, International Union for the Conservation of Nature.

It's addressed to you, Captain Wagner.

"Captain Edward F. Wagner, United States Navy, Office of the Chief of Naval Operations.

"Dear Captain Wagner, the proposal to bury obsolete nuclear submarines in the ocean floor is of great concern to Friends of the Earth. We believe the ocean option is the least wise of the choices you have before you. The probability of

L.20 leakage into the biosphere is higher with marine storage than surface storage. A current understanding of the pressure

L.1 effects, corrosion rates and mobilization and geologic action is far inferior to our knowledge of those phenomenon on land.

"A further adequate technique for monitoring leakage

of radioactive materials under the ocean and cleanup of escaping radioactivity will be extremely difficult if not impossible. The application of civilian criteria for a high-level waste disposal to the technique being proposed by the Navy would disqualify this dumping procedure. Burying nuclear submarines on the ocean floor may temporarily solve our generation's problem of what to do with our legacy of radioactive waste, but it's hardly a fair legacy to bequeath to our children and those who follow them.

J.76
W.1
A.16
F.10

"Some radioactive materials remain dangerous far longer than the United States or even human civilization has been in existence, and we must broaden our vision from one lifetime to that of many.

"We recommend that nuclear wastes of all kinds be stored on sites already contaminated with such material until safer alternatives are found. We support efforts to find the safest permanent storage methods that can be developed. Our view is that such methods will probably be land based. The proposed inexpensive scuttling of nuclear submarines will foreclose such options. The ocean bottom alternative that appears financially cheaper for the moment is likely to become costly in monetary terms and irreparable damage to the ocean, their life and perhaps the well-being of the human species.

H.4

N.3

It is our responsibility to assure that the costs of our waste not be laid on the doorsteps of generations to come."

And this is submitted by Jim Redejanic (ph), Assistant to the Chairman of the Friends of the Earth.

I have a few personal comments to make. Captain Wagner, it might surprise you to know that some of us were also in the Navy. I was once a naval officer myself, and probably started about the same time you did -- 1956. I don't know when you began. USN.

I would say you would have to look far and wide right now to find people in California who were sincerely and deeply involved and interested in actually dumping waste in the California ocean here. I think you're convinced of that by now yourself, although I don't know from your face what you are convinced of.

I gave up my Navy career and I became recently a commercial fisherman. And I fish off this coast, and I used to fish off the Farallon Islands until I realized that tens of hundreds of thousands of barrels of radioactive waste had been dumped there. I got a little angry at this and a little worried, and I began to think somebody is wrecking my income. I began to realize that radioactive material as it enters the food chain
L.36 becomes more and more concentrated as it rises higher and higher
L.37 on the food chain. And my fish are about as high as you can get, except for me and other people like me.

When I found out that an estimated one-third of the
L.6 barrels off the Farallons were leaking, I began to wonder if

L.53 there was anything or anybody that could tell me just how radioactive my fish were. I mean, what was I actually catching? And there was nothing. No one could tell me. I began to wonder if I was selling radioactively hot fish to people. And I began to worry about it. So I stopped fishing there. And the reason -- the real reason I stopped is because I know that low-level radioactivity is carcinogenic. And even if you don't think that low-level radioactivity is potentially carcinogenic -- which I think very few people believe -- then you ask someone who believes that to eat a radioactive fish.

I stopped fishing at Farallons also because I've seen how cancer works firsthand. My mother died of it; my grandmother died of it; my uncle and a close friend died of it. It's a very long, slow, painful, horrible death. It drives the victim crazy with pain. I don't believe even the Navy wants anyone to die like that.

I propose three things: One, that hearings be held J.15 in coastal fishing towns at Monterey, San Francisco, Bodega Bay, Fort Bragg and Eureka. You can get a real sense of what the coastal people feel. I'm sure you feel deeply about the ocean yourself.

I propose that until adequate realistic environmental impact studies are undertaken by respected disinterested scientific people, that there be no further dumping of radioactive waste in our ocean.

And I propose -- three -- something that my fellow fishermen might be a little hot about, and no pun intended. That the Farallon Islands be closed to sport and commercial fishing until we know just exactly what we are catching and eating there.

Finally, I want to thank the Navy for offering us the opportunity to come together here. You have allowed a whole variety of sometimes disparate groups -- disparate not desperate -- disparate groups and individuals a welcome chance to come together in an ever greater and more powerful antinuclear movement.

Thank you very much.

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UNIDENTIFIED SPEAKER: Merere Paradise asked me to ask you if she could come next. She was promised by you at the lunch break to come after Jackson Davis.

CAPTAIN WAGNER: Ms. Paradise may come next. She represents the Farallon Foundation.

--o0o--

#85

MORERE PARADISE

Good afternoon, Captain Wagner. I'm sorry that we could not meet under more pleasant circumstances. I'm concerned for your well-being as well as mine, otherwise I would not be here. I'm here on behalf of the Farallon Foundation. I have two statements from people that are involved in our organization.

The first one is a letter from Gordon L. Chan, who is a Ph.D. in the Department of Biology. He is also on the Scientific Advisory Board for the Farallon Foundation. The letter starts as follows. It is addressed to Louis Syler, who is the president.

"Dear Mr. Syler, I have read the DEIS for the disposal of defueled naval submarine reactors off our

Mendocino Coast. In summary, I would like to reject this DEIS report for the following reasons: There is no or very little reference of released radionuclides for marine organisms.

T.13 Applying study of terrestrial freshwater organisms to a marine biota is not scientifically applicable in my line of thinking.

L.13 L.43 T.18 J.9 There is no study on accumulative consumption of released radionuclides by benthic or prolific species. What are the effects on the reproductive sequences? What is the population of marine biota in the Mendocino trench area? What are the densities of critical marine species that live in that area?

L.1 Are there any specific marine organisms that are few in numbers and might be endemic to this locality? Could it be possible

J.9 that rare marine species can be eliminated by the release of these nuclides? Until I see such predisposal studies, I would not unload such submarine vessels in the marine habitat. To do so would be a serious mistake in the science of preparatory care of our national resources."

This is signed sincerely, Gordon L. Chan, Ph.D., Biology Department.

Okay. This next letter is from John Harris, Ph.D. in Radiation Biology. He is also an M.D. specialist in oncology; that is cancer studies. He's also on the Scientific Advisory Board for Farallon Foundation.

The letter starts as follows: "As a radiation biologist with over 20 years of research experience on the

effects of radiation, and as a physician whose medical specialty is radiation therapy -- use of radiation for the treatment of cancer patients -- I have an extensive experience with and knowledge of the biological effects of ionization radiation -- excuse me -- ionizing radiation.

"I am a member of many scientific and medical societies and have served, for some years, as the United States representative to the International Atomic Energy Agency working subgroup on modification of radiation therapy in cancer patients. This background provides me with a unique viewpoint from which to comment on the Draft Environmental Impact Statement mentioned above.

"This DEIS argues that disposal of 100 nuclear submarines in the ocean environment is a desirable option because it is cheaper, it is simpler and requires no new regulations relative to other options. It is a seductive document, replete with mathematical models, formulae and graphs which obscure and minimize the real issues. It is pertinent to note in this connection that the authorship includes 13 engineers and mathematicians but only two biologists -- one wildlife biologist Ph.D. and one M.S. in environmental studies with a three-year experience. N.11

"It is critically important that we remember the old adage that those who fail to learn lessons of history are doomed to repeat them. From the unfortunate results of

NOTE: This testimony was also submitted (June 1983) as a document which appears in Exhibit 707.

J.20

T.3

our A bomb experience through the many industrial chemical accidents whose litigations fill our courts, we should have learned by now that government documents which are replete with reassurances of safety based on complicated and calculated scenarios neglect one central fact: Nature does not always understand mathematics;and the calculations, no matter how sophisticated, inevitably are based on incomplete data.

J.20

"When such calculations involve trivial matters, the consequences are often annoying, at best. However, when a potential crisis of the magnitude involved in miscalculations of the consequences of atomic submarine disposal in the ocean environment are involved, then lack of any data may well prove catastrophic.

"The report concludes that the 6 million curies of radioactive materials from 100 submarines would undergo a significant amount of radioactive decay before its containment shell corrodes. They bolster the argument with very short-term data from two sunken submarines and go to great lengths to indicate how secure the calculations can make one feel about the containment, for as long as 200 years.

A.7

L.20

"The fact of the matter is that there would still be as much as 5,000 curies of cobalt 60 alone present even 1,000 years from the disposal time. Surely the mathematicians would not have us believe that the subs will be intact in 1,000 years. It should be apparent that the heartfelt wish that these

L.22

isotopes will not get into the human environment because they would be insoluble is just that -- a wish, not a reality based on any data.

J.20

"The report, for all its mathematical beauty, contains little or no hard data regarding the fate of these various isotopes, by themselves or as changed by the marine environment. In my opinion, it is tantamount to insanity to believe that we can irretrievably dump 100 nuclear submarines -- and one wonders how much more in the future -- with impunity. I think that we are talking about nothing less than potential contamination of the biosphere for future generations, and we are considering this based on cost and very limited data. The land option, while admittedly more expensive, would at least permit ongoing monitoring and possibly retrieval as needed. Experience with and facilities for this option already exist and should be used.

"As a citizen of California, a resident of the Pacific coastline and a scientist and physician who has worked with and researched the effects of radiation for over two decades, I call upon the California State Legislature to take a strong position against this potential insanity and to utilize every means at its command to insure that nuclear wastes are not disposed of in the marine environment."

This letter is signed by John W. Harris, Ph.D., M.D., Associate Professor of Radiation and Oncology.

Captain Wagner, in conclusion, I would like to say as a concerned individual for the well-being of all of humanity, I plead to the United States Navy to not dump into the ocean anywhere in the world and to do further investigation into other viable options such as the land controlled situation where the monitoring could take place.

And I now also plead to the public to educate themselves further and take advantage of these testimonies that have been given here today. Take this opportunity to become active. I strongly urge you to listen to your conscience. Act with expedience and integrity on these issues that can no longer be ignored. We must take responsibility. Many of us have been ignoring this situation for a long time. It is up to the public to change things; to bring about a safe environment; to insure the survival of humanity of our world.

Thank you.

CAPTAIN WAGNER: Thank you, Ms. Paradise.

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CAPTAIN WAGNER: The next registered speaker is Scott McCreary, representing Bay Chapter of the Oceanic Society.

--o0o--

#86

SCOTT McCREARY

Thank you very much for the opportunity to speak to you today. I am Scott McCreary, Vice President of the Bay Chapter of the Oceanic Society; one of three chapters in California. I represent a Northern California membership of 1800 people. Today we join with the National Oceanic Society, the Farallon Foundation and others in expressing our opposition to the Navy's plan to scuttle up to 100 obsolete nuclear submarines off Cape Mendocino; thereby adding 6.2 million curies of radioactivity to the oceans.

Our motivation for speaking today is both scientific concern and our philosophical position that nuclear materials produced in the United States should not be disposed in the ocean bottoms. We share the concern of the Oceanic Society's Scientific Advisory Committee whose members critique the Navy's DEIS. We believe the document is flawed, both in the data it fails to present and in the methodology by which conclusions are reached.

Sources of radioactivity are not adequately considered in the Navy's DEIS. Starting with samples from the sites of the Thresher and Scorpion accidents, the Navy should reexamine the statement that subs posed no risk to the marine environment.

A.12 We believe additional data is needed from the so-called crud deposits of nuclear cooling systems.

L.35 Further, the document doesn't take account of corrosion effects that would permit escape of radioactivity to a marine environment. Pathways from waste forms to the marine food chain and to humans are inadequately considered.

U.9 The Navy chose to ignore studies by Shell in the VC for EPA and other studies concerning the migration of waste forms to the water column, sediments, benthic organisms and then to fish.

L.55 Possible pathways associated with the artificial reef effect of organisms settling on subs is not investigated

Q.13 nor is the possible role of bacteria addressed in the mobilization of radionuclides.

Shortcomings in the methodology are numerous. There are basic inconsistencies between the DEIS in supporting oceanographic studies.

S.25 None of the measurements presented are accompanied by error terms, making it impossible to verify the precision or accuracy of the data.

R.24 The construction of worse case scenarios are confused, and we believe inappropriate.

Beyond these fundamental problems with data and computation, I would offer another critique of the Navy's

document. As the principal author of the Draft EIS for the Department of Commerce action on the California coast, I've had firsthand experience being on the other side of the hearing table in this sort of situation.

The President's Council on Environmental Quality drew up some standards for the contents of the Environmental Impact Statement with very specific concepts in mind. One was the idea that irreversible commitments of resources should be examined, and especially closely. The Navy's disposal option appears to be our typical example of an irreversible commitment of resources. The Navy's own statements indicate that once scuttled, the subs would be irretrievable. W.1

This is a direct contradiction of the Anderson Amendment signed into law by President Reagan. F.2

Looking closely at irreversible commitments of resources means careful monitoring to make sure nothing goes wrong.

Both the budget presented in the DEIS and the nature of the disposal program would make adequate monitoring all but impossible. J.76

The second key concept in the CEO guidelines is the insistence that cumulative effects of federal actions be assessed. A proper discussion of cumulative impact should present the Navy's plan in the context of past and future actions. In this case, we must understand cumulative impacts to refer to ocean disposal of radioactive materials through L.7

other programs; both in the country and internationally.

Our own Department of Energy has investigated ocean disposal for spent fuel rods from nuclear power plants and from nuclear waste from the Manhattan project. Ocean disposal of nuclear waste looms as a likely spinoff of the proliferation of so-called many reactors throughout other industrial nations and the third world.

F.8

Given this universal ocean disposal options, the Navy's programs must be viewed as both a symbolic and legal precedent affecting the global ocean continents.

The spector of radioactive waste amounting to as much as 200 billion curies by the year 2000 from nuclear reactors plus additional radioactive waste from military weapons, research, manufacture and disposal makes the thought of ocean disposal truly frightening.

Our decision will be used as the precedent by other nations with nuclear capabilities. This already includes six nuclear weapons powers of today and will likely include over a dozen other nations by the turn of the century. Scores more countries have received radioactive materials for research and power reactors and through clandestine operations. And we are preparing the capabilities to manufacture these materials on their own. Where will the radioactive waste from all this activity be disposed? The precedent that would be set by the United States' ocean dumping our decommissioned

submarines is in itself a critical impact that must be assessed in your environmental impact document.

I would like to raise the nature of this decision process as a concern of my organization. Like the National Oceanic Society, the Bay Chapter is committed to bring the best possible technical data to the decision process. This position has been voiced in our recent statements on the quality of San Francisco Bay offshore drilling and now nuclear dumping at sea.

Last June we convened the first State of the Bay Conference, a quorum of 300 academics and advocates to develop ways of tracking the quality of San Francisco Bay -- this is the document that contains that work.

We presented index numbers for water quality, freshwater inflow into the Bay, fisheries and habitates. These were exposed to cross-examination critique and discussion in an open forum. In contrast, the Navy has provided minimal opportunity for public access to this decision process.

As an organization with interest directly related to the proposal, we are alarmed that not one hearing has been scheduled in a coastal community on the DEIS. Very little effort was made to tap a scientific community or the many users of the marine environment with the direct interest in this issue. In fact, the people in this room today are a more fraction of those with a stake in the outcome of the Navy's

J.15

decision.

As a final point, I would like to raise the issue of the economic justification of an ocean disposal program. Economic calculations are used by the Navy to justify ocean disposal as a preferred alternative. Yet a genuine reckoning of the consequences of high levels of radioactivity finding its way from waste forms to the marine food chain would suggest the other alternative -- land disposal.

N.3

Consider that the oceans and the coastline are common property resources. They belong to all of us. We should ask those likely to be affected by this action how much they would want as compensation before the submarines are scuttled. I suggest that the people of California -- in fact the people in this room -- would ask a very high price indeed.

Thank you for the opportunity to speak.

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CAPTAIN WAGNER: The next registered speaker is Jonathan McHugh, representing People for A Nuclear Free Pacific.

--o0o--

#87

JONATHAN McHUGH

Hi. My name is Jon McHugh. I'm with People for A Nuclear Free Pacific, and we represent people all over, around the ocean here, from the United States to Canada, New Zealand, Australia, Japan -- basically ocean people everywhere.

And right now at this hearing, I've noticed that there tends to be an adversarial relationship between the people of this meeting and the Department of the Navy. And I think this is too bad because it's the Navy's duty to protect and defend the American people. And I think the views that are being expressed here is that the Navy is not doing this.

I think that the first question that must be asked at this hearing is why does the Navy want to decommission these Polaris submarines. And one of the reasons is that in order to comply with this Strategic Limitations Talks, in order to put more Tridents into the water, we have got to take some Polaris out. And -- okay.

The introduction of these new class of subs is presumably for the protection of the American people, and presumably that these actions are representing the will of the American people.

Well, in 1982 the express will of the majority of Californians was that we wanted a nuclear freeze. That we considered the continuation of the arms race a threat to our security and not, you know, benefiting our security.

The continuation of the arms race is against the express will of the people of the State, and this continuation is democracy ignored and abused.

We want a freeze on the production of radioactive poisons. These poisons are nonthreshold pollutants that are very much similar to PCB's. And these were outlawed in 1976 because of the problems with nonthreshold pollutants. Basically, they can't be diluted, and -- I mean, they'll still kill people anyway, even if they are diluted.

L.36
L.1
G.2

We depend on the ocean for food, and in the future we may depend on it even more. The dumping of 5 million curies into the ocean doesn't seem prudent when scientific knowledge on transport mechanisms are in their infancy. Therefore it's necessary that the Navy wait and store the subs in dry dock until sufficient knowledge is gathered.

Furthermore that the Navy and Congress make sure that it is the will of the American people that it is our desire to maintain the arms race. I don't believe it is.

The victory of a nuclear freeze initiative in eight of nine states clearly supports this belief.

The atmospheric weapons testing by the Department of Defense has increased the levels of radioactive hydrogen in the ocean by 43 times. The increase in cancer has become endemic, and this is certainly related to radioactive releases into the environment. And I'm sure you're aware of the reasons why atmospheric testing were discontinued. Tritium is only one of the isotopes. Sesium was another one; plutonium.

The Department of Defense is in the business of protecting its citizens, not in the business of killing them.

UNIDENTIFIED SPEAKER: It should be. That was a should be. They should be.

MR. McHUGH: Oh, okay. Okay, the Department of Defense should be in the business of protecting the citizens, and not in the business of killing them.

L.37

When you consider the body concentration effects in the food chain of radionuclides, you realize that what you dump in the ocean will come back to you on your dinner plate. I live in Santa Barbara, and there the Navy has dumped radioactive waste in the submarine trench off the Channel Islands.

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U.5
U.2

Recently a graduate student at UC Santa Barbara has done research on how the radioactive materials get into the food chain even though they are at great depths. And that is the eggs fall into the trench, and then the young fish swim up, and then other fish eat them. So even where there is not upwelling, there is still a possibility of this radioactive materials getting into the food chain.

It took human knowledge to create radioactive waste which endangers the health of the American people, and it will take knowledge to protect ourselves from radioactive waste as well.

We would like you to bring back a message to Washington and the Defense Department that we want to be defended from the threat of nuclear waste. Furthermore that peoples all over the Pacific want our ocean to be kept clean. Remember it is your duty to protect our democracy, and that is the democratic will of the people as expressed through elections -- to halt the production of nuclear weapons and associated waste, even if it is against your own personal views.

We want to rid the planet of nuclear weapons. Let it start here. Let it start now, and let it start with us.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Mr. Tom O'Neil, representing the Environmental Protection Information Center.

MR. O'NEIL: That's okay, I already spoke.

CAPTAIN WAGNER: Fine. Thank you.

Then we'll move onto the next speaker, Mr. Charles Orth, representing Ban the Ocean Nuclear Dumping.

--oOo--

#88

CHARLES ORTH

I'm Mr. Orth, and I do represent BOND here today. Quite a few of our people are also here. I would also like to note that we do have about 40 people that we bused here that left at 4:30 this morning, many of them having drove, oh, an hour to an hour and a half to reach the bus to begin with. They arrived at 10:30, and thereby by your current agenda, they who have to leave by 9:00 o'clock tonight to be able to work tomorrow -- they are already missing a workday today -- I feel you should take into regards those people who did sign up at a later date -- and I'm sure some of the earlier people will waive their rights to testify until a later time. Please regard this.

On behalf of the people of the Mendocino County who are unable to attend this distant hearing site as required by the Department of the Navy, through a verbal testimonial, as ambassador for the coalition of groups calling itself BOND -- Ban Ocean Nuclear Dumping -- I stand before you with a voice full of concern of many thousands; filled with a fear that our Government will not stop the ocean disposal of radioactive waste.

It is the oceans where seventy percent of all oxygen from photosynthesis occurs in the biological process of marine microorganisms. What effect will our disposal of radioactive waste have on these minute organisms that exist in every form and every depth of the ocean environment? We as a people demand to know. L.13

Before you today we speak on the DEIS, on the disposal of decommissioned, defueled naval submarine reactor plants. The sites are in the deep ocean waters off the United States' 200-mile offshore economic zone. How long before other proposals such as the purported sub seabed disposal of low- and medium-level radioactive waste becomes public; as has the proposal to dump without containers of any kind the original radioactive tailings of the Manhattan project? L.9

As an informed group, our comments here today will adhere to all present and future proposals for the dumping of both toxic and radioactive waste in any ocean or naturally occurring body of water. We feel that any water-born program

submits any environment to unacceptable risks as shown by studies done on the Columbia River, the Savannah River and at White Oak Lake near Oakridge, Tennessee.

And I quote from Dr. Robert Pendleton, a nuclear and genetic biologist of the University of Utah, quote: "Very small amounts of radioactive waste were dumped into White Oak Lake. Fish that appeared afterwards were fantastic. They changed into many grotesque shapes and sizes. The most amazing thing was not the genetic mutations but the fact that some fish were found many miles downstream from the lake glowing like Christmas trees," end of quote.

Does the Navy feel that such a result in the rattail fish species of the great ocean depths would be as intriguing as were the Sea Wolf's bluish glowing when it was powered by its now infamous sodium reactor plant? I wonder that with such a beacon effect we still have not found this reactor dumped by the Navy off our East Coast. J.85

Talking about missing or lost material, where are the EPA's studies and film taken of the Farallons' nuclear dump site before the current administration's tenure in office began? Are we to trust the EPA as currently structured to protect and release these documents as part of the final draft on the submarine disposal at sea? They relate to the leaking of radioactive waste into the marine environment. We find no mention of any studies of past sites where any nuclear material L.6

was positively positioned in relationship to any test patterns.

J.42 Specifically, the studies as shown in the current DEIS show only nonnuclear areas, as once again the Navy is unable to show any part of a nuclear reactor plant once placed into a deep ocean environment.

Three such plants exist: the sodium reactor plant which first powered the Sea Wolf and then by accident the fully-fueled reactors of both the Thresher and the Scorpion nuclear subs.

I cite Public Law number 97424 in the Ocean Dumping Act of January 6, 1983, Section J: J.76 "A comprehensive monitoring plan to be carried out by the applicant to determine the full effect of disposal on the marine environment, living resources, or human health."

F.2 Section K(2) requires, I quote: "The administrator shall include in any permit to which paragraph I J is fully implemented, including the analysis by the administrator of the samples required to be taken under this plan."

Section K requires such other information which the administrator may require in order to determine the full effects of such disposal. This law requires a far larger monitoring budget than contained in the DEIS as each and every sub must be monitored fully for faults and/or leaks over a long and extensive time period.

W.1 Also no cost analysis has been done on a plan for the removal or cost of containment of the disposed nuclear material

if the container leaks or decomposes as required in Section E of Public Law 97424. L.53 L.20 Also the current DEIS contains no analysis of testimony about the resulting environmental and economic conditions if the containers fail to contain the radioactive waste material when initially deposited at the specific site as required in Section D of the Public Law 97424.

These additional requirements must be fully addressed in any final Environmental Impact Statement.

The people of Sonoma, Mendocino and Humboldt Counties by their elected representatives at all county, state and federal official levels have requested that additional hearings be held J.15 locally in both Fort Bragg and Eureka. Also the coalition to oppose the ocean dumping of radioactive waste has formally requested the Secretary of the Navy John Lehman a 90-day extension of the comment deadline on the Navy's DEIS for submarine disposal.

The current members of this coalition are in alphabetical order: Ban Nuclear Dumping, Can Disarm, Center for Environmental Education, Committee to Bridge the Gap, Critical Mass and Energy Projects, the Farallon Foundation, Friends of the Earth, Greenpeace, National Audubon Society, Natural Resources Defense Council, Nuclear Free Pacific, Nuclear Information Resource Service, Ocean Education Project, Oceanic Society, Sierra Club, Union of Concerned Scientists and the Wilderness Society.

The depth of our real concerns are here amply shown. And as adequate time has not allowed a full study or even a wide availability of the current DEIS on sub disposal, not to mention the great hardships of a far away workday hearing location, we once again ask for local hearings; these hearings to occur in Fort Bragg and Eureka, and an extension of 90 days on the comment period on DEIS before us today.

L.15

Currently, BOND holds seven percent of the Mendocino community on petition, and I will read this petition to you.

"Petition Against Radioactive Ocean Dumping.

"Because radioactive waste is concentrated in the food chain, increasing its toxicity; because radioactive substances have been shown to cause cancer; because people use the ocean as a source of food, recreation, livelihood and inspiration, we the undersigned demand that the Environmental Protection Agency and the Department of Energy not allow offshore dumping of any radioactive waste."

L.36
L.37
L.53

This petition is about to go national and from there international. So you'll be hearing a lot more about that. These people are stating their opposition to any radioactive waste dumping into any ocean environment and calls for a ban on any such plans or actions.

We do not feel that this hearing addresses the majority of issues still to be put forth by a large part of our interested population or that the time period for public comments allows

for an informed and well-planned review of a critical governmental proposal affecting the future of our offshore ocean environment and/or resource impact.

As we represent a citizens' group, we know the needs of a working population. With time in which to adequately address such a complicated issue due to the effect our environment over hundreds -- due to affect our environment over hundreds and possibly thousands of years.

BOND will submit written comments at a later time.

Thank you.

CAPTAIN WAGNER: Ladies and gentlemen, in order to give our hardworking reporters a few minutes of rest, I want to take a five-minute recess.

We will reconvene the hearing in five minutes.

(Whereupon a brief recess was taken.)

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268

CAPTAIN WAGNER: Ladies and gentlemen, if you would resume your seats, please, we will reconvene our hearing.

Ladies and gentlemen, we have two -- if I can have your attention. We have two organizations of school children who have also come a long way today, and so if I have no objections, I would like at this time to have these two organizations of school children come on next so the children can go back home.

The first organization is from the Point Arena Elementary School. Here with Miss Elana Gerstein are some children, and I will introduce each of the children individually and ask them to make their statement at the microphone.

First is Julie Green, please.

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#89

JULIE GREEN

Hello. My name is Julie Green, and I come from Mendocino County. And I live in a little town called Anchor Bay. And I go to Point Arena Elementary School, and I'm in eighth grade. And I come here representing my whole class and many other people.

And I want to speak out against the dumping of the nuclear subs off the coastline that I have looked at ever since

I was two years old. I want to say that if the Navy were to dump these nuclear subs, they would lose all of my respect. I have always grown up to believe that the Navy was supposed to protect our ocean. If they dump the subs, they will be contaminating it and harming it. I think that because you built these things, you should think of something better to do with them. I do not want them built so much that I would suffer from them. Like my friends, I care about the effects that it will have on fish and animals of the sea, but I also care about the people that it will affect when the radiation poison leaks out of these subs. It will leak into the sea. Fish that live in the sea will get contaminated; and if people eat this fish, they will be contaminated.

L.14
L.20
L.36

If a pregnant woman ate this fish, her child would probably be born defective. Think of all the children that would be born defective. How could you live with the guilt of ruining a future human life? What if it was your grandchildren or their grandchildren that were harmed by this act? You have the power to save life or destroy it.

I hope you choose life because I want to live safely. That's all I have to say.

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#90

CAPTAIN WAGNER: Our next speaker is Elana Gerstein, also from Point Arena Elementary.

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ELANA GERSTEIN

My name is Elana Gerstein, and I've come up here from Gualala which is right on the coast of Mendocino County.

This isn't easy for me. I'm only doing this because I really care about what I'm about to say. I really care for the ocean. I love the animals of the sea and all the other things that go along with our beautiful coast. I agree with all that has been said against the dumping of the nuclear subs, and I too am here to speak my feelings on this important subject.

Unlike others, I was lucky enough to come here, and I know a lot of people who care just as much as I do.

We don't know all of the dangers the dumping of subs will cause our ocean. Why are we taking this chance? You people are making a big decision, and your choice is going to affect many. I thought Navy people cared for the ocean, but by dumping the subs, you are actually putting the sea in great danger. You people are meant to protect us, not harm us.

Let's just wait until we have a safe way of getting

rid of these nuclear subs. Why is it that the submarines are run by nuclear power? I feel that we should find a better way so that we don't have to deal with any more of these problems. The submarines cost a lot of money, and we hardly have the money to take care of our own people.

I find it very stupid that we would make such dangerous material when we don't even know how to safely get rid of it. What you are wanting to do is very dangerous, and I don't see how you can even consider it.

Please don't dump the -- Please don't dump the nuclear subs -- Please don't dump the nuclear subs off our coast.

Thank you.

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CAPTAIN WAGNER: Our next speaker is Sara Press, from the Point Arena Elementary School.

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#91

SARA PRESS

Hi. My name is Sara Press, and I'm from Anchor Bay, which is in Mendocino County. I'm in the seventh grade.

I am speaking for a lot of people at home who couldn't take the day off to come down here.

It's hard to believe that you people in the Navy who have spent so much time on sea can barely see it being destroyed. Who knows what the subs can do after they are dumped into the ocean? I live by the ocean, and I -- and I see the -- I hear the sea lions and other animals. I would not like to see their homes being ruined. L.14

When you were young, did you have to worry about what was going to happen to the earth and the land around you?

Fishing is one of the leading industries in Mendocino County. And the dumping would be near a prime fishing area. That's not very smart. L.53 We should stop making -- We should stop making any more submarines and find a safe way to get rid of the ones that we have. N.3 We shouldn't have even started

to build them until we found a safe way to get rid of them.

The fish and other sea animals can't say what they feel about radioactivity matter being dumped into their homes; so we people have to speak for them: Don't dump the submarines.

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CAPTAIN WAGNER: The next speaker is Lea Rude, from the Point Arena Elementary School.

--o0o--

#92

LEA RUDE

Hi. My name is Lea Rude, and I'm in the eighth grade. I live in Point Arena, California, where my home is about two miles from the ocean. It is very hard for me to say what I feel and it is also very hard because I'm not only talking for myself but for many people who live on the coast and many of my friends.

I really love to be by the ocean and see the California gray whales migrating up and down the coast.

I don't know -- I don't know much about nuclear power, but I do know that it may someday destroy our earth. And if nuclear submarines are dumped off the coast, it will destroy sea life, plant life and a vast amount of water. This ocean is the home of many. Please don't destroy it.

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CAPTAIN WAGNER: The next speaker is Oona Sherman, from the Point Arena Elementary School.

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#93

OONA SHERMAN

Before I say the way I feel, I want you to know that this is a very scary experience for me, and that I'm only doing this because I care about our ocean -- which I live less than a mile from.

My name is Oona Sherman. I'm in seventh grade, and I live in Anchor Bay, which is in Mendocino County.

Just because I'm only 12 doesn't mean I don't care about my ocean or that I don't have the right to speak out. I came down here, missing school, because this is something I believe in.

Dumping these nuclear subs in our coast would ruin our ocean, which would also ruin the world and everything on it. It is also pointless; and I just don't understand why this dumping is being considered.

I realize that you have to get rid of this waste that you made, but I don't think it was very responsible to make dangerous nuclear waste without finding a good way to get rid of it.

I find it really disgusting that you Navy personnel with your obvious respect for the ocean could even consider this. You see, I live so close to the ocean that I can see fish rock while I'm eating breakfast and can hear the sea lions. It really sickens me that this part of life will be set off-balance. And I want everyone here to know that I will do everything I can to stop this world destruction.

This issue is very important to me and a lot of my friends and family, and I don't think that there is even one good reason for it.

Thank you.

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CAPTAIN WAGNER: Our final speaker from the Point Arena Elementary School is Brendan Mobert.

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#94

BRENDAN MOBERT

My name is Brendan Mobert, and I represent -- I represent the third grade in Point Arena. And this is how I feel about this group and a few other things.

This is an angry group, and they have reason for it. I wish to say that nobody here is wrong, but then again nobody here is right. At this minute, I haven't heard everybody's speech, but I think you are -- I think -- let's see -- that the Navy is endangering the earth and all its life.

I have to live with your mistaken -- I mean their mistakes, and they don't. Everybody's life here is something special about it -- has something special. And I suggest that you remember us and that we count too.

CAPTAIN WAGNER: I would like to thank each of the students from Point Arena Elementary School.

--o0o--

#95

CAPTAIN WAGNER: The next organization -- the next school that is represented is the Fire Creek School.

And the first speaker, I believe, is Susan Powell.

UNIDENTIFIED SPEAKER: Thank you. I think you better come back to Powell.

I just had a few things that I would like to say first, and then some of the children have some things they would like to say also.

I don't have anything really scientific to say, but when I first heard the idea of the submarines being dumped in the ocean, I was so appalled and shocked. And I started to wonder what was it that -- you know, I've almost become hardened to the fact that there is nuclear waste all around us. But what was it that really grabbed me about that? And the more I thought about it, the more I thought it was because the earth -- life on earth came from the ocean. It's the source. And I don't mean just, you know, the little single-celled algae that put oxygen into the atmosphere or even the first vertebrae that crawled up on some beach, you know, way back then. I started thinking about how all of us really come from the ocean because we spend the first nine months of our existence in fluid that is in many respects identical to ocean water. We all come from that same salty womb, I guess. And I think we should respect that. I think we have to really honor that.

And I can't think of anything else. That is really what I wanted to say.

The children have a song that we would like to sing first, and then afterwards some of us have some remarks.

--oOo--

STUDENTS FROM FIRE CREEK SCHOOL

(Song)

"Don't dump your subs in our ocean, our ocean, our
ocean.
Don't dump your subs in our ocean, our ocean's clean.
Don't dump your nukes in our ocean, our ocean, our
ocean.
Don't dump your nukes in our ocean, our ocean's clean.
Don't dump your trash in our ocean, our ocean, our
ocean.
Don't dump your trash in our ocean, our ocean's clean."

UNIDENTIFIED STUDENT SPEAKER: Let us live long in this world. This is the water of the people. And I learned this from an Indian prayer. I do not want to live a nuclear life.

UNIDENTIFIED STUDENT SPEAKER: I wonder if the Navy cares about children's future.

UNIDENTIFIED SPEAKER: Children, why don't you go give him your picture.

Some of the children feel that pictures speak louder than their words.

Thank you.

UNIDENTIFIED SPEAKER: I would like to speak for her. She's 18 months old, and she would like to live a clean life. And she would like not for you to dump these nuclear submarines in our ocean.

CAPTAIN WAGNER: Thank you, all the students of Fire Creek School.

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CAPTAIN WAGNER: The next registered speaker is Judith Redwing, representing Women for Survival.

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#96

JUDITH REDWING

My name is Judith Redwing. I represent Women for Survival, a group from the Mendocino Coast, which also has a chapter in Santa Fe, New Mexico, which as we all know is where the nuclear fuel cycle began with uranium mining on native peoples' lands.

I come here today to say that there will be no ocean dumping of nuclear submarines or any nuclear waste into any ocean anywhere for all of the valid reasons that many people have spoken here today and will continue to speak to; including the fact that it is not safe. We cannot scientifically, medically, sensibly or truthfully say that radiation is safe. When you say that leaks are possible, that is admitting that, yes, the water may be poisoned; the fish may be poisoned; the people may be poisoned.

L.20

L.36

The first speaker this morning said that radiation in fish and animal life would be "localized." When fishing is a major industry in all parts of the Pacific Ocean, when the ocean floor is riddled with fault lines, and when fish such as whales and others move from one part of the ocean to another, how can we call this potential for disease localized?

F.19 L.20

There is no proof that nuclear submarines when dropped to the floor of the ocean will remain intact. The studies done at the Farallon Islands set proof that there are harmful radioactive leaks from waste dumped that have not even been addressed by this DEIS.

F.2 W.1

And according to the Anderson Amendment, even a test sub dumped will have to be retrievable; and according to your report, that is not possible.

No one is going to die immediately, but one in three people in this country in this planet are dying of cancer right now. It's no coincidence.

Your Draft Environmental Impact Statement says that it is more economically feasible to dump nuclear subs in the ocean. It seems most economically feasible to research methods to stabilize radioactivity in nuclear waste, to develop alternative sources of energy and to spend money on healing this planet and her people rather than destroying it a million times over with nuclear bombs and war toys.

I come here today because I am charged with the pain and the anger and the rage of this earth. Though you and your men in Washington may not understand the concept, the earth, the ocean is the mother of us all, of your children as well as

ours. She will not tolerate your poison, the garbage, the destruction any more. Why do you think there are earthquakes? Why do you think there are volcanoes? When will you learn these lessons?

I come here with the voices and the support of many, many people in Mendocino County and with the inspiration of the children who spoke before me.

And I say to you: (song)

"We ain't gonna let you dump your poison into
the sea, into the sea, into the sea.
Ain't gonna let you dump your poison into the sea.
We are gonna keep on talking,
Keep on fighting until you find another way,
Until you find another way,
And until we hear you say you're gonna stop your
war machine
And stop your death machine
And turn your energy around."

CAPTAIN WAGNER: Thank you, Miss Redwing.

CAPTAIN WAGNER: The next registered speaker is Rella, representing People for A Nuclear Free Future.

RELLA: Captain Wagner, I think that one person has inadvertently been skipped over. Her name is Linda Peters. Before I assume my position at the podium, she can assume hers. Linda Peters.

CAPTAIN WAGNER: I do not have a registration card for her.

MS. PETERS: I called two weeks ago, and I filled out a registration card this morning. And my car is about to go in a tow-away zone at 4:00 o'clock, so --

CAPTAIN WAGNER: Fine.

MS. PETERS: -- I really want to talk right now.

--o0o--

#97

LINDA PETERS

My name is Linda Peters, and I'm here representing the Soroptimists International of Ukiah, of which I'm a member. Our club first became aware of the submarine disposal problem in May of last year, and we felt it was something that the people in our county should be aware of; so we wrote a letter to the Mendocino County Board of Supervisors requesting an

educational nonbiased public hearing on the matter. They in turn joined with the Sonoma County Board of Supervisors and the Humboldt County Supervisors in requesting that the Navy and the EPA hold such a hearing in Fort Bragg since it was part of the DEIS process anyway. They were turned down.

Senator Keene made the same request of the Navy and the EPA and was also turned down. Congressman Bosco along with 27 other congressional representatives in California called for hearings in Eureka and Fort Bragg, and they were also turned down.

Now, we understand your reasoning is that the method is what's to be decided and not the site. I read your letter to one of the organizations, and it seems to us in order to decide between land disposal and sea disposal that you need the input from people that know the sea; not just the scientists, but the people that live and work around the ocean -- Excuse me, sir, can you be quiet while I'm talking?

UNIDENTIFIED SPEAKER: All right.

MS. PETERS: I would like that; thank you.

Okay. We understand your reasoning as of the method is to be decided and not the site. And we feel that in order to decide between ocean disposal and land disposal that you need to have input from people that know the sea; not just the scientists, but also the people that live around the sea and the ones particularly that fish in the ocean.

You've made it very inconvenient for these people to be here today. Being -- and even in your other hearings, they've all been in inland cities. So at the risk of whipping a dead horse, we request once more that the Navy and the EPA hold the hearings in Fort Bragg and other coastal city that has a fishing industry. And we consider that this document is unacceptable unless you do this.

J.15

Now, I want to bring up the subject of cancer. It's been talked about a little bit today. The Soroptimists Club is a service organization made up of businesswomen, and one of the ways we serve our community is by driving cancer victims from Ukiah to Santa Rosa for treatment. Now, no amount of reading on the subject of cancer or studying the statistics has the impact of spending a few moments with someone who is dying of cancer. So we are very concerned about putting any form of carcinogenic substances into the environment.

I have a pamphlet here -- it's from the American Cancer Society, which is a fairly conservative organization. And it's called Cancer Facts and Figures in 1980. I'm sorry it's not 1983, but I got this pamphlet during a seven-month period that I spent with my mother while she was dying with cancer. And I'm sure that the 1983 figures are probably worse than these.

Now, what it says in here -- and these are quotes -- is that one out of four people will get cancer in their

lifetime. This does not include skin cancer, except for melanoma, which is a very deadly form of cancer; probably the most deadly. Two out of three of these people that get the disease will die from it. It used to be four out of five people would die from it. And one might think that modern technology has reduced cancer deaths, but if you read on, you'll find it also says in here that out of every 100,000 people in 1933, 112 died of cancer. Oddly enough, since a few people -- fewer people that get the disease are now dying; in 1977, 133 people of every 100,000 died of cancer. Now that's a nineteen percent increase in the cancer death rate in less than 50 years.

By the way, it also states -- which is appropriate here at this point after hearing the children speak -- that cancer kills more children between the ages of three to fourteen than any other disease.

It also states that the majority of cancer is environmentally related.

Anyone can get this document. It's not very hard to get a hold of. You just go to the American Cancer Society and ask them for a copy.

The environment doesn't change enough in 50 years by itself to cause a nineteen percent increase in the death rate of cancer. And by the way, because fewer people are dying of cancer that get it, what you can deduct from this is that the increase in cancer itself is even greater than nineteen percent. It's only through pollution caused by people that this can be happening. No government agency, no corporation, no business or individual that puts carcinogenic substances in the environment has -- or do I expect will -- step forward to take responsibility for these added cancer deaths.

In fact, just last week, two items were in the news that are along these lines. One was that the EPA has been withholding documents from Congress regarding toxic waste disposal sites. The other item was that women who call themselves the Atomic Widows are now organizing, demanding that the Government and the armed services take responsibility for the deaths of their husbands. Their husbands were used as guinea pigs during atomic testing and have since died of cancer. It was one of the most emotional news items that I ever saw. There were women singing and crying because they missed their husbands. I know we are not supposed to get too emotional here. We are supposed to talk like androids. But this is a very emotional subject.

The Government and the armed services have been trying very hard to ignore these people. Their husbands when they were alive have been saying things to the Government and the armed services, and they haven't gotten anywhere. And now they are dying, and their wives and the children are carrying on.

The EPA and the armed services are rapidly losing the

trust of the American people.

To sum it all up, we Soroptimists feel that the DEIS does not prove to us that either method of disposal is acceptable because they do not absolutely prevent radioactive leakage into the environment. We are particularly concerned about the ocean dumping because it's impossible to retrieve the submarines if necessary. We also feel that this method would most probably affect the fishing industry economically wherever it might take place. We feel you should hold the submarines in storage until you can prove beyond a doubt that you can prevent radioactive leakage into the environment.

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W.1
L.53
G.2

And now speaking as an individual. I'm a mother of two children, and I might guess -- I don't know -- but maybe you're a parent also. And I'm here due to my responsibility to my children and to the future generations of all people. And I think that you have the same responsibility. And I would imagine that if you continue with your job, having to listen to testimony like we've been giving you here today, that it won't be long before you're aligned with us. People in the company of truth have a hard time ignoring it.

Thank you.

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#98

CAPTAIN WAGNER: The next registered speaker then is Rella from the People for A Nuclear Free Future.

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RELLA

Good day. My name is Rella, and I'm a representative of a very active and very dedicated organization in Fort Bragg with the working people --

UNIDENTIFIED SPEAKER: Would you move closer to the microphone, please?

RELLA: Sure.

Acting locally, thinking locally.

I would like to begin my five-minute presentation with two minutes of silence. And I would like to -- in the process of that silence -- have each of us touch at least one other person. What I would like people to do, if they feel so inclined, I would like them to close their eyes and envision a world of peace; envision a world without nuclear submarines, without nuclear bombs.

(Whereupon there was two minutes of silence.)

I say power to the people. Americans are taught to love. Americans are taught to judge other societies by the

respect their government show for their citizens. We understand that individual rights may not be sacrificed by any authority for the public good. Individual rights are the public good.

But the nuclear age has left our country with a poor record. For example, in the South Pacific, the Navy misled the Bikini islanders into leaving their beautiful island homes so that the island can be used for nuclear weapon test sites; while the South Pacific people were subsequently neglected, degraded, impoverished and poisoned with subsequent suffering of radiation sickness, hair loss, skin lesions, malnutrition, miscarriage and grave sadness as a result of their sacrifice which they were told was "for the good of all humankind."

Meanwhile, the Navy assured them they had nothing to fear. It issued strict and confusing dietary orders, and on occasion warned them not to drink local water; although they often had no alternative.

When the South Pacific people left Bikini, they were too unsophisticated to ask why the United States didn't test this stuff in New York. But after almost 40 years of mistreatment, they are so sophisticated now that they have voted for the first nuclear free constitution.

In our own country, desert bomb tests were made only when the wind blew away from the City of Las Vegas and toward the small town of St. George, Utah. The people of St. George could not believe that their own government would expose them to serious danger, though they too often got cryptic instructions to wash their clothes twice, hose off all cars coming into town, avoid local water and local milk.

The people of St. George have paid a terrible price for their trust in -- in cancer, birth defects and leukemia.

J.6

Now, Cape Mendocino has been selected for the dumping of nuclear submarines possibly, and of course we are assured by the Navy that there is no danger to us or to the ocean environment. But the Navy betrays the truth in rejecting a San Diego site because San Diego has a larger population. And we would be fools not to know what that means. It means that we too are an acceptable sacrifice to a purpose, facilitating the ever-growing nuclear arsenal that a majority of Americans now seriously question.

Forty years of nuclear history and nuclear horrors have not been lost on the American public. The real public good, the human right of each of us to decent treatment by a truthful government must be redeemed.

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CAPTAIN WAGNER: The next registered speaker is Cathy Ryan, representing Greenpeace.

--o0o--

#99

CATHY RYAN

Good afternoon, Captain Wagner. My name is Cathy Ryan, and I'm here today on behalf of Greenpeace Pacific Southwest. Greenpeace welcomes this opportunity to address the Navy on land as well as by sea. Thank you very much.

Greenpeace is an international environmental organization. Our purpose is to promote environmental protection over the long term. Our campaigns are designed to foster awareness of the threat of environmental degradation through research, educational programs and nonviolent direct actions.

Since Greenpeace's beginnings in 1971, the oceans have been a central concern of the organization. Largely due to our efforts to protect marine life and the ocean environment, Greenpeace presently has over 240,000 contributing members in the United States, and we represent over 1,000,000 members worldwide.

Before I address the specifics of the Draft EIS, I would also like to add my comments of my concern to those before me. To the fact that this hearing is taking place halfway through the commentary period, which is due to end March 31st, 1983. These comments are taking place now rather than after this period has been completed.

Additionally, over the last six weeks, I have repeatedly heard from concerned individuals who have not been able to obtain a copy of the Draft Environmental Impact Statement; much less analyze and prepare for today critical comments on this 400-page technical document.

The 90-day commentary period the Navy has provided is not sufficient time for the public to analyze the bulk of technical data and considerations of the Draft EIS.

Greenpeace as part of a national coalition has submitted a request for a 90-day extension of public commentary time. We would encourage the Navy to agree to an extension to allow the public the proper time to study a plan with such serious implications.

I would also like to register my organization's concern that these hearings are being conducted in inland cities rather than the -- in the coastal communities that will feel the first impact if the ocean plan does proceed. I would hope that the Navy will recognize the need to hold further public hearings in coastal locations -- particularly Fort Bragg and Eureka, who have for very many months been requesting these hearings from the Navy.

J.15

Today I will address the Navy's examination of the ocean dumping option for the disposal of these radiated nuclear submarines. Although the Navy maintains that they have not yet selected preferred method of submarine disposal, environmentalists, fishermen, scientists, policy makers, state, government and citizens alike around the country and in other nations are concerned that more radioactive waste will be dumped into the ocean.

Greenpeace supports the Anderson Amendment recently passed by Congress which establishes a two-year moratorium on radioactive waste disposal at sea. We also support the interim moratorium adopted last week by the international group at the London Dumping Convention which places a moratorium on rad waste ocean disposal pending further scientific review.

I would point out that the United States was only one of six countries who opposed the moratorium at the London Dumping Convention. Nineteen nations voted in favor. Three of the nineteen nations which voted in favor of the moratorium were nuclear nations.

In the past two years, we've unfortunately seen the United States relinquishing its leadership role in marine protection to leading the battle cry for a diminishing number of dumping nations. Domestically, the Navy's plan is only the beginning for opening the ocean for ocean disposal. This is evidenced by the February 1st release of a notice by the Department of Energy for considering ocean disposal for fuse rap soils left over from the Manhattan project.

Greenpeace opposes the ocean disposal of radioactive waste. We are concerned because ocean dumping this waste means prematurely resuming a practice which could severely impact the public health and the marine environment before the effects of 23 years of past ocean dumping are clearly understood. There are too many scientific unknowns about the fate of radionuclides in the marine environment to add even one defueled submarine reactor plant to the ocean's growing radioactive waste inventory. One submarine reactor alone at 62,000 curies -- that's a DEIS estimate -- represents approximately one-half of the entire amount of radioactivity already estimated to have been dumped by the United States between 1946 and 1970. And the Navy must dispose of over 100 decommissioned nuclear subs.

L.6

L.1

The finding of Dr. Jackson Davis and others indicate that there are many questions that must be answered regarding the biological transport passage of radionuclides, oceanic currents and cumulative effects of passing current dumping operations. Scientific studies contracted by the United States Environmental Protection Agency have revealed evidence of radionuclide bioaccumulation in the marine food chain. Specifically, Dr. William Shell's study of americium 241,

U.9

contamination of rattail fish off the coast of New York and New Jersey is cause for great concern. I understand that that segment will appear tonight on the 20/20 special on ABC at 10:00 o'clock.

Especially in light of the almost complete absence of EPA radioactive waste dump site monitoring, careful consideration must be given to today's testimony by the Oceanic Society and others as they critique the DEIS on technical grounds.

Scientists are pointing to an unacceptable grasp of essential information that could be used to predict the transport of radionuclides in the marine environment. In addition to the lack of scientific review given past ocean dumping, two other concerns are the lack of ability to monitor the radioactivity once it's in the ocean and the irretrievablity of the submarines as stated in the DEIS. Past efforts of the EPA to review waste containers off the Farallon Islands bear this out. Once these subs are dumped, they are on the ocean floor forever. There are 16 different radioactive nuclides in the 62,000 curies that these subs will initially contain. These radioactive isotopes range in half lives of 5.3 years for cobalt 60 to 80,000 years for nickel 59. The steel containment of the waste drums off the Farallon Islands lasted only 20 to 40 years.

J.76
W.1

Comments which have been prepared for Greenpeace USA by

Dr. Marvin Resnicor (ph.)of the Council of Environmental Priorities indicate that the Draft EIS is fatally flawed in its estimates of the initial radioactivity present in the reactors when taken out of service. [A.10] The DEIS understates the curie count of cobalt 60 by a factor of 6, and a curie count of niobium 94 by a factor of 100.

When contrasting the two disposal options, the final solution of ocean disposal versus a responsible program of monitoring and maintenance in protective storage, it seems ludicrous to risk long-term irreversible public and environmental damage when a responsible solution can be developed.

[G.2] Greenpeace proposes that the Navy continue to maintain irradiated submarines in the protective storage in naval shipyards to allow the anticipated early rapid decay of short-lived radioisotopes. Information in the DEIS indicate that a proper time frame will be from 20 to 50 years.

Supporting this recommendation is a statement in the DEIS, and I quote, "Nuclear submarines can also be placed into storage for a long time without risk to the environment. The submarines would be kept in protective storage. About 20 years, each ship would be taken out of the water for an inspection and repainting to assure continued storage."

Furthermore, Greenpeace believes the DEIS must address the following considerations: One, what is the safest

transporation route for these radioactive wastes? Recognizing that shipment is one of the weakest links in the disposal process due to the possibility of accident and public exposure, great consideration must be given to the safest transport route. [E.23]

Two, what environmental concerns have been raised by the public near the two land burial sites that the DEIS does not cover? Are there more appropriate burial sites not covered by the DEIS? [I.2]

And three, can there be monitoring plans for a land base burial site? Can they be developed? The DEIS does not do this at all. [I.13]

In conclusion, ocean dumping is a nonsolution. It forces upon us a permanent means of disposal and precludes any option for safe responsible disposal for this radioactive waste. Given a lack of clear information regarding radioactivity of the submarines themselves, we call for independent verification and accountability of the Navy's nuclear propulsion program, especially in regard to the disposal of decommissioned, defueled nuclear submarines. Checks by the EPA and civilian monitoring agencies are not enough. Based on the lack of retrievability and the inability to monitor the subs once in the ocean as well as the underestimates of actual radioactivity in the subs and life expectancy of the radionuclides and containerization and the inconsistency with U. S. law and global policy, Greenpeace suggests respectfully that the Navy scuttle the ocean disposal plan and redraft a new environmental impact statement computing proper attention to the alternatives to ocean disposal.

For the record, I would also like to acknowledge the number of groups that are present here today. And if you could stand as I read your names. I'll just continue right now. Nationally, the environmental coalition and of environmental groups and public interest grouns include: Ban Ocean Nuclear Dumping -- if you can hold your applause,the list is rather long -- Can Disarm, Center for Environmental Education, Committee to Bridge the Gap -- please stay standing -- Critical Mass Energy Project, the Farallon Foundation, Friends of the Earth, National Audubon Society, Natural Resources Defense Council, Nuclear Free Pacific, Nuclear Information Resource Service, Ocean Education Project, Oceanic Society, Sierra Club, Union of Concerned Scientists, Wilderness Society.

In California these groups also include the Abalone Alliance, Concerned About Ocean Dumping, Defender of Wildlife, Democrats for Peace Conversion, Orange County Alliance for Survival, Orange County Peace Conversion Project, Save our Shore, Southern California Alliance for Survival, Marin Conservation League, Salmon Trollers Marketing Association of Fort Bragg, and Pacific Coast Federation of Fishermen's

Association.

I apologize if I left any of you out -- it's because I haven't spoken with you personally.

Thank you for your time. And I realize that is the fourth time you've heard this in the last two weeks.

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CAPTAIN WAGNER: The next registered speaker is Jared L. Rossman, representing Tom Long Watershed Association.

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#100

JARED ROSSMAN

I'm Jared Rossman. The Tom Long Watershed Association is a group of about 27 families on the tributary of the Eel River right near where it goes into the Pacific Ocean.

What we seem to be witnessing here is kind of a people's EIS. It seems to me if they took this transcript and with a little of the Navy's help and money edited it, we would have everything we need. We have a People Environmental Impact Statement on exactly what they should do with these submarines.

I would like to ask Captain Wagner kind of a process question. It doesn't seem like there's anybody here -- at least anybody who's not in the Navy's pay -- who is going to speak in favor of this proposal. And I've never seen any kind of unanimity like this in any political endeavor that I've been involved in. And it leads me to ask the following question: Since usually the purpose of a hearing like this is to weigh and balance the remarks that are made in favor of a proposal against the remarks that are made against a proposal

and then come up with a determination; whereas here since we have nobody speaking for the proposal, the only balancing that can really be done is the word of this near unanimous stand of all these groups, officials, organizations and individuals in California, all of whom are experts in living against the Navy's experts in living.

And I'm wondering -- We are going to be watching the results of this hearing really carefully,because if these public hearings in order to provide input into a process are to be meaningful at all, then such an absolutely unanimous stand by a state's people should be absolutely devastating to the conclusions that have already been arrived at in the Draft.

And if it comes back that we really haven't caused any change at all by this unanimous stand, then we are not going to be left with very many options as a united people.

I would like to thank everybody who's given the technical comments as well as those who have given the comments from the heart -- not that the technical ones aren't from the heart, but I know how hard it is to go through these 400-page documents and come up with anything meaningful and stimulating in the way of numbers. So I'm going to not give any more facts, just a few brief feelings about this.

The first is a comment on creatures that befoul their own nests. I'm not -- I don't mean this to be funny at all, and I think it's really actually more scientifically rigorous than it might seem. But the people of the State of California are being put by the Navy in a position, as we have been put time and time again, of toilet training the Federal Government. It's not funny. Humans feel that animals that poison their own nests are crazy. We think that they are aberrant. We think they have rabies or something.

Well, we are fouling our own nest with this; just plain and simple.

Now, earlier in the opening comments, Mr. Mangeno reading for the Navy mentioned what he called quote the natural background radiation as versus the miniscule amounts of radiation that the Navy says we will be getting unnaturally.

I would just like to point out that what he called quote the natural background radiation is not natural. It's the result of all of the bomb tests overground and underground and all of the other ways in which nuclear radioactive isotopes have been put into the environment in the last 30 or 40 years. And it's kind of a telling indication that we are being offered a chance to include these as part of our natural background radiation and then move on from there.

And I just want to ask if we're to accept this, the next time after all of this additional number of curies is added into the environment, are we going to be asked when the next big dumping is going to be proposed to us, we'll look at

the amount of -- are we going to be including what we are dumping now into what we will then call the natural background radiation? It isn't natural. And just because it's there -- because we've made some mistakes in the past, doesn't mean we have to keep putting more of it there.

This leads me to a brief maxim, which is technology that in its uses is too far ahead of its real and total i.e. moral implications and consequences. It's technology that either had to be abandoned or disguised. Let's pretend that dead nuclear submarines are natural features of our landscape. It won't wash.

Captain Wagner, you promoters -- and the Navy is and has been one -- you promoters of nuclear devices have been trying to force upon the people of California one piece of radioactive waste after another for years and for decades. The Navy is forcing us together. It's no longer worth our whiles to fight piecemeal, one by one against each element of the nuclear cycle here in California. From the digging of uranium out of the ground through the testing and manufacture of bombs at Livermore Weapons Lab through the firing off of first strike nuclear missiles from Vandenburg Base through the nuclear power plants that dot the coast and inland of California on through the waste disposal in whatever form it comes out, the entire nuclear cycle is going to come under attack in California. We are going to be working together for a nuclear free California in every respect.

Now, nobody wants this stuff in their backyard; that's what it really comes down to. No community in America any more not in 1983, if it ever did -- is going to vote to accept nuclear waste in its own backyard. No community. And if you think that the ocean doesn't have a community, you're wrong. We are the community of the ocean. It's harder to blockade an ocean dumping of a nuclear submarine than it is to blockade a bomb factory or missile launch or nuclear power plant, but we are going to figure out a way to do it if you push it that far.

Please take the message back to Washington: California is a nuclear free zone. Our land and our soils, we are going to be there to protect them.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Dorothy Ruef from Gualala, representing the Gualala Nuclear Education.

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#101

DOROTHY RUEF

My name is Dorothy Ruef. I represent the Gualala Nuclear Education.

UNIDENTIFIED SPEAKER: Louder, please.

MS. RUEF: My name is Dorothy Ruef, and I represent the Gualala Nuclear Education. Gualala being a town in the sub Mendocino Coast.

With all due respect to Captain Wagner from the Navy who came so far to hear us today, I would like to not address him specifically but to address you. I need to talk about the Navy at this moment, however. I think you and I -- I think we all -- tend to hold the Navy in a certain awe. They wear uniforms and have titles; they have ranks. They represent the military with all this power. They are, to a certain extent, foreign to us, and we fear them. And at the hearings today, we feel that they hold somewhat of a life and death decision over us. I think a lot of us have come here and feel to a certain extent like gladiators before the great Roman emperor, and we have to put our best and most valued attempts forward to meet with their approval. And we do it, and then we wait for his sign.

Well, the Navy might like us to think that way, but it's really not true. The U. S. Navy and Captain Wagner will not be making the final decision in this matter. They are not the gods that we have to worry about. The U. S. Navy is not a policy-making branch of the U. S. Government. It may advise them, but it does not make decisions. All the Navy can do is follow orders down through a chain of command. And they get their orders from the President, his administration and Congress.

The Navy will not have its final decision on where to dump anything. That decision is solely the responsibility of the current administration and Congress. My point is that in effect, to a certain degree, we've all been duped. We are wasting our time refuting the Draft EIS. It's not our responsibility to point out its many faults, nor to propose alternatives. And everything we say here today will not matter one iota because the men who need to hear it -- the true Roman emperors -- aren't here today.

Captain Wagner is merely doing his duty as part of the great administration game to draw our fire and to fuse our energies. And we play into his hands and their hands when we get caught up in the Draft EIS. We've all been to carnivals

and country fairs. We've seen the booths where you plunk down your two bits and somebody gives you a gun with ten corks in it, and you shoot at the ducks that are moving across the backdrop.

Well, to a certain extent, this hearing today is a little bit like the carnival, and Captain Wagner is the duck. And we hope that if we hit him, we win something. But the more we shoot at him, the more we are diverted from the real issue, which is to change the policy of the men who run the ducks.

So my advice is to scrap the letters to the Secretary of the Navy John Lehman or to anybody else in the Navy. The Navy already has their orders, and their orders are clear. It's -- obviously, they want to stall us. They want to make it as difficult or as inconvenient for us to talk to them and to present any real communication with the policy makers.

Second, we should forget the letters and the appeals to the EPA. Not only does the EPA display a flagrant disregard for the people and the things it's supposed to protect, but it has somehow managed to mismanage $2,000,000 in the last two years of the funds that were designed to protect the environment -- which by the way is more than enough money to make up the added cost of burying 100 nuclear submarines as safely as possible on land.

Third, we can scratch off appealing to the President or anyone in his Cabinet. You might remember the Sierra Club petition to remove James Watt from office. It garnered 1,000,000 signatures. What did President Reagan do with it? He ignored it.

We have one avenue of approach left, and that is through Congress. We must leave this hearing today with as much energy as we came and direct it all to Congress. It would be easy -- and indeed the Reagan Administration is hoping -- for us all to walk out of here thinking: "Well, I went to the hearing; I spoke to the Navy. I've done as much as I can do. Now, it's up to the Navy."

Don't allow -- Don't allow yourself to be allowed into thinking that this hearing is any more than a superficial influence on the final decision of what to do with the submarines. Our country is reworking its whole rad waste disposal policy, and the ultimate decision on that policy comes from Congress.

So it's now time for us to form grass roots opposition to the Navy's plan. We must each become a lobbyist in his own right and take it upon ourselves to get publicity for this proposal. We must write articles for our newspapers, letters to the editor or create media events. It's time to deluge our Congressmen with letters, phone calls, and mailograms. We must do it repeatedly. We must do it often -- once a week will be just fine. And we must get our friends involved in the process also. We have to get the whole West Coast writing, and we have

to get all the Congressmen aware of the situation and on our side.

In closing, I would like to say it's only through public ignorance and apathy that a ploy such as this irresponsible and dangerous sinking of the submarines can be permitted. And it's our fault -- yours and mine -- if the public remains ignorant and indifferent long enough to permit this.

So pace yourselves and keep your energy up. And if your Congressmen don't hear from you, we may really be duped.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Valerie Sklorevshy, representing Malibu's Ocean Protection.

--o0o--

#102

VALERIE SKLOREVSHY

My name is Valerie Sklorevshy, and I'm a member of MOP. MOPADOP -- Malibu Ocean Protection.

Women of the world have never taken an active role in this race to see all of humanity die. But they have been wiping away the tears and the blood forever. To wipe away the blood and the tears is not enough. The task is to stop it.

We are talking about here nuclear war, the nuclear annihilation of all of creation.

To the folks in the Pentagon, the military industrial complex, the people at Vandenburg, the Navy, the Army, we the people -- the public -- will not submit to the injustice of nuclear weapons destroying us, destroying you, destroying all of creation. It is our living responsibility of being alive and a human being to seriously contest the deadly peril of nuclear weapons: weapons that make cancer the destiny of humanity.

I'm speaking for my friends who were resisters. They

are in jail all over this country. People in this room that I see -- I've seen at blockades all over this country. People are willing to put their lives down and say, "No, we have to speak for the children, the future generations or we won't have any future generations."

I was up in Bangor, Washington for the loading of the Trident submarine this summer. It can destroy 408 cities at one time; the whole northern hemisphere. It has got to stop. If the Navy this summer in Bangor, Washington had 100 ships out there, and they had a lot of men out there and those men all had guns. That's how they faced the peacemakers. We were there with our children, with our hearts speaking for people of the Pacific and people of the world. Where are the men in the Navy today? I look at this one man here, and I'm going, "Are you representing all of the military industrial complex -- the Navy, the Army?"

I went to a meeting in L.A. last week, and it was 300 men for the military industrial complex in that room. There's one man here. We are trying to have our voices heard. Friends in jail are suffering every day, and it started with the native Americans in this land when this Government and the men in the military industrial complex started to mine uranium, and then the people started to die. It's been going on in this country for too long. It's the men in charge of Congress, the men that have always been our presidents, the men that are building the bombs. I am speaking for the women and the children who are not here today. Please. We are trying to love you, to take care of you and to take care of all of creation, which is what women have basically done all our lives. We've tried to take care of life and creation. People here are speaking with their hearts and their souls, and they are pleading "Please hear us."

Who are we talking to? Are we talking to ourselves again? Again? How long will it go on? Do I have an answer -- Do you have an answer for that?

CAPTAIN WAGNER: As I said earlier, Miss Sklorevsky, I'm not here to debate. Your comment is part of the record. The record becomes part of the final transcript for the final EIS. We are here to receive your statements for the record.

MS. SKLOREVSKY: My statement for the record is: No nuclear war. No nuclear insanity. No destroying creation. Please.

--o0o--

CAPTAIN WAGNER: Ladies and gentlemen, we'll take another five-minute recess to allow our reporters to have a slight rest. We'll resume the hearing in five minutes.

(Whereupon a brief recess was taken.)

CAPTAIN WAGNER: Ladies and gentlemen, we have our reporters back, and I would like to reconvene the meeting, please. I have two more organizational spokesmen from this morning's registration, and then when we finish those two individuals, we will move into individual testimony and get as much of that done as we can before we take a dinner break.

The next registered speaker is Mr. Greg Wellish representing Acorn Alliance.

--o0o--

#103

GREG WELLISH

Good afternoon, Captain Wagner and ladies and gentlemen who have been so patient to be here all day even though most of the press has left, and I know most of these people are going to be here late until tonight or however long this hearing goes on and to tomorrow, if that's necessary. I find it a little uncomfortable -- I've been sitting and watching people's backs all morning, and I'll try to address you all, and you, too, specifically, Captain Wagner.

I'm -- my name is Gregory Wellish. I'm representing the Acorn Alliance. We're a citizens' group in southern Humboldt County that is concerned with radiation, with all environmental problems, and we see this as a really big one. It's sort of ironic to me that it's the Navy that is proposing dumping submarines into the ocean; the ocean, the water. That's the Navy's element; that's why the Navy exists because through our history it's been necessary for governments to protect themselves and for commerce to use the ocean. The Navy is the protector of the ocean. That's why I find it extremely strange that now the people have to protect the ocean from the Navy. It's just sort of a bizarre twist. We don't know. You're really saying in this EIS, "We don't know what this is going to do. We don't know now." Now is when you're talking about doing -- you're not saying you want to do it tomorrow, you're saying some point in the future, and that's why this document has been prepared and why future documents are being prepared.

But basically what you're saying in this document is that you don't know what it's going to do. That is totally unacceptable. When these subs are dumped two and a half

W.1

miles into the ocean, they are irretrievable. You say right in here you do not have the technology at this time to retrieve them. There is no excuse for this. The Anderson Amendment states that it can't be done if they are not retrievable.

F.2

The only way that it can be handled for right now is for them to be stored on the land site, not a permanent storage, but to be held in mothballs to be stored until something is known.

G.2

We do not know. We don't know now; we might not know for 20 or 30 years. These submarines that you want to dump in the ocean were commissioned 20, 30 years ago. Thirty years ago, most of them in the '50's and in the late '60's. Now, does this mean that every 30 years you're going to have a new batch of submarines to dump in the ocean? It's going to start to build up. There's no way the people of this country, and especially the people of the State of California, are going to let you do this. It's not going to happen.

I've heard people say here that this is just a ploy; the Navy's here to draw our energy away. I don't care who it is, you, the Congress, the President, any agency. This country is founded on government for and by the people. The people are going to have the final say in this.

Now, there's been very good scientific testimony here today by the experts. The experts that you don't have in this book; the experts that should be in this book: You're saying this is what's known. You don't know, and you don't have the experts saying what they know. It's totally unacceptable. It's just totally out there.

United States has always been a leader in the world, and we still are, and we're going to continue to be. There are other nations currently dumping radioactive waste in the oceans. F.8
This has got to stop. We're not doing it now, and it's holding a balance -- we're holding a balance right here. If the

L.9
F.8

United States, especially starting with the Navy, is allowed to do this, we're going to see this increase all over the world. Greenpeace is already working very hard to stop it where it is going on.

The United States -- we're the leader. The world looks to us for nuclear examples; for all examples. We're the ones that have to say no; we have to say this isn't going to happen. We're not going to let the government do it, we're not going to let private industries do it, and we're not going to let other countries in the world do it.

A few weeks ago the international commission voted, and the United States was one that voted to allow nuclear dumping to continue. It's a sham. The people of the United States don't want these things dumped in the ocean, and it's just totally important that we read this; that we're the ones that show -- that show today, that show in the future what has to happen.

These reactors that Admiral Rickover designed -- a gentleman spoke about Admiral Rickover earlier -- he designed them, and it was a great idea; it worked. Okay. Private industry came along and from his plans they started building reactors. Now, we've got nuclear reactors that are just monstrous, nothing like what Admiral Rickover designed, and it's just going on and on.

The Navy has a special responsibility here because it

was the Navy that started this process of nuclear reactors. Admiral Rickover doesn't approve; lots of people that worked on these reactors don't approve. Why is it going on? I'll ask anyone in the room. Why is it going on?

Yeah -- Yeah, exactly. Dollars, money, industry, the military industrial complex. Submarines -- submarines are going to be dumped in the ocean so that new submarines can be built. So we can look forward to this every 30 years, a new set of submarines because the old ones are obsolete; because the old ones are too hot for men to be on safely. D.4

The submarines -- You say right in here they're too hot to be safely decommissioned. The exposure rate for the people that have to put the concrete in the pipes between the bulkheads are going to be exposed to horrendous amounts of radiation. In -- The atomic veterans who have also been mentioned today, they were exposed to radiation. They did not know the effects. They weren't told what it would do; they were told it was simply harmless; they were told you could stand and watch it; they were told it was beautiful, the sight of a mushroom cloud. We know the effects now. The effects are known. The effects are known by scientists; the effects are known by doctors; and the effects are known in the hearts of the people of this country and very quickly coming up, the people of the world. We're leading. We're leading and the rest of the world is following, and they know what's going on.

We can stand up here and talk to the Navy all day or all year. We can ask them to continue these hearings, and on behalf of my group, I would like to ask them to continue these hearings. There should be an extension of 90 days for public commentary to June 30th, and we strongly feel that hearings should be held in Eureka and Fort Bragg. (J.15) This is where the people are. Not everybody can leave their jobs. I happen to work for very good people who let me come here to Sacramento, 200 miles, over 200 miles to do this. Some of you have come further. A lot of people who wanted to couldn't come because of their families, because of their jobs. I find this sort of interesting that all of us -- over 200 of us -- came here today, and we came from all over California to talk to one man from the Navy who came from Washington. I really don't understand why he could come here and we had to come here, too.

A few politicians are here in Sacramento. The politicians aren't the ones that matter, it's the people, and you've got to talk to the people. You're saying, "We're going to affect your environment by what we plan to do," yet at the same time you're excluding the testimony of the people who are most affected. You're only allowing your leaders to be able to come here to speak. There are fishermen who would have lots of things to tell you, more than that big man and the other gentlemen who spoke for the fishing industry today.

There has to be an extension, and this document has to get out to more people. A lot of people don't understand what the Navy plans to do. They don't know how many submarines, and they don't know that once this starts, it's going to continue. The Navy doesn't intend to just dump 100 submarines. That is just the beginning.

I am for a nuclear free California. I'd like to show you something here. This is a map of nuclear America. There's maps on the back wall and outside. This map has documentation of nuclear reactors, naval facilities, research and development facilities, manufacturing testing sites, deployment sites. California is pockmarked with this. It's cancerous. I've added question marks. One here off of Cape Mendocino and one here off of North Carolina. Are we going to let them continue? They've already pockmarked our country. Are we going to let them continue with the ocean? There's very few spaces left in the country. There's not one state in the country that does not have some sort of nuclear pollution in it. It is not right for the ocean, the ocean which the Navy exists on, exists because of. We're going to dump it in the ocean. I've heard it mentioned today about the food chain and about the (L.36) cumulative effect of radiation, and that's exactly what I'm saying. The cumulative effect. (L.7) Your document speaks only of these particular 100 submarines being dumped in a particular spot, or it's not a particular spot where you choose. It's the

L.9
F.8

cumulative effect. You might be able to dump those submarines without any harm. I don't know. I would be willing to say that it's going to have some effect on the environment, but I do know that if we keep dumping them, if the United States Government starts dumping them and then allows private industry to dump them, the rest of the world is going to keep dumping them.

The point is that we need to start looking at what we are going to do in the future. It's one thing to say I'm going to dump them in the ocean. It's a whole nother thing to say we're going to wait -- we are going to wait until the documentation is in. We're going to wait until we know for sure.

I would like to present this map of the United States in nuclear America as part of my testimony.

CAPTAIN WAGNER: Could I ask you, Mr. Wellish, to summarize, if you may, so that other speakers can get on?

MR. WELLISH: I'll wind up very quickly.

CAPTAIN WAGNER: Thank you.

MR. WELLISH: The Navy is holding these hearings now. Many groups are asking that they be held again. I think it's appropriate that they be held again, but I agree with the woman who spoke earlier, it's not the Navy that's going to have the final decision, it's the people that are going to have the final decision. There's no way the people of this state are going to allow the Navy to dump these submarines in the ocean. If it

comes down to us putting our bodies on the line, that's where they'll be, on the line.

Thank you.

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#104

CAPTAIN WAGNER: The next registered speaker is Mr. G. Nelson Wolfe, representing Save Our Shores, Incorporated.

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G. NELSON WOLFE

Yes, Captain Wagner, my name is G. Nelson Wolfe testifying today on behalf of Save Our Shores, Incorporated, an organization dedicated to the conservation and protection of the marine environment in Central and Northern California. I'm also testifying as a formal commercial fisherman.

We join with the Oceanic Society, the Farallon Foundation, and all the other organizations' representatives and individuals expressing our grave concern over the educational and scientific process which the Navy has undertaken in considering this proposal.

The dumping of nuclear waste into the oceans must be addressed within the broader context which is the national and international question of what are we going to do with nuclear waste. It's a question which cries out for comprehensive national and international policies. This question belongs not only to the experts, but to the general public. There are moral and political considerations as well

as scientific ones involved. Even supposedly small amounts of increased radioactivity are part of a broader picture and are potentially dangerous precedents.

There are presently proposals on line for the disposal of high-level nuclear waste into deep sea sediments, World War II Manhattan Project wastes, not to mention such waste dumping by France, Great Britain, Switzerland, Japan and others.

Marine organisms and fish recognize no national boundaries nor does radioactivity once it is released. How is it that this proposal can fail to acknowledge this large a context? There's a real question when it comes to what the quote safe levels of radioactivity are. Even small increments in radiation can increase the levels of radiation to which the environment and the world's populations are already exposed. Levels which members of the medical community already suggest are too high. It is estimated that natural radiation exposure alone is responsible for 19,000 cancer deaths each year and between 58,000 and 580,000 genetic deaths each year.

If an irrecoverable decommissioned nuclear submarine were to release even a small additional amount of radioactivity in the poorly understood marine benthic community, and that combined with other exposures were eventually transported to human beings and became responsible for even one additional cancer death, which one of you gentlemen would be responsible for defending this document to that individual?

L.1 W.1 J.76

The contemplation of disposing of such waste in a medium of which we still have relatively little information at a depth which we could neither adequately monitor nor recover if something should go wrong invites only problems at the outset.

F.12 J.9 W.1

Inadequate and incomplete scientific analyses of the shoestring monitoring program and the omission of current and relevant research coupled with the admitted irretrievability of the vessels are all arguments belonging to the Navy's very document suggesting that the ocean disposal option should not be considered further.

N.3

The Navy would like us to believe that the low cost is the most favorable aspect of the ocean disposal option. Yet how can you quantify the potential costs in terms of human health and safety and have you done so?

To proceed with this action before having the adequate scientific information about the disposal environment with which to justify it would be unscientific, unwise and irresponsible. Given the dismal recent history of waste dumping and monitoring for which this nation and the world is only beginning to pay the price, the public cries out for agencies they can trust. We would hope that the appropriate agencies would be moving to correct the grave mistakes represented by the Love Canal, Times Beach or the Farallon Islands; to restore the public's confidence and trust.

L.53 J.9

The potential quote costs with respect to nuclear waste dumping for present and future generations are far too great for the public to accept a hurried, inadequate process which this document and the public education and participation opportunities surrounding it suggest. The inherent bias towards the ocean disposal option and the appointment of the former director of the Navy's Office of Radiation Programs, a known advocate of the ocean disposal option, the permitting authority for ocean dumping at the EPA goes nowhere in assuring the public's true interests are being represented objectively in this matter.

It is essential that such agencies be reminded who your constituency actually is. The Navy works not only for the Navy. The EPA works not only for the EPA and a few big business clients nor really for any particular administration. They must work to protect the health and the safety of the people of this country which by law they are mandated to protect. With this document and with the ocean disposal option as presented, you are clearly not doing the job.

I'd just like to follow up. At the beginning of this long and interesting day, I believe Mr. Mangeno of your office presented a very slick and interesting presentation about the proposal. He stated that the radiation impact and the localization of the -- of any release of radioactivity would be highly localized and minimal. The fact is that he

L.1 really does not have the scientific data to support that statement, and I find it somewhat disgraceful that someone commanded with the education of the public about an issue as serious as this would talk about facts for which he has no evidence. I think he owes it to the people here today; he owes it to the U. S. Navy, and just all the people involved in such a decision as this entails to make it very clear what the facts actually are.

I think it's a far, far better thing to admit and have the courage to admit that which we don't know now rather than coming back later and saying we didn't know.

Thank you very much.

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CAPTAIN WAGNER: At this time, ladies and gentlemen, we are going to proceed with testimony by individuals. Again, I would like to ask your cooperation in adhering to the five-minute time limits so that we can hear as many representative views as possible.

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CAPTAIN WAGNER: The first individual is Steven Antler. Is Mr. Antler here? Some individuals might have stepped out. I will continue down the list, and if someone is going to get Mr. Antler, let me know when he gets here.

RON GUENTHER: We signed up for a short Sierra Club statement, Redwood Chapter, as an organization.

CAPTAIN WAGNER: Your name, sir?

RON GUENTHER: Ron Guenther.

CAPTAIN WAGNER: Ron Guenther?

RON GUENTHER: Representing the Sierra Club - Redwood Chapter.

CAPTAIN WAGNER: Does anyone object to having Mr. Guenther speak?

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#105*

RON GUENTHER

Thank you very much, Captain Wagner, and people. My name is Ron Guenther. I'm chair of the Sierra Club - Redwood Chapter's Executive Committee, and I am here today to represent Redwood Chapter Sierra Club members in California's Del Norte, Humboldt, Mendocino, Sonoma, Solano, Napa, Lake and Siskiyou Counties. I first of all would like to thank

***Other issues discussed by Mr. Guenther are side barred in Exhibit 105a.**

Dorothy Rutherford in reference to, you'll recall, the Watt's Petition. Between 2 and 3 million names have come in on that petition. They're still coming in, and we are still optimistic about replacing Mr. Watt.

First of all, we'd like to go on record as requesting a vastly improved Environmental Impact Statement on this proposal so that the concerned public and decision makers can be completely aware of the actual realistic impact of the proposal before any decisions are made.

We'd also like to go on record as opposing the sea disposal option based on the very limited and inadequate information available to us in the project's Draft EIS simply because of the enormous cumulative ocean radiation totals and because the oceans are so much a source of the planetary life support system. We feel a much better evaluation of this proposal is necessary.

Now, we have a very lengthy written statement in the record. Many of our concerns have already been spoken to in the most eloquent way in this hearing, and what I'd like to do is just simply highlight a few of our very special concerns here.

First of all, we're concerned especially with the very poor evaluation of the so-called artificial reef effect wherein life forms will multiply far beyond the normal numbers when they are near a large sunken object. We're also

concerned with the Navy's denial of life at the site bottom; they're in contradiction to its own photographic evidence record in the EIS itself.

According to the evidence records that we've been looking at, there is marine life at the site leading directly to the human food chain. There's an important upwelling phenomenon at the site. There is a rich fishery that depends upon it that is heavily utilized by people.

It seems quite obvious to us that much more needs to be known about how radioactivity moves through the food chain to the higher life forms, including man.

According to the information that we have, some of the best data on how this radioactive transfer process takes place was the result of testing at the Farallon Islands nuclear dump site. We find it incredible that this data was not included in the Draft EIS, and our request is that it not only be included in the Final EIS, but that it be evaluated and utilized in getting recommendations and decisions coming from the Final EIS. This is the Farallon Islands nuclear dump site test data. F.12*

All right. We're very much concerned with the retrievability issue from a little bit different viewpoint than some of the other speakers. What we're dealing with here is a completely untested process. It may not work. If the reactor plants are ever sunk into this deep ocean here, we

***Other issues discussed by Mr. Guenther are side barred in Exhibit 105a.**

W.1

may desperately want to retrieve them within a very few years, and I would point out on page 213, Section E, that the Navy is not admitting in this Draft EIS that it is impossible to retrieve these nuclear plants once they're dumped into the ocean. The language used here is that it is not feasible using today's technology, and this is not the same thing as saying it's impossible.

And what we are going to request here of you is that if the Navy makes a finding that it's impossible to retrieve them under any conditions, that it ought to unequivocally say so in the Final EIS.

W.1

If a possibility exists for retrievability, what we would request would be a cost and probability analysis of retrievability. In other words, the public has a right to know how much it's going to cost. If it's going to cost 2 to 300 million dollars apiece to raise each reactor plant from the bottom of the ocean, the public has a right to know that. And I might add to that that this kind of a cost figure could have a very devastating effect on the Navy's economic justification for ocean dumping. And we find this one of the most important deficiencies in the EIS and urgently request that it be corrected.

Our final concerns are with cumulative impact which the Draft EIS totally fails to evaluate, in our opinion, and it seems very probable that once we establish an ocean dumping site off the coast, that the pressures are going to be

enormous to dump all kinds of other kinds of radioactive wastes at the site: worn out civilian nuclear power plants, contaminated soils, all kinds of nuclear waste.

F.8

In addition to that, other nations are looking to the U. S. to follow our example, and they will follow us in this nuclear ocean dumping if we resume it. This is one of the most important cumulative impacts that hasn't been dealt with in the EIS, and we request that it be done in the Final EIS.

In addition to that, the Draft EIS fails to evaluate the cumulative effect of the proposed decommissioned submarine reactor plant disposal program on the worldwide nuclear arms buildup. And it seems very clear if we escalate the nuclear arms race to this ocean disposal proposal, other nations could follow our example. A cumulative impact could have devastating effects on the planetary life support systems and simply must be evaluated, in our opinion, before any decisions can be made at all on the reactor plant disposal proposal.

H.12

Finally, the Redwood Chapter has taken a strong position on radioactive waste source reduction. We simply must quit generating nuclear waste if the planetary life support system is to survive, in our opinion, and we would like to recommend a solution to the Navy for its radioactive waste disposal problems -- just quit generating them.

Thank you.

CAPTAIN WAGNER: Ladies and gentlemen, again, I recognize that there are some organizational spokesmen who have not been called. They signed -- or they registered later this morning for this afternoon. I'm still working on the individuals who registered by or prior to 9:00 o'clock, and I'd like to proceed with that list. After the dinner break, we will try to get to the other organizational spokesmen as well.

Next registered speaker is Mr. Steven Antler.

(Speaker is not present.)

Proceed with Mr. Mark Berkich here from Comptche, California.

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#106 *

MARK BERKICH

First of all, I would like to say thank you for this opportunity to speak here today. I come from Comptche. It's a small town in Mendocino County. Our community is approximately 16 miles from the Mendocino Coastline. Late last spring I learned of the Navy's plan to dump 100 radioactive submarines off our beautiful coast. At that time I decided that I would set up an information table at the local post office, and I brought some petitions against the dumping and some postcards

addressed to the EPA asking that the EPA not grant permission to the Navy for the radioactive submarine dumping. At the end of the day, over 100 people had come to the post office. They all signed the petitions, they all sent the cards to the EPA. No one was in favor of the Navy's plan to dump the submarines. I was really surprised. I mean, it's kind of a red neck community in a way. I thought there would be someone on the other side, but there wasn't, so I figured I must have been on the right side. My neighbors as well as myself, we eat a lot of fish from this area, and being depressed times, as a matter of fact, a major portion of protein in our diets comes from the nearby ocean.

We're really concerned that the radiation from the scuttled submarines will enter the food chain. Steelhead trout, salmon, they spawn in creeks just 200 feet from where I live. These fish, they live in the ocean, and they feed in the area of the proposed dump site, and then they're going to come back and spawn right where I live. L.36 *

So, you know, I mean, the concern is really there. The Navy says that the dangers of this radiation from the submarines will be gone before the containers disintegrate. Well, radioactive cobalt 60 has a half life of 5,263 years, and radioactive nickel 59 has a half life of 80,000 years. L.20

Now, these are just two of the radioactive substances of many that are going to be dumped, and probably already have

*Another issue discussed by Mr. Berkich is side barred in Exhibit 317.

been dumped. And I'm just a layman, but it's plain to see that this ocean dumping is just out. I mean, no way.

L.6 Virtually no monitoring has been done on the existing rad waste dump sites in the ocean to determine the effect on the sea life and whether or not the radionuclides are making their way through the food chain to humans. This information must be known before any further dumping of rad waste is allowed anywhere in the world's oceans.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Brian Casey Biro from Gualala, California.

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#107

BRIAN CASEY BIRO

Hi. I usually go by Brian Casey, but my real last name now is Biro. I'm here mostly just for one reason, and that's fear that we'll make the wrong mistakes again because of past mistakes with the land and air -- making choices of land and air -- how to control pollution. I've really been messed up, and we've got polluted lands everywhere in every state, and the air -- I get a sore throat driving through L.A. with the windows rolled up. It's just real bad, and I don't want the ocean destroyed because -- I mean -- polluted because that's our main source of air, food and a lot of our stuff. And if we destroy the ocean, then all life is practically doomed. And the ocean gives us our food and air. In return we give it nuclear waste, and I don't think that's very fair.

I also think that before the Navy and all the armed forces even made these nuclear weapons, they should have learned how to control them and how to control the waste, and they should find the right way to disoose of the waste instead of the easirst way.

My generation gets to look forward to nuclear war, nuclear waste, pollution, unemployment, and all that stuff. And nuclear waste not disposed of properly isn't going to help my future any, and so I don't want nuclear subs polluting our ocean.

And also I just want to remind everybody that it's the kids of today that have to live with your mistakes tomorrow.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Mr. Doug Boone of Atherton, California.

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#108

DOUG BOONE

Hi. My name is Doug Boone.

Fellow residents of the world, neighbors of these United States of America:

The subject we are addressing today is one of highest priority to every living creature on this planet. We must not make foolish decisions which endanger ourselves and/or others. I'm a licensed commercial fisherman, salmon, in the State of Alaska. I was born in California, but I am now a resident and vote in Alaska.

The migratory patterns of salmon take them throughout domestic as well as foreign waters. Thousands of United States citizens are employed on fishing boats and many thousands more in the related processing industries. L.53

Polluting our oceans destroys our food, our jobs, and, therefore, our national security. Our destiny is in jeopardy once again. I voted for the nuclear freeze; I now voice my opinion once again to delay this to be duly represented by my elected officials. Voices cry out throughout this land; we demand to be heard. We do not want nuclear subs dumped in our oceans; we do not want our defenses used against us. We want a reasonable solution to this problem, one that we can live with, not one that will kill our fish and eventually ourselves. We must have honest studies done by the Environmental Protection Agency and other qualified organizations. We must publicly study these reports and use our electoral process to achieve our goals. It is up to our elected representatives to use their influence and power to delay this foolish move until such time as we can arrive at an equitable solution agreeable to all parties.

F.8 We must also consider the implications of our actions in regard to world leadership. We must set an example of our freedom by making wise decisions.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Marlene Boone of Laytonville, California.

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#109

MARLENE BOONE

My name is Marlene Boone. I live in Mendocino County with my husband Steve and our two sons. We regularly shop and do our business at Mendocino and Fort Bragg. At times when we are there, our sons delight in wading in the ocean water along the shore. I hope that our future children will also be able to experience the same pleasures without the fear of contamination.

I am deeply concerned over the Navy wanting to dispose of 120 nuclear submarines in the ocean near Cape Mendocino. I am not convinced that it is safe nor am I comfortable with the possible long-term effects. To resume the disposal of more nuclear waste while uncertainties of past irresponsible disposals still linger does not make sense to me. A healthy marine environment is so necessary to our survival. Modern man has a history of interfering with nature which always seems to come back and haunt us. L.6

Let's stop now long enough to be sure that we're not making the worst mistake of all -- threatening the very survival of future generations.

Thank you for allowing me this time to express myself.

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CAPTAIN WAGNER: The next registered speaker is Mr. David Booth of Miranda, California.

--o0o--

#110

DAVID BOOTH

Yes, I'm David Booth, a concerned individual, and I'm prepared now to depart from most of my prepared comments because a point Dorothy from Gualala made has the ring of truth to me now. I think she is probably quite right, that you are a sitting duck or the strong man of the Reagan Administration and that this whole affair is a ruse, and perhaps this is a futile attempt to convince you, but I think something has come to me.

I think it's very ironic that perhaps the intent of the administration was to weaken us to dissipate our energies, but unwittingly, they have shown us our strength. Never have I seen such unanimity to one issue, and I'm really impressed, and I know that we are going to fight this demon wherever we find it, and we'll write our Congressmen, and perhaps you do have a disproportionate influence in Washington, and for that reason I make my personal plea to you: To go to Washington and convey our sentiments, but beyond that, I know that I'll keep

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fighting on this issue wherever necessary, and I know the rest of these people in this audience are not discouraged one bit by what they have learned here today. So it's very ironic, and we'll be back.

--o0o--

CAPTAIN WAGNER: The next registered speaker is Mr. Don Brown of Santa Cruz, California.

Is Mr. Brown here?

(Speaker is not present.)

Then Mr. Sam Camp of Redwood, California.

UNIDENTIFIED SPEAKER: He had to leave.

CAPTAIN WAGNER: He had to leave?

Mr. Derick Cassidy of Sacramento, California.

Garrett Connelly, Santa Barbara, California.

UNIDENTIFIED SPEAKER: He spoke.

CAPTAIN WAGNER: Okay. Thank you.

Jane Corey of Elk, California.

--o0o--

JANE COREY

#111

My name is Jane Corey. I'm a teacher. I have other people's children entrusted to me. I go to many meetings, and I have many conferences with individual parents. The children are always new and exciting to me. Sometimes, however, I feel that I have heard every variety of parental concern, and it becomes difficult to give each parent the fresh hearing and response that he or she deserves.

Sitting in an auditorium for 12 hours is not conducive to fresh responses. I hope, however, that those of you representing the Navy will be able to hear the unanimity among those of us who oppose ocean sub dumping. I hope that you will be able to perceive us as individual voices deserving to be heard with fresh ears.

I live in Elk, a small town on the Mendocino Coast. The feelings I have are shared by my community and my fellow teachers. We think it imperative that you have another hearing in a central location on the coast. We ask you that you extend the deadline for response to the DEIS. We are all of us all too familiar with the increased rate of cancer among friends, relatives and acquaintances. We know that radioactive wastes are carcinogenic; anything dumped into the ocean enters the food chain.

J.15

L.36

It is irresponsible to behave as if hiding toxic substances in the ocean will solve our problems. Decommissioned nuclear submarines with no place to go will be a sore spot and remind us of the responsibility we take on in dealing with nuclear engery.

I own a bottle of Malathion. I no longer believe in using this pesticide, but I am stuck with it in my garage. There's really no place I have to dump it, and I don't want to pass it on to someone else to use. It's a reminder to me

to be a cautious consumer. Dangerous antiques are likewise a reminder to our nation that we need in the future to more carefully consider the long-term effects of our defense experiments.

And I have a statement from my friend Kate Dougherty who couldn't be here today, and she would welcome anyone's response to what she has to say at Kate Dougherty, Box 70, Elk, California 95432.

"As a nation, we have chosen nuclear weapons to defend us. Somehow we feel there is a threat more horrible than the threat of extinction of all life on earth. Or in order to keep off the threat of extinction, we must make larger threats and back these up with facts, with weapons. I don't know if anyone is quite sure which reasoning sustains us, but the fact remains that we have made nuclear weapons; we continue to create them and are planning to continue to do so.

"I live on the coast of Mendocino in a town called Elk. I choose to live here because I wish to live a full life. And then the question, Full life? What is a full life? Of all the sources I have come across, nature has been my best and sometimes all too honest instructor. The sea, among other things, has taught me that there are other communities to which I belong than that of nation. The Pacific Ocean directly affects not only the Mendocino Coast, but all of the coast of California, Washington, Oregon, Canada, Mexico, Guatemala, Nicaragua,

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Costa Rica, El Salvador, Panama, Colombia, Ecuador, Peru, Chile, the Soviet Union, China, New Guinea, Korea, Australia, Japan, the Philippines, Hawaii, New Zealand, Vietnam.

"The Pacific Ocean is a very important common denominator to the humans living in these countries. Besides connecting life by a common bond, the ocean is itself a vast complex relationship of interconnected communities varying in size from the one-celled algae to the multi-celled sperm whale.

"These communities we call ocean have a major influence upon the life support systems of the entire earth. It is ludicrous for our government to prepare an environmental impact study for the review of the citizens of this state and of this nation when many, many more are affected by the ramifications of this proposal.

"It is morally criminal that we -- and I do mean you and I -- jeopardize the lives of inhabitants off the coasts of the Pacific, the very life of the ocean itself, and the balance of our whole earth because we as a nation have decided this to be the best place to dispose wastes of weapons that defend our particular national way of life.

"The weapons are our weapons. The war is our war. The waste is ours. Each state should take responsibility for disposing portions of it in their own boundaries."

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CAPTAIN WAGNER: The next registered speaker is Ruthann Corwin from Novato, California.

--o0o--

#112

RUTHANN CORWIN

Thank you, Captain Wagner. That's Novato, California.

I'm Dr. Ruthann Corwin from Marin County, California. I hold a Ph.D. in applied ecology from the University of California, and I am on the Board of Directors of the San Francisco Chapter of the Oceanic Society. But since you have heard from our designated representative, I am testifying as a concerned citizen with specific expertise in environmental impact assessment and knowledge of the multiple ways in which humans are polluting and disrupting marine habitats.

I would like to begin by expressing my concern that you are only here to take statements; that there is no one here to answer specific technical questions and to have a give and take with the experts on these critical issues.

It is in such debate and in response to questions that the state of knowledge becomes truly apparent. This hearing is only a partial public disclosure process, and I think it is important to note that for the record.

While it is certainly true from all the testimony that we've heard today that it will take political action to finally settle this issue, the legal record's also important, and I think you have been warned that the Environmental Impact Statement which you are considering here today is a seriously deficient document. It does not provide the Navy or the public with a true understanding of the potential effects of the ocean dumping not only of radioactive wastes but also of the other toxic materials such as cadmium, chromium and other heavy metals which are also present in the material to be disposed.

L.7 L.10

Missing from the discussion of environmental effects is any reference to the cumulative effects and possible synergistic effects of this activity along with existing and other potential ocean dumping activities plus other coastal and offshore activities adding pollution to the marine environment.

The effect of this omission is to give rise to a fundamental methodological flaw in your evaluative statements as illustrated by your Table 1 and at many other locations in the Draft Environmental Impact Statement: The continual and inconsistent use of comparative rather than additive assessments to put your rough calculations of exposure into context.

As one example, I call your attention to the statement on page 4-10 with respect to exposure of bottom dwelling sea

life. After calculation of one year's dose to a hypothetical bottom organism from nickel 59, the analysis states, and I quote, an exposure rate of 0.3 rad per year is small compared to the annual internal exposure to the actually-occurring radionuclide polonium 210 that may be received by some midwater dwelling species (600 to 1500 feet in depth).

Reference 4.29 estimates that the natural doses to the most affected organ (hepatopancreas) of certain species of shrimp may be as high as 195 rem per year.

S.25

First of all, no range of errors are given for these figures. If each might be off by one order of magnitude -- and I think we have heard testimony here today that we might look at several orders of magnitude for many of these numbers -- the difference that you are relying on to make this comparison may not be so apparently significant.

L.16

Secondly, the exposure of a hypothetical benthic organism at two to three miles depth is being compared to one measure for one midwater dwelling organism at 600 to 1500 feet of depth which illustrates more than just the fallacy of the comparison itself.

J.20

It also illustrates the appalling lack of data for making a more valid comparison. The estimated exposure rate may be quite significant for the genetic stability of populations of sensitive deep-water species in the vicinity of the dump site.

That is the question that has to be answered, not comparison of species somewhere else.

L.7

Thirdly, the question is not whether one source of exposure is significantly lower than a natural source, it is eventually the total exposure to which marine organisms and eventually people are subjected that is the real issue because it is the total risk we are concerned about, that we are affected by -- not the relative contribution of one source or another.

This is a continuing problem with radioactive or pollution risk assessments. Those who do these studies seem always surprised when people are not willing to accept the level of risk that seems slight, assuming we trust the estimated figures compared to other risks we take daily such as riding on the highway.

What decision makers fail to realize is that we can make a conscious decision whether to be exposed to the risk of driving or flying in an airplane from New York to Los Angeles. When it comes to this kind of radioactive exposure or most marine pollution exposure generally, we have little voluntary choice.

As the sources of such exposure mount in our lives, it is a rational man who says that it is the risk in addition to those he faces daily that he prefers not to face, especially those exposures over which he has no control.

An additional problem is the document's unquestioning assumptions regarding the level of acceptable risk. Biologists have found that each increment in radioactivy to which living cells are exposed produces a direct increment in mutation rate. There are no threshold values for radiation below which mutational damage may not occur. Thus, there is no such thing as a safe dose of radiation.

Since most mutations are detrimental to an organism, it is important to recognize that any and all additions to the radiation load received by an organism, including people, are potentially harmful.

It follows that comparative statements such as those in your summary on pages S-10, S-12, in analyses such as exposure to bottom dwelling sea life which I gave as an example and in the various comparative tables in the text are not valid. The correct framework for understanding effects is not compare potential exposure from this activity with a single other source of exposure such as natural background radiation, rather it would be to add natural exposure plus this potential exposure plus present man-made radioactivity introduced into the environment plus possible additional use of the oceans for disposal of radioactive wastes based on the precedent that this activity may set to get a true picture of the total radioactive burden potentially affecting marine organisms and man.

L.7

L.9

The rivers and coasts of our nation do not carry only natural thorium and uranium isotopes suggested in Table 4-7, but also chronic and accidental contamination from nuclear power plants and nuclear weapons activity.

L.7 At an effluent dispersion conference recently I attended, we were shown profiles of the radioactivity L.6 accumulating in the sediments of the Hudson River downstream from New York nuclear power plants. Radiation from the Hanford facility has been traced in the Columbia River and out into the Pacific Ocean and probably forms part of the background count for the proposed California offshore dump site.

It is likely that background levels or natural levels cited in some of your references contain anthropogenic L.13 radioisotopes from atomic bomb testing as well as land-based sources. The EIS should discuss what is known of the stresses that marine organisms are already being subjected to from these sources. You could make the comparative differences in your tables even more impressive by adding other sources, but the evaluative conclusions that are drawn would still be invalid.

The oceans are a surprising place. The lesson of the British Windscale experience where ocean discharged radionuclides were taken up by seaweeds which then washed L.39 ashore and contaminated the beaches is that we don't know what could happen.

The organisms of the ocean are already being altered

by the activities of man. When you calculate the costs of O.26 these disposal operations for comparison of options, you must also subtract the potential lost value of marine organisms and disturbances of the gene pool, for these are true costs of industrial uses of the ocean which are not being taken into account. No mention is made in the EIS of these values.

Scientists at California universities are only now investigating the chemical structures and properties of unusual metabolic products of California marine life. Chemistry, biochemistry, pharmacology, medicine and agriculture are all benefiting from marine life research, even as the subject of their investigations are threatened by increasing industrialization of the marine environment.

Northern California is one region whose benthic organisms are poorly known, and it is likely that biological surveys of possible dump sites will reveal new and unusual J.9 organisms not yet studied by science. These biological studies should be completed before the EIS is approved.

We threaten our future when we endanger biological resources whose gene pools are the evolutionary heritage of mankind. We are losing species at a rapid rate all over this planet, and we cannot afford to endanger a new area whose potential is unknown.

The fact of increased risk with increased exposure means that no additional exposure is justified. We must stop

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J.76
W.1

creating more of these life threatening substances now. We must choose to dispose of existing wastes in a way that maximizes our ability to watch them closely and to control them if something goes wrong.

I urge you to revise this inadequate document to illustrate the real risks and costs of radioactive materials disposal, including the specific points I raised above. Our Navy's nuclear submarine program was one of the chief impetuses for development of the nuclear power industry which has spread the potential for radioactive pollution worldwide.

Let the Navy now set a precedent for maximum control of these dangerous wastes. It would be very appropriate for the Navy to lead us away from a technology which we have learned undermines the very security of life and human welfare our armed forces are pledged to protect.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Janet Crone of Willits, California.

--o0o--

#113

JANET CRONE

Can you hear? Okay.

I'm Janet Crone of Willits. I decided to speak -- I hadn't been planning to -- because I care. As a mother of six and a grandmother of one, I care about the future. As a long-time citizen, taxpayer and voter, I care about the actions of my country and its agencies.

L.53
O.34

As a partner in a small business making ocean related decorative items, I care about the future of small businesses whose incomes are tied to ocean tourism which is related to the health of the ocean and even before the health of the ocean is gone, to the public perception of the health of the ocean.

Captain, I hope you have some awareness that the Navy has done you a tremendous disservice. They have prepared a sloppy DEIS, and in a sense, for an essentially immoral plan, and then they have sent you down here ostensibly all alone, you sit there with a lot of empty seats to listen to a lot of irate but very well-prepared individuals take this plan apart.

Perhaps from this you might learn something about the kind of values that are embedded in the opposing views of those who wrote that plan and those who have spoken here today against that plan. A lot of questions have been raised and will continue to be raised concerning the research and the lack of research into the potential environmental effects of putting more radioactivity into the ocean.

L.39 W.1 Given all those unknowns, and given the impossibility of recovering either the waste or the subs from the ocean depths, what is being proposed in an ocean disposal option is a massive experiment with the ocean.

Given that there do exist these wastes and these subs and that there does exist a need to dispose of them, what we are all here saying is that the ocean is not a place for experiments of this magnitude.

G.2 The no action choice, as it is called, is a choice to wait; continue the research for real and lasting solutions is preferred to even the slightest possibility of contaminating the ocean now or 200 years from now or 1,000 years from now.

We are here, a lot of us, with an underlying fear that we will not be heard though we may speak eloquently; that we will not be listened to where it matters though we attest to 100 or 1,000 problems and unanswered questions, and we are

still here, and we've been here all day and still at this hour we are here in these numbers and still we speak with our various degrees of knowledge and fluency. We speak because decisions about the safety of the earth and of future generations are to be made through processes such as these, or at least that's what we are told.

When we have stood at blockades and been arrested for acting in accord with our own convictions, we have been told over and over again that we should use the legal channels, and so we do as we have done for decades, now, because we want to have used every available channel to protest contamination of the ocean and of the earth.

Now, I would say to the Navy, you pride yourselves on the defense of our country and feel sometimes, I think, that our efforts threaten that work; and I believe you need to recognize that we pride ourselves on our defense of the planet and of all life, and we feel that any nuclear activity -- but ocean dumping we are talking about right here -- threatens existence itself, and we find ourselves utterly unable to understand how you can believe it will matter how strongly you defend our country -- it's the only way this can be done is by endangering the ocean which nurishes the country and all of life.

After World War I, there were trials in which people of the free world condemned those that we held responsible for crimes against humanity. We rejected every excuse they came up with. We said that the sanctity of human life is a higher law, and that the daily working decisions of every human being must place those considerations above the dictates of party or nation or project.

Today we stand here in this tribunal of our nation, and we call upon those of our countrymen who will be making this decision about where to put the subs, and we charge you that as representatives of the country which introduced into the world community the concept of those higher laws as operative in your daily actions, that you make those decisions in accord with these laws; laws which say that even the defense of our own country, even trying to find a cheaper solution, does not give us the right to experiment with the ocean or with life.

N.3

Yes, we must deal with the existing waste, but no, we do not have to take chances on disposal techniques. We need to use the no-action option, and we must change it from a no-action option to one which becomes a massive and well-funded search for real solutions that have been promised to us for almost 40 years and which as yet have not been found.

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CAPTAIN WAGNER: The next registered speaker is William Crooks of Gualala, California.

--o0o--

#114

WILLIAM CROOKS

That's a tough act to follow. My name is William Crooks, and I live on the Mendocino Coast at Anchor Bay. I'm an engineer retired after 21 years of employment by IBM.

Upon hearing that the Navy wants to scrap upwards of 100 nuclear powered submarines over the next few years, some questions obviously come to mind. I'd like to address three of those:

Why dispose of the subs? Why not retrofit or modify to keep them in service to assist us in keeping down the cost of our ultra costly arms race?

G.3

I'm not convinced that the Navy is cost effective with planned expenditures of 14.2 billion, and I repeat, 14.2 billion dollars by the Navy for FFG-7 missile frigates and 7.9 billion for Trident Missile I's.

It behooves the use of any and all equipment for longer periods of time to allow us for safe disposal.

Two, if disposal in the oceans of the reactor

J.7

components are so inert and so harmless for the report by the Department of the Navy, why not dump them in many sites off all coasts to save money towing the subs thousands and thousands of miles?

The answer, of course, is that this material is not harmless.

Third, why can't we allow ocean dumping of nuclear or radioactive material to be resumed? There are two basic reasons for not allowing the resumption of the dumping of nuclear radioactive material in the ocean.

L.9

First, if the Navy is allowed to start dumping, then other and probably all agencies will want to do the same. I'm sure that other agencies can prepare the same arguments that appear in the Navy's current report which is questionable at best.

Second, the other point to be made is that the nuclear -- that the reactor components should be buried in the Navy land, or in the designated land sites so that they may be retrieved when science finds a method to neutralize nuclear radioactive material.

Science will find the solution, as it must, and then the reactor compartments can be made harmless.

In summary, I make the following representation: Bury the reactor components in the designated land sites for monitoring; and last but not least, deposit the remainder of

the dismantled subs in the closest proposed land site to save the cost of transportation.

J.15

Thank you for allowing me to speak before you, Captain Wagner. We hope you will follow up with more meetings on the coast. We'd like for you to come on over. A Navy captain shouldn't be so far from the water, anyway.

Thank you.

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CAPTAIN WAGNER: Next registered speaker is Mr. Jeff Hohensee of Laytonville, California.

UNIDENTIFIED SPEAKER: Excuse me, sir, aren't these supposed to go in alphabetical order?

CAPTAIN WAGNER: Yes, they are.

UNIDENTIFIED SPEAKER: My name is Ronald Glick, and I was here at 9:00 o'clock in the morning, and I signed up to speak.

CAPTAIN WAGNER: My cards are not alphabetized properly.

Mr. Hohensee, if you would please allow Mr. Glick -- Ron Glick of McKinleyville, California.

--o0o--

#115

RONALD GLICK

Thank you. It's been a long day. I'm a citizen of the United States of America as I trust you are, Captain. My name is Ron Glick. I'm a citizen of the United States of America, and I trust that you are, as you are in the Navy, and I trust that the Commander in Chief of the Armed Forces is also a citizen, otherwise he couldn't have got the job.

And when I was trying to figure this thing all out, I

tried to see what logic the Commander in Chief would have and what logic the Navy would have for doing this, and this is what I came up with.

It is in our national security interest to have nuclear submarines. Well, part of having those nuclear submarines means eventually we have to do something with them when they're obsolete or too radioactive to handle or whatever.

So what the Navy has decided, or the Commander in Chief or somebody has decided, that what we ought to do is sink 'em in Davy Jones' Locker. Well, by the Environmental Impact Statement, the Draft that the Navy has published, they have calculated that there will be no significant risk, but any radiation is bad. We know this, that none of it is good. It causes mutations, cancer, leukemia and maybe other things, for all I know. And so even this little insignificant bit is in addition to whatever else there is in the environment, and it is bad, and it is bad for the people that it comes in contact with. L.7

Now, the Navy and the President in their desire for national security has decided we -- or is proposing that we sink these things off the coast near where I live, and as an individual, I am -- thereby, my health is thereby more endangered by their presence than would they not be there.

So in essence, what they're saying to me is that for the betterment of the United States of America, the people of the United States of America, the national security of the people of the United States of America, that we're going to put these things here, and we're sorry, Ron, but that's the way it goes.

Well, I would like to take issue with that and to express the gravity of how dangerous this is. I would like to read a short passage which will be less than all told five minutes from Beneto Mussolini's "Fascism Doctrine and Institutions."

"Anti-individualistic, the fascist conception of life, stresses the importance of the state and accepts the individual only insofar as his interests coincide with those of the state which stands for the conscious and universal will of man and with historic entity. It is opposed to classical liberalism which arose as a reaction to absolutism and exhausted its historical function when the state became the expression of the conscience and the will of the people. Liberalism denied the state in the name of the individual. Fascism reasserts the right of the state as expressing the real essence of the individual, and if liberty is to be the attribute of living men and not of abstract dummies invested by individualistic liberalism, then fascism stands for liberty and for the only liberty worth having, the liberty of the state and of the individual within the state."

Now, there's been some question raised here as to whethe

there's any point in us being here; is this just some ritual that we go through as a nation to provide public comments?

And as one citizen who cherishes democracy to another citizen who, I think, does because you took the time to allow the children to speak because it is a lesson in democracy for them to come here and be able to speak.

I urge you to go back to Washington and explain to the people at the top, and if that means you have to go into the office of the Commander in Chief and give him the message: How dangerous an act this is to go against the will of the people.

Thank you.

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CAPTAIN WAGNER: Jeff Hohensee.

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#116

JEFF HOHENSEE

Thank you. As between the artificial lights and the artificial air and everything else in here --

As a concerned citizen, I worry about our government's actions. The people of the United States have a cavalier attitude toward natural resources which is quickly pulling us toward dependence on foreign sources. On either end of the nuclear bulkhead are potentially recycleable materials. As our resources dwindle more and more, things become feasible to recycle. Today that scrap metal may be economically unretrievable. Has any economist ever read accurately 20 years down the road? Once nuclear submarines are dumped into the ocean, they are basically unretrievable. Their fate is up to the ocean, and to quote an old sailor's antidote, "The ocean does not forgive your mistakes." W.1

The nuclear waste disposal problem is new to our generation. We inherited it from a society whose faith in technology was boundless. Technology today is nowhere near

curing all the havoc it's created. Technology, like man, its creator, is imperfect. Mistake is an integral part of his existence. Can we guarantee our grandchildren that we aren't perpetrating a disaster on them? We don't have any idea how the embedment of steel will affect the longevity of the holding capacity of the bulkheads. We don't have the technology to dump anything, let alone nuclear submarines intact to the depths we are proposing. We don't even have the ability to monitor them once they're there. Q.13 J.76

In college we are taught to bend statistics to tell any truth. We know statistics speak with forked tongues. What if in our pompous ignorance we do unleash a nuclear genocide?

Can we hide behind our rhetoric when people are being born mutants. Throughout the EIS, the word "assumption" is weaved into most of the predictions. What if our assumptions are false? What if at some point nuclear waste is released in the environment? What can I tell my children when they look me in the eye and ask me, "Why did you let the Navy do it, Daddy? Was it because it was easy? Because you were in a hurry"? L.43 L.40 L.20

We live in a generation where convenience at any cost has been the bottom line. Well, maybe dumping nuclear waste in the ocean is the most expedient way to deal with it today, but what about tomorrow? We owe it to our future to take firmer N.3

steps when we're dancing in the arms of nuclear waste. An ounce of prevention is worth a pound of cure. Only as much nuclear waste needs to be disposed of as we create. Please stop nuclear waste.

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CAPTAIN WAGNER: Ladies and gentlemen, we are going to take a recess now for dinner. We're going to reconvene the hearing at 7:30. I'm told that the building has to be closed during the time that we're gone. It will be reopened at 7:15, so we will recess at this time and reconvene at 7:30.

--o0o--

Testimony at the Public Hearing

on the

Draft Environmental Impact Statement

on the

Disposal of Decommissioned Nuclear Submarines

Thursday, February 24, 1983

Department of Water Resources
1416 9th Street
Sacramento, California

Evening Session

Reported by: Theresa French, CSR No. 5790
Ida Ruth Lundsten, CSR No. 5791

CAPTAIN WAGNER: Ladies and gentlemen, we'll reconvene the hearing.

Is there anyone in the audience who was not here this afternoon when we recessed? Let me just for a minute set the procedure.

I'm Captain Edward Wagner. I'm here as the Navy's hearing officer to conduct one of the scheduled public hearings on the Navy's Draft Environmental Impact Statement on the disposal of decommissioned, defueled nuclear powered submarine reactor plants.

The purpose of this hearing is to take testimony regarding the Navy's Draft Environmental Impact Statement. The purpose is neither to plead the Navy's case nor to engage in debate. My responsibility is to receive statements in the form of testimony so that they can be considered in preparing the Navy's Final Environmental Impact Statement.

I'm affording those individuals and organizations an opportunity to provide testimony. We are in the process of listening to individual testimony from individual speakers, and the time limit on the individual so that everyone will have an opportunity to express their views is five minutes.

The procedure for public testimony is as follows: I will announce each registered speaker. You need to register if you want to provide testimony. And if you haven't already registered, you should fill out a registration card at the registration desk to accomplish that.

When you are called, proceed to the microphone. Please state your name. And if we get back to organizational spokesmen tonight, please list your organization if any -- even though I call your name, I want to make sure that the record gets that name correctly in case I mispronounce or we have misspellings or whatever.

Please address your comments to me. Again, if your statement is so long that it's going to exceed the time limit that we've established, I remind you that you can submit that statement in writing. It will be entered into the record in its full content. And you can summarize your statement in the five-minute period.

So let's proceed with the first registered speaker -- or the next registered speaker, who is Elizabeth Ann Halfcock (ph) from Redway, California.

Is Miss Halfcock here?

(Speaker not present.)

CAPTAIN WAGNER: I believe we will move to the next speaker. I believe this is Lori Kern from Willits, California, or it could be Lori Kim from Willits, California.

(Speaker not present.)

CAPTAIN WAGNER: And then let's ask Mr. Edward Martinez from Santa Cruz, California -- or I could have the last name wrong, it could be Martiner from Santa Cruz, California.

(Speaker not present.)

CAPTAIN WAGNER: Brendan Mobert from Gualala, California.

UNIDENTIFIED SPEAKER: Brendan has spoken.

BRENDAN MOBERT: I have already spoken.

CAPTAIN WAGNER: Thank you.

Kenneth L. Mobert from Gualala, California.

--o0o--

MARY MOBERT

#117

My name is Mary Mobert, I speak for my husband. Sir, it is very hard for me to understand as a student of physics why this artificial discussion is going on in the first place. There is no lack of data establishing the absolute folly of dumping toxic waste anywhere -- let alone the ocean.

If you apply the notions of criminal negligence or for that matter criminal insanity to this Environmental Impact Statement, I believe that any of its preparers would be quickly led away.

L.20

We are not discussing some abstract concept but the very survival of life on this planet. What manner of idiot would say that a container of lethal waste could be safely stored

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L.20

for 50,000 years? I am sure that by the time this letter is read, plenty of arguments both emotional and logical will have been made.

The bone that I would like to pick is just who do you think you are kidding in the first place? It is clearly obvious that this meeting is a fraud and quite likely illegal. This so-called meeting was carefully constructed to make it difficult -- if not impossible -- for the people it affects most to have any say in it. Though I have legal -- little legal experience, I am -- I am reasonably sure that a good constitutional lawyer would have little trouble bringing suit against both the Navy and the Government.

In short, this meeting is a carefully planned farce with deadly serious possibilities.

There has never been a crime more villainous than the murder of a whole world.

Thank you.

--o0o--

CAPTAIN WAGNER: The next registered speaker is Kirk R. Mobert from Gualala, California.

--o0o--

#118

KIRK R. MOBERT

Hello, I'm Kirk R. Mobert. And believe it or not, I wrote a speech but I folded it and put it in my pocket, so it's a little ruined. I'll have to wing this one.

First of all, I live in Gualala. And I swim in the ocean down at the beach and, you know, I dive and the whole thing. And I'm glad I'm -- I wasn't one of the unfortunate ones to find any fish -- you know, any messed up fish like some fishermen here before.

But I would just like to say that nuclear ocean dumping is sort of a waste. And putting -- putting the subs in -- well, in the oceans is pretty bad -- pretty bad too. Kind of crazy.

I just also would like to say that as Brian Casey said before: If you make mistakes, I have to live with it and so do my children and my grandchildren.

That's pretty much all I have to say.

--o0o--

CAPTAIN WAGNER: The next registered speaker -- excuse me -- is Mary Mobert who just spoke for her husband.

Would you like to speak for yourself? From Gualala, California.

--o0o--

#119

MARY MOBERT

Thank you. My name is Mary Mobert. I'm a nobody.

UNIDENTIFIED SPEAKER: Louder, please.

MS. MOBERT: Thank you.

I'm a nobody as were most of the people here. I live a quiet life, most days filled with parenting and paying bills and keeping life and limb together, as do most of the people here.

So why didn't I keep my nose in my business? Why did I waste two days getting here and sitting here to spend at the most five minutes talking to people who I feel chances are won't be listening anyway?

I haven't been to a protest since the Vietnam War days. The years have proven that these protests sent ripples through society right to the top and eventually changed things. I'm adding my small voice to other voices -- large and small --

that have been telling you that all these nuclear toys you boys have been insisting upon playing with expede a high price that will be paid in full, not by you, but by your children and their children's children.

We are beginning to see it in the environment now. Animals, birds and fish are showing the effects of poison we have dumped on them. The earth has begun to revolt against the way we are treating her and her children. The weather is changing and experts on the subject can't say what will happen next.

The Navy sits in Washington clothed in its brass-plated pride, gazing down on all us reactionaries, ignoring 30 years of evidence and testimony and asking the question: To dump or not to dump and on whom?

You have the gall to print a 400-page tome that says, "All will be well; just trust us." I know a man who trusted you in the early '50's. He signed onto a ship and wound up in the Marshalls standing on deck as did all MSTS civilian personnel aboard, facing away from the blast of the first H bomb testing. He was never told where he was going nor did he give his permission to be a guinea pig in your experiment. He has had no children since -- and though he tried several times. He is now a retired merchantile Marine, and he is fighting a losing battle with cancer. That man is my father-in-law. And you cared about your effects on his life about as much as you care about the lives of the people who have been sitting here today.

You think you have the right to suck our life's blood and to pay for your flesh-melting, soul-crushing, life-destroying toys. You think you have the right to reek slow insidious poisonous death on our progeny without our permission; to litter the world's backyard with your cast-off, deadly dolls. Well, think again.

This meeting is just not one of two to add to a thin coat of democratic varnish to your already carefully laid plans. It's one of a long line of meetings that will hopefully break the deadly chain that will change opinions.

We will win. Set your mind on it. For we outnumber you. We tell you"Wake up." You're dancing a dangerous dance with a very dangerous lady. You've lulled yourself into believing that you are safe through your strength and your power -- Be aware.

You can't continue this diluted game of slap and tickle, hide and seek with this woman. Her clock was wound at creation's inception and will continue to tick beyond this planet's demise. If you continue your folly of throwing caution in her face, the price the world will pay will be beyond the imagining of men. When that Geiger clock strikes, Lady Death will impose her will on us all, and you in your air conditioned, comfortable bunker and I on my hill with

my goats will be burnt up; in my hiding place or not and in your hiding place or not.

Many of us have taken the trouble to bring our children here as a part of the educative process on both sides. We wanted them to see you in action. We wanted you to hear from those whom you will affect the most; their thoughts and concerns in their own voice. We wanted you to look them in the face and remember those faces as you decide to what degree you -- with your cold-blooded calculation -- will murder them.

The Navy is used to the no-action syndrome. You've been sitting on your proverbial poop deck in the nonaction attitude for years.

So please, for the sake of my kids and for those kids who were here, keep sitting on that nonaction syndrome, and it will be very much appreciated.

Thank you.

--o0o--

#120

CAPTAIN WAGNER: The next registered speaker is Morning Star from Willits, California.

--o0o--

MORNING STAR

My name is Morning Star, and I come from Willits. This is a ceremony that we are doing here, and, therefore, I will use my ceremonial name. And I, Morning Star Rainbow Medicine Woman Bridge of Life Protected by the Golden Eagle, will call on all the power in all of the people in this room to thank the Navy, our brothers, and the brothers and sisters in this room for sharing in this ceremony.

I wish to speak to the DEIS from my heart as a nature person. The earth is alive. We are part of a delicate balance. To see humankind as above this balance and therefore to believe that we can safely control it is foolish. To see humankind as superior to all other life limits the vision of mankind. This limited vision is reflected in scientific theory; limited to belief in only the existence of that which can been seen or in some way proven.

Atoms existed for eons before man saw them. The earth as a living being exists whether or not mankind knows it and

acknowledges it. I don't need scientific proof to know that we are part of the earth and that nuclear waste dumped into the ocean is a desecration of our sacred waters, seriously disturbing the balance of life.

I ask all the people in this room to focus their attention on the moment when their hearts opened and they awakened to this reality. And I ask them to join me in prayer for all our brothers in the Pentagon that their hearts may too be opened to feel their oneness with our earth.

Thank you.

--o0o--

326

CAPTAIN WAGNER: The next speaker is Ede Morris of Redwood Valley, California.

LEWIS KORN: Pardon me, I'm Lewis Korn and I think that you -- the Ms come after the Ks. I didn't hear my name called.

CAPTAIN WAGNER: We are working, sir, on the registrations that occurred prior to or at 9:00 o'clock this morning. If you registered after that time, we haven't got to those yet.

MR. KORN: I believe I did come at 9:00.

CAPTAIN WAGNER: We'll bring you next, sir.

--o0o--

#121

EDE MORRIS

My name is Ede Morris, and I left my husband and two small children in Redwood Valley which is in Mendocino County so I could come here today and sing a song for you. It has to do with the history of the coastline in California and the destruction that is taking place here.

(This is a song.)

On the golden shore of the Pacific Ocean the
Spaniards came for gold

and the Padres brought the cross of Jesus to
the Indians who were sold
as slaves to the conquering white man who
robbed them of their gods
and took their land till they made a stand on the
coast of California.
The white man came to the land of the sun
he took what he wanted left the Indians none
The Great Spirit warned them that the power
would come
now the Earth is in pain and there's nowhere
we can run.
The settlers came in search of Freedom not
knowing it was lost
and the hunters killed the buffalo but the
Indians paid the cost
of their brave young men and land that had been
theirs for so long
they were driven to the hills so far away
from the coast of California.
The white man came to the land of the sun
he took what he wanted left the Indians none
The Great Spirit warned them that the power
would come
now the Earth is in pain and there's nowhere

we can run.
The cities grew till the air was black from
the cars and factory smoke
and the kings and queens of Hollywood found
Jesus as their hope
for all the sins of their indulgence in the
myre of booze and drugs
they sit and wait for the big earthquake on
the coast of California.
The white man came to the land of the sun
he took what he wanted left the Indians none
The Great Spirit warned them that the power
would come
now the Earth is in pain and there's nowhere
we can run.
On the golden shore of the Pacific Ocean
they're drillin' for more oil
You can see the rigs suckin' up the juice from
the coastline they will spill
And blackness filled the water where blue ocean
once had been
and the people lost their fine shore lots on
the coast of California.
The white man came to the land of the sun
he took what he wanted left the Indians none

The Great Spirit warned them that the power
would come
now the Earth is in pain and there's nowhere
we can run.
Power companies built nuclear plants on the
center of a fault
so the people said they'd go to jail if the
destruction didn't halt
and radiation filled the ocean where clear water
once had been
and the Indian bones have lost their homes on
the coast of California.
The white man came to the land of the sun
he took what he wanted left the Indians none
The Great Spirit warned them that the power
would come
now the Earth is in pain and there's nowhere
we can run.
Now the Navy wants to dump nuclear subs
to make room for the deadlier Trident
They'll make the ocean their permanent home
a radioactive environment
But the people said they don't want them
for the ocean is our source
We must all join hands

and take a stand
on the coast of California.
We must all join hands
and take a stand
on the coast of California.

Well, I'm really glad I got to do this. I waited all day, and I was pretty tense. But I want to let you know again that as a founding member of the Abalone Alliance, I know how fast grass-roots movements grow, and this movement is going to grow and be very powerful.

And I recommend that you listen to what's been said today; take heed to what we told you, and please don't dump the subs or the waste in the ocean.

Thank you.

--o0o--

#122

LEWIS KORN

I've prepared a speech which I'm not going to read. Thank you. I'm not going to read my speech because everybody said everything I wanted to say, but I need to say something.

Can you hear me?

CAPTAIN WAGNER: Could you please state your name, sir?

MR. KORN: I'm Lewis Korn, I live in Willits.

And I want to say to all of you who has the staying power to stay so long, for coming many of you so far --

I just want to say a few things. The environmental burdens become body burdens. Toxics, pesticides, hazardous chemicals, nuclear radiation are becoming intolerable burdens. Some terrible but illuminating experiments are performed.

Frogs dropped into scalding water will, if they can, immediately jump out. When placed into cool water that is gradually heated to boiling, they make no effort to escape until they are too weakened and cannot move. We must learn from the poor frogs so that we do not follow their example. We must learn to not do that to frogs and to ourselves.

You know, we are really one life. And if we understood that, we wouldn't be doing this to ourselves. And it's biologically true that we are one life. If you take the single cell and it divided in half and both halves are the same life in two cells. And when you -- when they divide in half, you've got the same life in four. And when -- when they evolve, you have the same life in different forms.

Why should we be doing this to each other? That's all.

--o0o--

CAPTAIN WAGNER: The next speaker is Lee O'Bryant from Fort Bragg, California.

UNIDENTIFIED SPEAKER: Miss O'Bryant had to leave -- Mrs. O'Bryant.

CAPTAIN WAGNER: Thank you.

LYNNE HARPER: Excuse me. I'm not Mrs. O'Bryant -- and I'm sure I missed out. I'm wondering if you could backtrack? Did you already do Lynne Harper?

CAPTAIN WAGNER: No. You may speak next, Ms. Harper.

--o0o--

LYNNE HARPER

#123

My name is Lynne Harper, and I'm from the hills outside of Covelo. And I don't recognize -- and I don't represent any big group. But I know how my friends and neighbors feel. And I know that we are upset enough about it to drive for seven hours to get here and to wait around all day.

And I have a little son, and I don't want you to dump nuclear waste in his world and mess it up.

--o0o--

330

#124

SAM: Excuse me, I signed up at around 9:00 and haven't been able to speak yet. I don't want to say very much, so --

CAPTAIN WAGNER: Go right ahead.

--o0o--

SAM *

Okay, great. I want to remind everybody that these are the same people that are saying that nuclear war is not --

UNIDENTIFIED SPEAKER: Your name?

SAM: What? Oh, my name is Sam, and I live ten miles from Cape Mendocino. And tonight we're speaking with people that think nuclear war is winnable. And I feel like anybody that -- that thinks it's safe to dump radioactive subs in the ocean needs to see a psychiatrist.

Thank you.

--o0o--

*Believed to be Mr. Sam Camp.

#88a*

CAPTAIN WAGNER: The next registered speaker is Charles Orth of Willits, California.

--o0o--

CHARLES ORTH

I'm sure you all know me from earlier today. Actually, I'm not going to hold you to taking verbal testimony as I am going to be using sounds I don't think you can recreate in your little punches.

The issue today is this little shell and the way we can feel about this little shell. And it's called reverence for life. And the issue here is black and white. It is a challenge to that reverance; that's why we see so many people here who have traveled so far. And why I don't feel you will be in Fort Bragg and Eureka, because you will not confront our reverence for our lives and the lives of things such as this shell -- that it may be a bone of something that lived. But it did live and it was whole and has been worked by the ocean and moved by the ocean, and it has intermingled in that environment. And we are part of that intermingling.

So I will now wish to call upon all of our concern that has been in this room today. And I call upon that which

*Issues discussed by Mr. Orth are side barred in Exhibit 88.

is silent so much you know us.

(Whereupon the speaker recited Indian chants.)

Thank you.

--o0o--

CAPTAIN WAGNER: The next registered speaker is Will Reed of Gualala, California.

--o0o--

#125

WILL REED

I am Will Reed from Anchor Bay, and persistence does win out every once in awhile.

I wanted first of all to say thank you everyone who is here. Thank you, Captain. And that I also put some time in the service. I was part of the Navy. However, it was called the Needy Navy -- the Coast Guard.

And I do -- I do believe in some of the values of our country, and I believe that we are among all -- a lot of folks in this world -- we're probably in the vanguard of trying to get back to something that was lost somewhere. And that's what I want to talk about.

I had -- like everyone else, I had these, you know, compiled notes. And so many others -- I'm speaking slowly -- so many other people have expressed their views more succinctly and more clearly than I can.

But what I want to touch on is something that is always reoccurring in whatever we all say -- witness brother's chant just a moment ago. It's a reoccurring theme of harmony. It's the integration of everything that is here and that we are a part of it. And if -- to think that we aren't is totally beyond conception for most of us here.

And it's basically a theme of just common sense, you know? It's this -- this spirituality, this level of awareness has always existed. It has always been around. It is what the generations -- the millennium the people have been talking about, and it's something that's more heartfelt than mentally felt. It's there in your heart. And it's -- There's a song -- I don't know if it's from a play -- it's called "On A Clear Day You Can See Forever."

And when you are not involved in something, you generally have the perspection of looking over at it, and most of us are a product.

I was -- I tell people I was born when they weren't making cars and trucks. They weren't; they were making tanks and bombs. I was born in 1944. And most of us are products of after that era. And we don't come from the -- have that same perspection like the purview of paranoia that the present administration is operating from, which is kind of a -- let's see -- a reality that didn't -- that existed 40 years ago and no longer exists.

And we can see that real clearly. And we are trying to express that that feeling -- it's a matter of trust. And it's

a matter of openness in one's heart. And that is growing. It's becoming a larger base. And witness in here a lot of us -- you know, I mean it's not the hardest travails that anyone in history has made, but we have made an effort to be here and we've been talking about it for a long time now and not just on this particular issue.

And we -- it's our children. Like, I think, someone said, you know, the children, they belong to the future. Well, we cannot know, and we don't want to pass on this legacy of -- I don't know -- just total lack of respect for what is in nature, in that harmony that exists within it.

And this -- this reality, this level of awareness that is growing is -- it's almost like up until the overriding ruling power or consensus has been to use up and abuse, and when it's -- when you are all done with it, you kind of just sort of, you know, shovel it off somewhere where no one else can see it, and you move on.

Well, we're moving on throughout the entire world practically, and the world is also running out of lackeys I mean, the third worlds are saying, "Hey, forget this; we don't like this -- you know, we don't want to do it any more."

And that's kind of what's going on.

And it's going on here and it's the younger people. And it's not just the younger people, but there's becoming more and more younger people that are seeing this as being a pretty obvious -- I mean, why else look at it in any other way?

And I may be beating a dead dog here, but that's kind of off the top.

What I wanted to talk about -- and just coincidentally, there was a wonderful woman who was from the Soroptimists who spoke earlier, and she was telling about the forgotten people from another era. Well, I just came from although I'm from Massachusetts years ago -- I came from Southern California. I just got back from taking care of my near-invalid father, who is dying of emphysema because he worked in the -- I'm having - wait a minute, let me get a hold of it.

He worked in shipyards during the war as a welder, and he now has asbestosis and was forced into retirement 20 years ago. And the Government does not want -- he's too young to get Social Security, and the Government doesn't want to give him a pension.

So he is another one of these people that kind of got swept aside. And there's lots of people like that, and we don't want to do that any more. We don't want children to have that to happen.

And it is -- and I don't come here as -- you know -- I don't feel like you're an adversary and, you know, it's us against you. We are all in this. And this is more of an appeal. And there she is right, the appeal should go to the elected people -- I mean, our elected officials.

It's compassion, and that's about all I have to say.

--oOo--

*#32a

CAPTAIN WAGNER: The next registered speaker is Beverly Roberts of Willits, California.

--oOo--

BEVERLY ROBERTS

Hello, my name is Beverly Roberts, I'm from Willits, California. And I feel that everyone here feels the same. They are all my friends, and I can tell you how I feel.

I originally wanted to come and talk because I was afraid. And I was afraid of many things, the main one being afraid of radiation.

When I first felt this fear of radiation, I wanted to find out more about it. So I looked at books, and I went through films. And the more I found out about it, the less afraid I became.

But there are other fears too. I'm afraid for people -- for the human race. I'm afraid for my children. I'm afraid for generations to come. I'm afraid for the people in the Marshall Islands. I'm afraid of the lies that I'm told by the Government. I have all these different things that make me afraid.

And the only thing that I can do to combat that fear

is to educate myself and to educate others so that they'll know the facts; we'll know the truth that will take away those fears.

I help teach in a third grade class. And before I came to the hearing, I talked to those children about emotional problems that they have in the classroom when some children aren't getting along with other children. And we talked about our fears, and we talked about the fears of friendship, of not having friends.

But I don't have that now because I see all my friends. And so after we talked, I said: "I won't be here next week because I'm going to Sacramento; going to Sacramento to talk to the Navy because the Navy has plans to -- to dispose of 120 decommissioned nuclear submarines in the ocean right outside Cape Mendocino."

And these children said, "Can we write to the Navy?"

And I said, "Yes, I see no reason why you can't write to the Navy."

And that's all I told them. The next day I picked my son up at noon and the third grade teacher gave me these letters, which I would like to read to you. They are all addressed to the Honorable Captain Wagner, Department of the Navy.

This is from a little girl eight years old: I don't feel good at all about the idea of dumping the radioactive

*Other issues discussed by Ms. Roberts are side barred in Exhibit 32.

*L.14
L.36

submarines in the ocean because it can wipe out millions of fish and whales and sharks for miles around; and it can hurt people also. I enjoy going to the ocean and playing in the waves, and I don't want to see it destroyed. Also it might pollute the air, even if a little bit escapes. I don't know who came up with the idea to dump them in the ocean, but I don't think it's a good idea. And please don't do it. Emily Stoik (ph.).

Jason Patterson: I feel very, very bad about you dumping these submarines into the ocean. It would kill a lot of fish and people, and it would ruin our food and could even kill you.

I feel that you aren't respecting us, and it can kill us -- which I don't want. We can't go to the beach; it stays for a long, long time. David Lockman.

Willie Riggs: If you guys let them go, you guys could give us cancer. Number one, they blow up. Number two, they give us cancer. Number three, they kill fish. We don't want to get cancer because we don't want to die.

E.33

Reef Roberts: I think you should put the old subs in the desert and bury them with cement and iron casings. And I mean it. No thanks.

BEVERLY ROBERTS: This is by Steven Allen: Don't do it because someone might eat the radioactive fish and die. I don't think you would punish us in that way and destroy our food.

BEVERLY ROBERTS: These children are eight years old.

Jeff Smith: I feel bad that you are dropping the submarines in the ocean. It will kill lots of fish and things. It might ruin our food. It can kill people.

BEVERLY ROBERTS: This is by Seth: I don't like the subs being dumped in the ocean because they will kill the fish. It will make our food dull. It will kill people. I think they should throw them in the ocean because they can poison lots of fish -- I don't think they should throw them in the ocean because they could poison lots of fish, and I or other people could eat the fish and get very sick. Number one: kill fish. Number two: ruin the ocean. Number three: hurt -

*Other issues discussed by Ms. Roberts are side barred in Exhibit 32.

California.

BEVERLY ROBERTS: This is by Maurine Paula Marris: "I think you should empty the subs and put them in the park. Number one: People will die. Number two: You will ruin our ocean.

"Patrick Simpson: I feel threatened. The subs should not be dumped in the sea."

BEVERLY ROBERTS: This is from Murissa: "I think that the subs can kill more than half of our earth. I do not want the subs dumped in the ocean -- this is underlined twice with three exclamation points.

"I feel that if you put them in the ocean, we would not have any fish. I feel if you dump them in the ocean, you could kill animals and lots of people." This is by Kevin.

"I don't think you should dump the subs in the ocean,

you could kill a lot of people and a lot of babies and fish and whales and animals. And there wouldn't be no ocean. It could make a lot of air stink."

This is a little picture -- no submarines in the ocean.

"I feel very bad that you are doing this, and I think you shouldn't put them in the sea because it will pollute it. And the nuclear bombs will kill the children." This is by Amber.

Thank you.

You can have this, and we'll mail you these. Thank you.

I want to say one more thing. Tomorrow morning when I get back to Willits, I am going to go back to the third grade class, and I'm going to tell them the things that I experienced here, and we'll talk again. And then we'll mail the letters in. Thank you.

--o0o--

CAPTAIN WAGNER: The next registered speaker is Dan Roberts from Willits, California.

--oOo--

#126

DAN ROBERTS

My name is Dan Roberts. My son is Reef Roberts and he means it.

The first thing I would like to say is thank you for helping us organize. I played basketball in high school, and I know before a game if we had a real good pep rally, we always won. And this has been the best pep rally I've ever been to.

I've learned a lot from this, and I hope you have too.

One question that came up that wasn't in what I wrote was that what would happen to a Trident submarine if it was loaded and exploded in the ocean. I know you can't answer that question, but that's a lot more serious than dumping submarines that's had the fuel lines taken out of it, right? Okay.

Don't poison my waters. I live 230 miles in a straight line from where you want to dump the submarines. I eat the fish from there. My wife eats the fish from there. My children eat the fish from there. My friends eat the fish from there.

My children's children will eat the fish from there, and they'll probably eat it even if you dump it in there and it's slightly radioactive because that's the way people are. You eat from there. Your wife and children eat from there. Your great-grandchildren will eat from there. You and I both know that sooner or later that radiation will leak out and get in the food chain.

L.20
L.36

Are we crazy? What kind of desperate people would poison their own food? And for thousands of years? Irretrievable. Irretrievable.

W.1

My great-grandchildren will stand there and shake their heads and go, "How could they? What were they thinking?" It's not an us-and-them situation -- it's us, everybody.

These subs must be disposed of where they will not enter the food chain or the water. What we really need is a way to stabilize the radioactive nature of the waste; make it not radioactive. There is surely a way. Some day it will be discovered. Spend a fortune now hiring scientists to work day and night on this critical situation. Learn how to make it inert, stable, not radioactive. Then the danger will be gone. Give a billion dollar award to whoever can figure it out. We can afford it. It's not as desperate as dumping them in the ocean where inevitably they will enter the food chain.

Please find a way to stabilize these wastes soon --

real soon, before you think about dumping them again. Make them not radioactive, inert, stable.

Have you ever heard of the idea that if you set a million monkeys down in front of a typewriter, eventually one of them would write Hamlet? It's a numerical fact within a given set of letters that eventually one of these monkeys would write Hamlet; and one of them did.

The first thing we did is we learned how to take the atom apart. And I've been an auto mechanic for about ten years, and the way I learned how to fix cars was I took them apart. And for a long time after I took them apart, it was real hard to get them back together, but I did learn how to get them back together.

So hire whoever it takes, whatever it costs to find the process that renders radioactive materials inert. I have thought about this problem for years. The only reasonable solution I could figure out for not poisoning the humans and the surface life of this planet is to discover just one of the methods of rendering radioactive materials inert. Surely here, it's a friendly universe full of checks and balances. Find the balancing act, whatever it costs. Take it out of my taxes. It will be fine with everyone. Survey the populace. Ask "Would it be okay to spend one million dollars finding a way to make radioactive materials inert and not dangerous?" I'll bet they would say yes.

Please. This is real and critical because even if you don't make any more nuclear submarines or power plants, there's still going to be this problem in the next 20 years of dealing with more and more waste. This is just the first little bit of waste that has to be dealt with. In the next 20 years, there's going to be phenominally more. Don't wait.

I await your awakening to the danger of making any more nuclear subs when we don't have the method of safely disposing of the old ones. Even if you quit making them, there are plenty of situations to be dealt with now and in the next 20 years. Hire all the scientists. It could put a lot of people to work, and it might not be the scientists who actually come up with the inspired idea of how to get it back together.

Please concentrate a great effort now on finding one -- only one -- of the methods of rendering nuclear materials inert, stable and no longer radioactive.

And don't dump them anywhere until you do. Reef means it.

--o0o--

CAPTAIN WAGNER: The next registered speaker is JulieMararumble (ph) of Albion, California.

UNIDENTIFIED SPEAKER: She had to leave.

CAPTAIN WAGNER: Thank you.

ART DOOLEY: Can I say something briefly because I would like to leave. I feel ill, I would like to leave. Can I say something?

CAPTAIN WAGNER: Go ahead, sir.

--o0o--

#127

ART DOOLEY

Well --

UNIDENTIFIED SPEAKER: State your name.

MR. DOOLEY: My name is Art Dooley. I filled out a card. My name is Art Dooley, I filled out a card at 4:00 o'clock this afternoon because I came here to listen to people. And I'm proud to say I did listen to people that spoke wisely on this issue. And now I would like to briefly speak according to this timeclock before I leave because I've just been feeling ill -- not about -- not about this place here, I've just been -- my stomach's been hurting.

But I would like to say that -- let's see. I thank

Greenpeace because I didn't even know about an environmental meeting of any kind in Sacramento. I've been living here more or less downtown for a year. And this is the first environmental issue that ever -- that I have heard that has been brought to the public in Sacramento. And I think it's very wise to bring issues of environment to the public, because environment, in my opinion, is the number one issue in the world today for all nations.

And I think all the nations in the world are committing a mass suicide by their ignoring issues of environment. And environment is the number one issue. And social progress and welfare is the number two issue. But environment is the health of all people. It involves the hospitals, and it involves the farms; it involves the fishermen.

And I would just like to speak briefly on radiation. I criticize the Navy Department. When I -- When I went in -- When I enlisted in the Army in 1967 and I was given an honorable medical discharge for a nerve condition afterwards -- but they -- they had me -- I was -- I was stationed for -- for -- they signed me up for Sam Houston, Texas, to study Environmental Specialist E3 because I had two years of college. And they thought that was very important a field to go into, environmental health specialist.

And you studied it at Fort Sam Houston, Texas, on the environment of all places and help the Army that way. The Army was concerned -- not only about me of course -- but they were concerned about their own safety. And I appreciate the Navy Department taking up this issue.

Now, you were accused on television of briefly having these hearings -- one in Seattle and one here in Sacramento -- real quickly in order -- real quickly and not even near the location. I don't know the facts -- but not even near the location of the theoretical dumpsite in the ocean out here. To have -- I guess you are required to have these hearings by the Defense Department in Washington. I don't know the details on this. I'm not going to make any guesswork on that.

And about radiation, I would like to speak about. I took a health course about a year ago -- Krogers Health, and its 1982 edition of health. And I have some statistics on radiation in my head, if they come to me.

Radiation is a very -- radiation is the most dangerous form of pollution in the world today. All these other toxic chemicals are very dangerous also. Some forms of radiation remain active for a million years. A lot of them -- as one of your previous speakers said -- one of them 80,000 years is the half life and 10,000 years half life -- you know, these are thousands of years and millions of years for radiation. A lot of these other toxic chemicals decay. Their decay rate -- they decay before the time period is completed.

So what you have to do -- what you have to do -- now,

with your uranium workers, uranium miners which are in this country and outside this country -- uranium miners have the highest fatality rate of any kind of -- of any other industrial workers in this country. Atomic workers have a close second. I don't think it's even close to that. But uranium miners have the highest fatality rate of any other workers in this country.

I drove a truck for a few years and became disabled and I've been collecting SSI disability for seven years and traveling the country more or less.

Now, my time is almost up. But John F. Kennedy I understand in -- outside of West Palm Beach, Florida -- he built a fallout shelter at the U. S. Government's expense for some reason -- I don't know why that would be. I didn't agree with everything Kennedy did. He was a good man, I'm sure, in the eyes of the Lord.

Now, he built a fallout shelter at Government expense I heard outside of West Palm Beach, Florida. The walls were lead and ten feet thick at Government expense for him and his family in case of a nuclear disaster.

Now, I understand that still exists down there outside of West Palm Beach, Florida. And that gives you some idea of the radiation intensity of the rays. And they also last for a million years before the things decay. And a lot of these other chemicals and toxic wastes are cancer-producing --

as radiation is. And they have serious effects on the body genetically as x-rays do -- excessive x-rays, up in the hundreds of x-rays in a year or something would cause radiation poisoning.

Now, where to dump these wastes? In the health book -- in the health book, they were talking about you can dump it in the ocean, but because of this radioactive waste happens to be hot -- I'm not speaking as an expert here, but I would like to get this off my mind to people that possibly could do something about it; responsible people.

Now --

UNIDENTIFIED SPEAKER: Time.

MR. DOOLEY: Radiation -- Pardon me?

UNIDENTIFIED SPEAKER: Your time is up.

MR. DOOLEY: Okay. Thank you.

--oOo--

CAPTAIN WAGNER: The next registered speaker is Michelle Sata I think or it could be Saca of California.

UNIDENTIFIED SPEAKER: Who?

CAPTAIN WAGNER: Michelle -- it looks like S-a-c-a -- Saca.

(Speaker not present.)

CAPTAIN WAGNER: We'll proceed with the next registered speaker, Tim Shinabarger from Point Arena, California.

--oOo--

#128

TIM SHINABARGER

Tim Shinabarger, 372501713. Thank you.

I would like to thank you two women for doing your work all day and into the night.

Captain Wagner, I'm glad you had the chance to hear some real normal people speak today instead of officers and big wigs. I often do hear sailors speak their minds. When they say, "Yes, sir," what do you think they're thinking? It's too bad the media and politicians have not heard us speak, but they left together early this afternoon.

Those of us who have had the courage to speak today have been on the front lines, except for that first guy, Mr. Mangeno. We've been on the front lines. We network pretty well, but the Government corporate network uses harassment, imprisonment and fascination on those of us who have the courage and ability to resist them in a committed, sustained way.

The man on my T-shirt Leonard Pelteir is in prison for life for defending his people and many of his allies were killed. So here we are. Ronald Reagan or one Trident submarine commander can kill more Russians in 10 minutes than Nazi Germany and Adolph Hitler killed in six years. And they killed 20 million.

One of the writers on nonviolence said: "We can't win at the bargaining table what we haven't already won in the field."

As the evening rolls on and the euphoria thins and the proceedings are revealed as a sham, it's important to me that we all keep centered and hold onto what energy we have left today.

The morning blockades at Livermore and places like that wear into exhaustion much like this meeting. The only difference I see that the security forces -- the Government security forces in this room didn't put us here, and I think we're going to be able to leave tonight.

Don't let our differences keep us divided. Solidarity.

Reunite.

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CAPTAIN WAGNER: The next registered speaker is Tim -- I believe it's Shallot or Snowot from Huntington, California.

(Speaker not present.)

CAPTAIN WAGNER: The next registered speaker is Rebecca Tanora (ph) from Garberville, California.

UNIDENTIFIED SPEAKER: She had to leave.

CAPTAIN WAGNER: Thank you.

Miss Sheila Tracy from Albion, California.

--oOo--

#129

SHEILA TRACY

My name is Sheila Tracy. I'm from Albion. I speak with the support of the many friends and residents of the coastal fishing community of Albion. And I say we are irrevocably opposed to the Navy's plan to irresponsibly shuttle defunct radioactive subs or any of its highly-toxic nuclear waste in our oceans, Atlantic or Pacific.

I see it as crucial to the continued existence of our planet that the people take on the role of guardian of the ocean waters. In the past we have entrusted that role to the officials of the Government set up to serve the interests of the people.

But in recent years, it has become increasingly apparent that the majority of our Government has become self-serving. Its interests for the most part are not in accordance with the will of the people. Its agencies have become bureaucratic tools to license themselves to use our own people as guinea pigs.

As a case in point, I would like to take notice here of the people of the Marshall Islands -- a part of the greater chain of islands in the South Pacific known as Micronesia. These people are now experiencing radiation poisoning -- we all here are so afraid of -- from a hydrogen bomb exploded on their island in 1952. They are suffering thyroid conditions, tumors, leukemia, stillbirths and the birth of creatures that don't even resemble anything human.

These islands are under the strategic trusteeship of the United States Government. But instead of protecting them, we have literally obliterated several of those island

homelands with our bombs. It is these people -- it is these people's islands that are the target for the missiles leaving the Vandenburg Air Force Base. .

You, the Navy, right now are in the process of committing genocide to these, the people of paradise.

In our Bill of Rights we are granted the right to life, liberty and the pursuit of happiness. When the Government obstructs these -- the people from these rights -- it is time to bring the power back to the essence of true government, to each one of us as individuals.

The nuclear waste problem is not a new issue; it is four decades old. Two fully-fueled reactors have been lost at sea. One nuclear reactor dumped with no records of its whereabouts. England has already dumped between 50,000 to 100,000 tons of low- to medium-level waste in the ocean to date. Our Government has dumped barrels of nuclear waste, which are now in floating off the Farallon Islands where fish are feeding off the organisms living on the barrels. L.6

Sweden has banned ocean dumping, and the Netherlands have ceased their dumping practices -- thanks to Greenpeace.

These are facts. Yet for all the value and validity of facts and statistics, only one look to the earth -- one only looks to the earth for its testimony of common sense. Radioactivity's half life will outlive us, will outlive our children, their children and all of the earth's children for hundreds of thousands of years to come. We are accumulating massive quantities of the most deadly substance the human race has ever known.

By dumping it in our oceans, we are turning our own worst weapon against ourselves. We must look at the oceans as being the final cleansing force for our earth; as is our bloodstream for our bodies.

When our bodies are afflicted with disease and that disease is localized, it is more likely to be discovered and treated quickly and effectively.

On the global level, the disease we are attempting to treat is the cancer of radioactive nuclear waste. Uncontrolled and ever accumulating, it cannot be detected by our God-given natural warning system. We are extremely vulnerable to radioactivity as we cannot smell it, hear it, taste it, see it or feel it. Our goal should be total elimination of nuclear power until, if that day should ever come, we arrive at a full understanding and capability to detoxify the waste product.

On a more immediate level, we should take our cue from that of the Sweden government who have banned further construction of nuclear plants and who treat nuclear waste as the hazard it truly is. They have built elaborate concrete underground storage structures to contain the radioactive waste where it can be rigidly monitored. To put

nuclear waste in the ocean subject to the unpredictable force of currents, unreachable and irretrievable, is a travesty of international human rights. This is our nuclear garbage, and it is only just for this country to deal responsibly with the radioactive nightmare it has created.

We have no right to put it in international waters, surrounded by international fish that feed the population of the people who have never had their homes lit by nuclear power or their shores patrolled by nuclear subs.

I walked in the dark of the night last night to witness our Mother Earth's own testimony. The half moon still reflected the sun's light. The earth's shadow still fell across the face of the moon. The night air still felt cool on my cheek and smelled good to breathe in. And the frogs poured out their life song in one harmonious rhythm.

And I wondered at the strength of the earth to absorb the indignity we so disrespectfully laden her with. And I wondered how the generals playing their war games and the investors counting their blue chips think their great-grandchildren will somehow remain untouched by this force.

Or is there no sacrifice too great to outweigh the love of power and money? I thought of how we, the people, can learn from the voice of the frogs: Alone, unsupported by our brothers and sisters, our sound fades into the vastness of the night. But together, unceasing, our

W.1
L.39

forcefulness can break the darkness of closed minds.

I thank you.

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CAPTAIN WAGNER: The next speaker is Susan Van Dodge from Willits, California.

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#130

SUSAN VAN DODGE

My name is Susan Van Dodge from Willits, California. I speak also for my son Neil Kirk. I would also like to speak in part for my family in southeastern Washington. I grew up 15 miles from the New Hanford Reservation. And I'm sure you've heard plenty of testimony in Seattle regarding the Hanford Reservation. Don't take the subs there. They have three-quarters of the nation's high-level rad waste there already; they don't need any more.

I have childhood friends who are dead from cancer. And my third grade teacher who never smoked a cigarette in her life is dead from cancer. This picture -- I don't know if it's visible or not -- appeared in Scientific America. I'm sorry I don't have the volume and the year. This is the epidemiology study -- one of the few that have been done of Washington and Oregon in the Hanford area. This is what it looks like in southeastern Washington, roughly, right? So, it's -- it's pretty bad there.

And the rest of what I have to say pertains to opening up. We have heard before people talk about opening up our hearts. And I would like to say that we all -- and by "we," I mean everybody who aspires to humanity in this room and in this world. We must stand as children before our Mother Earth with the open minds of children to hear an increasingly irrefutable volume of evidence. This volume of evidence that shows that radiation has already damaged our bodies and genetic system, the air and the soil and the water, indeed the very life of our earth -- that is damaged to some extent.

For the first time in history, we have the morbid privilege of being able to clearly conceive of the death of the earth. I mean, that is what our generation is faced with. We must also hear with our minds -- that must be open or that must become open -- the volume of evidence that shows us the very least we can do -- and others have said this before me -- the very least that we can do about the radioactive waste disposal problem for which there is really no answer -- there is no answer that even approaches forever.

The very least we can do is stop making more radioactive garbage. Unfortunately, the controls at this point of making radioactive garbage rests with the perpetrator of the nuclear cycle -- with big business and the military industrial complex.

At every single point that people in this country and

earth -- protests from uranium mining to MX testing -- we find that behind the oppositions of protests are the people who stand to make profit at every point of the nuclear cycle.

And we could start now and keep naming the list for a long time. But it goes: GE, Dupont, Standard Oil, Lockheed, Boeing and on and on and on.

It will be our voices and our minds and hopefully the voices of and minds of people that we affect and change. It will be when we influence this corporate structure, and they understand that their profits will diminish as the earth and resources diminish and that perhaps one day their profits and they will be nothing at all. Then our earth will have a chance -- if it's not too late. Then as the deadly process is hopefully halted, it will be up to us at that point to take control finally of the resources for ourselves; keep them in our own hands and keep the earth safe forever.

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CAPTAIN WAGNER: The next registered speaker is Walt Wagner from San Francisco, California.

Is Mr. Wagner here?

(Speaker not present.)

CAPTAIN WAGNER: The next registered speaker then is Christopher J. Wilson from Ben Lomond, California.

Is Mr. Wilson here?

(Speaker not present.)

CAPTAIN WAGNER: Mr. Dan Young?

UNIDENTIFIED SPEAKER: He had to leave.

CAPTAIN WAGNER: Thank you.

Ladies and gentlemen, that completes the registration of the individuals from this morning's registration. I have a stack of registrations here, again,going back to organizational spokesmen.

I would like to take a five-minute break to, again, give an opportunity for our reporters to rest their hands. We will resume the hearing in five minutes and then come back into the remainder of the organizational spokesmen.

UNIDENTIFIED SPEAKER: How long is it going to go tonight?

CAPTAIN WAGNER: We will probably go until about 11:00. And that's because we have to allow our -- our ladies who have helped us in recording to -- to quit at that time. So we'll go, you know, until that time or until we don't have any more

testimony.

(A brief recess was taken.)

CAPTAIN WAGNER: Ladies and gentlemen, we will resume the hearing. You will please take your seats. We have a great deal of registered people both individuals and spokesmen for organizations to get through during this hearing tonight. We also have the people who have to get back on their bus.

What I would like to do is this. I have about 15 organizational spokesmen, and I will go through each of the organizational spokesmen and give you an opportunity to speak. If, however, you would like to waive your right to speak orally and you would care to submit a written statement for the record, which is also acceptable and will get into the record, you may indicate so, and we'll just proceed through in a faster manner in terms of oral testimony.

So as I read these organizational people, if you want to submit your testimony in writing, please say so and I'll go to the next person. Otherwise, you'll have the floor.

And the first individual is Holly Sweetbooth representing Salmon Creek Community School.

MS. SWEETBOOTH: I'm going to waive my chance until all the people on the bus have had their chance.

CAPTAIN WAGNER: The next registered speaker is Marie Celest (ph), representing Pluto Vaneze (ph), Vaneze, is it? Pluto Vaneze.

Is Miss Celest here?

Miss Barbara Connelly from Elk Community Center Board.

MS. CONNELLY: I'll waive my turn until people on the bus --

CAPTAIN WAGNER: Elliot Diamond representing Moonstone Alliance.

UNIDENTIFIED SPEAKER: They had to leave.

CAPTAIN WAGNER: Had to leave?

Marguerite Dodgeon (ph) representing Golden State Trollers, Incorporated.

UNIDENTIFIED SPEAKER: Marguerite had to leave about four hours ago.

CAPTAIN WAGNER: Thank you.

Dobie Dolphin representing All Us Mollusks.

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#131*

DOBIE DOLPHIN

My name is Dobie Dolphin. I live in Albion, California, which is a small coastal community in Mendocino County. I'd like to thank the people who waived their right to speak.

I'm a commercial fisherwoman and a professional diver, and I love the ocean. I came here today on a bus with 40 other

Mendocino County residents. For today it cost us about $3,000 in lost wages and bus rental fees to attend this hearing. The Navy has sent one person, Captain Wagner, who I'm sure is being paid while he's attending this hearing.

By the time we get home, we'll have been away for 24 hours; maybe more for some of us. Some people are going to come to work tomorrow morning really tired, but it was important for us to come here, and for each of us who did come here, there are five or ten people at home who couldn't come, and I must urge the Navy to hold hearings locally in Fort Bragg and in Eureka so they can hear come who had to work or take care of their children. J.15*

I'm going to try to make this short even though I feel kind of ripped off because I feel like I have things to say, but because of the time I'm not going to because we do have to make the bus. And I know there are other people who want to speak. But I'm totally opposed to any dumping of radioactive wastes in the ocean.

The two issues that I feel the Navy hasn't fairly addressed, two of the main issues, are the pathways by which radiation enters the human body, and bioaccumulation. And just -- I know everyone's really tired and it's hard to hear numbers, but this might be interesting. L.35 L.37

In a book called "The Atom and the Energy Revolution" by Norman Lansdell, there's a study done of the Columbia River, and

*Other issues discussed by Ms. Dolphin are side barred in Exhibits 131a and 131b.

he found that while the radioactivity in the water of the Columbia River was relatively insignificant, the radioactivity of the plankton in the river was 2,000 times greater than that in the water.

The radioactivity of the fish and of the ducks feeding on the plankton was 15,000 to 40,000 times greater respectively. Radioactivity of the young swallows fed by insects caught by their parents in the river was 500,000 times greater than the radioactivity in the water. And the radioactivity of egg yolks of water birds was more than a million times greater than the radioactivity in the water.

L.36

So when the Navy says they're just dumping an insignificant amount in the water, that's kind of irrelevant because as it goes up the food chain it accumulates so that it's more. And the theory of the maximum permissible dosage

L.7

is kind of irrelevant, too, because it really depends on the total accumulative effect of all the radiation, and this is not addressed at all.

The other thing I'm kind of disappointed about is that there's no chance for dialogue, there's no chance for a forum where citizens, scientists of the public, can get together with scientists of the Navy and talk about things that aren't clear as opposed to us giving all our testimony and not knowing whether it's really being heard. It's frustrating.

Yesterday I read in the paper that the U. S. Government had to buy a whole town in the United States because the dioxin levels were so high that it's not safe for people to live there. Now, I'm sure when they first started using dioxins in this town, they assured the people that it would be totally safe. Well, the government's not going to be able to buy the oceans. They're not for sale.

So I urge once again that the Navy hold local hearings in Fort Bragg and Eureka, and that the period for comments is extended at least 90 days.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Mitch Farrow (ph) representing Trinidad Bay Fisherman's Marketing Association.

Mr. Farrow?

(Speaker not present.)

CAPTAIN WAGNER: The next registered speaker is Star Gardenance (ph) representing Mother Bears.

UNIDENTIFIED SPEAKER: She's gone.

CAPTAIN WAGNER: I believe the next name is Liz Helenchild representing KMFB FM Radio.

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#132

LIZ HELENCHILD

Captain Wagner, I'll be brief. I would like to in -- I live -- I'm Liz Helenchild, and I live on the coast, on the Mendocino Coast. I live in the village of Mendocino, and I would like to personally invite you to hold hearings on the coast on the matter of offshore nuclear dumping.

I would also like to suggest that perhaps the Navy would like to, since they are so fond of the nuclear submarines, to dump them a little closer to Washington.

I mean, there are rolling lawns and great estates in

that part of the country, and I think it might be comforting to have the warmth of the nuclear subs close to home. I mean, they're the Navy's babies. And it would be quite easy to monitor them were they closer to home, and much less dilatorious to the food chain.

I have a letter from some friends who couldn't make it, and it goes:

"To Everyone Concerned -

"I regret being unable to attend this meeting personally and appreciate being able to let the feelings of our family be known.

"We are deeply concerned about the use of nuclear energy for both weapons and peaceful use. While in many ways this energy source may seem ideal, we can't ignore the fact that at the present time there are no safe ways to dispose of or to store nuclear waste.

"This brings us to the issue of today's meeting -- the proposed dumping of nuclear subs off the Mendocino Coast. This may at face value be seen to be a good solution to the problem of how to dispose of the submarines, but if we look past today and into the future, we see that we are leaving our children and future generations a possible problem that will be without solution. How can you re-gather nuclear contamination once it has escaped into ocean waters, the food chain and our bodies? The physical problems that nuclear contamination reeks on our

L.20
L.36
W.1

L.53 bodies and the gene pool is fact. Why risk it -- either off our coast or anyone else's? Especially why risk it off a coast that supplies fish eaten locally and in many other places, too?

H.12 "We propose that more research be devoted to this very real problem of nuclear storage and disposal and that we keep production of new wastes at a standstill or bare minimum and that we strive for answers that will serve the children of the future and not just our present needs.

"Thank you for your time and attention.

"Respectfully submitted," Dani Moyer of Comptche, Marcia L. Douglas of Comptche, Douglas R. Moyer, presumably of Comptche, and Gail R. Goldoor, also of Comptche.

J.15 "P.S. We would appreciate future meetings to be held nearer to our area. Thank you."

Thank you, Captain Wagner.

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CAPTAIN WAGNER: The next registered speaker is Tim Kearney representing Abalone Alliance of Marin.

UNIDENTIFIED SPEAKER: I think he left.

DAVID GURNEY (ph): Excuse me. My name is David Gurney, and I registered. I think you skipped over me somehow. I'd like to make a brief statement.

CAPTAIN WAGNER: Certainly, sir.

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DAVID GURNEY #133*

Captain Wagner and these two gentlemen here who drafted this Environmental Impact Report, I address you.

My name is David Gurney. I'm from Mendocino County, California, and I've spent three years as a commercial fisherman harvesting salmon, cod and albacore out of Fort Bragg, Point Arena, Bodega Bay, San Francisco and Morro Bay. I was working out of Morro Bay when the Diablo Canyon action was going on, so I had a chance to go there and witness 2,000 people put their lives on the line and be arrested and taken in for their beliefs. I feel there's an incredible irony here.

You represent the U. S. Navy, an agency which is

*Other issues discussed by Mr. Gurney are side barred in Exhibit 193.

obligated and in the service of the people of the United States of America to protect and guard our welfare, and yet on the very doorstep of our western shores you propose to dump a time bomb, a poisonous legacy that would threaten our lives, our children and generations to come.

I feel our responsibility does not end here. To dump these wastes in any of the world's oceans is an act of war against the environment and humanity and all life. I feel that such an action would constitute severe negligence of the duty of the U. S. Navy to pursue the cause of peace and freedom for the United States and the world.

Further, I feel that being a threat to life itself, this plan is unconstitutional because it violates our guaranteed rights of life, liberty and the pursuit of happiness.

*L.53 N.3

The life of a fisherman gives one a close appreciation of the beauty and intricate and complex pattern of life that exists along our western coast. The abundant fishing grounds that are threatened will be an important food source for all of us in the future. We ask you that for the sake of life on this planet to abandon this irresponsible plan.

Thank you.

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CAPTAIN WAGNER: Ladies and gentlemen, again, I am calling up people representing organizations. I still have seven or eight left, and I still have a large list of individuals, alphabetically, and so if I pass over your name and you've registered as an individual, I haven't got to that list yet. I soon will.

The next registered speaker is Eleanor Lewallen representing Anderson Valley Nuclear Awareness Committee.

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ELEANOR LEWALLEN

#3a**

Captain Wagner, I'm coming to speak to you from at least three perspectives. One is as a member and representative of the Anderson Valley Awareness Committee in Anderson Valley in Mendocino County which has 15 or 20 active members and numerous supporters throughout our valley. Our purpose is both educational and activism to help prevent the nuclear perils which face us now.

I am also speaking as a partner and co-owner of the Mendocino Sea Vegetable Company. It's a new company, sea vegetable company, that my husband and I own. We harvest

***Other issues discussed by Mr. Gurney are side barred in Exhibit 193.**
****Issues discussed by Ms. Lewallen are side barred in Exhibits 3 and 3b.**

sea vegetables off the Mendocino Coast.

And thirdly, I'm speaking as a mother of two young children, and personally representing many, many of the mothers in Anderson Valley with young children who simply could not leave them and who were unable to bring them with them.

So I want you to know that when I speak, it's not only for our local mothers, but mothers all over who really care, and they simply can't leave their children to testify before you, and some of them don't even have the time to write you letters, but they really care.

So when I take the time to do it, I know I'm speaking for thousands and thousands of mothers with little children, and as I speak to you now, my husband is hopefully putting our two children to bed. I'm really thankful that he is staying at home tonight so I could be away for 24 hours to express my mind and my heart to you.

I made lots of notes. I've been meditating on this for weeks and months, and I've really wanted to speak with you. I don't know if you remember - I wrote you a letter probably a month and a half ago when I was still very sick. I was hospitalized, and when I was in the hospital I was dizzy, my head was throbbing, and what kept coming into my consciousness was the ocean and nuclear sub dumping, and it would make me dizzier, and my head would be throbbing, and it made me realize how much psychic energy it takes to oppose forces like the

Navy and the U. S. Government as a responsible citizen.

I didn't -- I realized it took time and physical energy and discipline, but I didn't realize the degree of psychic energy until I was really ill in the hospital with physical collapse, and so I would let that fear come in, that concern, and then I'd say, "Okay. I can't do anything, but when I get well, I'll do something."

I kept waiting until I got well, and I still kept having headaches for weeks after. And finally my husband said, "They're going to dump those subs, and I can't stand it," and I sat and wrote you a letter.

Do you remember receiving a letter from me? You do remember? I'm glad you do, and I will tell you that when I wrote that letter, I started writing -- I got to all caps, and I found myself literally yelling at you in that letter, and I was angry that the Navy would even consider dumping nuclear submarines in the ocean. And I asked you at that time, "Who said you could do it? You know, it's not your ocean to do that. It's our ocean, and we plan to guard the ocean."

I assume you remember that, too. I felt really strongly about it, and I just really wanted to yell at the Navy, and I wanted to yell at the people. And on one level I want to reach out to you expressing my love for the earth and expressing we people who are earth-bonded who love the earth and who love the ocean, our love for the earth and for the

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people of the earth, and wanting you to hear that, hear the love, and on the other hand, on the other level, I was just feeling furious that any agency could think that they could do that. The same day I wrote a letter to Anne Gorsuch that was basically the same. She's the head of the EPA, as you all know.

I had a brief personal correspondence with her because my husband studied with her in India. I actually got a letter from her, and one of the things she said was, "We're trying to get scientific evidence that will validate that it's safe to dump nuclear waste in the ocean."

I think that was a mistake on her part to be so out front, but that's what she said in her letter. So at any rate, I just wanted to let you know that after I wrote that letter I just felt like screaming, you know. I felt that's like all caps, but it hasn't come out. My throat was sore. I still was really sick, and so no one else was at home and I just shook a pillow and I screamed. It didn't hurt anyone, but it let out some of the fury that I was feeling that any agency that thinks they can dump anything in our ocean and can harm our ocean and our earth.

So I just want to tell you, it's not your ocean to do it with. And as I say it, although I feel very angry, I also want to tell you with a lot of love that I want you to hear what we're saying, and I want -- I hope that as you've

heard all of us speaking with compassion and wisdom, the professors, the people who had the data who can speak from a scientific background, I hope that it's really gotten to both your mind and your heart and that you will join us. I hope that there has been some kind of personal transformation as you've listened for hours and hours and hours. I hope that you have really heard us.

Now, one thing I brought -- I wanted to bring sea vegetables to share with people. Last night as I was packing, I realized, you know, this is a good crop. This is one of the bags that we use for packaging our sea vegetables, and once we've harvested them off the ocean and once we've dried them -- and I wanted to share some with you. I'd like you to try tasting some. When we go harvesting, usually my husband goes all by himself very early in the morning because the tides, the low tides are real early. It's very hard to take the whole family, so I'm often at home. But whenever I can get child care, when I get a chance, I go out and do sea vegetable harvesting, too.

And I want to tell you that I really love the ocean. I am bonded to the ocean, and I'm an earth guardian and an ocean guardian, and I know that a lot of us are. That's why we're here. That's part of our job. That's what we do. We don't get paid for it in money, but that's part of our job.

And I also want to tell you it really feels wonderful to know that we're part of a community that guards the earth, and we have -- I personally have as much concern for the rest of the earth and that no one be harmed from nuclear weapons, no one be harmed from nuclear pollution all over the earth, but I happen to live right here, and so I can address myself right here as a responsibile citizen and I'm really thankful that in America we have these freedoms.

I missed another demonstration today for a Russian man who's been in prison for seven years for simply wanting to leave Russia because he's a Jew, and there was another simultaneous demonstration going on. So we really are in many ways privileged that we can speak out against government policies and it's up to us to insure that democracy will continue.

So I want to hand you these sea vegetables and just kind of end with a quiet meditation.

This is Alaria marginata, known as Wakame by the Japanese, and it's also known as sea jerkey. It's delicious. Okay.

This is Nori, known as Nori to the Japanese and Porphyra perforada. This is sea palm frond. They're all really good either cooked or raw. They have good levels of protein, trace elements, minerals. And if you dump the subs in the ocean, you're going to ruin our business. This business, on a very simple level, sustains our family, and if you dump

the subs, you're going to ruin our business. And I would be here even if we weren't in the sea vegetable business, but I want to let you know that I'm one of the many people whose livelihood you would be destroying.

Now, the last thing I'm going to do is read you something that I wrote as I was sitting right on the Mendocino Headlands just as I was about to come to the finishing process of a Cookbook on Sea Vegetable Gourmet and Forager's Guide that we've been working very hard on for about a year to share our information with people, and before I read this, I also want to say that the native American peoples harvested sea vegetables for the past 10,000 years, so it's not something new, although as West Coast city refugees, we are a pioneering business, and it is a real excellent food source for the future for hungry people.

So that's what we're involved in, but I want to read just this last thought I had as I was sitting over the ocean.

Thank you, Ocean Spirit, for sharing with us
your gifts of beauty, energy, calm, immensity,
healing, and for revealing to us your abundance
in the world of sea vegetables, connecting us
deeper to the moon, the tides' rhythms, the
seasons. May we continue to share your presence
with others. May we continue to be among your
guardians. Amen.

CAPTAIN WAGNER: The next registered speaker is Terry Robinson.

TERRY ROBINSON: I'll waive until the others go.

CAPTAIN WAGNER: Julie Rumble (ph) representing New Growth Forest Services.

UNIDENTIFIED SPEAKER: She left.

CAPTAIN WAGNER: Janet Seaforth representing National Women's Political Caucus.

--o0o--

*#134

JANET SEAFORTH

Captain Wagner, I am Janet Seaforth, the vice chair of the Mendocino County Chapter of the National Women's Political Caucus.

According to our national goals, we have agreed to preserve our natural environment, and we intend to uphold those goals. Therefore, we're against the nuclear sub dumping into the ocean, and we all know that if dumped, the radiation in these subs may be leaking their poisons for generations to come and will be irretrievably carried by the food chain.

* L.20 L.36 W.1

Many of us feel that our best national security is the protection of our children and the generations of children

to come. This protection is your duty as a military person as in the creation of a truly safe America, one free from the nuclear poisons that threaten all our lives.

The National Women's Political Caucus protests the continuous ignorance and irresponsibility that the U. S. Navy is exhibiting in dealing with the nuclear problem.

We urge you to put your energy and attention into better solutions than these projected plans that are not acceptable.

Thank you.

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*Other issues discussed by Ms. Seaforth are side barred in Exhibit 134a.

CAPTAIN WAGNER: The next registered speaker is Mr. Arthur Whang representing Committee to Bridge the Gap.

Is Mr. Whang here?

(Speaker not present.)

CAPTAIN WAGNER: Mika Willona (ph) representing Northwest Forest Workers' Association.

Mika Willona here, please?

That completes the organizational people. I'm going to go into individuals now, again, with a -- requesting a five-minute time limit so everyone gets a time to speak.

Once again, if you wish to waive your right to speak such that the people that have to go on the bus will have an opportunity before they go, I will give you that opportunity.

Lynn Adler from Willits, California.

LYNN ADLER: I waive my right.

CAPTAIN WAGNER: Rebecca Batell (ph) of Willits, California.

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REBECCA BATELL

Hello. My name is Rebecca Batell. The people on the bus thank everyone for giving us an opportunity to speak before

#135

we go.

I would like to address several issues. First of all, this is a public hearing. I personally, in my trip today, have encountered eleven people in public situations, including the 34-year State employee who runs the information booth in the lobby, who were not aware of this meeting or why they were having it.

The information lady in the lobby whose job it is to give government information only knew there was a Navy meeting; did not know why or was not able to give any information about it.

We need 90 more days at least so you can have serious public feedback.

Secondly, I would like to ask you, Are you going back to the Pentagon?

CAPTAIN WAGNER: Again, we aren't here to debate. Please state --

MS. BATELL: The reason I asked, I would like you to give a message from me to the people that you encounter when you go back to wherever it is that you go.

When they say, "Hey, how's California? Were the nuts nutty? Ha, ha. How was it in California?" I would like you to have a response from California to give those people. I would like you to say, "Do you know someone in California told me that if we do this and if this happens, then our grandchildren won't be able to join the Navy because there won't be an ocean. They'll have to join the Army."

Your Navy comrades will hear that response from us.

Thirdly, I would like to address the Environmental Impact Report which is why we are here. In my opinion, the key word in that entire report is assumption. Their assumptions are state of the art technology according to Navy engineers and Navy biologists and Navy whatevers.

I'd like to relate my personal experience. My father was in the Army. He was an officer. His job was nuclear weapons training. When everyone said the soldiers were told to go and stand there and hold their eyes shut and then they wouldn't get it, my father was one of the men who told them that. He still has in his possession a 30-year-old manual very similar to the ones that you have, except his has a yellow cover and it's not done on a word processor, it has bigger print - it was typed.

In it it says -- he won't let me have it because it's radioactive and he knows it will zap my children -- he keeps it himself -- in it it says that personnel cannot go into a ground zero situation until the next day unless the wind is blowing. If the wind is blowing, then it blows it away and they can go in in a matter of hours.

I have seen that paragraph in his training manual. When he trained at White Sands, New Mexico, in the first week

of his training, he would teach them how to use a slide rule and give them logarithms for a test. He would teach them how to use a Geiger counter. He would teach them the basic information.

He was called for a TDY to Nevada to do a class there for foreign students. They were from Germany and Italy and France. At the end of the first week when he sent them -- when he gave them their test to see if they could work a slide rule and to see if they could do a Geiger counter, they all failed the Geiger counter test.

He thought, "What's wrong with these men? Why can't they do this?"

Finally it occurred to him that perhaps they had not failed. Sure enough, he went outside and tried the Geiger counter. The background radiation level which they're supposed to test as part of their exam was five times higher in Nevada than it was in New Mexico. They all hadn't failed the Geiger counter part of the test. He had not allowed for such an enormous disparity between background radiation in one state and background radiation two states over.

The background radiation that is so calmly referred to as sort of being normal from the sun is not in fact normal from the sun. It's normal from 20 years ago when they didn't have it, but they haven't kept records. The assumptions that he taught these people came from the book -- came from the manual that he was given by the government. He personally supervised a test where military soldiers washed their hands in nuclear materials, in radioactive water, using several different kinds of soap to determine which one washed the radioactivity off the arms best. And then the sergeant would run the Geiger counter up and down their arms -- and he stood at some length -- and wrote down the results.

I, 20 years later, said to him, "How could you do that?"

He said, well, he was a captain at the time and the major told him to. All the assumptions in the book that he got were there. That's how it was done. Nobody said, "Well, assumption isn't a questionable word."

Everybody said, "It says in the book do this; therefore, one does this."

L.40

It says hide your eyes from the blast. It does not say hide your body. It only says hide your eyes, so they hid their eyes.

"Assumption" is not a valid word to use to base an entire Environmental Impact Report on. The assumptions made then, everyone believed them. No one was lying; nobody was tricking; nobody thought they were going to get away with anything. They believed it. I am sure today there are people in the service who believe, who sincerely believe, that these are correct, valid assumptions based upon their information. However, they could very well, and perhaps very well, and I

believe they are mistaken, sincerely, genuinely, honestly mistaken, and it is the mistake that we have to deal with when you talk about assumption.

G.2

Consider it could be mistaken; consider it might be mistaken; consider it is mistaken -- mothball them. Wait. Maybe -- It is my father's favorite joke that that educational manual, the card should be taken from the Library of Congress catalog out of educational and should be put in fiction. Perhaps the EER that's here today, 20 years from now, we will laugh and say it should be filed under fiction. We cannot know now. Things are changing too fast; information is coming too fast. We have to wait. Mothballing for 20 years is nothing for us, but for our children's children, it may change the entire world.

L.1

Please mothball. Thank you.

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UNIDENTIFIED SPEAKER: Excuse me for just one moment. I want to just make an announcement that I wasn't sure that everyone was aware that we have the author of this Environmental Statement right here with us and his name is Carl Dietrich. He's right sitting here taking notes, so if anyone has any questions or comments, and when you're talking,

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you can talk here to the Navy or you can talk here to the man here who is in charge of writing this who works for the Department of Navy and the Department of Energy.

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CAPTAIN WAGNER: The next registered speaker is Saul Bloom (ph) of Greenpeace, Pacific Southwest.

Susan Bodine of Mendocino, California.

--o0o--

#136

SUSAN BODINE

Thank you. I'm Susan Bodine. I live in the Navarro Watershed in Mendocino County. I think what happened here today is that we have proved that -- well, to our own satisfaction -- that the U. S. Navy has been participating in a disinformation program paid for by our taxes, and I just hope that it's on the record now that everybody seems to know that it's a lie except for you guys, and we just want to let you know that you're the only ones left who believe it any more.

But the other thing is that all of the nukes, the bombs, the power plants, the reactors, the subs, have all been built on the American people's ignorance and inertia. We knew when we came here that it was all a lie. Now we know very specifically what the particular lies are, and we are no longer ignorant. We are educated, and we are no longer inert.

Thank you.

* #137

CAPTAIN WAGNER: Nancy Cragin, Fort Bragg, California.

--o0o--

NANCY CRAGIN

I'm going to be brief. I had something that I had prepared, but I think I'm just going to speak because, I mean -- oh, well.

My name is Nancy Cragin. I moved to Fort Bragg from, of all places, San Diego, 15 years ago to get away from pollution and to raise a family in the north coast which is a beautiful place to visit. If you'd like to come up and take a look sometime, we'd be glad to have you look around.

I brought a book with me. It's called the "Hundredth Monkey," and I'd like to give it to you as a gift. We bought a case of them, and we're giving them to everybody we, you know, we see.

I also brought a poem that my daughter had me send with me. Her name is Amy Salo. She's ten years old, and I couldn't bring her because it's a kind of an inopportune day, and it's a long ways away from home.

"We love whales, we love flowers;

Don't destroy them; stop nuclear powers."

When I was a child I used to have dreams -- I didn't know what they were -- of falling out of bed onto the floor. I didn't understand them, and as I grew older, I understood that the psychological implications of nuclear power had really engrained themselves in my head as I was growing up. And as I became aware of what was happening, it was almost too late for me to do anything about it. And I heard these young children here talk today about how they felt about growing up in a world that they didn't have anything to do with.

Well, I'm 35 years old, and I grew up in a world that I didn't have anything to do with either, and I didn't like it. And I had lots of problems because of it, and I still do. And I want to see it end. And I haven't been involved in anything like this since the Vietnam protests, since I moved to Mendocino County, so I guess it's time for me to start somewhere, and this is where I'm starting.

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*Issues discussed by Ms. Cragin are side barred in Exhibits 137a and 137c.

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CAPTAIN WAGNER: Mark DePolo (ph) from Sacto, California.

Erica Fielder (ph) from Caspar, California.

UNIDENTIFIED SPEAKER: She waives her turn.

CAPTAIN WAGNER: Thank you.

Rosalee Gong (ph) from Willits, California.

UNIDENTIFIED SPEAKER: She waives her testimony.

CAPTAIN WAGNER: Excuse me. Was Miss Gong here?

UNIDENTIFIED SPEAKER: She waives her testimony.

CAPTAIN WAGNER: Thank you.

Lynne Harper from Covelo, California.

UNIDENTIFIED SPEAKER: She spoke earlier.

CAPTAIN WAGNER: Thank you.

Paloma Hill (ph) from Willits, California.

UNIDENTIFIED SPEAKER: She waives.

CAPTAIN WAGNER: Patty Hogol (ph) from Gualala, California.

UNIDENTIFIED SPEAKER: She left about 5:00 o'clock. She went home to take care of her children.

CAPTAIN WAGNER: Mary Jo Leyden, Fort Bragg, California.

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#138

MARY JO LEYDEN

Peace be with you, sir.

At least when the Indians were burying their hatchets they didn't have to worry about radioactivity. This is a card I keep with me. It's a very personal item. I've had it for years. It's a momento of a close friend, and it relates to matters of conscience and the decision one must make in purity of conscience. It says:

"One asks, What is to Come?
The other asks, What is right?
And that is the difference
Between the slave and the free man."

And it is my belief that you are a free man. You are neither a slave nor a sitting duck. This is a poem written by Pope John Paul. It's called "The Armaments-Factory Worker." I think it's equally applicable to both American and Soviet forces.

"I cannot influence the fate of the globe.
Do I start wars? How can I know
whether I'm for or against?
No, I don't sin.
It worries me not to have influence,
that it is not I who sin.
I only turn screws, weld together
parts of destruction,

never grasping the whole,
or the human lot.
I could do otherwise (would parts be left cut?)
contributing then to sanctified toil
which no one would blot out in action or belie in speech.
Though what I create is all wrong,
the world's evil is none of my doing.
But is that enough?"

I think that's a fairly clear statement of the folly of blind obedience, and there would be no folly greater than to dump the nuclear submarines off one of the richest areas in the Pacific Ocean.

First, from my friends at the Catholic Worker and in the Southern California Catholic Peace Coalition, no thank you.

For my sisters at the monastery with beach front property in the Redwoods, no thank you. We don't need nuclear waste.

And for myself, I was born in Mendocino County. No thank you. It was a nightmare to return home from Los Angeles and discover that this iniquitous plan had been contrived. I wondered how the dump sign was supposed to read. Whether it was in any way like a county dump -- only on Wednesdays or maybe only on Friday; and then I read the Environmental Impact Statement, more glaring by the omission of care than any other omission.

The statistical and logistical errors and assumptions therein, the neglect in research can only indicate a selfless kind of servitude in a government that masters by money and not by virtue; by waste and not by preservation.

But I trust that in the soul of our nation there remains left enough spirit to right the wrong of malice, and those wrongs are clearly indicated by our need to scuttle any submarine.

The unanimous opposition to the disposal of the submarines is indicative of a deeply-felt union in the support of peace. The freedom from hostility within ourselves and without ourselves; the freedom of a people pledging itself not only not to inflict harm but realizing that we can prevent harm being inflicted on ourselves by the error of our own waste.

It is a pitty that the history of wars is longer than the history of our attempts to make peace.

I ask you to listen with your hearts to the root of the word "Pacific" -- peace. To hear the delicate hush of the waves like the beat of a second heart in the liquid prism of love that multiplies itself in the color of the land and the wealth of the people's own emotion and tenderness for the land and the sea. The lyric that lulls music from the still hollow of a seashell -- I know you've heard those waves. I know that any person who's spent time on a ship has been put to sleep blissfully by them and would want them to be there for the next generation to love.

I ask you to know it well and yield your heart to the compassion the sea held for you before you beheld the sea. I ask you to find in an ocean called peace the current of reverence itself; the strength of courage to propose solutions in your Environmental Impact Statement to seek more logical alternatives than sea dumping or the present habits of land disposal that are currently used in the United States because there are better ways, and if there are not, money should not be so important as the patient development of better ways.

N.3

I ask that you become free men. That when it is necessary to disobey in obedience to a higher order, that it should be done. That when you ask what is to come, you will have conscience enough to know what is right; that of your own volition, of its very own volition, the Department of the Navy will change its mind. That would be a great grace, and it would be a far greater grace for the legislature, for the Department of the Navy and for the people you serve to work together to find meaningful alternatives to these proposals already offered. And I trust that that could be done in the spirit of goodwill.

I ask you to put away the unwanted cargo of nuclear neglect and replace it with a vital reactive, the virtue of

friendship in common bonding through what we share with the people of the Soviet Union, Japan, the Marshall Islands. All those peoples who occupy the Pacific Ocean -- to share that land in the same spirit that the Indians shared this continent with us originally.

I ask you to bury those submarines and never build another one -- not in your heart, not in your mind, never again.

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CAPTAIN WAGNER: The next registered speaker is Edward Luben (ph) of Caspar, California.

EDWARD LUBEN: I pass my turn.

CAPTAIN WAGNER: John Maloney of Mendocino, California.

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#139

JOHN MALONEY

I've been eating some of this seaweed here. It's really good stuff.

John Maloney's my name. I live in Caspar, which is a very nice little town. I've lived there seven years. I have been all over this country. I've been living in Mendocino now seven years. It's the best place that I've found.

I'd like to echo an invitation that my sister gave you, and you gentlemen to come up and see us sometime. I think that you would like it.

I'm here as a parent of three children. I'm very concerned about them. They are much more concerned than I am. I'm 45 years old. I'm also talking for about 57 people who aren't here -- who couldn't take the time to be here. Those 57 people asked that you have hearings where they can get to in Mendocino, Fort Bragg, Bodega Bay, Eureka, lots of places. J.15

There are some unanswered questions on the coast. We've heard rumors that you've already sunk the reactor from the nuclear ship Savannah. I ask now, as a part of the record, Where is the reactor from the Savannah? I know you won't answer me. D.8

I'd like to talk about Nuremberg under the principles of the Nuremberg war crimes -- trials. You are personally responsible for the damage that is going to be done if those subs are dumped, you and every officer of the Navy.

In the past winter, which has been pretty wet here, and we've seen lots of -- on the television and the newspapers -- lots of talk about the savage ocean, killer surf, monstrous waves. Those are adjectives that only can be applied to people.

That ocean out there is about the most natural thing there is. If someone is dumb enough to build something close enough to the ocean where it's going to come up once every ten or fifteen years or once every hundred years, that thing's not going to be there very long. But if you do what you are talking about, then it is going to become a savage ocean, killer surf.

Back long ago when our ancestors began coming down out of the trees and becoming what we call civilized, they learned something that has been passed on which has become part of the racial memory. You don't shit where you eat. L.36

L.36

Well, the ocean's where we eat. I would like to say to the people on the coast I know that are unalterably opposed to the dumping of any nuclear waste in our ocean or any ocean.

I'd like to offer some things into the record here.

(Whereupon rocks, seashells and feathers were offered into the record.)

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CAPTAIN WAGNER: The next speaker is Kate Marianchild from Philo, California.

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#140

KATE MARIANCHILD

My name is Kate Marianchild. I'm from Philo, California. I don't want to cut short what I have to say, but I'll try to say it fast.

L.53

I am the daughter and best friend of Marian who died five years ago of cancer. I am a businesswoman whose livelihood is endangered by the proposed poisoning of the ocean. It would be destroyed by the poisoning of the Pacific Coast.

I'm also the daughter of Wilbur Edison Roberts (ph), Rear Admiral, U. S. Navy.

It was very hard for me to get here today. I felt a lot of anger for having to be away from home for 24 precious hours testifying against a stupid and destructive proposal. I would rather have spent this 24-hour period working to prevent the 1,440 rapes against women and children by men that happen every 24 hours and one of which is happening right now. One happens every minute.

But I made it here because I could not stand to stand by and watch this travesty that we've been discussing today. I find it ludicrous and sad that we're debating this issue, the future of the source of all life, the future of the infinitely vital and alive Pacific Ocean in a sterile enclosed room miles from the ocean itself.

L.53

I demand that congressional hearings be held on the coast where we can see and hear and feel and smell the ocean and that those hearings be held on weekends, if necessary, until everyone who has something to say on the subject has been heard.

For a living, I harvest and sell sea vegetables commonly known as seaweeds. Seaweeds are probably the most nutritious class of plant food on earth; perhaps the most nutritious food period on earth. They contain ten to twenty times the nutrients of land vegetables and have properties that heal and/or prevent many medical problems such as high cholesterol levels, scalds and burns, arthritis, hay fever, overweight and underweight, thyroid malfunctioning, dietary radiation poisoning and many others.

Sea vegetables are more and more widely consumed around the world and are vital to our future food supply. If submarines are dumped off the Mendocino Coast, I will have no choice but to stop harvesting sea vegetables because I cannot in good conscience pass on death by radiation to any other people.

In the event of dumping, I will have to sue the U. S. Navy for loss of livelihood for the remainder of my life. I also expect that I and others will file a class action suit against the Navy -- those of us who earn our living from the sea and from the tourist trade. These suits will cost the Navy a lot of money. It will also be interesting to watch the EPA try to buy the Pacific Ocean and its coastlines as it is currently trying to buy Times Beach.

L.53

I call on you on behalf of my mother and all past, present and future cancer victims and all the plants and creatures of the sea to cease your death-obsessive activities, to find safe and, if necessary, expensive methods for submarine disposal and to redirect the resources of the U. S. military to irreparations for damages already done to the earth and her peoples.

N.3

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CAPTAIN WAGNER: The next speaker is Sommer Mateu of Little River, California.

SOMMER MATEU: I waive my right to speak till the people on the bus have gone.

CAPTAIN WAGNER: Kelly McDermit (ph) from Point Arena, California.

UNIDENTIFIED SPEAKER: She's gone.

CAPTAIN WAGNER: Gone?

Marshall McNeil, Albion, California.

--o0o--

#141

MARSHALL McNEIL

I am Marshall McNeil. I am a citizen of the coast and live in Albion. I want to affirm and acknowledge the interconnectiveness of all the waters that are on the earth, and I speak as a citizen and am opposed to the scuttling of the subs into the ocean and the dumping of any waste.

L.39

I know that we must find a better way, and I know that better ways exist. The risks and hazards have been pointed out and many questions have been raised. And because of this, there is the point -- the question of a reasonable doubt that has been raised, and I think this and this alone necessitates

an immediate cessation of any plan for governmental scuttling.

I think the resources of the U. S. Government must be directed to the solution of the disposal and the pollution problems that the existence of nuclear waste pose for us, and no solution can be considered final while there's any question of reasonable doubt.

In the immediate future I'd like to see a revised DEIS that covers all the questions that have been raised, and I would like to see further hearings held on the coast. J.15

I believe that when the healing of the planet and of the people become a priority, becomes our priority as a people, then our safety and our security in the world becomes assured.

Thank you.

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CAPTAIN WAGNER: Ladies and gentlemen, I must take another five-minute break for our reporters again, and we will resume testimony in five minutes.

(A brief recess was taken.)

CAPTAIN WAGNER: I believe we have two individuals who have to go back to the bus who have not spoken. We're going to give them priority, if they're still here.

The first speaker is Ann Kissick (ph), I believe, from Mendocino, California.

ANN KISSICK: I think I'm going to pass. Thank you.

CAPTAIN WAGNER: Yes, ma'am.

The next speaker is Peter Sears from Covelo, California.

--o0o--

#142

PETER SEARS

My name is Peter Sears. As to where I come from, I will close with that information. Aside from representing myself and my infant son who will be a year old on the 21st of next month, I also represent some local organizations. Recently The Willits Nuclear Awareness Coalition and Ban Ocean Nuclear Bomb Dumping helped fund a trip of mine to Washington so that I could speak to people there on this issue.

I also represent another group known as the High Mountain Llamas Pioneers (ph) by virtue of the fact that they wanted to have a voice at this hearing.

To summarize my personal experiences of the last few months is a real challenge in five minutes, but I'm going to try.

I've spoken to legislators and legislative aides, and I've spoken to uncountable people from environmental groups, and I've spoken to people in the service, and I've talked to people across the land in my travels on the airplanes and on the land, and I haven't met anybody who thinks it's a good idea to put radioactive waste in the ocean.

And what I really would like to do is to pick up the theme that's been touched on here of the strength and the rate of growth of the grass roots movement, the phenomenon that we're all a part of and that we're all observing.

It's not bounded by national boundaries. It's a worldwide phenomena. Revolution is a continuing process. It doesn't stop with any nation's particular event. It's been said that in America, to use the word revolution, you delay it by seven seconds every time you use the word, so I want to introduce you to, if you haven't been, to the concept of transformation because what we're dealing with is in fact a transformation. It's a global transformation. It's being directed and guided by powers outside of the human realm, and all the humans I know of that are aware of that are joyful to be a part of that experience.

If I could summarize the attitude of the American grass roots relationship to their feelings of distress and betrayal, I will tell you that the first time I went to Washington recently was on my own to do some protesting and fasting, and I came home with the help of my thumb, and I crossed across these entire -- the continent with the help of fellow Americans. One of them was a sergeant coming home from a weekend course he'd taken in the mountains of North Carolina on a CBR -- that's Chemical and Radiological Warfare, and a B is in there somewhere, too, for Biological -- and he was telling me and admitting that what he had heard at this conference was pure propaganda that the position of the Army was, since Nixon outlawed further stockpiling of nerve gas and other chemical weapons, we've fallen so -- he -- I have to tell this fast or it's not even worth telling.

The story was the same as Reagan's story for this supposed gap -- we're so far behind Russia that we've got to catch up and make more nerve weapons, and I asked him if he believed that, and he said, "No."

And I said, "If you are ever asked to apply them in an actual case of warfare, would you do it?"

And he said, "No."

And that's the flavor I want to relate to you in such a

short time that I'm allowed. That this is a phenomenon that's happening, and it's happening because people are beginning to practice what they've been taught from kindergarten is the basis of our nation's being.

Many of us haven't practiced it. And what I've experienced and seen and felt is a growth that is growing so fast that it will not be stopped.

A year ago I sent an invitation via an open letter to the Commander in Chief to join us, explaining that this revolution is one of individual conscience, and that we're taking responsibility because we all are responsible. In it -- it's beyond my set of beliefs to think that you haven't been touched today. You and you and you and you and you and all the people here.

The fact that you wear a uniform or a pin stripe suit does not separate you from me or us. That's an illusion, and that will bring me toward sort of the end of what I want to say which is that all the great truth teachings of Molinos stress the idea that in the material realm we are fooled by the illusion of separateness. We're not separate. It's important to realize that these mystical teachings are being verified in what has become the new religion: science.

On the leading edge of every discipline in the world of science is coming information that says our minds go beyond our body. We're connected. We're interconnected. We are all individual parts of a single life, so where I come from I have a house, and my house is at the base of Table Rock near Toho in Mendocino, California. Where I live is in this temple which I built with the Heavenly Father and the Divine Mother's help, both names to describe aspects of the one life.

So I'm here to acknowledge that we're all part of that one life, and I'm going to make an assumption. I'm going to assume that you cannot go back untouched from what you've seen and heard today. I mean, I think I'm going to give a warning, too, simply because I want you to know that this battle between light and dark is global, it's solar systemwide, it's galactic, and you're an integral part of it. And if you resist it without me knowing the details of how it will happen, I can guarantee you that you will be swept out of the way.

So I want to thank you ahead of time for the changes that you're going to experience in your lives in the coming months, and I want to guarantee you that in the end you're going to find joy for taking a stand where you have to take a stand.

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CAPTAIN WAGNER: I'm going to go back now in the order that people relinquished their time.

The next registered speaker is Holly Sweetbooth representing Salmon Creek School.

UNIDENTIFIED SPEAKER: She left.

CAPTAIN WAGNER: She left?

The next registered speaker is Barbara Connelly from Elk Community Center Board.

--o0o--

BARBARA CONNELLY

#143

My name is Barbara Connelly. I live in the coastal town of Elk, California. As a mother, as a citizen of Mendocino County, as a member of the Elk Community Center Board, and as a lover of the ocean, I protest the planned dumping of nuclear submarines off the coast of Cape Mendocino.

This proposed dumping would not only harm the fishing industry of our area tremendously, the proposed site being one of the most fertile albacore breeding and spawning areas along the coast, it would jeopardize all of us by providing a direct way for radiation to get into our food chain. L.53 L.36

I have heard from local fishermen that this site does

J.31 experience a lot of upwelling which accounts for its being such a fertile fishing area. If nuclear submarines are dumped in this area, the radioactivity released from the subs would spread directly into the lower life forms living on the bottom of the ocean floor which in turn are food for albacore and other fish during upwellings.

I find it highly unusual that the Navy did not realize that this site is a productive fishing area, and it didn't acknowledge the major upwellings of the waters which occur here.

U.5 Being a mother, the idea of having my children's food sources contaminated with radioactive substances concerns me greatly. I feel that too little is known about the effects of radiation in the food chain, and what little is known is covered up to the best possible extent, keeping the public as ignorant as possible to the risks involved.

I feel we will be experiencing the effects of all the additional radiation we have dumped in our environment in future generations. Is this the legacy we wish to leave to our children and our children's children? No.

J.15 Also, as a representative of the Elk Community Center Board, I am requesting that all further hearings regarding any dumping of nuclear waste off the coast of Cape Mendocino be held locally in either Fort Bragg or Eureka. We are also requesting that the time period for public comment to the DEIS

at least receive a 90-day extension.

L.20 J.76 Finally, I do not believe that dumping radioactive waste anywhere in the ocean is an appropriate way to dispose of waste. I feel that this is an out-of-sight, out-of-mind philosophy, and dumping is an act of total irresponsibility. Once in the ocean, how can these radioactive leaks from these subs be monitored and accounted for? It seems obvious to me, and probably obvious to everyone in the room, left in the room, that keeping them on land creates more of an opportunity to monitor the amount and study the effects of radiation leaking from the submarines.

It also gives us more of a choice on how we want to dispose of the weapons responsibly in the future.

Thank you.

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CAPTAIN WAGNER: The next registered speaker is Terry Robinson representing Artists for Responsible Energy.

--oOo--

#144

TERRY ROBINSON

Captain Wagner, my name is Terry Robinson. I'm from Willits, California, Mendocino County. I see now why the hearings are held here in Sacramento. As a matter of fact, I was here at the Water Quality hearing the other day about Diablo Canyon, and through the afternoon I realized there's many captains here. I saw quite a few of them over in the Capitol Building there. There's one in each elevator. They're captains of their own ship, and theirs, too -- their direction, too, is dictated by a string.

We're sorry that we're unable to address the policies of the EIS. You've heard all about those, though, but due to the limited number of books that were published, it will never be a best seller unless it's condensed and put into Reader's Digest, and then it might become authoritative or at least religiously read by a few who only read the joke sections, as most people do who read the Reader's Digest.

Whether we had a copy or not, it might as well have gone through the EPA paper shredder for the facts stated to be cut to pieces.

Artists for Responsible Energy represents a large number of people in the Mendocino area. Many artists, you know, visit Mendocino yearly and work sketching and painting the beautiful scenery surrounding the area, and these great expressions of freedom and beauty would come to an end if Mendocino was to become a sacrificed area.

Since Mendocino is totally a historic landmark, I believe it would be against existing laws to purposely destroy any part of it. I guess it wouldn't matter if I received a copy of the EIS since many of the facts have been classified and are beyond the reach of the alarmed public. But I know that all three pathways of exposure: ingestion, inhalation and external, are all possible with the life styles that I lead.

Along with Artists for Responsible Energy, I represent the members' children, my children, their children, theirs and theirs and on and on to guarantee the same sort of characteristics as myself; that is, with two ears, two eyes, a nose somewhat in the middle of the face and slightly below this, a mouth to speak out against the runaway power of disregard for life and all species on this only planet we can sustain on.

At the Diablo hearing on Tuesday in this room, I was appalled to read in the PG&E's Draft that because certain species of fish were mobile that the impact was of no responsibility to PG&E or the Water Quality Board. I'm glad to see that in the land of the free is extended to the little fishies to the point that if they want to swim in radioactive waste, that's their own fault.

The idea that you and your nuclear-economy cohorts can truthfully say that radioactivity exists already in the air that we breathe and the water that we swim in and drink is true, but why is that except for your own disregard?

PG&E said they could not uphold their own standards of waste emissions and feel like it would be fair to make these standards after the fact of waste emissions. Sounds similar to the Navy's.

Now, you claim that you cannot -- that you can monitor these emissions with equipment that has not even been tried and tested. This is an experiment. There are international laws on experimentation of this nature with radioactive materials. They date back to the late '40's. They were drafted because of the atrocities of a leader gone berserk, Adolph Hitler.

The Nuremberg trials state unequivocally, you know, for sure, that radioactive materials could not be used experimentally against unsuspecting human beings of any race. There are laws that made genocide totally unlawful, yet native

Americans have been subjected to uranium exploitation for profits for a few. They have suffered death, sterilization, relocation and insult because of being held prisoners to the horrendous economic system. Safety equipment was not provided.

By the words of your nuclear cohorts, PG&E claimed that when asked after their statement that nuclear has killed nobody -- and I must regard this as official PG&E documentation when it's asked that nuclear power has killed nobody, and the question was: What about native Americans in the mines, and I quote, I mean people, unquote by the headstart engineer of Diablo Canyon (who) stated that in April of 1982 in Ukiah.

It's documented on tapes as well as the documentation that goes on here of the people in this room, and we feel that if you perpetrate this atmosphere of nuclear waste of human life, it behooves me that after all this talk of how much that administration is spending on building new weapons that least expensive is not always the best. You pride yourselves on how much money you can milk from the public to buy equipment as though the most expensive is the best alternative to build. You pride yourselves when you can use the state of the art technologies, but when the items become obsolete, you want to use technologies as simple as a hand-dug outhouse.

We feel if you want to quote costs of items to the public before a project, then give a complete cost until the final cost, including the toilet paper work necessary to pull up your britches and walk away clean.

If any other nation, especially that if it were Russia, were to strategically place radioactive time bombs in waters of major fishing concerns within miles of the coast of these United States of America, the news headlines would still be dripping wet with the early afternoon edition declaring it an act of war.

We cannot fail to see that any attempt, be it foreign or domestic, to place such controversial elements in our populace's proximity is none other than that: an act of war on the American public. We won't stand for it.

Another state, Iowa, has just joined the nuclear freeze in the last couple of days. If your disregard continues and your military industrial coup goes against all principles of this nation, you, and I mean even you, Captain Wagner, will be held responsible. And if we have to go down to Bolivia to seek you and your cohorts out for trial, I'm sure the people will do it, and that goes to the authors of this book.

We ask that you reverse your position and stop creating worthless and senseless devices that kill and maim even without detonation. Personally, with all the troubles and loss of people's hours from various jobs, and those who must go around pointing out your fallacies in reports, when you're gone -- when you're going to quit thinking that your

shallow studies are going to be met without any opposition with regard to truth, when are you going to wipe out your guns and put them -- let's see -- when are you going to wipe out your guns and put them -- whip out your guns and put them on these unsuspecting people because they're not going to stand by, and they're innocent to the fact, I believe, the understanding that there is a coup in this government right now. There still exists a president that was not elected by the people. That's truth in the fact that an encyclopedia came out a month before the elections stating that Ronald Reagan was the next president of the United States. You got a vice president that packs probably a pistol under his side holster and who knows darn well about dangerous handguns and any weapons of any sort because he used to run the CIA.

And we feel it's a coup. And we also feel that your peace is not our peace.

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MORTON REX (ph): Captain Wagner, I did not register to speak, but I would like to if you can find the time.

CAPTAIN WAGNER: It's up to the other individuals here who have registered if they would like to relinquish the time.

--o0o--

#145

MORTON REX

My name is Morty Rex. I'm from Willits, California.

To Captain Wagner, Paul, I believe that's your name, all those still here, and to those of you I do not know who you are or who you stand for:

When I first arrived here, I did not think I would say anything today, but after listening to all of those who spoke, I have decided that I, like many others, have waited too long to speak out.

I feel that it is only obvious that after what has been revealed today, DEIS and the Navy do not truly have the option of dumping these subs in any body of water, for even if their decision falls in that direction, we, the people, will not stand by.

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CAPTAIN WAGNER: Lynn Adler (ph) from Willits, California.

UNIDENTIFIED SPEAKER: She's on the bus.

CAPTAIN WAGNER: Erica Fielder from Caspar, California.

UNIDENTIFIED SPEAKER: Bus person.

CAPTAIN WAGNER: Okay. Rosalee Gong from Willits, California.

UNIDENTIFIED SPEAKER: She's a mermaid, and she had to go back to the sea. She said no nukes, though.

CAPTAIN WAGNER: Paloma Hill from Willits, California.

UNIDENTIFIED SPEAKER: She's on the bus.

CAPTAIN WAGNER: Edward Luben from Caspar, California.

UNIDENTIFIED SPEAKER: Bus person.

CAPTAIN WAGNER: Sommer Mateu, Little River, California.

--o0o--

#146

SOMMER MATEU

My name is Sommer Mateu, and I'm from Little River.

Yagoshimas (ph). Yagoshimas.

Yagoshimas is a Japanese greeting. Literally it means I need you. The Japanese language is rich, and it has several meanings. It means that in addition to my needing you, you need me, and there are many things that I can teach you and that you can teach me.

More than anything else, Yagoshimas means respect, and I just wanted to say that before I started.

What I'm about to say is a representation only of what I feel, but, I believe, that my feelings are parallel to those of my peers.

I'm a student at the Mendocino Community School, and I'm 18 years old. I don't want to talk to you about statistics or figures or the book you wrote or your friends wrote. The only thing that I want you to understand is that I'm scared. For my whole childhood, I grew up with the belief that I would live in a world that would be whole and free and clean, and I made plans and dreams, and they're shattering. I can't view my future with anticipation. Instead, I dread the fact that in 40 years maybe I'll be dead. Maybe I'm going to die of cancer.

I'm terrified to have children. I don't even consider that as a possibility now. It's amazing to me that with all our technological advancements in the last century with the cumulative effects of all of our knowledge, that instead of learning to feed the starving child, we develop a sure way to commit suicide, all of us together at the same time.

I'm sorry that I'm here, and I'm sorry that you're here. I only wish that this situation never could have come up.

I guess that's all I have to say.

Thank you.

CAPTAIN WAGNER: Thank you.

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CAPTAIN WAGNER: The next speaker is Lynn Middleton (ph) from Redway, California.

UNIDENTIFIED SPEAKER: She left.

CAPTAIN WAGNER: Mia Miller from Mendocino, California.

--o0o--

#147

MIA MILLER

Good night. My name is Mia Miller. I'm an 18-year-old girl, and I'm a student at Mendocino Community School.

No one can guarantee that I will live longer than today, but nuclear power and nuclear waste decrease my chance, my children's chances, or any future generation's chance to live in a happy, healthy environment.

My heart is stronger than any lie to live by. I hope in God's name that we learn this lesson well. Once again, we have touched the apple of destruction, only it's the atom apple this time.

The sea is a soul healer, not a life stealer. If I may quote from Ronald Reagan, "If you've seen one redwood tree, you've seen them all," unquote. And I say you cannot say that about our ocean. We must be humble, and we must follow our hearts. Please stop this lie. It's against my religion.

From all of you I receive; to all of you I give; together we care, and in this we live.

--o0o--

VINE McKINNON & HALL
SACRAMENTO, CALIFORNIA

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CAPTAIN WAGNER: Dick Myers from Colusa, California.

--o0o--

DICK MYERS

It's been a long day. Next time I'll get here before 9:00 o'clock. I got here at 10:30.

My thanks to you, Captain, for the good job you've done today. I hold no animosity towards you as an individual just because I don't approve of what the Navy is attempting to do. You've done a good job. I think you've acted as an officer and a gentleman, and we appreciate that.

I have no short-term vested interest, economic or otherwise, in this issue. I live in the Northern Sacramento Valley. I'm not a commercial fisherman. I'm not a member of the Oceanographic Society. I don't live on the coast. I'm not a proponent of unilateral disarmament. I'm not a member of the Audubon Society, and I have not been diagnosed as having cancer.

I'm not now nor ever have been a member of the communist party, but I'm not ignorant. I recognize the threat. This issue is of great importance. It may affect the health and well-being of millions of people for many years into the future.

But more important than that, more important than the issue of nuclear sub disposal, is the process by which our government and industries escape responsibility for their decisions when those decisions are responsible for injuring and killing many of our citizens and citizens of other countries.

And I cite to you the atomic veterans, dead or dying from cancer, and their dead or sick children; the Agent Orange veterans, dead or dying, and their dead or sick children; the Agent Orange Vietnamese, dead or dying, and their dead or sick children; the Agent Orange persons whose watershed and sometimes themselves have been sprayed with herbicides, dead or sick, and their dead or sick children; the native Micronesians, dead or dying, their dead or sick children; Americans downwind from atomic test sites, dead or dying, their dead or sick children; Americans exposed to contaminated air, water or food by releases of radiation from all military and commercial atomic operations, dead or dying, their dead or sick children.

Karen Silkwood, Three Mile Island incidents; Hanford, Washington, radioactive contamination of groundwater; Love Canal; Farallon Islands' dumping; Johns-Manville Asbestos, crime against employees and the ensuing bankruptcy allowed by the court to protect the company; Times Beach contamination coverup by the EPA; Price-Anderson Act asks removal of full civil redress after an atomic incident; polluted air and water, acid rain on us and our Canadian friends, and even here in Sacramento we have water supplies contaminated with carcinogens, we have Aerojet as a neighbor, et cetera, et cetera, et cetera, et cetera.

I believe the situation to be quite serious. We are somewhat concerned as a people. President Nixon established the EPA. Unfortunately, the EPA has gone the way of Nixon.

President Reagan is not concerned about our health and welfare. He has gutted the EPA, and James Watt represents President Reagan's philosophy in the Department of Interior. He has made a sham of our governmental agencies. He and the nuclear industry are looking for an economic solution for disposing of nuclear waste.

L.9

If the Navy dumps the nuclear subs in the ocean, then the door will be open to dispose of commercial reactors the same way. It's a very -- it's very economic for those of us over 70 years old. We won't live long enough to pay the full price. Today we find that the government and industry can and do kill with premeditation and don't have to answer to the public for their deeds.

This hearing today establishes a certain lack of credibility in the Draft EIS the Navy has prepared. So what? Our politicians may ignore it as they continue to do in other similar matters.

I understand there is a representative of the firm that prepared the Environmental Impact Statement, and I would

encourage that individual to address the issues squarely when preparing answers to all the questions that we posed today; not to just whitewash our concerns so as to please the Department of Navy.

I would like to close with a comment that we live in a democracy, and our politicians are a reflection of our society. We elected President Reagan. We only have ourselves to blame for the situation we find ourselves in. We need criminal penalties for people who kill. Until we have those laws, our government and our corporations will continue on their present course. We have the ability to make those laws, and I intend to work towards that end.

The Navy's proposal to dump radioactive submarines off the California coast is the most blatant disrespect for myself and my children that I've ever witnessed.

Thank you.

--oOo--

CAPTAIN WAGNER: Mr. Peter Mahegian (ph) from Compton, California.

UNIDENTIFIED SPEAKER: He went back to the butterflies.

CAPTAIN WAGNER: Julie Norman from Merlin, Oregon.

(Speaker not present.)

CAPTAIN WAGNER: I can't read the first name on this, but I'm going to try. Moree Paradise.

UNIDENTIFIED SPEAKER: She went back to Paradise.

CAPTAIN WAGNER: I believe she spoke already.

Larry River from Willits, California.

(Speaker not present.)

CAPTAIN WAGNER: Marlene River from Willits, California.

(Speaker not present.)

CAPTAIN WAGNER: Shannon River from Willits, California.

(Speaker not present.)

CAPTAIN WAGNER: Rose Slevinsky (ph) from Mendocino, California.

UNIDENTIFIED SPEAKER: Gone.

CAPTAIN WAGNER: Cochela Zamora (ph) from Miranda, California.

UNIDENTIFIED SPEAKER: She left.

CAPTAIN WAGNER: Jean Batenburg (ph) from San Francisco, California.

(Speaker not present.)

CAPTAIN WAGNER: And I have trouble with this one, too.

Bear with me, and if it sounds familiar, please identify yourself.

Anso Backe or Bach.

ANDREW BACHELS: Is that possibly Andrew Bachels, sir?

CAPTAIN WAGNER: Yes, sir.

ANDREW BACHELS: B-a-c-h-e-l-s?

CAPTAIN WAGNER: That's correct. Excuse me.

ANDREW BACHELS: That's all right. I have something to say.

--oOo--

ANDREW BACHELS

#149

I'm very interested in atomics. I don't know -- Can you hear me all right, sir?

CAPTAIN WAGNER: Yes, I can.

MR. BACHELS: Okay. I got a little radiation exposure when I was in the military. And the Korean Advisory Group -- when we were counseled when I got off the boat in Sasebo, Japan -- in infantry --

THE REPORTER: You're going to have to use the mic.

MR. BACHELS: I'm terribly sorry. You want me to speak into the microphone? All right.

This is personal history, sir. All I can do is speak for myself and my experience with atomics which is somewhat extensive.

I was born in San Francisco in 1932, raised in Sierra County, California. You possibly know where it is.

Beginning the Second World War -- that is to say Pearl Harbor Day -- I was just a little kid up in Goodyear Bar, California, and I thought it was the most exciting thing I'd ever seen when all the big wigs come downtown lookin' up in the sky. I couldn't see any Japanese balloons, but that did permit my father Andrew Bachels, before me, and my mother, who is alive and well, thank you, and myself to go down to San Francisco because Father could go to work for Bethlehem Steel building ships for whatever purposes. And that way I could live at the corner of Haight and Fillmore in San Francisco during the Second World War and observe the action through Midtown Theater, see all the propaganda, one side or the other, you know.

When I got out of Liola High School (ph), San Francisco, I played trombone, and in those days if you kept your grade points up in college -- do you understand me -- then you had a deferment. Well, Uncle Sam and I had a slight disagreement between 1952 and 1953. When I transferred from San Francisco State College, where my friend Hagawara (ph) was taking care of some business, over to the University of

California, I got my greetings over the Christmas holidays from Uncle Sam. I thought, "All right, fine. No problem."

I went back to the Selective Service Board, San Francisco State, and he said, "I'm sorry. You're not registered here. We can't help you."

So I got in my Model A Ford and cruised over to Berkeley, talked to the Selective Service Board over there. He said, "I'm sorry. We can't help you either," because in the fine print, way down at the bottom, the Selective Service Act at that time, if you transfer schools, even if you might be a genius, then you're fair game.

So with a bit of unhappiness I went down to Fort Ord, California, through 16 weeks of intensive infantry basics -- I companied 63rd Infantry Regimen -- in the spring of '53, before Panmunjom, when in my company in basic training I personally observed American children being killed. And so I volunteered to ship out as light infantry, and I went out of Camp Stone -- light infantry. Got to Sasebo, Japan; saw boatloads and boatloads of people coming back from your little 38th Parallel numbers, crazy, presumably.

After about a month, finally they called my name, Andrew Bachels, Jr., and said, "Would you like to volunteer to stay here in Japan to go to signal school at Hiroshima, Japan," which is near Kure, Japan, which is a port city for Hiroshima, "and get out of the infantry and into the Signal Corps "because we need high-speed radio operators and teletypists?"

So I trained at Hiroshima in '53, and in those days we in the Army were counseled to spend as much possible time as we could with the Navy. Well, that was fine with me -- it didn't bother me one bit, sir, at Tsu-Shima, Japan. That happens to be the old Naval Academy. Very nice little island.

So naturally, we went to Hiroshima, you know, other places that you could see what your little atomic games could do which was sort of nice, cute, different anyway.

Well, at that point in time I picked up, oh, radiation poisoning, to put it simply, on my pituitary gland. I'm an acromegaliac. That is to say, elevated growth hormone levels. It wasn't picked up on, although I've known that I've had brain cancer for better than ten years. It wasn't picked up on until last year, sir, at Reno VA Hospital by a fine old family doctor named Ernest Mazzaferri who got his reputation by laying around cancer wards, be they black lung, be they radiation, be they whatever, listening to the dying soldiers or other civilians to find out what their personal histories might possibly be and whether there was some way to diagnose and treat cancer of the brain early enough.

As luck would have it -- as luck would have it even though I'm not a quote, unquote, disabled American Veteran, Uncle Sam this past year has been more than kind to me by spending God only knows how many gillion bucks over there in

Reno doing proper diagnostic work; shooting me down to Fort Myer for a transsphenoidal approach, you know, and picking out that little sucker. I'm only 50 years old, sir, but I can guarantee you on my union license of a carpenter and millwright out of Santa Fe, New Mexico, when it became crippling to me working at Los Alamos, disabling, old fun and games up there as a millwright, and we weren't told that the damn things were polluted. We had an opportunity in the middle of winter to go to work -- hey, automatic.

Well, that's when it became chronic for myself, but no one -- none of the doctors could diagnose it. I've been diagnosed multiflex schizophrenic with paranoid tendencies and blah, blah, blah, blah, blah. And basically, it was due to radiation poisoning.

Now I'm feeling better, but I'm awful tired of your games, and as far as submarines go, just think of the Yellow Submarine. There ain't nothin' more I can say. But if you want any more factual information, there's only two kinds of crazies in God's earth, sir, dead or alive.

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CAPTAIN WAGNER: Next registered speaker is Kathryn Luckovitch (ph) from San Francisco, California.

UNIDENTIFIED SPEAKER: She said choose the life, not death and went home to take care of her children.

CAPTAIN WAGNER: Mr. Art Dooley from Sacramento, California.

(Speaker not present.)

CAPTAIN WAGNER: Conrad Golich (ph) from Bolinas, California.

UNIDENTIFIED SPEAKER: I believe that he wanted to say that you put your nukes in the Pentagon.

CAPTAIN WAGNER: Sid Hall from Nevada City, California.

UNIDENTIFIED SPEAKER: He said no nukes, that's kooks.

CAPTAIN WAGNER: Alan Hogel (ph) from Gualala, California.

(Speaker not present.)

CAPTAIN WAGNER: Patty Kemp (ph) from Citrus Heights, California.

UNIDENTIFIED SPEAKER: She said for the oranges, no nukes.

CAPTAIN WAGNER: Mr. Joseph Marshall from San Francisco, California.

UNIDENTIFIED SPEAKER: He didn't say anything -- he said no nukes.

CAPTAIN WAGNER: The next speaker is Michale or

Michael T. Walker from Nevada City, California.

(Speaker not present.)

CAPTAIN WAGNER: Cyndi Clarke from Shingle Springs, California.

--oOo--

#150

CYNDI CLARKE

My name is Cyndi Clarke, and I'm here because I care, and I hope to God that you're here because you care.

When I first heard of radiation or nuclear energy, I had an intuition that scared me, and intuition is a heartfelt feeling. Anyway, this intuition on nuclear energy I had was no good.

Well, I'm a type of person that has to understand the workings of something before I can speak for or against it. Well, I'm a student of physics and nuclear energy now, and I can speak against it, and I can speak from my intuition.

You know what I found out? I found that my intuition said that this is no good, and we made a big mistake when we started playing with fission; big-time mistake, and I believe you are an intelligent man and also realize that we have made a big-time mistake.

Since we are dealing with a mistake, I want to share with you my logic on mistakes. I'll be very simple; it's very simple. When I make a mistake, number one, I first acknowledge the mistake. Number two A, if the mistake can be corrected, then I take steps toward correcting the mistake if at all possible. Two B, if the mistake can't be corrected, then I try to repeat -- I try not to repeat the mistake and learn from it.

I'm sharing this logic because when I make mistakes, I don't feel very good about them, but I know I must learn from them. I'm guessing that when you make mistakes, they affect you the same way.

Well, dealing with this subject of nuclear waste, there is no correcting what we have done. So I guess we have to go to plan two B when I deal with mistakes which tells me that we should not repeat this fiasco and learn from it. We shouldn't build any more nuclear submarines.

And I was reading this thing, and I can't understand how you can even say that in Hanford plant there's low, low radioactive waste there, and that we can put these nuclear submarines up there with them because they're low active, radioactive.

Now, the submarines may be low radioactive, but the nuclear wastes that are already there are not. Do you think 25,000 years is low level? That is not low level. That's

25,000 years of people guarding that; keeping it cool all the time. That's insane. That is just insane, and as far as money, you tell here -- you break this down in money. It says here -- you give us all these things. Okay. It definitely is much cheaper the way it looks here, that we should just go for just dumping it in the ocean, but, come on, money should not even come into the subject of environment safety because for the reasons that we can spend millions of dollars in El Salvador killing people and trying to make democrats out of everyone changing their government.

We can spend billions of dollars, and we can let Argentina borrow guns with our dollars when we don't even have it ourself. I can't even believe it.

And then we spend thousands of dollars for inaugurations and making the Governor's Mansion wonderfully beautiful when people -- I have to put this in -- criticize Governor Brown for sleeping on a floor. Come on. Where are people's priorities these days? They have no priorities. There's no religion in this government. Religion of the United States is money, money and power. That's what the religion is I see, and it's really sad and devastating, and as far as I'm concerned, the alternative you give me, I am only left with saying, "Okay. I don't want to make a decision; I don't want to make a decision for that girl right there that says if she had a family up in Washington, Hanford, I don't want to have to make

N.3

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a decision and say, "Yeah, damn it, put 'em up there."

I know it's not fair, but I'm going to have to make this decision because you've given me these choices. Right? So I'm going to tell you what my decision is. No one's confronted this, but I can't leave this room without saying what I think you should do because there's no other way out.

What I think you should do is -- I guess we should first of all talk about where the nuclear wastes go that come from those submarines, that nuclear waste we have to put somewhere. So I don't see why we should separate the two and put it in the ocean. We might as well put it up in Hanford with the rest of 'em, but goddamn it, it's not going to make any damn bit of difference anyway.

I only have one more thing to say, and that is -- where is it? I hate these things -- Why doesn't the Navy ask the public whether or not they want more nuclear submarines? Why don't you start there, damn it, instead of asking us the ultimate end? I think -- it just infuriates me, and there's nothing that we can do but just tell you, and I'm sorry that I got so excited, but damn it, it makes me upset.

--o0o--

CAPTAIN WAGNER: I'd like to ask our reporters to give us maybe five to ten more minutes of time. I have three more registered speakers. I'd like to see if they are here, and if the reporters could stay, we could complete the testimony tonight.

All right. The next registered speaker is Owlswan Free-Eagle from Calpella, California.

--o0o--

#151

OWLSWAN FREE-EAGLE

Owlswan Free-Eagle from Calpella, California. That's my legal name. I was once a lieutenant in the Army. That's curious. It's hard to stand here and talk. It's so --

UNIDENTIFIED SPEAKER: Like talking to the wall?

OWLSWAN FREE-EAGLE: On the cover of the Sacramento Bee, as I came in here, I noticed that 40 years later, people are determining that the Japanese shouldn't have been interned, and 30 years later, they decided that they shouldn't have dropped atom bombs in the environment because all the sheep died and the flowers got sick.

What are we going to learn 30 years after we dump submarines in the ocean? That's what I want to know. The fact that you want to dispose of submarines is insane enough since it's well-established there's no lower limit for radiation poisoning, and since there are so many other blatant radiators, you're just asking for your share of death. That's all you want is your share of the death.

A.17

It's clever of you to split the fuel issue off from the submarine issue. You think you can divide and conquer. You can't. We're not going to let you.

All this belies the fact that we're still building these vessels which are only made to bring death. They're only made to bring death. That's all they're here for is death. We're alive. That doesn't have anything to do with us.

The military of the world sucks 600 billion dollars -- that too -- but it sucks 600 billion dollars or more a year, 600 billion dollars or more a year from the people of the world; 600 billion dollars a year. You can't tell me that if we spent this money on peace and communication that we couldn't have it almost instantly. Why doesn't Ronald Reagan propose this? Only because greed -- and only because of the greed and some pseudohearts need 600 billion dollars' worth of protecting.

Our solution for it is to put the subs in the Pentagon and seal off the Pentagon room by room while we put the subs in the Pentagon, and then seal off the Pentagon and end war. That's our solution. We don't want subs dumped. We don't

want subs built. We don't want first-strike weapons. We don't want nuclear power reactors in any form any place. We want peace now.

--o0o--

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CAPTAIN WAGNER: Sam Camp from Redway, California.

UNIDENTIFIED SPEAKER: He spoke already.

CAPTAIN WAGNER: The last registered speaker is Mr. Tom Willis of Sacramento, California.

--o0o--

#152

TOM WILLIS

Good evening, Captain. I'm Tom Willis, Sacramento, SOP, Save Our Pacific. I'd like to relate to the Navy several old salt stories. They also relate to the state from where this gentleman who was exposed to nuclear radiation came from or worked.

The Federal Government decided that it would be a good idea to conserve oil by pouring it down into some salt mines, and when the Federal Government went back to check on the oil supply, the oil could not be located. The Govenor of New Mexico said it would be fine with him to use a part of his state in the salt mines for nuclear waste disposal.

So I have a proposal. We could take these nuclear subs, bring them in through Texas Harbor, transport them to New Mexico, dump them down in those salt mines, and maybe

they'll disappear, and it will no longer be a problem for man.

I'd like to go right into the Environmental Impact Statement summary as a radical departure. Under ocean disposal, it says, "Locations for possible ocean disposal have not been selected." That is very good. We thank the Navy for that.

"But if there was to be a selection process..." the summary goes on "...the general approach is to avoid areas which produce large amounts of seafood or which are sources of food for seafood; to avoid areas which are currently used by man for any purpose; and to avoid areas which have potential..." I repeat, potential "...for future use."

It is my position that that includes all of the Pacific, and I am sure that people on the East Coast would probably say the same applies to the Atlantic. I certainly do not enforce the dumping of nuclear waste in any ocean whatsoever.

Under comparison of disposal methods, it is pointed out that about ten acres would be required for the disposal of 100 nuclear submarine nuclear compartments; that 100 nuclear submarines disposed of in the ocean would require 100 square miles.

Since we have this problem, we might as well deal with it in the most compact way that the Navy can conceive of. So then I go back to land disposal. There are two sites which have been selected as already being used for disposal of low-level radioactive waste. This would be a compatable use to dispose of the reactor chambers on either of those sites. I suggest that since nuclear submarines are used in both the Atlantic and Pacific and other waters, that -- and I understand there have already been a few accidents -- that if a submarine is salvageable and it happens to be on the West Coast, that it be taken to the Hanford site.

If there is a nuclear submarine accident, and there's any salvageability to the submarine, that would be taken to the East Coast site at Savannah River.

On the last page, as someone pointed out, there are really only three alternatives that are costed out here. Sea disposal of entire submarines; bury the reactor compartment and sink the remainder at sea; bury the reactor compartment and salvage the remainder of the submarine, and then that is shown to be extremely non-cost effective, the price of that option being double the price of sinking the entire submarine at sea.

E.7

I'm opposed to all three of those options. I recommend something different. If there is to be land burial of the reactor compartment, this will entail cutting the submarines into parts and removing the reactor compartment. Then one possibility is to use the same land transport system which would be used for the reactor chambers, to use that with the remainder of the submarines, take them over to those nuclear dumps and dump them.

The other possibility, which might sound more

far-fetched, but it might be a true possibility, would be a little air lift. Once the submarine is brought into dry dock and the nuclear reactor compartment separated from the submarine, the remaining parts might possibly be transported by air.

If either or both of these land sites are used, I would propose that the Savannah River site not be utilized for more than twenty-five percent maximum waste disposal from this source from the submarines being discussed here. The difference in acreage and the necessity to use the West Coast in emergencies and for other uses suggests that perhaps the Hanford site would not be ideal for one hundred percent, but because of the relative small size of the Savannah River site, twenty-five percent would seem to be a reasonable maximum.

I consider this a fine opportunity that all of us citizens are enabled to express our opinions, but I do consider it as SOP. It's a SOP to be addressing what is done with nuclear submarines which we have not supported in the first place when the priorities of government should be to work toward a nuclear freeze or to work toward a disarmament of the major powers of the world as a SOP, but I do thank you for the opportunity.

CAPTAIN WAGNER: Thank you, sir.

--o0o--

VINE McKINNON & HALL
SACRAMENTO, CALIFORNIA

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CAPTAIN WAGNER: Ladies and gentlemen, I have no further registrations. Has anyone registered to speak who has not yet been given the opportunity?

On behalf of the United States Navy, I would like to thank the citizens of California for your participation, very intense interest and your testimony today, both those of you who are still here and your friends and neighbors who have left.

I would also like to thank our two reporters for their long and hard dedicated work today.

UNIDENTIFIED SPEAKER: Can you tell us where the transcripts are going?

CAPTAIN WAGNER: Yes, they go back, and they are included in the Final Environmental Impact Statement. Any additional comments that you would like to make may be sent to me at the address that I gave out earlier today.

This hearing is adjourned.

UNIDENTIFIED SPEAKER: How can we get a copy of the transcripts?

CAPTAIN WAGNER: Send your name and address, and ask on that specifically for a copy of it.

--o0o--

REPORTER'S CERTIFICATE

STATE OF CALIFORNIA)
(ss.
COUNTY OF SACRAMENTO)

I certify that I, THERESA FRENCH, a Certified Shorthand Reporter in the State of California, was present at the time and place aforementioned to report in shorthand writing the foregoing proceedings.

I further certify that the foregoing proceedings were taken by me in shorthand writing at the time above mentioned and that the foregoing is a full, true and correct transcription of the proceedings had at said time and place.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal of office this 2 day of May, 1983.

Theresa French

THERESA FRENCH, CSR No. 5790
Notary Public in and for the County of Sacramento, State of California.

OFFICIAL SEAL
THERESA FRENCH
NOTARY PUBLIC - CALIFORNIA
SACRAMENTO COUNTY

REPORTER'S CERTIFICATE

STATE OF CALIFORNIA)
(ss.
COUNTY OF SACRAMENTO)

I certify that I, IDA RUTH LUNDSTEN, a Certified Shorthand Reporter in the State of California, was present at the time and place aforementioned to report in shorthand writing the foregoing proceedings.

I further certify that the foregoing proceedings were taken by me in shorthand writing at the time above mentioned and that the foregoing is a full, true and correct transcription of the proceedings had at said time and place.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal of office this 2nd day of May, 1983.

IDA RUTH LUNDSTEN
NOTARY PUBLIC
SACRAMENTO COUNTY, CALIFORNIA
My Commission Expires April 2, 1985

Ida Ruth Lundsten
IDA RUTH LUNDSTEN, CSR No. 5791
Notary Public in and for the County of Sacramento, State of California.

#153*

February 24, 1983

Sidney Abbott, Garland Harris
10424 Wheeler Street
Mendocino, CA 95460
P.O. Box 1051-

My name is Sidney Abbott. I own a home and work in the town of Mendocino, on the Coast, where I live with my partner Garland Harris.
We feel that it is important to make three points today.

First, that the sea disposal option is too risky, too many uncertainties exist in both the disposal and monitoring phases. The results of a mistake are profound-- radioactivity entering the food chain, and radioactivity being drawn southward towards San Francisco by the prevailing currents-- being among them. | L.39* | J.76 | L.36

Secondly, that the land disposal alternative is preferable. Primarily because monitoring is more realistic, and the wastes are retrievable if leaking occurs.

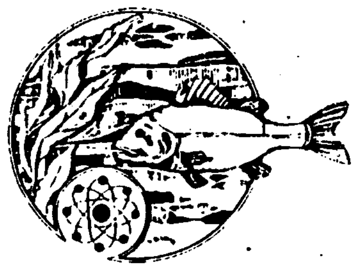
Finally, that hearings on this issue, ocean disposal of nuclear submarines should be held on the coast so that the people of the coast can be heard. Of my friends who agree on the importance of this issue, relatively few have been able to make the costly and time consuming trip to be here today. To arrive at an idea of this ratio, simply count my statement ten times or more, and the same with the statements of many speaking today. Many. Many more people wished to be here today than could be here today. I urge you to hear them by having a hearing on the coast. | J.15

*Other issues discussed by Mr. Harris are side barred in Exhibit 337.

#37b*

Final Report

Oceanic Society
Scientific Committee Report
on
Draft Environmental Impact Statement
on the
Disposal of Decommissioned,
Defueled Naval Submarine
Reactor Plants



March 11, 1983

The Oceanic Society
Magee Avenue
Stamford, CT 06902

- and -

Fort Mason Center
Building E
San Francisco, CA 94123

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This Report was based on the Scientific Committee's deliberations and written by Oceanic Society staff members. The Oceanic Society is a national marine conservation organization with 60,000 members across the country. The Society sponsors ocean policy analysis, marine education and research programs from its offices in Stamford, CT and San Francisco, CA. The Society publishes OCEANS magazine six times each year for its members. To join the Society and support its analysis of the sea disposal issue send your name and complete address with $18.00 in annual dues to: The Oceanic Society, Stamford Marine Center, Magee Avenue, Stamford, CT, 06902.

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*Other issues discussed by these commenters are side barred in Exhibits 15, 15a, 37, 37a, and 37c.

#37b (Cont)

1.0 Abstract

An independent Scientific Committee was impaneled by the Oceanic Society to assess a Draft Environmental Impact Statement (DEIS) on disposal of decommissioned, defueled nuclear submarines issued by the U.S. Navy December 22, 1982. The DEIS includes a discussion of land burial of reactor compartments at Savannah River, South Carolina or Hanford, Washington compared with sea disposal of the entire submarine at sites off Cape Hatteras, North Carolina or Cape Mendocino, California. The Committee met February 3 and 4 in San Francisco and those deliberations provide the basis for this report by Oceanic Society staff.

L.1 A fundamental concern of Scientific Committee members centered on the absence of detailed knowledge about many aspects of deep sea ecology. Compared to other ocean ecosystems, the deep sea is poorly studied. Additional research is needed to understand the deep ocean environment and provide an adequate basis for assessing the potential impact of sea disposal of nuclear submarines.

Committee members felt the strongest arguments against sea disposal included: the need for additional study of potential pathways for radioactivity to migrate through the marine environment; the need for additional study of the probability and potential impact of accidental sinking of a submarine while being towed to a disposal site; the absence of consideration of cumulative impacts of incremental increases in radioactivity released to the marine environment; the inadequacy of the Navy's proposed monitoring program; and a lack of attention to an alternative land disposal option which may minimize release of radioactivity to the environment.

After removing the reactor compartment as proposed in the DEIS discussion of land disposal, Committee members felt the Navy should consider placing this sealed section of the hull in an open trench

in an arid or semi-arid environment. Radioactivity in the submarine should be shielded from the environment by the thick bulkheads and hull of the submarine. A reactor compartment left exposed to dry air will rust at a much slower rate than one buried on land or sunk at sea, Committee members predicted. The "open trench" option was not considered in the Navy's December, 1982 DEIS.

#37b (Cont)

2.0 Background

The Oceanic Society has long been concerned with the marine environmental effect associated with the use of nuclear power and sea disposal of radioactive wastes. Oceanic Society forums on this issue include "Nuclear Power & the Sound," convened at Yale University in 1978, and "Nuclear Waste Management: the Ocean Alternative," held at the Georgetown University Law Center in 1980. Oceanic Society publications summarizing these sessions provide an important introduction to this subject area. In 1980, responding to a Congressional request, the Society impaneled a Technical Advisory Committee in San Francisco to evaluate Environmental Protection Agency studies of past U.S. dumpings of low level waste.

In January, 1982, the U.S. Navy announced its intention to prepare a "generic" environmental impact statement comparing sea and land disposal alternatives for disposal of defueled, decommissioned nuclear submarines during the next three decades.

Responding to the Navy announcement, the Oceanic Society issued a Briefing Report in December, 1982, which alerted decision makers, conservationists, coastal citizens and elected officials to scientific and technical questions which must be answered in the Navy's impact statement and supporting oceanographic studies. The Navy issued a Draft Environmental Impact Statement (DEIS) in late December 1982, and planned first to receive comments on this document until March 31, 1983. At the request of the Oceanic Society and other conservation groups, the comment period was extended to end on June 30, 1983.

According to the DEIS, during the next 30 years 100 of the 120 nuclear powered submarines now in service will be decommissioned. Five additional submarines have already been taken out of service and placed in storage. The principal source of concern is radioactivity which, during operation of the submarine's propulsion system, accumulates in

the stainless steel equipment which comprise the vessel's reactor and steam generator. This machinery is located in a section of the sub called the reactor compartment which extends between two watertight bulkheads in the center of the submarine.

Of the 62,000 curies of radioactive materials remaining in each defueled submarine, the DEIS reports 99.9 percent "is an integral part of the corrosion resistant alloy forming the plant components." Since corrosion of these metal components will be a major mechanism for release of this radioactivity to the environment, the DEIS states: "Most of the radioactive nuclides would have decayed to stable atoms before they could possibly be released to the environment by the slow corrosion process." Cobalt 60, Nickel-63, Carbon-14, Nickel-59, Niobium-94 and Technetium 99 are among the long lived radionuclides expected to persist in the submarines and be released to the environment.

The Navy proposes to either sink the entire submarine at sea or remove the reactor compartment and bury this one section of the ship on land. If the land alternative is selected, the remaining, non-radioactive section of the sub would be scuttled at sea or scrapped. In either land or sea disposal, the DEIS states corrosion resistant metals used in the hull and reactor plant will produce slow rates of corrosion and allow the bulk of radionuclides to decay to stable elements before these substances can be released.

Land disposal sites considered in the DEIS are existing nuclear waste disposal facilities at the Savannah River Plant, South Carolina and the Hanford Site, Washington. "Generic" sea disposal sites considered in the DEIS include a "Lower Continental Rise Area" some 220 nautical miles due east of Cape Hatteras, North Carolina; a "Hatteras Abyssal Plain Area" some 200 nautical miles southeast of Cape Hatteras,

#37b (Cont)

and a site some 160 nautical miles west of Cape Mendocino, California. Designation of a sea disposal site would come from the U.S. Environmental Protection Agency, according to the DEIS.

The DEIS concludes that neither sea nor land disposal would damage the environment. Sea disposal is characterized as less expensive (by $1.9 million per submarine); requiring less shipyard work; isolated from human activity; requiring an Environmental Protection Agency permit; non-retrievable; and arousing more controversy than land disposal. Land disposal is summarized as permitting retrieval for up to 200 years; not requiring new regulations; utilizing existing waste disposal sites; more expensive than sea disposal; and requiring more shipyard work. The Navy's Draft Environmental Impact Statement does not indicate a preferred disposal option or proposed course of federal action.

3.0 Regulatory Context

In 1969 the National Environmental Policy Act (NEPA) Pub. L. 91-190, 42 U.S.C.A. Section 4321 et seq., was signed into law. In addition to requiring that an environmental impact statement (EIS) be prepared by federal agencies to accompany "every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment" (Section 102 (2) (c)), NEPA created a council, the Council on Environmental Quality (CEQ), "to review and appraise the various programs and activities of the federal government in light of the policies set forth in [NEPA]" (Section 204(3)). The CEQ has established guidelines for preparing an EIS, which were updated on 1 July 1982. (40 Fed. Reg. Section 1500 et seq.).

Section 102(2)(c) of NEPA provides that, where there are major federal actions significantly affecting the quality of the human environment, a detailed DEIS and subsequent Final EIS must be prepared by the responsible officials and agencies on:

- (i) the environmental impact of the proposed action,
- (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
- (iii) alternatives to the proposed action,
- (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
- (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

During the thirteen years that NEPA has been on the books, regulatory policy, congressional oversight and judicial decisions have interpreted the purposes and requirements of NEPA. While a lengthy review of NEPA considerations is not necessary in order to assess the validity of the scientific and technical concerns set forth herein, we have

#37b (Cont)

attached as Appendix A a compilation of several pertinent CEQ regulations.

The regulations which are appended define such considerations as: the expected scope of an EIS (Section 1508.25); the types of alternatives that must be analyzed (Section 1502.15); the "environmental consequences" (Section 1502.16); the "cumulative impacts" (Section 1508.7); and the "effects" (Section 1505.8) must be addressed. Guidance is also provided in the CEQ regulations for situations where the preparers of an EIS have "incomplete or unavailable information" (Section 1502.22), or where they have prepared a "cost-benefit analysis" (Section 1502.23).

Those regulations provide a regulatory framework for assessing the adequacy of the Navy's DEIS. Many of the scientific and technical concerns expressed herein represent examples of instances where the Navy has failed to satisfy the requirements of NEPA and the CEQ regulations. This regulatory framework is complimented by the "Anderson Amendment" to the Ocean Dumping Act which Congress approved as part of a measure increasing the federal gasoline tax. The text of this amendment is included in Appendix A.

4.0 Committee Findings

Following release of the DEIS, the Oceanic Society consulted with scientists across the country to assess the document and its supporting oceanographic studies as compiled by Sandia National Laboratories. A Scientific Committee was impaneled to review this information within the time provided by the Navy's limited comment period. An extension of the comment period requested by the Society and others was approved by the Navy in mid-March. Under the extension, comments will be received by the Navy through June 30, 1983.

Copies of the DEIS and Sandia report were circulated among the Committee early in 1983. Initial comments by members on this material were distributed to the Committee in preparation for a February 3 and 4 meeting in San Francisco. A Committee roster and list of participants in that meeting is found in Section 5.

This report reflects concerns expressed by individual members of the Committee and identifies areas of consensus which emerged during the meeting. The Oceanic Society intends to use this information to develop testimony for public hearings; brief citizens and elected officials; and prepare a comprehensive response to the DEIS.

Critical concerns considered by the Committee include availability of radioactivity (Section 4.1); pathways of radioactivity, (Section 4.2); cumulative impacts (Section 4.3); alternatives, (Section 4.4); and monitoring (Section 4.5), as presented in the DEIS. Committee members found the strongest arguments against sea disposal include:

* irretrievability of the submarines from the ocean floor, making it impossible to remove the subs should these ships become a significant source of radioactivity in the marine environment. The importance of being able to retrieve these submarines is increased by the limited amount of knowledge available on deep sea ecosystems. W.1* L.1

*Other issues discussed by these commenters are side barred in Exhibits 15, 15a, 37, 37a, and 37c.

#37b (Cont)

* inadequacy of the proposed monitoring program to gauge releases of radioactivity from the submarine over extended periods of time.
J.76 The Navy must propose a monitoring program plan which includes cost estimates and a description of monitoring procedures to be used.

* inadequacy of consideration of the land alternative in the DEIS, reflecting insufficient attention to the costs and potential
O.2 benefits of land disposal.

* inadequacy of consideration of "worst case transportation accidents section of the DEIS which must be revised to reflect the
L.57 statistical probability that at least one submarine will be lost on the Continental Shelf while being towed to a disposal site.

* inadequacy of consideration of the policy precedent this
F.8 proposal would establish for sea disposal of other radioactive wastes off Cape Hatteras, Cape Mendocino or other ocean sites.

Based on the Committee's deliberations, the best alternative
H.3 -- one unfortunately not considered in the DEIS -- appears to be disposal of the reactor compartment on the surface of land in an arid or semi-arid environment.

The Committee viewed with concern the weak scholarship which
J.20 surfaced repeatedly in the DEIS. The DEIS was seen as containing signi-
F.12 ficant gaps in the information presented, reflecting technical defi-
U.9 ciencies and raising a substantial number of issues requiring addi-
J.12 tional information before a reasoned disposal decision can be made.
J.9 Flaws, such as use of old information when more recent data is readily available, weakens the credibility of the DEIS.

The strength of considerations presented in the DEIS is further undercut by internal inconsistencies between the supporting research and the DEIS Summary which make it difficult to evaluate assumptions and conclusions. In the Summary, for example, consumption of 145 pounds of seafood per year is used in a "worst case" calculation (page S-11). But the supporting data in Appendices I and J of the DEIS cite a variety of quantities in grams per day for use of the effects of con- T.11
sumption computation, (pages I-11 and I 33) and there is no formula presented for conversion of the maximum consumption of 179 g/day into millirems per year of exposure. Inconsistency is also found within sections. Differences in organization in DEIS Tables 4 I and 4-4, X.1
(pages 4-1 and 4 13), make it difficult to weigh the difference in radioactivity release between land disposal of one reactor compartment and sea disposal of one submarine. The DEIS can also be criticized for utilizing inappropriate standards in discussing human health impacts. In Appendix J, for example, the DEIS states the maximum individual exposure from an accident is less than the EPA drinking water require-
ment "that prevents any individual from receiving a total body or any U.19
organ exposure of more than 4 mrem per year," (I-17). If this drinking water standard is applicable, the DEIS should note that the actual individual exposure in a worst case accident appears to be very close to the 4 mrem limit (3.9 mrem by one Committee member's calculation).

A significant deficiency in the DEIS is the failure to include error terms in the presentation of data. This omission makes it S.25
difficult -- if not impossible -- to confidently consider data presented in the DEIS. This deepens confusion surrounding "worst case" calculations, some of which some Committee members believe may be off by up to nine orders of magnitude. The very fact that qualified inde-
pendent scientists have difficulty in understanding and replicating U.21
many of the calculations relied upon in the DEIS does not bode well for the critical evaluations required of decision makers and regulators and provides little hope for meaningful participation by even the most interested representatives of the general public.

#37b (Cont)

4.1 Availability

Committee members discussed three areas of serious concern while reviewing the DEIS' consideration of radioactivity's availability following disposal of nuclear submarines in the deep ocean.

a. Corrosion product activity, more commonly referred to as "crud," is formed as the result of interaction between reactor coolant and interior metal surfaces of the reactor, primary piping, pumps and steam generators. The DEIS states crud accounts for 0.01 percent of radioactivity in each submarine. Data for land based reactors, however, suggests these corrosion product deposits may be a much more significant and serious source of radioactivity: a source which could easily become available to the marine environment. In revising the DEIS, data from land based reactors must be considered and supplemented with analysis of crud from shipboard nuclear reactors particularly those that may have been lost in the marine environment. Composition of the crud must be described and alpha emitting radionuclides found in these materials must be identified. Specific questions to be considered include: A.12

* What is the radionuclide composition of the crud which will be released from the coatings of the heat exchanger/primary coolant loop?

A.11 * Does this crud contain significant quantities of long lived alpha emitting radionuclides such as AM^{241}, $Cm^{242-244}$, Pu^{239}, and Pu^{238}?

A.13 * What is the rate of solubilization of the crud in marine waters, or in the water to be placed in the reactor compartment before sinking? This is important to both the anaerobic as well as the aerobic environments.

* Will marine bacteria mobilize the radionuclides in the crud and make them more available for food chain uptake? A.13

* What is the total weight of crud adhering to the interior of the reactor and heat exchange system? What is the total surface area which contains the material adhering to the surface? A.12

b. Data from the Thresher and Scorpion wrecks is insufficient, as presented in the DEIS, to substantiate conclusions that these submarines are not a hazard to the marine environment or human health. First, additional information is needed to determine if the reactor compartments of these submarines have been located and, if so, whether the compartments are open to the marine environment. Locations of sampling station sites in the DEIS must be described in relation to the reactor and reactor compartment. If the reactor compartment has not been breached, then corrosion would be the primary mechanism for release of radioactivity and the hull would continue to contain radioactivity until the fifth or sixth decade of the 21st century. At that time the reactor compartment's bulkhead would be opened to the marine environment by corrosion, according to rates projected in Table 4-2 of the DEIS (page 4-12). J.43 J.64

Sediment, water and marine life collected from the site of the U.S.S.R.'s submarine which the Glomar Explorer attempted to raise also could provide additional significant data to use in considering the projections contained in this DEIS. J.34

c. Corrosion rates in the DEIS were mainly obtained from values found in the literature. Additional consideration is needed to determine if there is an active electrode coupling among the Fe surface, the FeO(OH) layer, the Fe_2O_3 layer, the $FeBO_3$ layer and sea water. The DEIS Q.13

#37b (Cont)

must also be revised to reflect whether lattice damage has occurred in the alloy crustal spacing due to radiation damage and if so, what effect this will have on corrosion rates. Rates of corrosion should also be specified for weld and piping materials, including data on the depth of welds.

At the Pacific site, anaerobic conditions exist a few centimeters below the sediment surface. Corrosion would be much greater there due to sulfide producing bacteria. The DEIS must be revised to show this mechanism has been considered. The potential for the bacteria to alter the complex of the radioactive materials and making them more soluable and available for biological uptake also merits close attention.

4.2 Pathways

Pathways through which radioactivity could potentially affect human health or damage the marine environment are of greatest concern in considering any proposed disposal activity. Significant information found in the large body of scientific literature which concerns migration of radionuclides from wastes to the water column, sediments and organisms has not been considered in the DEIS. L.35

a. Studies conducted for the U.S. Environmental Protection Agency and others demonstrate the existance of possible pathways for radioactivity to migrate from low-level radioactive waste into rattail fish (grenadiers). Work by Schell and Nevissi done under contract to the EPA, for example, shows migration of one radionuclide from waste drums into bottom sediments, bottom dwelling invertebrates, and to these fish. This is but one study which shows migration of radioactivity from wastes into the marine environment. These studies serve as a warning that biological pathways for radioactivity have not been adequately assessed. Further investigations are necessary and all this research must be considered in a revised DEIS. U.9

b. The artificial reef effect has not been considered adequately in the DEIS. Experience with radioactive waste dumpsites, oil platforms, and ships sunk at sea has established that any structure placed on the continental shelf attracts and holds new and more abundant communities of fishes and invertebrates. The processes at work in this phenomenon, commonly called the "artificial reef effect," are enhanced food supply in the form of fouling organisms and algae that grow on the new hard substrate and enhancement of habitat by creating spatial heterogeneity. Increased spatial heterogeneity gives small fish and mobile invertebrates places to hide and the structures seem to provide larger fish with landmarks which allow them to establish a "home range" L.55

#37b (Cont)

or territory in an otherwise featureless environment. The potential for an artificial reef effect in the deep ocean presents unanswered ecological questions. Among them is whether this will occur when decommissioned nuclear submarines are placed on the abyssal plain. The possible occurance of this phenomenon and its role as a biological pathway must be considered in revising the DEIS. Specific attention must also be paid to the artificial reef effect in the context of accidental sinking on the continental shelf and identifying potential short cuts in biological pathways.

c. The potential impact of accidental sinking of a sub on the continental shelf receives inadequate consideration. Set in the context of recurring severe weather patterns off both Cape Hatteras and Cape Mendocino, it seems probable at least one submarine would be lost while
L.61 in transit to the dumping grounds. The basis for predicting 0.3 accidents per 100 submarines must be modified to represent actual towing losses in the disposal areas. Impacts of a "worst case accident" on the continental shelf merit additional consideration, especially in
L.53 terms of predicting human health effects and the accident's impact on commercial and recreational fishing as well as coastal tourism. Whether the predicted 3 rem exposure to a population of 30,000 is considered an acceptable exposure rate must be considered.

d. "Worst case" calculations are confused and appear to be in
U.21 error at one point by as much as nine orders of magnitude. Throughout the DEIS there is a lack of consistency in terms describing "worst" and "average" case senarios. A uniform approach to terminology, calcula-
R.24 tions and tables must be adopted to make a discussion of exposure doses resulting from accidents meaningful.

e. The absence of error terms quantifying the range and vari-
S.25 ability of measurements is a serious deficiency in the DEIS which makes it impossible to consider the level of confidence represented by the data reported.

f. The ecological characterizations of the proposed dumpsite off North Carolina underestimate the physical and biological activity of the marine environment. They must include a baseline description of the bathydemersal fish which inhabit the abyssal plain. These fish are J.9 the most abundant large organisms at these depths. Due to their mobility they are a potential biological vector for horizontal and vertical transport of materials released from submarines. Knowledge of baseline concentration of trace metals; natural and artificial radionuclides; and metal-sequestering proteins in the various organs and tissues of these organisms along with a thorough understanding of their food habits are prerequisites for any assessment of the potential for environmental contamination from nuclear submarine disposal. This information must be considered in revising the DEIS.

g. Currents at the Lower Continental Rise Area off North Carolina are, according to existing scientific data, significantly stronger than shown in the DEIS. These bottom currents appear to J.28 attain sufficient velocity to cause erosion of sediments at this site. Additional study of this concern must lead to revision of the DEIS.

h. The DEIS should be revised to include a Specific Activity assessment of sea disposal. The Critical Pathways assessment utilized in the DEIS does have greater acceptance and use because it is simple in theory, easily understood and simpler to explain. The Specific Activity approach is more abstract but has its place in this case where parameters in the food web are as poorly known as they are for the U.6 pathways of radionuclides from the abyssal depths of the ocean to man. The Specific Activity approach may also be of use when pathways cannot be easily monitored. However, standing alone, it would not provide adequate understanding as to the amount of radioactivity moving through the food chain. Specific Activity studies would complement Critical Pathways assessments.

#37b (Cont)

4.3 Cumulative Impacts

L.7 Neither the DEIS nor scientific research cited in support of the document consider disposal of decommissioned nuclear submarines within the context of cumulative sources of radioactivity. This is a significant omission which makes it difficult, if not impossible, to adequately consider the incremental increase in radioactivity entailed in land or sea disposal of decommissioned nuclear submarines. Council on Environmental Quality Regulations require consideration of cumulative impacts in preparing environmental impacts. Revision of the DEIS must incorporate adequate data, information and discussion to address this issue.

In considering the sea disposal option, consideration of cumulative impacts should begin with development of a comprehensive register of all radioactivity known or reasonably expected to enter the marine environment. This global inventory should include, but not be limited to, past, present and potential levels of radioactivity from: weapons testing (atmospheric fallout); historic U.S. and foreign radioactive waste operations; accidental losses of nuclear materials (including submarines); sea disposal of low level wastes under IAEA standards; other U.S. and foreign proposals for low level waste disposal; implacement of high level wastes in the seabed; operation of and/or discharges from civilian and military reactors; processing and reprocessing plants discharges; scientific experiments; accidental release; and proposed disposal of decommissioned nuclear submarines as well as other military or civilian wastes.

This assessment should include an estimate of the marine environment's capacity to assimilate radioactivity without damage. This estimate must be based on sound science and will, in all probability, require additional research. Assessment of cumulative impacts should include descriptions of past, present and projected effects both in terms of human health and specific components of the marine ecosystem.

4.4 Alternatives

Alternatives to sea disposal merit more detailed and comprehensive consideration in the DEIS. Examination of land disposal options must be expanded to address:

* mitigation of corrosion, specifically through disposal of reactor compartments in open trenches in an arid or semi-arid environment. As noted in the DEIS, the reactor compartment provides a substantial barrier against intrusion and pollution. Corrosion is recognized as the principal mechanism for release of radioactivity to the environment. Placement in arid or semi-arid locations appears to offer a significantly slower rate of corrosion -- and thus a slower release rate of radioactivity to the environment -- than either land burial or sea disposal. The surface disposal alternative is not mentioned in the DEIS but must be considered in revising that document. H.3

* monitoring, through consideration of a detailed program for measuring effects of reactor compartment disposal at the Savannah River or Hanford facilities. A meaningful review of monitoring land disposal is not found in the DEIS. Instead, the current text appears to imply existing monitoring programs at these facilities will be sufficient. As a generic or programmatic DEIS, the document should include a detailed discussion of land disposal monitoring in the form of a long term plan with cost projections. The degree to which existing monitoring programs could be incorporated into this effort must be considered with appropriate adjustments in allocated and projected costs. Reliance on monitoring programs described in Environmental Impact Statements from 1975 and 1978 is not, in itself, adequate. I.13

* retrievability, which is only possible with land disposal, is not adequately considered. In the DEIS, the Navy states recovery of decommissioned nuclear submarines from the ocean floor is not feasible. W.1

#37b (Cont)

Whether enough is known about radioactivity in the deep ocean to justify disposal of non-retrievable nuclear waste is a matter of scientific controversy.

W.1 Committee members concluded retrievability is a critical concern which warrants detailed consideration in revising the DEIS. The Committee noted land disposal of reactor compartments would permit retrieval of these wastes should that become necessary. The Committee concluded that the Navy's inability to retrieve submarines from the ocean bottom is sufficient grounds for rejection of

F.2 the sea disposal alternative. It should also be noted that current federal law requires that nuclear waste placed in the ocean must be retrievable.

O.7 Committee members characterized consideration of the land alternative in the DEIS as sketchy and inadequate. In revising the DEIS, the role of civilian contractors currently operating low level waste disposal sites at Hanford and Savannah River must be clarified with specific consideration given to additional cost factors resulting from: profit margins of economics operating the sites; payments to the State of Washington for a perpetual care and maintenance fund; payment of a percentage of gross to the State of Washington; and use of a commercial site versus available federal sites. Cost projections, apparently based

O.2 on 1975 and 1978 Environmental Impact Statements, must be revised to reflect current data. Additional details of cost estimates projected for disposal of the submarine hull (through scuttling or scrapping) after removal of the reactor compartment must be provided. Additional consideration must be given to: justification of or alternatives to welding the hull back together after the reactor compartment is removed

O.12 to permit sea disposal; estimating expense for "declassifying" obsolete submarines to permit scrapping operations; and reflecting income from sale of non-radioactive hulls as scrap in cost estimates.

4.5 Monitoring

Monitoring programs as reflected in the DEIS are inadequate to measure effects, the Committee concluded. Absense of a comprehensive monitoring program made it impossible to assess the relative merits of the sea disposal alternative. The ocean option cannot be considered, committee members said, in the absense of an adequate monitoring program.

In revising the DEIS, the Navy must consider and describe in detail the scope and costs of long-term monitoring of submarines on the deep ocean floor. Specific attention must be given to locating monitoring stations within 25 meters of the reactor compartment and in a network of sites where the plume of radioactivity from a submarine can be monitored. Details of plans for biota sampling, sediment sampling, use of submersibles and development of in situ monitoring equipment must be considered. The committee concluded the level of funds proposed in the DEIS is inadequate to support a sound monitoring program. J.76

The "best estimate" for corrosion described in Appendix G of the DEIS suggests the reactor compartment would be penetrated within 100 years and that bottom currents would begin flowing through the reactor itself within 400 years of disposal. This estimate is used in Figure G-2 to show release of radioactivity to the environment as occuring in +/-100 and +/-400 years. Comprehensive monitoring programs, then, must extend beyond short-term studies to include releases of radioactivity projected for 100 to 400 years from now. Yet the monitoring program described in Appendix K of the DEIS proposes only a $9 million budget for monitoring "during and after the period of active disposal." Further, in Section IV-C, the DEIS states frequency of post-disposal monitoring will be determined by initial results -- results from a period when the DEIS predicts no release of radioactivity to the marine environment. J.79

#37b (Cont)

The DEIS must also consider institutional impediments to conducting monitoring programs for very long (400+ year) periods. Experience during the past three decades has demonstrated the difficulty in retaining records -- let alone continuing monitoring programs -- of nuclear wastes placed in the marine environment. To a significant degree, records of nearly 100,000 curies of radioactive wastes dumped at sea from 1946 to 1970 are inadequate or missing and research and monitoring at historic sites is virtually non-existant following only limitedly successful and sporadic research and retrieval efforts conducted at high cost.

Editor's Note: Following the Committee's deliberations and completion of this report, Dr. Marvin Resnikoff of the Council on
A.10 | Economic Priorities issued a paper disputing Navy calculations on the amount of radioactivity in the submarines. Dr. Resnikoff projects levels of Cobalt-60 and Niobium-94 will be significantly higher than shown in the DEIS. Based on this, he concludes submarines should be placed in protective storage for up to 50 years while short-lived radionuclides
G.7 | decay. Then, he states, the reactor vessel should be removed and placed in a deep-mined repository. This "deep burial" option was not considered in the DEIS. In light of Dr. Resnikoff's work, reexamination of all disposal alternatives may be required.

5.0 Committee Membership

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#37b (Cont)

Appendix A.

This Appendix includes Council of Environmental Quality (CEQ) regulations which apply to the Navy's Draft Environmental Impact Statement (DEIS) along with the "Anderson Amendment" to Section 104 of the Ocean Dumping Act which Congress approved in 1982 as part of legislation increasing the federal gasoline tax.

§1508.25 Scope

Scope consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement. The scope of an individual statement may depend on its relationships to other statements (§§1502.20 and 1508.28). To determine the scope of environmental impact statements, agencies shall consider 3 types of actions, 3 types of alternatives, and 3 types of impacts. They include:

(a) Actions (other than unconnected single actions) which may be:

(1) Connected actions, which means that they are closely related and therefore should be discussed in the same impact statement. Actions are connected if they:

(i) Automatically trigger other actions which may require environmental impact statements.

(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.

(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

(2) Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

(3) Similar actions, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. An agency may wish to analyze these actions in the same impact statement. It should do so when the best way to assess adequately the combined impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement.

(b) Alternatives, which include: (1) No action alternative.

(2) Other reasonable courses of actions.

(3) Mitigation measures (not in the proposed action).

(c) Impacts, which may be: (1) Direct; (2) indirect; (3) cumulative.

§1502.14 Alternatives including the proposed action

This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (§ 1502.15) and the Environmental Consequences (§ 1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public. In this section agencies shall:

(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.

(c) Include reasonable alternatives not within the jurisdiction of the lead agency.

(d) Include the alternative of no action.

(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.

(f) Include appropriate mitigation measures not already included in the proposed action or alternatives.

Appendix A. (cont.)

§1502.15 Affected environment

The environmental impact statement shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced. Agencies shall avoid useless bulk in statements and shall concentrate effort and attention on important issues. Verbose descriptions of the affected environment are themselves no measure of the adequacy of an environmental impact statement.

§1502.16 Environmental consequences

This section forms the scientific and analytic basis for the comparisons under § 1502.14. It shall consolidate the discussions of those elements required by secs. 102(2)(C) (i), (ii) (iv), and (v) of NEPA which are within the scope of the statement and as much of sec. 102(2)(C)(iii) as is necessary to support the comparisons. The discussion will include the environmental impacts of the alternatives including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented. This section should not duplicate discussions in § 1502.14. It shall include discussions of:

(a) Direct effects and their significance (§ 1508.8).

§1502.16 (Con.)

(b) Indirect effects and their significance (§ 1508.8).

(c) Possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned. (See § 1506.2(d).)

(d) The environmental effects of alternatives including the proposed action. The comparisons under § 1502.14 will be based on this discussion.

(e) Energy requirements and conservation potential of various alternatives and mitigation measures.

(f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.

(g) Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures.

(h) Means to mitigate adverse environmental impacts (if not fully covered under § 1502.14(f)).

(43 FR 55994, Nov. 29, 1978; 44 FR 873, Jan. 3, 1979)

§1508.7 Cumulative impact

"Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

#37b (Cont)

Appendix A. (cont.)

§1508.8 Effects

"Effects" include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

§1502.22 Incomplete or unavailable information

When an agency is evaluating significant adverse effects on the human environment in an environmental impact statement and there are gaps in relevant information or scientific uncertainty, the agency shall always make clear that such information is lacking or that uncertainty exists.

(a) If the information relevant to adverse impacts is essential to a reasoned choice among alternatives and is not known and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

(b) If (1) the information relevant to adverse impacts is essential to a reasoned choice among alternatives and is not known and the overall costs of obtaining it are exorbitant or (2) the information relevant to adverse impacts is important to the decision and the means to obtain it are not known (e.g., the means for obtaining it are beyond the state of the art) the agency shall weigh the need for the action against the risk and severity of possible adverse impacts were the action to proceed in the face of uncertainty. If the agency proceeds, it shall include a worst case analysis and an indication of the probability or improbability of its occurrence.

§1502.23 Cost-benefit analysis

If a cost benefit analysis relevant to the choice among environmentally different alternatives is being considered for the proposed action, it shall be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. To assess the adequacy of compliance with sec. 102(2)(B) of the Act the statement shall, when a cost-benefit analysis is prepared, discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities. For purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations. In any event, an environmental impact statement should at least indicate those considerations, including factors not related to environmental quality, which are likely to be relevant and important to a decision.

Appendix A. (cont.)

Amendments to Section 104 of
the Marine, Protection, Research and Sanctuaries Act of 1972
(the Ocean Dumping Act), Public Law 97-424
January 6, 1983

OCEAN DUMPING

SEC. 424. (a) Section 104 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1414(b)) is amended by adding the following new subsections at the end thereof:

"(h) Notwithstanding any provision of title I of the Marine Protection, Research, and Sanctuaries Act of 1972 to the contrary, during the two-year period beginning on the date of enactment of this subsection, no permit may be issued under such title I that authorizes the dumping of any low level radioactive waste unless the Administrator of the Environmental Protection Agency determines—

"(1) that the proposed dumping is necessary to conduct research—

"(A) on new technology related to ocean dumping, or

"(B) to determine the degree to which the dumping of such substance will degrade the marine environment;

"(2) that the scale of the proposed dumping is limited to the smallest amount of such material and the shortest duration of time that is necessary to fulfill the purposes of the research, such that the dumping will have minimal adverse impact upon human health, welfare, and amenities, and the marine environment, ecological systems, economic potentialities, and other legitimate uses;

"(3) after consultation with the Secretary of Commerce, that the potential benefits of such research will outweigh any such adverse impact; and

"(4) that the proposed dumping will be preceded by appropriate baseline monitoring studies of the proposed dump site and its surrounding environment.

Each permit issued pursuant to this subsection shall be subject to such conditions and restrictions as the Administrator determines to be necessary to minimize possible adverse impact of such dumping.

"(i)(1) Two years after the date of enactment of this subsection, the Administrator may not issue a permit under this title for the disposal of radioactive waste material until the applicant, in addition to complying with all other requirements of this title, prepares, with respect to the site at which the disposal is proposed, a Radioactive Material Disposal Impact Assessment which shall include—

"(A) a listing of all radioactive materials in each container to be disposed, the number of containers to be dumped, the structural diagrams of each container, the number of curies of each material in each container, and the exposure levels in rems at the inside and outside of each container;

"(B) an analysis of the environmental impact of the proposed action, at the site at which the applicant desires to dispose of the material, upon human health and welfare and marine life;

"(C) any adverse environmental effects at the site which cannot be avoided should the proposal be implemented;

"(D) an analysis of the resulting environmental and economic conditions if the containers fail to contain the radioactive waste material when initially deposited at the specific site;

"(E) a plan for the removal or containment of the disposed nuclear material if the container leaks or decomposes;

"(F) a determination by each affected State whether the proposed action is consistent with its approved Coastal Zone Management Program;

"(G) an analysis of the economic impact upon other users of marine resources;

"(H) alternatives to the proposed action;

"(I) comments and results of consultation with State officials and public hearings held in the coastal States that are nearest to the affected areas;

"(J) a comprehensive monitoring plan to be carried out by the applicant to determine the full effect of the disposal on the marine environment, living resources, or human health, which plan shall include, but not be limited to, the monitoring of exterior container radiation samples, the taking of water and sediment samples, and fish and benthic animal samples, adjacent to the containers, and the acquisition of such other information as the Administrator may require; and

"(K) such other information which the Administrator may require in order to determine the full effects of such disposal.

"(2) The Administrator shall include, in any permit to which paragraph (1) applies, such terms and conditions as may be necessary to ensure that the monitoring plan required under paragraph (1)(J) is fully implemented, including the analysis by the Administrator of the samples required to be taken under the plan.

"(3) The Administrator shall submit a copy of the assessment prepared under paragraph (1) with respect to any permit to the Committee on Merchant Marine and Fisheries of the House of Representatives and the Committee on Environment and Public Works of the Senate.

"(4) (A) Upon a determination by the Administrator that a permit to which this subsection applies should be issued, the Administrator shall transmit such a recommendation to the House of Representatives and the Senate.

"(B) No permit may be issued by the Administrator under this act for the disposal of radioactive materials in the ocean unless the Congress, by approval of a resolution described in paragraph (D) within 90 days of continuous session of the Congress beginning on the date after the date of receipt by the Senate and the House of Representatives of such recommendation, authorizes the Administrator to grant a permit to dispose of radioactive material under this Act.

"(C) For purposes of this subsection—

"(1) continuity of session of the Congress is broken only by an adjournment sine die;

"(2) the days on which either House is not in session because of an adjournment of more than three days to a day certain are excluded in the computation of the 90 day calendar period.

"(D) For the purposes of this subsection, the term "resolution" means a joint resolution the resolving clause of which is as follows: "That the House of Representatives and the Senate approve and authorize the Administrator of the Environmental Protection Agency to grant a permit to under the Marine Protection, Research, and Sanctuaries Act of 1972 to dispose of radioactive materials in the ocean as recommended by the Administrator to the Congress on ——, 19—", the first blank space therein to be filled with the appropriate applicant to dispose of nuclear material and the second blank therein to be filled with the date on which the Administrator submits the recommendation to the House of Representatives and the Senate."

#67a

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June 30, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

These are our final comments on the "Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants," dated December, 1982.

J.15 First, we note with deep concern that the Navy has refused the repeated requests for public hearings in the fishing ports nearest the Pacific Study Area. The Navy's failure to conduct hearings in places accessible to the commercial fishermen who are most familiar with the study area casts
J.9 doubt on the accuracy and reliability of the information concerning the study area contained in the DEIS, including the data and conclusions about what fish are found at the
J.31 site and in what concentrations, about whether there is significant upwelling that could bring radiation to the surface quickly, about which way and how fast the prevailing currents
J.28 could carry the radioactive pollution, and about vessel traffic in the area.

On February 18, 1982, well within the deadline for comments on the scope of the DEIS, Senator Keene wrote to you calling your attention to the fact that the "annotated outline" of the DEIS failed to consider cumulative impacts, as required by Council on Environmental Quality regulations. You responded
L.7 with assurances that the DEIS would include a consideration of cumulative impacts. In spite of this assurance, no such

information appears in the DEIS, which therefore is inadequate even as a draft. The Navy needs to issue a second draft EIS including information on the cumulative impacts of radioactive pollution caused by the two nuclear attacks on Japan and by L.7
South Pacific weapons tests, fallout from nuclear weapons tests throughout the world, past ocean dumping of radioactive wastes at the Farallon Islands and elsewhere by the United States and other nations, future radioactive waste dumping at the same location as the submarines (recognizing that this location L.9
is likely to become the United States' all-purpose radioactive waste dump site), future radioactive waste dumping by Japan and other nations (recognizing that the United States' bad example F.8
is certain to encourage other nations to dump), natural background radiation, and all other sources. We respectfully request public hearings in Fort Bragg and Eureka, the major J.15
fishing ports nearest to the Pacific Study Area, during the comment period on the second draft EIS.

We note a major flaw in the data that the DEIS presents to support its conclusion on what it considers the key factor: dollar costs. In the "abstract" on the title page, and throughout the DEIS, it concludes again and again that the only reason to prefer sea disposal over land burial or storage is lower costs. The DEIS, however, fails to consider the costs of the J.76
eternal monitoring of the submarines that federal law would require, and it fails to present any data or calculations to O.2
support this significant conclusion.

We also note a major flaw in the data and conclusions on what we consider the key factor: retrievability, or the lack of it. W.1
The DEIS ambiguously states that "retrievability would not be possible with current technology." Does this mean that the submarines might become retrievable with some future technology? If so, the EIS needs to discuss this future technology, and its costs. If not, it needs to state clearly that the submarines, once sunk, will be irretrievable.

Finally, enclosed are two pieces of California legislation which pertain to the matter: Senate Joint Resolution 27 of 1982, which remains the only officially adopted position of the State of California on these questions; and Assembly Bill 138 of 1983, which passed the State Assembly on June 8 and which we are confident will pass the State Senate and become law by the beginning of 1984.

Thank you for your consideration of these comments. We look forward to the opportunity to comment further.

Sincerely,

BARRY KEENE
Senator

DAN HAUSER
Assemblyman

BK/DH:bgd
Enclosures
cc: Hon. John Van De Kamp, Attorney General, State of California
Mr. Michael Fischer, Executive Director, Calif. Coastal Comm.

AMENDED IN ASSEMBLY FEBRUARY 10, 1983

CALIFORNIA LEGISLATURE—1983–84 REGULAR SESSION

ASSEMBLY BILL No. 138

Introduced by Assemblyman Hauser
(Coauthor: Senator Keene)

December 20, 1982

An act to add Section 25613 to the Health and Safety Code, relating to radioactive waste.

LEGISLATIVE COUNSEL'S DIGEST

AB 138, as amended, Hauser. Radioactive waste: ocean disposal.

Under the federal Coastal Zone Management Act of 1972, the Secretary of Commerce may make grants to any coastal state for the purpose of developing a coastal state management program. Each federal agency conducting or supporting activities directly affecting the coastal zone is required to conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs.

Under the California Coastal Act of 1976, which constitutes California's coastal zone management program for purposes of the federal act, the California Coastal Commission has the primary responsibility for implementing the state act.

Existing state law also prohibits the disposal of radioactive waste which would result in the significant radioactive contamination of the the environment and authorizes the State Department of Health Services to prohibit the disposal of radioactive waste.

This bill would make a legislative finding concerning the dumping of radioactive waste into the ocean and would require the commission, in cooperation with the department

and other specified entities, to use all means available to the commission, pursuant to law, to prevent the dumping of radioactive waste in the ocean, ~~if~~ *unless* the commission makes specified findings *regarding that dumping*.

Vote: majority. Appropriation: no. Fiscal committee: yes. State-mandated local program: no.

The people of the State of California do enact as follows:

SECTION 1. Section 25613 is added to the Health and Safety Code, to read:

25613. (a) The Legislature finds and declares that the dumping of radioactive waste, including the scuttling of radioactive nuclear submarines, into the Pacific Ocean, could adversely affect the California coastal zone.

(b) The California Coastal Commission, in cooperation when appropriate with the department, *the Department of Justice,* the Department of Fish and Game, and the Joint Committee on Fisheries and Aquaculture, shall use any means available to the commission, pursuant to law, to prevent any dumping of radioactive waste in the Pacific Ocean by any public or private entity, ~~if~~ *unless* the commission finds that the dumping would have ~~an~~ *no* adverse impact upon the resources and environmental values of the California coastal zone and would ~~not~~ be conducted in accordance with all applicable federal and state laws, including the federal Coastal Zone Management Act of 1972 (16 U.S.C. Secs. 1451 et seq.) as amended by P.L. 94-370, 1976, and P.L. 96-464, 1980.

O

#67a (Cont)

Senate Joint Resolution No. 27

RESOLUTION CHAPTER 179

Senate Joint Resolution No. 27—Relative to radioactive waste.

[Filed with Secretary of State September 2, 1982.]

LEGISLATIVE COUNSEL'S DIGEST

SJR 27, Keene. Radioactive waste.

This measure would memorialize the President and Congress to ban the scuttling of nuclear submarines off the coast of California and all other radioactive waste disposal in Pacific Ocean waters under the control of the United States until and unless future valid and reliable scientific studies prove it is safe. The measure would support a proposed amendment to the Marine Protection Research and Sanctuaries Act which would require that any federal agency proposing to dump radioactive wastes in the ocean to provide Congress and the public with certain information concerning the proposed dumping and would permit either house of Congress to veto any permit of the Environmental Protection Agency authorizing such dumping. The measure would propose an international treaty to ban disposal of radioactive waste in the Pacific Ocean, as specified. The measure would also request that specified agencies of the federal government provide information relating to marine life in the vicinity of existing radioactive dumpsites in the ocean waters near California. The measure would memorialize Congress to investigate the effects of radioactive contamination of the oceans. The measure would request Congress and the President to require the Environmental Protection Agency to give notice prior to publication of changes in ocean dumping regulations to Pacific coast state and local governments and to consult with those agencies and to conduct public hearings on the Pacific coast before adoption of the regulations. The measure would request the Pacific states and the United States Pacific territories to join California in opposing all radioactive waste disposal in the Pacific, as specified, and would invite those entities to attend meetings in Monterey, California, on November 15, 16, and 17, 1982, to plan common strategy for this opposition.

WHEREAS, The oceans of the world are vital to all life on the continents; and

WHEREAS, The ocean waters off the shore of California are the basis for the state's commercial and recreational fisheries which are a source of food for the people of California and are important to coastal recreation and tourism economies; and

WHEREAS, The marine environment is a fragile ecosystem that may be significantly altered or contaminated by shortsighted

disposal of radioactive wastes; and

WHEREAS, Radioactive wastes have been dumped in the coastal waters off the shore of California and some samples of ocean sediment have been found to be contaminated with radioactive materials, including plutonium; and

WHEREAS, The consequences of nuclear wastes in the marine environment are poorly understood and pose a threat to the human food chain; and

WHEREAS, Congress is considering HR 6113 by Representative Norman D'Amours of New Hampshire to extend and amend the Marine Protection Research and Sanctuaries Act; and

WHEREAS, Representative Glenn Anderson of California has proposed an amendment to HR 6113 to require that any federal agency proposing to dump radioactive wastes in the ocean shall provide Congress and the public with site-specific information about the full health, environmental, and economic consequences of the proposed dumping; and

WHEREAS, The Anderson amendment also would allow either house of Congress to veto any permit the Environmental Protection Agency might issue for ocean dumping of radioactive waste; and

WHEREAS, The United States Environmental Protection Agency is preparing regulations to lift the current moratorium on ocean dumping of radioactive wastes in United States territorial waters, which has been in effect since 1970, and the United States Department of Energy is developing the option of seabed disposal of radioactive wastes; and

WHEREAS, The United States Navy is considering plans to scuttle decommissioned nuclear submarines in the ocean, possibly off the shore of Cape Mendocino; and

WHEREAS, Japan is considering plans to dump high-level radioactive wastes in the Pacific Ocean north of Micronesia, a United States trust territory; and

WHEREAS, The Pacific Marine Fisheries Commission, formed by interstate compact of the Pacific states, is scheduled to meet in Monterey, California, on November 15, 16, and 17, 1982, and is scheduled to discuss radioactive waste dumping in the Pacific Ocean; now, therefore, be it

Resolved by the Senate and Assembly of the State of California, jointly, That the Legislature of the State of California respectfully memorializes the President and Congress to ban the scuttling of nuclear submarines off the coast of California and all other radioactive waste disposal in Pacific Ocean waters under the control of the United States until and unless future valid and reliable scientific studies prove it is safe; and be it further

Resolved, That the Legislature supports the Anderson amendment to the Marine Protection Research and Sanctuaries Act as a reasonable interim measure while further scientific research is conducted; and be it further

#67a (Cont)

Resolved, That the Legislature proposes an international treaty to ban the disposal of radioactive wastes anywhere in the Pacific Ocean until and unless future valid and reliable scientific studies prove it safe, and requests that the Congress and the President work diplomatically to oppose any disposal of radioactive wastes anywhere in the Pacific until the treaty takes effect; and be it further

Resolved, That the Legislature respectfully memorializes the Congress to conduct an investigation of the effects of all radioactive contamination of the oceans from all sources to determine the effects of the contamination and to prevent repetition of radioactive waste dumping done without public notice or in violation of laws; and be it further

Resolved, That the Legislature finds and declares that regular monitoring of marine life in the vicinity of the existing radioactive waste dumpsites off the shore of California, including those near the Farallon Islands, is necessary to protect the public health of the people of California; and be it further

Resolved, That the Legislature requests that the Congress, the President, the Environmental Protection Agency, the National Marine Fisheries Service, and the National Oceanic and Atmospheric Administration provide for this needed regular monitoring and provide full information from the monitoring to the California Legislature and to the California State Department of Health Services; and be it further

Resolved, That the Legislature requests that the Congress and the President require the Environmental Protection Agency to provide Pacific coast state and local governments with advance notice prior to publication in the Federal Register of any changes in ocean dumping regulations, and require the Environmental Protection Agency to consult with Pacific coast state and local governments and to conduct public hearings on the Pacific coast before adoption of any changes in ocean dumping regulations; and be it further

Resolved, That the Legislature respectfully requests the Pacific states and United States Pacific territories to join California in opposing all radioactive waste disposal in the Pacific until and unless future valid and reliable scientific studies prove it is safe, and invites the Pacific states and United States Pacific territories to a meeting in Monterey, California, on November 15, 16, and 17, 1982, in connection with the meeting of the Pacific Marine Fisheries Commission, to plan common strategy for this opposition; and be it further

Resolved, That the Secretary of the Senate transmit copies of this resolution to the President and Vice President of the United States, to the Speaker of the House of Representatives, to each Senator and Representative from California in the Congress of the United States, to the Administrator of the Environmental Protection Agency, to the Director of the National Marine Fisheries Service, to the Administrator of the National Oceanic and Atmospheric

Administration, and to the Governors and presiding officers of the Legislatures of Alaska, Hawaii, Idaho, Oregon, and Washington, and to the Governor of each of the United States Pacific territories

O

#72a*

TELEPHONE
(707) 468-4221

COUNTY OF MENDOCINO
BOARD OF SUPERVISORS
COURTHOUSE
UKIAH, CALIFORNIA 95482

TESTIMONY BEFORE U.S. NAVY/EPA HEARING ON DEIS
REGARDING OCEAN DISPOSAL OF NUCLEAR WASTES

I come before you today as Chairman of the Mendocino County Board of Supervisors, representing that Board in its position of unanimous opposition to disposal of nuclear wastes in the Pacific Ocean.

*J.2 There is little comfort for us in the statement by Chapman B. Cox of the Navy Logistics Section that Cape Mendocino has been selected only as a "representative study area" which "may be subsequently designated" as the west coast disposal site. We fully realize that few locations other than Cape Mendocino would meet the required selection criteria.

L.53 N.3 Beyond our narrow, parochial interest that radioactive material not be dumped off our coastline, within our fishery, is the larger issue of whether such dumping should occur anywhere off the coast of the United States, or any other country. Surely, the Navy and the EPA do not expect the counties and states located on coastlines to accept this DEIS as evidence of the federal government's commitment to a sound nuclear waste disposal program. I need only draw your attention to the October 1981

*Other issues discussed by Mr. Hamburg are side barred in Exhibits 72 and 72b.

BOARD STATEMENT

GAO report which admits that the "Federal government has no complete and accurate catalogue of information on how much, what kind, and where low level radioactive waste (has been) dumped." With this type of record to point to, there should be no surprise in the fact that you are not trusted to carry forth such a broad and delicate program. L.6

It is the position of the Mendocino County Board of Supervisors that the DEIS does not adequately address the issue of migration of nucleotides from waste forms to the water column, to sediments, and to organisms. The critical issue of pathways of radioactivity to humans must be considered in full detail. We note with grave concern that the data presented in the DEIS on albacore catches in the vicinity of the Mendocino site are based on 13-23 year old information while current data suggest a much more significant fishery in the area. J.20 L.35 L.1 J.12

The Mendocino Board stands united with our neighboring City Councils and Boards of Supervisors, as well as with scores of state and federal elected officials, and millions of our own citizens in opposing the profligate use of our precious ocean resource as a "garbage can" for the federal government. Further, we support the Oceanic Society in their proposal that the federal policy prohibiting disposal of radioactive wastes in the marine environment continue until:

#72a (Cont)

1. A single, coordinated, comprehensive nuclear waste management program is established by the federal government in one agency.

L.6 L.7 2. An increased program of scientific study, evaluation and continuing monitoring is launched to determine in definitive, data-based terms the impact of past radioactive waste disposal on the marine environment. This effort must include monitoring of food fish taken in the ocean and from the retail markets to test for radioactivity and toxic contamination.

J.76 L.6 W.1 3. Criteria are established for marine disposal of nuclear waste that include as high priorities provisions for continued monitoring of disposal at new sites as well as measures for monitoring past dumps and retrieval.

4. Federal regulations mandate the best available technology for packaging, transport, and disposal of these wastes.

We firmly believe that marine disposal should be considered only as a last resort once all terrestial disposal options have been explored, utilized, and exhausted.

DAN HAMBURG
Supervisor
SECOND DISTRICT

COUNTY OF MENDOCINO
Board of Supervisors
COURTHOUSE
UKIAH, CALIFORNIA 95482

Telephone
COURTHOUSE
(707) 468 4221
HOME
(707) 468 9036

TESTIMONY BEFORE U.S. NAVY/EPA HEARING ON DEIS
REGARDING OCEAN DISPOSAL OF NUCLEAR WASTES

At this point, I would like to make a further statement as an individual Supervisor. I believe that the matter before us is far greater than simply which ocean gets the garbage, which fishery is polluted, or even, whether ocean or land disposal ultimately becomes the preferred option.

The discussion in the DEIS is centered on what to do over the next few years with 100 radioactive submarine hulks. These subs represent only a tiny fraction of the total amount of nuclear waste for which there is no planned disposal method. This tremendous tonnage of nuclear waste represents only a fraction of the overall problem of toxic waste disposal in the nation.

Of grave concern to me is the message I am receiving from the high officials of the Reagan Administration that environmental protection in general, and nuclear and toxic waste disposal in particular, are being neglected under the guise of "deregulation". This Administration seems to believe that what is good for the military and for the large corporation is best for America.

#72a (Cont)

PERSONAL STATEMENT Page 2

It is indicative of this Administration's stance that the very agencies which are responsible for environmental protection and stewardship of our resources are pushing hard to open our continental shelf to the oil rig and our fishing grounds to the obsolete radioactive submarine. Perhaps it is what we might reasonably expect from an Administration that dubs its latest multi-megaton nuclear weapon, the "Peace Keeper". It's enough to make one believe that the Orwellian nightmare has arrived, and a year ahead of schedule at that.

It is appalling to me that what we obstensibly are doing here is trying to figure out how to dump the Polaris in order to make room for the Trident. Does it not occur to this Administration and its adherents that this is a path of folly? In fact, it is arrogance, the worst kind of folly because it threatens our very survival as a species.

N.12 First, we construct weaponry capable of massive, unprecedented death and destruction. Then, in discarding this weaponry, in order to construct ever more efficient and potent death machines, we risk grave ecological damage. Where is the plan, Navy and EPA, to dispose of the Trident when its time for burial has come? And what of the kilotons of other spent weapons and obsolete power plants that litter the Earth and spread their radioactive menace?

PERSONAL STATEMENT Page 3

I believe it is time for an overview. It is time to take stock, to redirect our efforts into harmony with other living things on this planet. Because the Earth will digest only so much of our shamelessness before it lays waste to the wastemaker.

DAN HAMBURG

DAN HAMBURG
Supervisor - Second District
County of Mendocino

Home
[illegible]
Ukiah, Calif. [illegible]
Phone [illegible]

Office
Courthouse
Ukiah, Calif. [illegible]
Phone [illegible]

#72b

COUNTY OF MENDOCINO
BOARD OF SUPERVISORS
COURTHOUSE
UKIAH, CALIFORNIA 95482

TELEPHONE
(707) 468-4221

June 28, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OP-22)
Department of the Navy
Washington, D.C. 20350

RE: Draft Environmental Impact Statement (EIS) on the diposal of decommissioned, defueled Naval Submarine Reactor Plants -- December, 1982

Dear Captain Wagner:

It is the understanding of the Mendocino County Board of Supervisors that the draft EIS referenced above describes two methods for disposal of decommissioned, defueled naval submarine reactor plants. One method described in the EIS is land disposal -- by burial -- at existing federal sites; and deep sea disposal ("ocean option") off the coast of Cape Hatteras, North Carolina and/or off the coast of Cape Mendocino, California. It is the disposal off the coast of Cape Mendocino that concerns this Board of Supervisors. After reviewing the above referenced EIS, the Board of Supervisors offers the following comments for consideration in the preparation of the Final Environmental Impact Statement.

*L.7 1. The draft EIS does not address cumulative environmental impacts from radioactivity entering the marine environment.

W.1 2. Present law requires any radioactive waste dumped into the ocean must be retrievable. The draft EIS does not address or indicate how compliance with this requirement would be met.

I.76 3. The monitoring program described to guage impacts on deepsea environments needs to be clarified on how the monitoring will be accomplished.

***Other issues discussed by Mr. Hamburg are side barred in Exhibits 72 and 72a.**

4. The draft EIS should address the concept of disposing decommissioned nuclear submarines via ocean dumping when it appears this concept violates the U.S. Ocean Dumping Act. L.4

5. The general concept mentioned above also appears to violate federal environmental law adopted to protect the ecological environment. And, therefore, should be addressed in the draft EIS.

6. The draft EIS does not take into consideration potential impacts on the local economy relative to fishing and tourism. The draft should address and comment on the potential impact on coastal fishing and tourism. L.53 O.34

7. The draft EIS should discuss other alternatives, i.e. special buildings, etc., rather than just the two (ocean dumping and underground burial) concepts discussed. H.3

Based on the above stated concerns the Mendocino County Board of Supervisors believe that the proposed "ocean option" to dispose of nuclear submarines will have a significant effect on the environment because it has the potential to degrade the quality of the ocean environment and cause substantial adverse effects on human beings, either directly or indirectly. Futhermore, the Board of Supervisors believe that the proposed "ocean option" breaches and is in conflict with published national and international regulations relating to ocean dumping. Finally, the Board of Supervisors believe that the "ocean option" will create a potential public health hazard by the disposal of radioactive materials which may pose a hazard to people or animal life in the affected area. Accordingly, the Board of Supervisors would appreciate the concerns stated above be addressed in the Final EIS. L.4 L.36 L.14

In addition to the above stated concerns regarding the draft EIS, the Mendocino County Board of Supervisors has gone on record (February 8, 1983) opposing the concept of nuclear waste disposal in the ocean. Furthermore, the County of Mendocino has received letters of support opposing the ocean dumping concept from the Counties of Santa Cruz, Santa Barbara, Marin, San Mateo, and Sonoma. In addition to the counties, support has also been received from the Cities of Fort Bragg, Crescent City, Capitola, Pismo Beach, Arcata, Point Arena, Half Moon Bay, Santa Barbara, Santa Monica, and Carmel (enclosures).

414

#72b (Cont)

Captain Edward F. Wagner
Page Three
June 28, 1983

To further express the Board of Supervisors' concerns regarding the concept of ocean dumping, a letter (enclosed) was also sent to Governor George Deukmejian delineating the Board's concern and requesting that he support specific legislation opposing the nuclear waste dumping in the ocean. It goes without saying that the Board of Supervisors, as well as others, are adamantly opposed to the dumping of nuclear waste in the ocean. We sincerely hope you will consider our concerns as well as others.

Should you have any questions regarding this matter, please feel free to contact me.

Sincerly,

Dan Hamburg
Chairman

VH:mah

COUNTY OF MENDOCINO
BOARD OF SUPERVISORS
COURTHOUSE
UKIAH, CALIFORNIA 95482

TELEPHONE
(707) 468-4221

April 12, 1983

Governor George Deukmejian
State Capitol
Sacramento, CA 95814

Honorable Governor Deukmejian:

The Mendocino County Board of Supervisors actively opposes the current proposal of the U.S. Navy and the Environmental Protection Agency (EPA) to scuttle spent radioactive submarines off Cape Mendocino.

We find the Draft Environmental Impact Statement (DEIS) recently released by the Navy to be woefully inadequate in that it fails to adequately address the critical issue of the migration of nucleotides from waste forms to the water column, to sediments, and to organisms. The critical issue of pathways of radioactivity to humans has not been considered in full detail. Further, we are concerned that the data presented in the DEIS on albacore catches in the vicinity of the Mendocino site are based on 13-23 year old information while current data suggest a much more significant fishery in the area. L.36 J.12

This Board feels that the federal government's overall commitment to a sound nuclear waste disposal program is highly questionable. We draw your attention to the 1981 General Accounting Office report on this subject which states: "The Federal government has no complete and accurate catalogue of information on how much, what kind, and where low level radioactive waste has been dumped in the past." With this type of record as evidence, it is impossible for us to be secure that the Navy should be trusted to carry forth such a broad and delicate program.

#72b (Cont)

Governor George Deukmejian April 12, 1983
Page 2

Assemblyman Dan Hauser (Arcata) has recently introduced AB 138 in the state legislature. This bill makes a finding that the dumping of nuclear wastes in the Pacific Ocean, including the scuttling of radioactive nuclear submarines, could adversely affect the California Coastal Zone. The bill requires that state agencies put strong effort toward the defeat of the Navy program.

The Mendocino County Board of Supervisors urges your active support of AB 138 and opposition to ocean dumping of nuclear waste. We have already been joined in our position by City Councils, Boards of Supervisors, and scores of state and federal elected officals throughout California and the nation as a whole. We hope that your voice, Governor, will join with these and put to final rest this ill-conceived plan.

Sincerely yours,

Dan Hamburg

DAN HAMBURG
Chairman, Mendocino County
Board of Supervisors

DH:rb

cc: Assemblyman Hauser
Senator Keene
Congressman Bosco
Senator Wilson
Senator Cranston

Resolution No. -71101

Administration Center
Santa Rosa, CA 95401

February 2, 1982

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SONOMA, STATE OF CALIFORNIA, ASKING THE FEDERAL GOVERNMENT TO BAN OCEAN DISPOSAL OF RADIOACTIVE WASTE AND DECOMMISSIONED NUCLEAR SUBMARINES

WHEREAS, the oceans of the world are vital to all life forms on earth, and

WHEREAS, the ocean waters off the Sonoma County and California coast are the basis for the County and State commercial and recreational fisheries, and

WHEREAS, the fishing industry constitutes a source of food for the County, State and are important to the economies of the north coast, and **L.53**

WHEREAS, the marine environment is a fragile ecosystem that could be altered by the disposal of known radioactive waste, and **L.14**

WHEREAS, past radioactive ocean waste disposal have rendered contamination to ocean sediment and the marine environment, and **L.6**

WHEREAS, the longterm effect of radioactive waste in the marine ecology are poorly understood and pose a threat to the human food chain, and **L.14**

WHEREAS, the United States Navy and U. S. Department of Energy are considering plans to sink decommissioned nuclear submarines off the shores of Northern California.

NOW, THEREFORE, BE IT RESOLVED that the Sonoma County Board of Supervisors request that the federal government ban all radioactive waste disposal, including decommissioned nuclear submarines, in ocean waters.

SUPERVISORS:

Adams Aye Putnam Aye Rudee Aye Carpenter Aye Esposti Aye

Ayes 5 Noes 0 Absent 0 Abstain 0

#72b (Cont)

BOARD OF SUPERVISORS
(408) 425-2201

COUNTY OF SANTA CRUZ

GOVERNMENTAL CENTER   701 OCEAN STREET   SANTA CRUZ, CALIFORNIA 95060-4069

DAN FORBUS	ROBLEY LEVY	GARY A. PATTON	E. WAYNE MOORE, JR.	JOE CUCCHIARA
FIRST DISTRICT	SECOND DISTRICT	THIRD DISTRICT	FOURTH DISTRICT	FIFTH DISTRICT

February 22, 1983

Dan Hamburg, Chairperson
Mendocino County Board of Supervisors
Courthouse
Ukiah, CA 95482

Dear Chairperson Hamburg:

Thank you for your letter of February 10, 1983 urging our Board to take action to oppose the ocean disposal of radioactive submarines. On February 15, 1983, our Board heard a presentation from The Oceanic Society and subsequently adopted the attached resolution opposing the ocean disposal of radioactive, obsolete nuclear submarines and urging that the Navy postpone any such disposal until it can be proven to be less harmful to human health and the environment than other practical methods of disposal.

I hope that this information will be helpful to you in your County's efforts to address this critical issue. Stay in touch!

Sincerely,

JOE CUCCHIARA, Chairperson
Board of Supervisors

JC:tk

cc: Clerk of the Board

Attachment

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF SANTA CRUZ, STATE OF CALIFORNIA

RESOLUTION NO. 58-83

On the motion of Supervisor Moore
duly seconded by Supervisor Levy
the following resolution is adopted:

RESOLUTION OPPOSING THE OCEAN DISPOSAL OF RADIOACTIVE SUBMARINES

WHEREAS, the U.S. Navy has prepared a program for the ocean disposal of at least 100 decommissioned nuclear submarines, as evidenced by the release of a draft environmental impact report on this plan; and

WHEREAS, the draft EIR indicates that such submarines will contain about 50,000 curies of residual radioactivity at the time of disposal; and

WHEREAS, medical science has proven that radioactivity endangers human health both from direct exposure and from ingesting food sources formerly exposed to radiation; and

WHEREAS, the United States Government terminated all ocean disposal of radioactive waste in 1970 as an unwise and unsafe program; and | L.6

WHEREAS, the disposal of radioactive submarines in the ocean could result in the concentration of radioactive materials in edible fish, as radioactive elements are transmitted up the food chain; and | L.36

WHEREAS, the Navy has stated that the priority site for this disposal on the west coast is 160 nautical miles southwest of Cape Mendocino, California; and | J.2

WHEREAS, all coastal locations along the California coast have the potential of receiving the effects of this proposed increased radioactive accumulation in the Pacific Ocean if such disposal actually takes place. | L.7

NOW, THEREFORE, BE IT RESOLVED that the Board of Supervisors of the County of Santa Cruz opposes the ocean disposal of radioactive submarines and further resolves that the U.S. Navy should postpone any ocean disposal plan for radioactive substances until:

1. The U.S. Government has established a single, coordinated comprehensive nuclear waste management program under the responsibility of one agency, and

2. The U.S. Environmental Protection Agency activates its promise to conduct a thorough scientific monitoring program of existing nuclear waste ocean disposal sites off California, and

3. The U.S. Government can prove that an ocean disposal option offers less harm to human health and the environment than other practical methods of disposal

#72b (Cont)

NOW, THEREFORE, BE IT FURTHER RESOLVED that the Board of Supervisors of Santa Cruz County urges the United States Government to encourage other governments with nuclear submarines and concerned international agencies to seriously address the issue of nuclear waste disposal in the ocean; and

NOW, THEREFORE, BE IT FURTHER RESOLVED that the Board of Supervisors of Santa Cruz County requests the United States Government to hold public hearings in coastal areas on this matter.

PASSED AND ADOPTED by the Board of Supervisors of the County of Santa Cruz, State of California, this 15th day of February, 1983 by the following vote:

AYES: SUPERVISORS FORBUS, MOORE, LEVY, CUCCHIARA
NOES: SUPERVISORS NONE
ABSENT: SUPERVISORS PATTON

Chairperson of said Board

ATTEST:

Clerk of said Board

Approved as to form:

[signature]
County Counsel

DISTRIBUTION:

President Reagan
Secretary of Defense
Secretary of Navy
Senator Cranston
Senator Wilson
Congressman Panetta
State Senator Mello
Assemblyman Farr
Save Our Shores
Humboldt and Mendocino Counties Board of Supervisors
Congressman Zschaw

THE BOARD OF SUPERVISORS OF MARIN COUNTY

ADMINISTRATION BUILDING
SUITE 315, CIVIC CENTER
SAN RAFAEL, CALIFORNIA 94903
TELEPHONE (415) 499 7331

March 10, 1983

COUNTY OF MENDOCINO BOARD OF ... MAR 1 1983 RECEIVED UKIAH, CALIFORNIA

Dan Hamburg, Chairman
Board of Supervisors
County of Mendocino
Ukiah, California 95482

Re: Nuclear Waste Disposal in the Pacific Ocean

Dear Mr. Hamburg:

Enclosed is copy of Resolution No. 83-83 adopted by the Marin County Board of Supervisors at its meeting on March 1st opposing nuclear waste dumping off the coast of California until more scientific data are available to prove that this is the safest method of disposal. | N.3

Incidentally, we have never received the report from the Oceanic Society and Dr. Herz's articles which were mentioned in your letter of February 10.

Please let us know if there there is further assistance needed in regard to this issue.

Very truly yours,

[signature]
VAN GILLESPIE, Clerk

mc

Encl.

Chairman BOB ROUMIGUIERE San Rafael 1st District | HAROLD C. BROWN JR. San Anselmo 2nd District | Vice Chairman AL ARAMBURU Tiburon 3rd District | GARY GIACOMINI San Geronimo 4th District | BOB STOCKWELL Novato 5th District | Clerk VAN GILLESPIE Regular Meeting

#72b (Cont)

RESOLUTION NO. 83-83

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF MARIN OPPOSING NUCLEAR WASTE DUMPING OFF THE COAST OF CALIFORNIA

WHEREAS, the Department of the Navy has not demonstrated that dumping defueled, decommissioned nuclear submarines off Cape Mendocino is safe; and

WHEREAS, the Marin County Board of Supervisors finds that additional study is necessary in this area; and

N.3 WHEREAS, the Navy has not proved that disposal of these submarines is environmentally sound and would not have a detrimental effect on the food chain;

NOW, THEREFORE, BE IT RESOLVED that the Marin County Board of Supervisors is in opposition to the disposal of these nuclear submarines off the coast of California until more scientific data are available to prove that this is the safest alternative and the least hazardous to the environment and to our citizens.

PASSED AND ADOPTED this 1st day of March, 1983, by the following vote, to wit:

AYES: SUPERVISORS Bob Stockwell, Gary Giacomini, Harold C. Brown, Al Aramburu, Bob Roumiguiere

NOES: None

ABSENT: None

Bob Roumiguiere

CHAIRMAN, BOARD OF SUPERVISORS

ATTEST:

Van Gillespie

COUNTY OF SANTA BARBARA

CALIFORNIA

OFFICE OF COUNTY CLERK RECORDER

February 25, 1983

The Honorable Board of Supervisors
County of Mendocino
Courthouse
Ukiah, CA 95482

Dear Honorable Board Members,

On February 22, 1983, the Santa Barbara County Board of Supervisors voted to support your opposition to the concept of disposal of Nuclear waste in the Pacific Ocean.

Yours truly,

Katherine Ann Maglio

Katherine Ann Maglio
Deputy Clerk-Recorder

KM

COUNTY OF MENDOCINO BOARD OF SUPERVISORS MAR 2 1983

#72b (Cont)

City of Carmel-by-the-Sea

POST OFFICE BOX CC
CARMEL, CALIFORNIA [illegible] [illegible]

February 28, 1983

Mr. Dan Hamburg
Chairman, County of Mendocino
Mendocino Board of Supervisors
Ukiah, California 95482

Dear Chairman Hamburg,

The Mayor of Carmel-by-the-Sea, Charlotte Townsend, forwarded a telegram to Sacramento, California, on Wednesday, February 23, 1983, stating the City of Carmel's opposition to the concept of disposal of nuclear waste in the Pacific Ocean.

The City of Carmel-by-the-Sea has historically been a forerunner on issues involving the preservation of our environment and is most distressed at the concept of using the California coastline as a "dumping site" for harmful waste.

Our appreciation to you for requesting the Cities and Counties in California to notify their elected and appointed officials of our opposition to this proposal.

Very truly yours,

Douglas J. Schmitz
City Administrator

DJS:lc
cc: Mayor and City Council

Board of Supervisors

COUNTY OF SAN MATEO

COUNTY GOVERNMENT CENTER • REDWOOD CITY • CALIFORNIA 94063 [illegible]

BOARD OF SUPERVISORS
[illegible]

Minerva L. Takis
[illegible]

February 24, 1983

Mr. Dan Hamburg
County of Mendocino
Board of Supervisors
Courthouse
Ukiah, CA 95482

Dear Mr. Hamburg:

The San Mateo County Board of Supervisors on February 22, 1983 unanimously adopted Resolution No. 44267, Opposition to Nuclear Waste Disposal in the Pacific Ocean. Attached is a copy of said Resolution for your files.

Very truly yours,

MINERVA L. TAKIS
Clerk of the Board

h

Attachment

P.S.: This letter will confirm our Board's action as given to you by phone ~~this morning~~.

#72b (Cont)

RESOLUTION NO. 44267

BOARD OF SUPERVISORS, COUNTY OF SAN MATEO, STATE OF CALIFORNIA

* * * * * * * * * * * * *

OPPOSITION TO NUCLEAR WASTE DISPOSAL IN THE PACIFIC OCEAN

WHEREAS, the United States Navy and the Environmental Protection Agency propose to dispose of 100 defueled, decommissioned nuclear submarines off Cape Mendocino; and

L.53 WHEREAS, studies point to the conclusion that this is an ill-concieved plan which poses serious threat to the North Coast fishing industry and to those who consume its product; and

WHEREAS, we further believe that alternatives exist which are far more environmentally sound and not nearly as hazardous to human beings;

NOW, THEREFORE, BE IT RESOLVED, that the San Mateo County Board of Supervisors joins the Mendocino Board of Supervisors in opposition to nuclear waste dumping off the California Coast.

\#\#\#\#\#\#\#\#\#\#\#\#\#

Regularly passed and adopted this 22nd day of February 19 83.

AYES and in favor of said resolution:

Supervisors: K. JACQUELINE SPEIER

JOHN M. WARD

ANNA G. ESHOO

ARLEN GREGORIO

WILLIAM J. SCHUMACHER

NOES and against said resolution:

Supervisors: ____________

Absent Supervisors: NONE

ARLEN GREGORIO
Chairman, Board of Supervisors
County of San Mateo
State of California

ATTEST:

MINERVA L. TAKIS
Clerk of said Board of Supervisors
(SEAL)

546

#72b (Cont)

SANTA MONICA

Mayor Ruth Yannatta Goldway

1685 Main Street, Santa Monica, California 90401

March 1, 1983

Dan Hamburg
Chairman, Board of Supervisors
County of Mendocino
Courthouse
Ukiah, CA 95482

Dear Mr. Hamburg:

This letter is to follow-up and re[illegible]ate our telephone conversation of February 23, 1983.

I am pleased to report to you that the Santa Monica City Council voted unanimously (at our Council meeting last week) to join with the County of Mendocino in its opposition to nuclear waste disposal in the Pacific Ocean.

Santa Monica has worked diligently over the last two years in close co-operation with both Southern Califonia coastal cities and Northern California coastal cities to protect the ocean from the desires of the current administration in Washington to destroy our natural resources. We have worked to stop off-shore oil drilling. We view this action in response to the proposal for nuclear waste disposal as consistent with, and part of, our efforts to preserve the natural environment of our oceans and to protect them from pollution caused by oil drilling and toxic dumping of all sorts.

We in Santa Monica appreciate your leadership with regard to this particular issue, and look forward to working with you over the next few years to continue to protect our coastline.

Sincerely,

RUTH YANNATTA GOLDWAY
MAYOR

RYG:svc

SHEILA LODGE
Mayor

March 3, 1983

The Honorable Dan Hamburg, Chairman
Board of Supervisors
County of Mendocino
Courthouse
Ukiah, California 95482

Dear Supervisor Hamburg:

On February 22, 1983 the Santa Barbara City Council voted unanimously to oppose the disposal of nuclear waste in the Pacific Ocean. We are very concerned about unknown long-term effects and strongly urge that any nuclear waste be placed in appropriate land sites until it is proved that it is safe to dispose of such waste in the ocean. L.53 N.3 L.39

Sincerely,

Sheila Lodge
Mayor

SL/pj

#72b (Cont)

City of Half Moon Bay

CITY HALL • 501 MAIN STREET
HALF MOON BAY, CALIFORNIA 94019

FROM THE OFFICE OF
City Clerk

TELEPHONE (415) 726 5566

COUNTY OF MENDOCINO BOARD OF SUPERVISORS MAR 10 1983 RECEIVED PER UKIAH, CALIFORNIA

March 8, 1983

Members of the Board of Supervisors
County of Mendocino
Courthouse
Ukiah, CA 95482

Honorable Board Members:

At their regular meeting of March 1, 1983, the City Council of the City of Half Moon Bay considered your letter of February 10, 1983 regarding Nuclear Waste Disposal in the Pacific Ocean, along with materials on the subject submitted by The Oceanic Society.

L.53 The Council agreed with your position in opposition to such disposal, particularly in light of the fishing industries which are an important part of Half Moon Bay's coastal economy. Concern
L.39 was especially expressed regarding the unknown long-term effects on the ocean's food chain.

Thank you for calling this matter to our City's attention.

Sincerely,

THE CITY OF HALF MOON BAY

Ralphena R. Guest
City Clerk

/rg

cc: The Oceanic Society

CITY of POINT ARENA

Incorporated 1908

247 Main Street, P.O. Box 67
Point Arena, California 95468

Telephone: 707 882-2334

February 25, 1983

Mendocino County Board of Supervisors
Courthouse
Ukiah, Ca. 95482

Attention: Dan Hamburg

RE: Nuclear Waste Disposal in the Pacific Ocean

Dear Mr. Hamburg:

The Point Arena City Council at their regular meeting of February 22, 1983 discussed your recent correspondence regarding the nuclear waste disposal and the Board's opposition to the proposal.

The City Council by minute order, voted to support the County's position to oppose the EPA and U.S. Navy concept of nuclear waste disposal off Cape Mendocino.

We hope our support will be recognized and be of some merit at the March 31st meeting.

Please keep us informed of the results.

Sincerely,

Mary Spangler
City Clerk

#72b (Cont)

City of ARCATA

February 24, 1983

The Honorable Dan Hamburg, Chairman
Board of Supervisors
County of Mendocino - Courthouse
Ukiah, California 95482

Dear Dan:

Please be informed that the Arcata City Council by unanimous vote on February 16, 1983, also took a position in opposition to the concept of disposal of nuclear waste in the Pacific Ocean. This motion passed in response to the proposal of the United States Navy and the Environmental Protection Agency to dispose of 100 defueled, decommissioned nuclear submarines off Cape Mendocino.

L.53 The Arcata City Council fully supports the conclusions of extensive studies by your board that this is an ill-conceived plan posing a serious threat to the North Coast Fishing Industry and those that consume its product. The concept of using one of our most precious resources, the ocean, as a nuclear "garbage dump" is not acceptable to this north coast community. The City also supports the idea of holding hearings in the coastal area.

Thank you for your work on this important matter of public policy. Let me know how else we may help.

Sincerely,

Sam Pennisi, Mayor
City of Arcata

SP/mb

CITY OF PISMO BEACH, CALIFORNIA

CITY HALL
1000 BELLO ST. • P.O. BOX 3
PISMO BEACH, CALIFORNIA, 93449
TELEPHONE 805/773/4657

March 15, 1983

Dan Hamburg, Chairman
Board of Supervisors
County of Mendocino
County Courthouse
Ukiah, CA 95482

RE: Support of Pismo Beach City Council opposing nuclear waste dumping in the Pacific Ocean

Dear Mr. Hamburg:

We appreciate your concern for the proposed dumping of decommissioned nuclear submarines off the coast of California. Our City Council has considered your concerns for safety and economic hardships to the fishing industry should the Navy's plan be approved. We agree with your concerns as well as those of the Oceanic Society and support your opposition to the nuclear waste dumping. We believe that there are more environmentally sound measures for disposal of nuclear waste than ocean dumping. The Federal Government must adopt such a plan to ensure the safety of all persons now and in the distant future since nuclear waste remains radioactive for sometimes thousands of years or longer. L.53

Therefore, our City Council has asked me to strongly support your position of opposition to nuclear waste dumping off the coast of California.

Sincerely,

Bill Richardson
Bill Richardson
Mayor

cc: Environmental Protection Agency
Governor George Deukmejian
The Oceanic Society

#72b (Cont)

March 17, 1983

Dan Hamburg, Chairman
Board of Supervisors
County of Mendocino
Courthouse
Ukiah, CA 95482

RE: Nuclear Waste Disposal in the Pacific Ocean

Dear Mr. Hamburg:

L.53 The Capitola City Council at its February 24th meeting went on record as opposing the disposal of nuclear waste in the Pacific Ocean. As you are probably aware, Capitola is located in Santa Cruz County and a great deal of our economy is based on people visiting our area to participate in various leisure time activities. Certainly the potential for contamination by the disposal of nuclear waste is one that would have a very detrimental impact on our city and county as well as our entire eco-system.

If you have any questions or require any further information, please contact me.

Sincerely,

CITY OF CAPITOLA

Stephen R. Burrell
City Manager

SRB:pae

COUNTY OF MENDOCINO
MAR 21 1983
RECEIVED
UKIAH, CALIFORNIA

CITY OF CRESCENT CITY
CALIFORNIA

Board of Supervisors
County of Mendocino
Courthouse
Ukiah, California 95482

February 15, 1983

FEB 17 1983
RECEIVED
UKIAH, CALIFORNIA

Attn: Chairman Dan Hamburg

Dear Chairman Hamburg:

I am in receipt of your memorandum dated February 10th, 1983 concerning Nuclear Waste Disposal in the Pacific Ocean. Prior to my making a recommendation to our City Council, I would appreciate an opportunity to review whatever available information you have regarding the potential environmental hazards of the Navy's dumping of nuclear submarines off our coastal waters.

I look forward to receiving this information from you in the near future.

Sincerely,

William G. McGinnis
CITY MANAGER

WGM:mkc

cc: Crescent City Harbor Commission

#72b (Cont)

City of Fort Bragg
Incorporated August 5, 1889
416 N. Franklin St.
Fort Bragg, Ca 95437
707-964-5325

COUNTY OF MENDOCINO BOARD OF SUPERVISORS MAR 17 1983 RECEIVED UKIAH, CALIF.

March 15, 1983

Mr. Dan Hamburg, Chairman
Board of Supervisors
County of Mendocino
Courthouse
Ukiah, CA 95482

Dear Chairman Hamburg:

Please find enclosed Resolution 1140-83 stating the City's position on the issue of disposal of nuclear ladened decommissioned submarines off the Mendocino Coast.

Respectfully,

Gary D. Milliman
City Administrator

nc
Enclosure

cc:

RESOLUTION NO. 1140-83

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF FORT BRAGG OPPOSING THE DISPOSAL OF NUCLEAR WASTE OR DECOMMISSIONED SUBMARINES IN WATERS OFF THE MENDOCINO COAST

WHEREAS, the United States Navy is proposing to dispose of nuclear waste laden submarines by scuttling at a location some 160 miles west of the City of Fort Bragg; and,

WHEREAS, current public concern has been expressed concerning this proposal and information from the Oceanic Society indicates that this proposal is potentially hazardous to both fish and human life. L.14 L.45 U.5

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Fort Bragg does hereby take an official position in opposition to the proposed disposal of nuclear waste laden submarines by scuttling off the Mendocino Coast.

BE IT FURTHER RESOLVED that the City Council of the City of Fort Bragg calls upon the Navy Department to conduct public hearings on any such proposal in the City of Fort Bragg which is the city in close proximity to the proposed site. J.2

The above and foregoing resolution was introduced by Councilman Seale, was seconded by Councilman Schade, and passed and adopted this 14th day of March, 1983, by the following vote:

AYES: Huber, Schade, Seale, Woelfel, Barney
NOES: None
ABSENT: None

Robert Barney
ROBERT BARNEY, MAYOR

ATTEST:

Carolyn R. Carpenter

#77a

Salmon Trollers Marketing Association, Incorporated
P.O. BOX 137 FORT BRAGG, CALIFORNIA 95437 707-964-8500

March 16, 1983

Captain Edward P. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

This letter is a summary and supplement to the testimony I gave at the Navy's hearing on their DEIS in Sacramento, on 2/24/83. In giving this testimony I represent myself and Port Bragg Salmon Trollers Marketing Association.

We support the Anderson Amendment and would favor permanent legislation forbidding ocean disposal of nuclear waste.

* J.19 | Site selection was poor based on the Navy's own criteria. The
Pacific study area is near major fault lines. It is also located
J.12 | near excellent albacore grounds as shown in 1974,76,77,78,80 and
81 reports, but not shown in the Navy's DEIS. The environmental
effects are not well known and not presented well in the Navy's
L.55 | DEIS. The Navy shows life on the bottom in the study areas and
admits the subs will act as reefs. This is one way for radiation
to get into the food chain. Remembering there is no safe dose of
L.37 | radiation, and radiation bioaccumulates as it moves up the food
chain; this will threaten the commercial fishing industry. Who
L.53 | will want to buy hot fish? This will cause great socio-economical
loss to the ocean states and it would be a great loss to all people.

W.1 | The monitoring of the subs is going to be very difficult and re-
J.76 | trievability virtually impossible. The cost of disposal doesn't
consider loss of any fishery, a comprehensive monitoring program,
or a retrieval program should one become necessary. I've heard
G.2 | ocean disposal referred to as a non-solution solution. We prefer
mothballing or a safer land disposal.

We object to the run-around California State Senator Barry Keene
has had throughout this issue. We also request an extension of the
J.15 | comment period and that additional hearings be held in Ft. Bragg
and Eureka.

Sincerely,

George Balding ymh

George Balding
STMA Director

cc: Alan Cranston, Pete Wilson, Doug Bosco, Barbara Boxer, Barry Keene, George Deukmejian, John Lehman Sec. of Navy, President Reagan

*Other issues discussed by Mr. Balding are side barred in Exhibit 77.

#78a

Statement of

NATHANIEL S. BINGHAM

President

PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS

to the Hearing Conducted by the

Office of the Chief of Naval Operations
United States Department of the Navy

on the

Draft Environmental Impact Statement
"Disposal of Decommissioned, Defueled Naval
Submarine Reactor Plants" at Sea

Sacramento, California
24 February 1983

Captain Wagner, ladies and gentlemen, good morning. My name is Nat Bingham. I am the president of the Pacific Coast Federation of Fishermen's Associations, representing 8,000 working fishermen in California and Oregon. I have been a fisherman on California's North Coast for 20 years.

California's fishing industry was shocked in the autumn of 1981 to learn of Navy plans to dispose of 100 obsolete nuclear submarines in the Pacific Ocean south and west of Cape Mendocino. The men and women of our fishing industry, a North Coast economic mainstay, were especially concerned with the effect the dumping program would have on their livelihoods.

More than a year has passed since that first terrifying news--a year in which the Navy might have substantially allayed the fears of the citizens of our coastal communities. Instead, the period has been consumed in a desperate struggle for information about the Navy plans, a struggle that has been met with government delays, denials and silence.

To give voice to the concerns of Californians over the dumping plan, the fishing industry asked for the introduction of Senate Joint Resolution No. 27 which asks that the scuttling be delayed until valid, reliable scientific studies prove it safe. With a quarter of the entire California Legislature joining as co-authors, the bill received virtually unanimous support from the Legislature.

The Joint Legislative Committee on Fisheries and Aquaculture has been assisted by some of California's top marine scientists in an effort to obtain and evaluate information concerning the dangers of dumping radioactive materials into the ocean and, as well, regarding the proposed dump site off Cape Mendocino. The difficulty these scientists have had in obtaining information concerning the Navy program at times appeared insurmountable.

In June 1982, our North Coast State Senator Barry Keene requested copies of specific studies completed by Oregon State University for the Navy, in some cases as early as 1978. He was forced to file a Freedom of Information Act request for these publicly funded materials. It was not until 7 August 1982 that Rear Admiral J. H. Webber responded, claiming the studies had not yet been summarized and interpreted and would not, therefore, be released. It was October before we received the 686-page report, "Oceanographic Studies to Support the Assessment of Submarine Disposal at Sea."

Up to this point, those responsible for the Navy's submarine disposal program had contended that no conclusions had been drawn or choices made favoring sea disposal over burial of the sub-reactors on land. Our analysis indicated, however, that our fears had been justified. The Oregon State studies emphasized the distance of the Cape Mendocino site from major population centers, it downplayed the area's contribution to fisheries harvests and mistakenly concluded that "no upwelling is present in the study area." The presence of upwelling-- the movement of water from great depths to the ocean's surface--in the study area is well known to North Coast fishermen who view the area as a major producer of economically important fish, especially albacore. J.31*

I have fished albacore in the vicinity of the proposed dump site. On one occasion, during the summer of 1976, I caught 150 - 300 albacore a day in this area for a five-day period. At this time, there were at least 100 other fishing vessels from Fort Bragg operating in this area with catches at least equal to my own. While fishing for salmon just inshore of the proposed dumping site, I have caught deep-water, bottom-dwelling species normally not found on the surface indicating that this is an area of strong upwellings. J.12 J.31

*Other issues discussed by Mr. Bingham are side barred in Exhibit 78.

#78a (Cont)

It is not surprising, therefore, that the Navy's draft environmental impact statement on the "Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants"--the subject of today's hearing--should prove inadequate, developed as it was on incomplete and, in some cases, erroneous information. Let me list some of the deficiencies we see in the DEIS and let me assure you we will provide more detailed concerns within the period allowed for written comments.

Lack of Cumulative Impact Analysis

L.7 In his 18 February 1982 letter to you, Senator Keene specifically pointed out that the federal Council on Environmental Quality regulations implementing the National Environmental Policy Act require the Navy to analyze how the action it proposes to carry out would contribute to the cumulative impact of other such actions. Part 1508.7 of the federal regulations defines cumulative impact as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency undertakes such other actions. Cumulative impacts, the regulations explain, can result from individually minor but collectively significant actions taking place over a period of time.

In his letter, Senator Keene suggested this to mean that the Navy must assess the accumulation of radionuclides in the environment, includin fallout from nuclear weapon testing, past dumping of radioactive wastes by the United States and foreign counties, background radiation, other future disposal plans where anticipated, and all other sources. In your response, you stated that the draft environmental impact statement "will also include a consideration of cumulative impacts of action in compliance with the Council on Environmental Quality regulations." No such consideration appears in the DEIS.

L.7 The absence of a cumulative impact analysis is, in our view, a grievous deficiency in the environmental documentation of this Navy project.

Alternative Disposal Costs Inadequately Compared

The DEIS, at page S-16, concludes "Sea disposal is seen to be the least costly method." Disposal at sea of entire submarines is priced at $5.2 million per ship, while the cost of land burial of each reactor

compartment and sea disposal of the remainder of each sub is estimated to add $2 million to that figure.

Missing, both from these pre-program studies and from the project cost estimates, are monitoring activities sufficient to determine the effect of the proposed dumping on the environmental health of the Pacific. J.76 Nothing is known of present radioactivity at the site and no commitment is made to determine how the actual corrosion rate of the abandoned submarines, and the resulting escape of radionuclides into the ocean ecosystem, will compare with the estimates used in justifying the Navy's decision. Q.13

As a fellow boat owner, although admittedly on a somewhat smaller scale, I am here to tell you that no vessel, large or small, survives long in the ocean without maintainance. Certainly, any boat on the bottom does not stay in one piece for long.

Were the cost of ocean monitoring included, it would likely rule out the Navy's apparently preferred option of disposing entire submarines at sea. J.76

Also missing are estimates of what the economic and social costs would be to the fishery due to losses from contamination of fish.

I would suggest mothballing the used submarines as the best means G.2 of disposal. They could, for example, be used for peaceful purposes such G.3 as oceanographic research. If, in fact however, the submarines are already so contaminated that they cannot be safely operated, then certainly they should not be dumped in the ocean. They should be buried ashore. D.4

Public Radiation Danger Misinterpreted

The DEIS presents estimates (Table 4-11) of the radioactivity exposure the general public would experience and concludes that the figures "show no significant difference between the two disposal options." In fact, the estimates suggest the public would suffer 42 times more radiation exposure were just one of the submarines slated for sea disposal involved in a handling accident. L.47

I refer you to the "Population Exposure" column of the table, rows B-2 and B-3.

#78a (Cont)

Proposed Action not Identified

E.2 The document before us today is not, in fact, a draft environmental impact statement. The pertinent federal regulations clearly require at Part 1502.14 that an EIS identify the proposed action. The document before us, however, concludes that "either option could be chosen."

A central purpose of an environmental impact statement is that it allows the public to see how--by what logic--an agency arrives at its preferred alternative. A document which obscures from the public the agency's chosen option defeats the purpose of the EIS process. I am sure the Council on Environmental Quality had this clearly in mind when it adopted regulation Part 1502.14.

I would like to turn from the defects in this specific environmental document to a brief discussion of how the Navy's ocean dumping program fits within the context of existing state and national law and policy. I might suggest at the outset the fit is not particularly natural, or logical. The points I have to share with you were brought to the attention of the Joint Legislative Fisheries Committee at its hearing on the Navy's plans held in San Francisco, 7 August 1982.

Federal Consistency Required

F.11 The State of California has prepared, and the federal government has certified, the California Coastal Management Program. The federal Coastal Zone Management Act prohibits any federal agency from conducting activities which directly affect California's coastal zone unless the federal agency first determines that they--the activities--are consistent with our management plan and the California Coastal Commission concours in that determination.

The California Coastal Act, the heart of our management program, requires that "uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healty populations of all species of marine organisms adequate for long-term commercial, recreational, scientific and educational purposes." We are concerned, frankly, that radionuclides released by the Navy's dumping program could bio-accumulate through the marine food chain and cause real or publicly perceived radiation damage to food fish species. Consumer rejection of California seafood products could devastate our industry and would be clearly inconsistent with our coastal management program.

L.37
L.53
O.34

I would like to add my voice to those of California's congressional delegation and Lt. Governor McCarthy and Senator Keene in requesting that additional hearings regarding this draft environmental impact statement be held in Fort Bragg and Eureka, California, in order that those most directly impacted by the proposed dumping program have the opportunity to adequately express their concerns. I would like to think the Navy is as concerned with the needs of California coastal communities as it is with more heavily represented Raleigh, North Carolina, and Columbia, South Carolina, where field hearings were held last week. J.15

Finally, I would request that the Navy extend the period for receiving public comments on the DEIS until at least 30 June of this year. The effect on the health of our world's oceans from the sort of use proposed here by the Navy will continue for a long time. I would urge those responsible for the disposal program to make every effort to seek the best scientific information available to guide their decision. And I would plead with equal urgency that you listen carefully to the fishermen and women of our coastal communities--those whose health and livelihoods may be changed forever by what you decide in the few months ahead. Thank you.

#105a

SIERRA CLUB - REDWOOD CHAPTER

P. O. Box 466, Santa Rosa, Ca. 95402

c/o 29900 Highway 20
Fort Bragg, California 95437

February 24, 1983

PUBLIC HEARING FINAL
AUGMENTATION PAGE 4.

Captain Edward F. Wagner
United States Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

PUBLIC HEARING RECORD

DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

Dear Captain Wagner and Department of the Navy:

The Sierra Club - Redwood Chapter's 4,100 members in California's Del Norte, Humboldt, Mendocino, Sonoma, Solano, Napa, Lake, and Siskiyou counties wish to go on record as requesting an improved Environmental Impact Statement, on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, for the purpose of better informing the concerned public and decision makers of the actual impacts of the proposal, before any decisions are made.

*L.1 L.7 The Redwood Chapter also wishes to go on record as opposing the sea disposal option based on the limited and inadequate information available to us at this time. The enormous cumulative ocean radiation totals, both proposed and potential, are of very great concern.

More specifically:

J.9 J.11 J.12 J.31 1) The evidence record is inadequate to support selection of the chosen Pacific Ocean Study Area site according to selection criteria presented on Draft EIS Page S-11 (Ocean Disposal). The evidence record presented is outdated and incomplete. It fails to recognize an important upwelling pheonomenon at the study site, a prolific

*Other issues discussed by Mr. Guenther are side barred in Exhibit 105.

-2-

fishery that is dependent upon it, and heavy utilization of this marine resource by man. Additionally, no evidence is presented that would indicate any lessening of potential for future use of this fishery as required by Criterion 3 (Ocean Disposal, Paragraph 2). We request an appropriate updating and augmentation of the evidence record leading to selection of the Pacific Ocean Study Area. J.11

2) The Draft EIS conclusion (Page S-12, Paragraph 2), that "...animal life on or near the sea floor in these study areas is very sparse. None of the animals are used by man or form part of a food chain known to lead to man," is unsupported by the available evidence, especially the EIS's own photographic evidence record presented on pages E-22 and E-23 (Figures E-13 and E-14). The photographic evidence record shows life forms at the study site which are part of the marine food chain leading to man. Additionally, the Draft EIS fails to recognize and to evaluate the so-called "artifical reef effect" wherein life forms will multiply far beyond normal levels in the vicinity of a large protective object such as a sunken ship, or submarine nuclear reactor chamber. This latter phenomenon, and its effects on biological productivity, may be an important reason that higher than normal radiation levels appeared in fish tested at the Farallon Islands nuclear dump site, and at significant distances from it. Much more needs to be known about how radioactivity deriving from an ocean nuclear dump site moves up through the marine food chain to the higher life forms, including man. We request that this evaluation be made in the Final EIS. U.1 T.19 L.55

3) The Redwood Chapter is concerned that all sources of radioactivity, including radioactive scale buildup in reactor core cooling pipes, were not considered in the Draft EIS. We request that those radiation sources be fully evaluated in the Final EIS. A.12

4) We are concerned that the Draft EIS does not present a workable and effective plan for monitoring radiation levels at the proposed ocean reactor disposal sites, and in the water columns affected by them. We request correction of this deficiency J.76

#105a (Cont)

as high priority in the Final EIS.

5) We are deeply concerned with the retrievability issue (Draft EIS Page 2-13, Section B.) We have heard expert testimony from the Omnis Society, and others, that the ocean disposal option is irreversible, that once disposed of in the deep ocean, the reactors will be impossible to retrieve, not just infeasible as the EIS states.
W.1 If a possibility exists for retrievability in case of mishap, as the Draft EIS clearly infers, then we request that the Final EIS make a cost and probability analysis for retrievability. If retrievability is clearly impossible, the Final EIS should so state.

6) We are concerned with the entire content of Appendix D (beginning with Draft EIS Page D-A1) concerning Radiological Environmental Monitoring At Sites Of Nuclear-Powered Submarine Thresher and Scorpion Sinkings. The conclusions reached on Page D-A1, Paragraphs 4 and 5, that "...none (of these samples) showed evidence of radioactivity released from either Thresher or Scorpion...thus, the Thresher and Scorpion have not had a significant effect on the radioactivity in the environment," are not supported by the evidence presented. There is no evidence that radiological
J.64 monitoring took place within thousands of feet of either the Thresher or Scorpion nuclear reactors. We request that this evidence deficiency either be overcome, or Appendix D be deleted from the Final EIS as irrelevant.

L.7 7) Finally, the Redwood Chapter is concerned with the issue of cumulative impact,
L.9 which the Draft EIS fails to evaluate. It seems probable that, once a high-level ocean nuclear dumping site is established, pressures will become enormous to dump other nuclear wastes not only at that site, but in the planetary oceans at other sites, as other nations follow the lead of the United States in ocean nuclear dumping activity. We request evaluation of the cumulative impact phenomenon in
L.7 the Final EIS.

Additionally, the Draft EIS fails to evaluate the cumulative effect of the proposed decommissioned submarine reactor plant disposal program on the worldwide nuclear arms buildup. As the disposal program's expressed purpose is to make way for larger and more deadly nuclear weapons systems, and as other nations are likely to follow the U.S. example, this important potential cumulative impact should be evaluated in the Final EIS. We request that this be done.

Thank you for your consideration. Please keep us informed of progress in the environmental evaluation of submarine reactor plant disposal. As I will be the responsible person for the Sierra Club's Redwood Chapter in this evaluation, please send all materials to the 29900 Highway 20, Fort Bragg, California 95437, address.

Ron Guenther, Chairman
Sierra Club - Redwood Chapter Executive Committee

Copies to: Federal and State Legislative Delegations

#131a

12 March

Dear Captain Wagner -

I was at the hearing in Sacramento on February 24th [redacted]. You may remember me, I spoke towards the end of the night & said I was angry that we had come such a long was and not all of us were going to be able to speak

I left that day wondering if you were affected by the hearing and by everyone's testimony

I wondered (and still do) - who makes the decision - the ultimate decision as to what happens to the submarines?

As far as I can tell, wherever they get disposed of, they will pose a tremendous health hazard. I think more money has to be spent

*H.14 for research. The Navy should offer a reward - a million dollars, for someone to come up with a safe, permanent disposal method for radioactive wastes.

The children of Albion were very disappointed when they wrote to you, and only received a form letter in return. I really you can't personally answer every letter you receive, but we don't feel there is any dialogue going on between the public & the Navy.

I'd like to think everyone who lives on this planet loves it, and that we can all work together for our combined health and safety.

Please listen to the people who are scared for future generations. Is it worth it to be hasty now and regretful later?

Sincerely,
Doble Dolphin
Box 344
Albion, Ca. 95410

*Other issues discussed by Ms. Dolphin are side barred in Exhibit 131.

#131b

Ban Ocean Nuclear Dumping
Post Office Box 1385
Mendocino, California 95460
June 15, 1983

Captain Edward F. Wagner, U. S. Navy
Office of the Chief of Naval Operations
OPNAV-22
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

In regards to the Navy's Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, BOND (Ban Ocean Nuclear Dumping) feels that there are many issues inadequately addressed, particularly in regards to the ocean disposal method. Noticeably absent, is data on how radioactivity enters the food chain. "Although no biological pathway from the deep ocean directly to man has been identified," the DEIS states on page 4-19, a hypothetical pathway is used which does not "result in large exposures to the few individuals who might be affected." If the Navy does not understand how radioactivity enters the food chain, how can it have a hypothetical example? L.38*

We are told that "Radiation exposure to the public from the release of radioactive material resulting from submarine disposal at sea would probably be zero." (DEIS, p. 4-17). A few sentences later, the report contradicts itself when it says, "However, it is not possible to be totally certain that no exposure would occur since corrosion would eventually release some radioactivity which might be transported to areas of human activity." (DEIS, p. 4-17).

"Internal radiation exposure to sea life in the immediate vicinity of the disposal site would occur, with the expected maximum effect taking place after many centuries of gradual release of radioactive material had occured." (DEIS, p. 4-9). Without knowing the full effects of radiation on the marine environment, it is highly irresponsible to contaminate the ocean with radioactive wastes. Once polluted by radioactivity, an ocean cannot be decontaminated.

The crux of the matter is, there is no such thing as a safe dosage of radioactivity. In 1978, Robert Minogue and Karl Goller of the Nuclear Regulatory Commission wrote, "any amount of radiation has a finite probability of inducing a health effect (e.g. cancer)." Government adopted "permissible" levels of radioactivity have decreased drastically since the 1950's as the dangers of radioactivity become more apparent. The rate of leukemia among veterans of atomic weapons tests in Nevada is 400 times the national average. It is giving information in a vacuum, to state how much radiation will be emitted from one submarine. Any new radiation must be taken in the context of all existing radiation. Much of the so called background radiation the Navy refers to is from past testing of atomic weapons and the resulting fallout in the air and water. L.7

Bioaccumulation, or the increase in toxicity as radioactivity makes its way up the food chain, is another topic not addressed in the DEIS. Norman Lonsdell in his book, The Atom and the Energy Revolution, reports on a study of the Columbia River in the L.37

1

western United States in which it was found that "while the radioactivity of the water was relatively insignificant,

1) the radioactivity of the river plankton was 2000 times greater;

2) the radioactivity of the fish and ducks feeding on the plankton was 15,000 and 40,000 times greater respectively;

3) the radioactivity of young swallows fed on insects caught by their parents in the river was 500,000 times greater and

4) the radioactivity of the egg yolks of water birds was more than a million times greater."

Studies of humans in the Columbia River area drive the point home. Measurement of radioactive zinc in the bodies of people who drink Columbia River water showed that these people have 57 picocuries of zinc-65 per kilogram of body weight - more than 4000 picocuries in a 154 pound person. A person drinking three glasses of milk and eating about a quarter of a pound of meat daily from the Columbia River Valley would have nine times that amount of radiation in his or her system - which is greater than that measured in some persons working in atomic energy installations." (From Perils of the Atom by Richard Curtis and Elizabeth Hogan).

On the East Coast, "Scrutiny of the wildlife in a pond receiving runoff from the Savannah River plant near Aiken, South Carolina, demonstrated that while the water in that pond contained only twenty-five thousandths of a picocurie per gram of zinc-65, the algae that lived on the water had a concentration of 148 picocuries per gram, an increase of 5920 times. The bones of bluegills, an omnivorous fish that fed both on the algae and on fish that ate the algae, had 218 picocuries per gram, a concentration of 8720 times the amount of zinc-65 found in the water." (From Perils of the Atom).

L.37 L.7 It is a very serious oversight on the part of the Navy not to have addressed this issue of bioaccumulation, as well as the cumulative effects of all radioactive dumping.

L.20 F.19 J.64 It is impossible to believe that leakage will be prevented, when the half-life of Niobium-94 (an element present in the reactor vessel) is 20,000 years. The Navy's test studies aren't very encouraging. The hull of the submarine ex-BLACKFIN, SS322 collapsed when on the way down, and "the ship broke in two roughly equal sections." (DEIS, p. D-6). We are then informed that "the general conclusions of Project Thurber were that a satisfactory sinking procedure had been developed." (DEIS, p. D-6). The next paragraph goes on to report on the accidental sinkings of the USS THRESHER, SSN 593 and USS SCORPION, SSN 589. Nowhere does the Navy admit they have located the missing reactor plants, but only "debris."

F.19 L.21 A bit further on in the report we find, "It is expected that the entire reactor plant would remain intact within the boundaries of the reactor compartment. If and when sea disposal of the first decommissioned submarine is performed, monitoring during and after the sinking operation either will confirm that containment has remained intact, or it will reveal that some problem was not anticipated and containment integrity was lost or diminished. In the latter case, the sea disposal of the second decommissioned submarine would not be carried out until the procedure had been altered as appropriate." (DEIS, p. D-9). In other words, the Navy will try to dump the submarines knowing that "the maintenance of containment integrity is not a 100 per cent certainty." (DEIS, p. D-9). This is not very comforting.

L.57 Transportation hazards have not been adequately addressed in the DEIS. In case of an accident, it would be impossible to retrieve the submarines, thus causing possible

contamination in heavily populated areas. Some residents of Mendocino County already feel uneasy that one reason our area was chosen instead of San Diego is because it is less populated. If ocean dumping of radioactive wastes is so safe, why search for a low-density location? If it is not safe, what formula does the Navy use to equate how many people's health and safety equals one dumped radioactive submarine? J.6 L.42

Moving from environmental to economic issues, the mere threat of radioactivity in commercial fish products would devastate the fishing industry and thereby the economy of Mendocino County. There is no mention in the DEIS of economic impacts on the fishing industry, the backbone of many coastal communities. Fish caught in the Pacific Ocean are eaten around the world. Boats from all nations come to fish in the waters of the north Pacific because they are so rich. The largest kelp beds in the world are off the coast of California and these play host to a veritable multitude of organisms which in turn sustain larger life forms. The ocean environment is very fragile; an impact on any one part of it will eventually be felt throughout the entire ocean. L.53 O.34

The reports the Navy used to support the statement that the studied dumpsite is low in albacore production, were from 1960-1970. More recent reports, from 1974 to the present indicate the contrary, that this area has in fact produced substantial albacore catches. The reports also indicate the highly migratory nature of albacore, they travel over vast distances and rarely return to the same place year after year. J.12

In coming to the conclusion that sea disposal would be cheaper than land disposal, the Navy fails to include the cost of escorting the submarines to the dumpsite, and the estimated costs of monitoring the submarines after they've been dumped are unrealistically low. Only one page of the DEIS is devoted to monitoring programs. This is unsatisfactory. If monitoring of dumpsites is so easy and relatively inexpensive, why hasn't the Farallon Islands dumpsite been more adequately monitored? The Navy's failure to realistically address this issue leads us to believe the Navy will act as they have in the Farallons, by refusing to monitor the site, while assuring the public that everything is fine. O.20 J.76 L.6

The Navy's plan to scuttle the submarines would set a poor precedent on an international level, ignoring the global climate. Under the treaty of the London Dumping Convention, of which the U.S. is a member, there is presently a two year moratorium on ocean dumping of radioactive wastes. Ocean dumping is a selfish and short-sighted solution to a very complex and dangerous problem. What kind of legacy would we be leaving the future unborn generations, thousands of years down the line? We feel that the time is past due for manufacturers of these wastes to take responsibility for their safe disposal. We can't afford failures or mistakes in this area. The public is becoming more acutely aware of the fact that more weapons create more wastes. What does the Navy intend to do with the Trident submarines, when they are obsolete or "too hot to handle" in another twenty or thirty years? And when future calculations are made as to how much radiation will be emitted by the dumped Trident submarines, the figure for background "normal" radiation levels will have increased from the radiation of the Polaris submarines, lying at the bottom of the sea. The danger is self-perpetuating and can only lead to polluted oceans and ultimately global disaster. F.8 N.12

We respectfully request that the Navy rearrange economic priorities, and devote more money and energy to finding a safe solution for the permanent disposal of radioactive wastes. Until this is achieved, it is irresponsible to create any more waste. We are fouling our own nest, which even animals instinctively know not to do.

#131b (Cont)

F.2 Congress has expressed its opposition to ocean dumping of radioactive wastes in
passing the Anderson Amendment to Section 104 of the Marine, Protection, Research and
Sanctuaries Act of 1972 (the Ocean Dumping Act), Public Law 97-424, passed on January 6,
1983. Section 4241 (1) states that the applicant must prepare "(E) A plan for the
removal or containment of the disposed nuclear material if the container leaks or
W.1 decomposes." Page 2-11 of the DEIS states, "Retrievability would not be feasible with
current technology." This factor alone would prohibit the scuttling of submarines in
the ocean. Continuing with Section 4241, the applicant must also prepare "(F) a
determination by each affected State whether the proposed action is consistent with its
F.11 approved Coastal Zone Management Program." The California Coastal Commission has
indicated that the Navy's plan is inconsistent with its CZMP. Paragraph (J) calls for
"a comprehensive monitoring plan to be carried out by the applicant to determine the
full effect of the disposal on the marine environment, living resources, or human
health, which plan shall inlude, but not be limited to, the monitoring of exterior
container radiation samples, the taking of water and sediment samples and fish and
benthic animal samples, adjacent to the containers and the acquisition of such other
information as the Administrator may require."

J.23 The DEIS also failed to take into account offshore mining or oil exploration, and how these would be affected by ocean disposal of nuclear submarines.

N.13 In a letter from Rear Admiral Webber, dated August 22, 1982, BOND was advised that "The Navy is committed to making the DEIS and the supporting documents referenced in the DEIS publicly available in meaningful form so that the issue of disposal of defueled decommissioned nuclear powered submarines can be fully examined by the public." We do not feel the Navy has lived up to this committment. On the contrary, we found the DEIS to be a very confusing, poorly referenced document.

One thing that is very disappointing to BOND is that there has been no chance
during this entire process for dialogue with the Navy. Many citizens of Mendocino
County went to Sacramento on February 24, 1983 for a public hearing which lasted from
9:00 AM to 11:00 PM and still not all of those who traveled 6 1/2 hours each way, were
able to speak. For this reason, and for the Navy to hear the voices of those who were
J.15 not able to take time off from their jobs to come to Sacramento, we respectfully
request, along with our elected officials Representative Doug Bosco, State Senator Barry
Keene, Assemblyman Dan Hauser and the Mendocino County Board of Supervisors, that the
Navy hold local public hearings, particularly in Fort Bragg and Eureka, as these areas
are the most directly involved in the Navy's proposed dumpsite.

L.1 In conclusion, it is our opinion that the DEIS shows an extreme lack of adequate
and conclusive data. Research on the subject of past ocean dumping of radioactive
L.6 wastes has led us to mistrust the Navy, particularly in terms of their concern for
public health and safety. This report does nothing to allay our fears, on the contrary
it serves to increase them. Before the Navy considers any more ocean dumping of
radioactve wastes, we implore you to accurately monitor existing dumpsites, such as the
one off the Farallon Islands. As long as we have such doubts and unanswered questions
about the long term effects of radiation in the ocean, BOND will continue to work,
through data gathering and distribution and other non-violent means, towards a safe and
responsible disposal program.

BOND also supports an option that is not given in the DEIS, and that is a concerted effort, using all available resources, including financial, to develop a safe, permanent disposal method for radioactive wastes, and the complete cessation of the generation of more wastes until this is found.

Thank you for your consideration of this letter.

Sincerely,

Dobie Dolphin, et.al.

Dobie Dolphin
Ede Morris
Tony Orth
Linda Peters

P.S. We have forwarded to Senator Cranston, 462 petitions containing over 4,600 signatures (primarily from Mendocino County) calling for a ban on ocean disposal of radioactive wastes.

#134a *

NATIONAL WOMEN'S POLITICAL CAUCUS
MENDOCINO COUNTY CHAPTER

March 4, 1983

To: Captain Edward F. Wagner
U.S. Navy, Office of Chief of Naval Operations
Dept. of the Navy Washington D.C. 20350

Dear Capt. Wagner

* W.1 We want to stress to you the importance of taking a stand now that will help solve the nuclear problem. We urge you to be more reasonable in your plans to skuttle the subs than in the D.E.I.S. report, and consider the alternatives given you by the Oceanic Society. As the damage to the environment would be irreversible if the submarines were dumped in the ocean.

We urge the Pentagon to work on solving the problem of making radiation inert as suggested. We feel that nuclear power and weapons are not in the interest of our national security. That a verifiable freeze is in order, and we should not continue this pollution by making more new Tridents.

Please take this opportunity to make the difference for a new safe direction in our progress as a culture that we want to continue. We are in dangerous waters Capt. Wagner, please use your influence to scrap D.E.I.S. for better plans.

Thank You,

Janet Seaforth
Janet Seaforth
Vice-Chair Mendocino Chapter N.W.P.C.

P.O. Box 367
Chib. Ca.
95466

#137a **

Stop Nuclear Sub Dumping off Mendocino!

My name is Nancy Cragin I've been a resident of Mendocino County for fifteen years as of this January.

I moved there, from Southern California to find a slower, quieter way of life! To find a beautiful place to eventually raise a family I don't often go to cities anymore, I find what I need right on the coast, it's my home and I love it there.

I'm not a scientist and dont have a lot data to present to this board, only feelings from my heart and the distinct fear that Nuclear power is my ultimate enemy.

Our earth has evolved for billions of years - 600 - billion years! This planet, so far as is known, is the only planet in this vast galaxy; our solar system that produces such a ~~vas~~ infinate variety of life.

The food chain system that perpetrates this life is so delicately balanced, that when one minute part of it is broken, it will eventually be transmitted up through higher L.36 L.14

*Other issues discussed by Ms. Seaforth are side barred in Exhibit 134.
**Other issues discussed by Ms. Cragin are side barred in Exhibit 137c.

436

#137a (Cont)

2

levels and no doubt cause destruction and eventual extinction to many forms of life, including humankind.

This is scientific fact, backed by world-renown researchers and thousands of pages of documented evidence.

Nuclear wastes are a threat to these precious life-giving eco-systems.

[illegible] → Plutonium does not go away for thousands of years. Nuclear wastes are the poisonous after-products of an era of scientific discovery gone mad!

One pinpoint of Plutonium, inhaled by a living being will eventually cause some form of a cancer - (lung - bone - leukemia) and probably an early death - not withstanding genetic deformities.

The sheer insanity of perpetrating a poison of these deadly proportions in our life-giving Oceans is horrifying to me and to my friends who have come here to speak - and to those who couldnt make the trip here.

3-

We inhabit a beautiful stretch of land on the north coast that supports its people in fairly simple ways, fishing being one of them.

The fact is that the U.S. Navy wants to dump 100 Nuclear sub cores - Reactors - off of our coastline - claiming no physical impact to the environment! They want to submerge them in fishing areas - where great grey whales migratory paths are - and they says that there is no way of retrieving them. What if there is a leak? L.53 N.3 W.1 L.20

Page 32 ←

100th monkey

I ask that the navy use an alternative land burial method (I realize that land burial is not a perfect method of disposal, but dumping nuclear wastes in our life giving oceans without realizing the eventual consequences to make way for more weapons of destruction is experimenting with our lives.) It's time to end it somewhere and this is a start.

page 42 ←

The money the Navy claims to be saving by sea burial is our money - our taxes and it seems that we should have a choice in this matter. N.3

On behalf of myself and the peoples of this earth who fear nuclear armaments, I ask that these poisons be contained and buried away from places where humans and animals will not be endangered L.14 L.36

#137b

We love whales
We love flowers
don't destroy them
stop nuclear powers!
—by
Amy Salo
age 10
Fort Bragg Ca.

#137c *

Dear Mr. Lehman.
As a resident
of Mendocino County-
a mother of
school-age children,
I would like to
stress very strongly
that I cannot
condon nuclear sub
Dumping off of our
beautiful coastline.
The damage to | L.57 *
the food chain in | L.36
event of an accident | W.1
is irrepairable. Please
reconsider the alternatives
Sincerely, Nancy Cragin

*Other issues discussed by Ms. Cragin are side barred in Exhibit 137a.

#154

Please return to attendant when completed.

NAME Marguerite Dodgen DATE

MAILING ADDRESS 10433 Ambassador Drive

CITY Rancho Cordova STATE CA ZIP 95670

SPEAKING AS: (Check one)

- [ ] Individual
- [X] Representing a Non-Government Organization
- [ ] Representing a Local Government Organization
- [ ] Representing a State Government Organization
- [ ] Representing a Federal Agency or Organization

NAME OF ORGANIZATION OR AGENCY Golden State Trollers Inc

MAILING ADDRESS 10433 Ambassador Dr

CITY Rancho Cordova STATE CA ZIP 95670

Written comments may be provided on the other side.

We are opposed to nuclear submarine dumping off the Coast of Calif.

#155

Please return to attendant when completed.

NAME Sally Bergy DATE 2/24/83

MAILING ADDRESS 7324 Veteran Lane

CITY Citrus Heights STATE Ca ZIP 95611

SPEAKING AS: (Check one)

- [X] Individual
- [X] Representing a Non-Government Organization
- [ ] Representing a Local Government Organization
- [ ] Representing a State Government Organization
- [ ] Representing a Federal Agency or Organization

NAME OF ORGANIZATION OR AGENCY Golden State Trollers Inc, [illegible] Women for [illegible] Fort Bragg Salmon Trollers

MAILING ADDRESS

CITY STATE ZIP

Written comments may be provided on the other side.

As a member of Golden State Trollers, Fort Bragg Salmon Trollers and the Fort Bragg Women for Fisheries I oppose the dumping of Nuclear Sub ~~off~~ in the Pacific Ocean.

#156

I do not know how you can even consider dumping into OUR ocean, would you personally do this in your own backyard.
It is up to us as a people to protect and heal our earth - not to destroy it - for ourselves and our children!!!
It's impossible anywhere on the earth to raise a child on milk, there natural food, without contaminating their bodies with radio active strontium 50!
This has got to stop!

Please return to attendant when completed.

NAME Woody Middleton DATE

MAILING ADDRESS Box 653

CITY Redway STATE Calif ZIP 95560

SPEAKING AS: (Check one)

- [x] Individual
- [ ] Representing a Non-Government Organization
- [ ] Representing a Local Government Organization
- [ ] Representing a State Government Organization
- [ ] Representing a Federal Agency or Organization

Will not Speak
See Comments other side

NAME OF ORGANIZATION OR AGENCY

MAILING ADDRESS

CITY STATE ZIP

Written comments may be provided on the other side.

440

#157

Please return to attendant when completed.

NAME Don Lipmanson DATE 2/24/83

MAILING ADDRESS POB 395

CITY Navarro STATE Ca. ZIP 95463

SPEAKING AS: (Check one) Will NOT speak

- [ ] Individual
- [x] Representing a Non-Government Organization
- [ ] Representing a Local Government Organization
- [ ] Representing a State Government Organization
- [ ] Representing a Federal Agency or Organization

NAME OF ORGANIZATION OR AGENCY Anderson Valley Nuclear Awareness Committee

MAILING ADDRESS Box 811

CITY Boonville STATE Ca ZIP 95415

Written comments may be provided on the other side.

(OVER) please

We oppose not only ocean disposal of nuclear wastes but the entire Trident submarine program which falsely bases security on missles rather than negotiated disarmament agreements

#158

TESTIMONY FOR HEARING ON OCEAN NUCLEAR SUBMARINE DUMPING

CALIF. RESOURCES BLDG
SACRAMENTO
FEB. 24/83

GOOD ~~MORNING~~ ~~AFTERNOON~~ EVENING,

MY NAME IS PETER NAHIGIAN. I'M A WOOD-WORKER LIVING IN MENDOCINO COUNTY ABOUT 15 MILES FROM THE COAST

TO BEGIN WITH I WOULD LIKE TO EXPRESS MY APPRECIATION FOR THE OPPORTUNITY TO SPEAK AT THESE HEARINGS

I WOULD ALSO LIKE TO EXPRESS MY DISAPPOINTMENT IN THE NAVY'S LACK OF RESPONSE TO THE DESIRES OF THE COASTAL RESIDENTS TO HAVE HEARINGS CLOSER TO HOME. I HAVE TRAVELED 5 HOURS AND WILL TRAVEL 5 MORE TO SPEAK THESE 5 MINUTES TO YOU. I AM SELF EMPLOYED AND CAN MAKE THE CHOICE TO SPEND MY TIME THIS WAY. I KNOW MANY WHO CAN NOT MAKE SUCH A CHOICE. THIS MAY NOT BE JUST A LOCAL ISSUE ~~THOUGH~~ HOWEVER, THERE DOES SEEM TO BE MORE LOCAL CONCERN ~~OVER THIS ISSUE THAN IN OTHER PARTS~~ THAN I'VE SEEN IN OTHER PARTS OF THE STATE; AND RIGHTLY SO. COASTAL RESIDENTS SHOULD CONCIDER THEMSELVES TO BE TRUSTEES OF THERE COASTAL WATERS.

(1)

AS I'VE LEARNED, THE NAVY IS CONSIDERING THE FEASABILITY OF SCUTTLING ITS DECOMMISSIONED NUCLEAR SUBMARINES IN OCEAN WATERS, SOME POINTS IN FAVOR OF OCEAN DUMPING BEING CONSIDERED ARE:

1. THAT ~~A~~ THE ~~TOTAL INNITIAL~~ COST OF DEALING WITH THE RADIOACTIVE WASTE WOULD BE LESS THAN LAND DISPOSAL
2. NO FURTHER REGULATIONS NEED BE MADE TO DEAL WITH WASTE MATERIALS IF DUMPED IN SUCH A MANNER (NAVY DRAFT E.I.S.)
3. & THAT IT WOULD SOLVE THE PROBLEM OF LIMITING STATE RESTRICTIONS FOR LAND BURIAL SITES

BEFORE I GO ANY FURTHER I'D LIKE TO COMMEND THE SELECT COMMITTEE ON FISHERIES AND AQUACULTURE'S REPRODUCTION OF KEY DOCUMENTS CONCERNING THIS MATTER. I'VE ALSO READ PARTS OF THE NAVY'S DRAFT E.I.S. ON "DISPOSAL OF DECOMMISSIONED NAVAL NUCLEAR REACTOR PLANTS"

ONE OF THE MAIN ARGUEMENTS IN FAVOR OF OCEAN DUMPING IS THE APPARANT COST SAVINGS. UPON CONSIDERING MORE OF ~~ALL~~ THE POSSIBILITIES, ~~(WHICH OF COARSE IS REALLY AN IMPOSSIBLE TASK. ESPECIALLY IN THIS SITUATION)~~, WE MIGHT COME

(1)

#158 (Cont)

TO A DIFFERENT CONCLUSION.

ACCORDING TO ROSS HEATH, DEAN OF THE SCHOOL OF OCEANOGRAPHY AT OREGON STATE UNIVERSITY AND ONE OF THE KEY PARTICIPANTS IN THE NAVAL RESEARCH PROGRAM, THE NAVY HAS, AS OF SEPTEMBER 1980 SPENT ONE MILLION DOLLARS ON OCEANOGRAPHIC RESEARCH AND ESTIMATES ONE MILLION MORE WILL BE SPENT BEFORE BROAD AREA STUDIES ARE COMPLETED. HEATH BELIEVES THAT TO DO ALL THE RE-ACTUAL DUMP SITES WILL COST MORE LIKE 5 MILLION DOLLARS PERHAPS TWICE THAT

ACCORDING TO THE NAVY E.I.S. SOMETHING LIKE 8 TO 12 MILLION CAN BE SAVED PER SUB IF OCEAN DUMPED RATHER THAN BURIED ON LAND

ALREADY THE NAVY ~~IS~~ SEEMS TO BE DESTINED
O.27 TO EXCEED ITS OCEAN DISPOSAL BUDGET. THE UNLIMITED POSSIBILITIES IN THE DEEP SEA COULD LEAD TO:

1. A MASSIVE AND POSSIBLY EXTENDED, (INDEFINETLY), RESEARCH BUDGET
2. J.76 ON-GOING MONITORING COSTS FOR ANYWHERE FROM 30 TO 100 YEARS. 30 YEARS BEING AS THE NAVY'S OBSERVED

(3)

THE END OF THE RACE BETWEEN THE J.76
DECOMPOSITION OF EITHER THE TOXIC L.20
RADIOACTIVE SUBSTANCES OR CONTAINMENT VESSEL

3. EXTENSIVE COSTS OF ACTUAL DUMPING OPERATIONS, CONSIDERING THE POSSIBILITY THAT ALL DOES NOT GO ACCORDING TO PLAN. A LOT CAN HAPPEN, IT SEEMS TO ME, UNDER 14,000 FEET OF WATER. O.26 EVEN WITH PRESENT TECHNOLOGIES. "OK BOYS LET'S BRING HER UP AND TRY IT AGAIN."
4. A CONCENTRATION INSTEAD OF DELUTION OF TOXIC/RADIOACTIVE SUBSTANCES IN THE FORM OF WHAT'S BEEN CALLED L.37 RADIOACTIVE CRUD AND RUST PARTICLES LYING ON THE OCEAN FLOOR. SEA LIFE WOULD THRIVE IN SUCH A HAPPY ADDITION TO THE SEA BED ARCHITECTURE. EVENTUALLY IT WOULD REACH THE SURFACE, BY UPWELLING PERHAPS, AND J.31 BE FED ON BY LARGER SEA LIFE. L.36 WHAT WOULD IT COST TO REPAIR THE SEA BASED FOOD CHAIN?
5. AN UNTHOUGHT OF EXCELLERATION OF

(4)

L.9 RADIOACTIVE WASTE ALL OVER THE WORLD SAYS, STAFF PHYSICIST WITH THE NATURAL RESOURCES DEFENSE COUNCIL, THOMAS COCHRAN: "IF SEA DISPOSAL BECOMES THE THING TO DO EVERYTIME A REACTOR IS DECOMMISSIONED, PRETTY SOON YOU ARE TALKING ABOUT A THOUSAND HULKS DOWN THERE."

IT SURPRISES ME TO FIND THAT THE NAVY WOULD CONSIDER THE ELLIMINATION OF FURTHER POLITICAL DEALINGS, IN THE FORM OF MORE STRICT FUTURE REGULATIONS ON RAD WASTE DESPOSAL, DESIRABLE; BUT ~~SO THE NAVY~~ SUCH HAS BEEN STATED IN IT'S DRAFT E.I.S. IN FACT IT NOT ONLY SURPRIZES ME IT SCARES ME TO THINK THAT SUCH AN INSTITUTION CAN HAVE THE SHORT-SITEDNESS TO TRY AND AVOID THE WISDOM OF THOSE FUTURE REGULATIONS.

I UNDERSTAND THE NAVY HAS HAD SOME PROBLEM IN FINDING STATES OPEN TO LAND BURIAL SITES. "NOBODY WANTS THE STUFF AROUND!"

THIS IS UNDERSTANDABLE BUT IT IS NO REASON TO DUMP IT IN THE OCEAN AND FORGET ABOUT IT. WHAT MAKES THIS COUNTRY WISE AND STRONGE IS IT'S PEOPLE, AND IF THEY REALIZE DANGERS IN WASTE ~~STORAGE~~ DESPOSAL THAN IT SHOULD BE A MESSAGE TO THE NAVY AND OTHER INSTITUTIONS PRODUCING RADIOACTIVE WASTE TO START A PLAN ~~FOR~~ TO REDUCE ITS PRODUCTION.

I ALSO UNDERSTAND THAT WE HAVE TO DO SOMETHING ABOUT THE SAFE CONTAINMENT OF WASTE ALREADY AND/BEING PRODUCED. SWEDEN HAS NO WHERE NEAR THE PROBLEM IN QUANTITY THAT WE HAVE THOUGH THEY ARE SPENDING A GOOD PART OF THERE FEDERAL BUDGET ON THE SAFE STORAGE OF ~~ITS~~ THEIR NUCLEAR WASTE.

I SAY CUT THE MONEY FOR PRODUCTION AND USE IT TO STORE SAFELY ~~ATOMIC~~ WHAT ALREADY HAS BEEN PRODUCED. ATOMIC ENERGY AND WEAPONS HAVE BEEN A WRONG TURN. WE, ALL OF US, AS INDIVIDUALS AND AS A NATION, NEED TO ADMIT OUR MISTAKES AND ACT TO CORRECT THEM. IT'S ONE OF LIFE'S MORE IMPORTANT EXERCISES

#158 (Cont)

SAFE CONTAINMENT WILL BE <u>COSTLY</u> BUT IT IS THE <u>ONLY</u> ALTERNATIVE AS I SEE IT. A BETTER LEGACY TO HAND FUTURE GENERATIONS IS THE OPPORTUNITY TO HELP SOLVE THIS PROBLEM THAN IS ONE OF UNSOLVABLE PROBLEMS.

THANK YOU,

P.S. I WOULD APPRECIATE AN EXPLANATION ON HOW RECORDED TESTIMONY IS ACTUALLY WEIGHED AND CONSIDERED IN YOUR FEASABILITY STUDY

I MEAN HOW DOES ONE SORT THRU ALL THIS MESS.

PETER NAHIGIAN
P.O. BOX 326
COMPTCHE, CA.
95427

#159

February 24, 1983

COMMITTEE TO BRIDGE THE GAP
1637 BUTLER AVENUE #203
LOS ANGELES, CALIFORNIA 90025
(213) 478 0829

TESTIMONY OF ARTHUR WANG ON BEHALF OF THE COMMITTEE TO BRIDGE THE GAP* BEFORE THE U.S. NAVY HEARINGS ON THE PROPOSED SEA DISPOSAL OF NUCLEAR SUBMARINE REACTOR VESSELS

The U.S. Navy's proposal to dispose of old nuclear reactors by dumping them in the ocean is environmentally unsound, scientifically unfounded, and ethically unwise. The potential risks of such a practice have been essentially ignored by the Navy as it has pushed ahead, despite Congressional and international opposition, with its desire to scuttle these highly radioactive reactors in the environmentally sensitive oceans.

Disposing of just two of these reactors in the oceans would be equivalent to the entire recorded U.S. sea disposal of radioactive wastes to date. And the Navy proposes to dispose of approximately one hundred such reactors, an increased environmental burden of considerable significance.

In steaming headlong along this route, the Navy has ignored mounting scientific evidence that oceans are the last place where radioactive wastes should be disposed of. Water is the primary substance from which radioactivity must be isolated, because water is one of the best means of
L.20 | transporting pollutants imaginable; salt water will corrode disposal containers; and the web of sea life will concentrate radionuclides and
L.37 | bring them back to us in the form of food fish. You cannot throw
L.36 | radioactive wastes into the ocean without those highly toxic materials returning to some degree in the fish we eat.

Apparently to avoid facing these hard realities, which would rule out ocean disposal of submarine reactors, the Navy has chosen to essentially ignore in its Draft Environmental Impact Statement the wealth of scientific data available from the troubled history of past radioactive waste sea disposal and to rely instead on theoretical calculations divorced
L.1 | from the real world of how radioactive wastes actually behave in the oceans. This is a dangerous form of sticking one's head in the sand or pulling numbers out of a hat. The scientific method is based on the premise that
J.20 | hard empirical data are vastly more reliable than calculational estimates.
T.3 | Since there is such serious question about the effects of past sea disposal of radioactive wastes, a proposal to dump 50 times more waste than previously disposed of by the U.S. during the past entire 35 years is poor policy based on ignoring of serious scientific questions.

* The Committee to Bridge the Gap is a Los Angeles-based environmental organization which has been researching sea disposal of radioactive wastes for the last four years.

The only reactor intentionally dumped by the U.S. was the reactor vessel from the Seawolf submarine, dumped about 120 miles off the Maryland-Delaware line in the last nineteen fifties. The Navy has not been able to monitor the effects of its dumping the Seawolf because the Navy hasn't been able to locate the Seawolf reactor vessel: And yet the public is told that disposal of reactors at sea is safe, when the Navy cannot even find, let alone monitor, the one reactor it has already intentionally dumped. | J.85
(The monitoring of the Thresher and Scorpion subs which sunk raised worrisome questions--already radioactivity has been found released nearby.) | J.41

The history of ocean disposal of radwaste is replete with the kinds of assertions found in the Navy's DEIS, assertions later found to be completely inaccurate. For example, radwastes were disposed of at a dumpsite off Los Angeles for over a decade on the assertion that the depth of the site was so great that there wouldn't be enough oxygen to support marine life. Years later this hypothesis was tested, yielding the surprise discovery that the dumpsite was teeming with marine life. It had also been assumed that the barrels disposed of would hold the radionuclides within until significant decay had occurred. At the end of the dumpsite's period of use, this assertion was likewise tested, yielding the result that a third of the barrels imploded before even hitting bottom, due to the water pressure at depth.

Over and over again agencies which are supposed to protect public health and safety have asserted, without evidence, that the public will be safe in the face of a proposed environmental insult; and over and over again the agencies were proven wrong, and the environment and the public suffer.

This must not be permitted in the case of the disposal huge amounts of radioactive wastes as those considered by the Navy in its plan to dump 100 reactors into the sea. The sea is far too precious to life, and the wastes far too dangerous.

446

#160

My name is Elizabeth Ann Hathcock. A friend & neighbor agreed to read this for me as my name did not appear in alphabetical order & therefore caused the extra 1½ hr. delay.

First I would like to express my gratitude for my elected officials Mr. Doug Bosco, Mr Barry Keene, Mr Mc Carthy & Mr. Hauser as well as the esteemed scientist from UC Santa Cruz, Mr Jackson Davis for ~~express~~ representing my thoughts & feelings so well in this issue. I ~~totally~~ totally support them & ~~our fishermen~~ in what they have said. ~~also~~ Mr Nat Bingham ~~sai~~ expressed my concerns for our fisherman as well.

It hardly seems coincidental that a highly radio-active material such as Plutonium be named after the Greek God of the Underworld, Pluto. Radio-activity is the issue here. ~~~~ ~~~~ what you have ~~~~ used in submarines & powerplants comes from the underworld not the sea. Have you considered burying your subs ~~it~~ 2½ miles deep in the earth? Have you considered the association of nuclear solution as representing the right arm of Satan?

There are many of my neighbors who wanted to express themselves here also but due to the travel time involved are unable too. I too urge you on their behalf, to hold public hearings in ~~~~ Costal area. J.15

Please, ~~in~~ Mothball your subs until you have a safe, truly safe, solution. G.2

God Bless you. May His light shine in your heart.

#161

P O Box 116
Caspar, Calif.
Feb 24, 1983

To Hearing Officers
Sacramento, Calif

Re: off shore nuclear submarine disposal

To Whom It May Concern,

I and others are unable to attend the "Fair Hearing" today due to costs and distance from our Home community. Care of children while at a Public Hearing is difficult to arrange when travel time takes up an eight + hour time period, both ways.

I.15 Therefore, I request/demand/respectfully ask that further "fair hearings" be held in Fort Bragg, Mendocino County, Calif. to enable local people a full opportunity to discuss, comment, analyze, contribute in the decision-making and information exchange process which will determine the future of our community. Without further "fair hearings", including on-site local access to decision-making people, the "Public Hearing" process will NOT be complete.

Please schedule hearings at COASTAL TOWN SITES to enable citizens to attend, hear, ~~participate~~ participate as many people who will be directly concerned with and affected by the U.S. governments proposals would like to communicate their concerns.

Eureka, Fort Bragg and ~~Point Arena~~ Point Arena are all hereby proposed for further public hearings re proposed nuclear submarine disposal environment impact assessment. Thank you.

Sincerely,

Rande Dalton
P.O Box 116
Caspar, Calif
95420

Much more can be said.

P.S. Many issues are raised in my mind from the draft E.I.S. Following are only a few: (1) Concern about safety, dangers, risks of radioactive wastes especially as it pertains to SEA PRESSURE — #s @ sq. inch at ocean floor. (2) leakage - impacts on fish, water contamination, (3) earthquake - ocean floor - tectonic plate movement - potential for "squashing" containers - see p. 3-8 - difference in the bottom of the ocean floor indicates earthy continental shelf, upthrust movement (compare with Pygmy Forest "Terraces" on land 6mi. inland to coast - 6 terraces, each representing geological time tables - ocean movement). (4) C, 4, 5, 6 - unclear method of calculation (5) ~~food~~ clean-radioactive Q.13 L.20 F.22 L.14

#161 (Cont)

re: EIS - Nuclear sub-dumping
- 2 -

Randi Dalton
P.O. Box 116
Caspar, Calif
2/24/83

.14 (5) fish - genetic damage - long-range?!

.42 (6) DA-16 - questionable data processing procedures. How can accurate predictions/analyses be made on the basis on "a holothurian" and "an echinoid" "two" !! macrourid fish, caught at the "edges" of the Scorpion debris field?? Random sampling methods & scientific procedures are all very clear about the importance of ACCURATE, DETAILED, FULL, HONEST measurement before correct decisions can be made. Independent research is needed - objective, non U.S. Navy-gov't.

Full disclosure & comparisons & application of research

.64 (7) Problems of what if....

a) terrorism
b) sabatage
c) political hostage of the ocean?!
d) ocean suicide/murder
e) survival - food supply destruction
.53 f) impacts on local fishing economy & community p. 4-8
g) transportation of radioactive wastes
W.1 .20 h) retrievability of leaking containers?? costs; physical ability to correct problems, when leakage occurs
.44 i) HOW LONG is Radioactive materials required to be kept from air, water, soil, human life, animals to be SAFE from genetic damage/environmental pollution?

GO SLOW!

Much more study needed & accurate research needed. I.20

Radioactivity exposure (p. 4-18) refers to "average individual" - what about radioactive exposure to seaweed, fish, entire marine ecosystem?? How were these figures derived? By whom, what method? 6×10^{-12}, 1×10^{-9} - please explain clearly... L.13 L.41

COSTS can be measured in MANY ways. If money is available & has been to build nuclear submarines, then it is necessary to have money also to SAFELY dispose of them, recycle the good parts, dismantle, make as undangerous as possible to for ALL our CITIZENS. N.3

Land disposal as alternatives MUST BE THOROUGHLY VIEWED.

Recycling, military conversion of economic jobs toward life-forces of health & happiness, safety, security not death and destruction will require long-term assessment of cumulative impacts of 1) resource use, 2) labor & employment 3) environment - on land and sea - damage &/or use, i.e. fish, water, air, quality. THE FUTURE - ours - is at stake, for generations to come. L.7

SEA PRESSURE IS OF UTMOST CONCERN. Please figure the dangers of accidents, difficulty of retrieving leaking containers!! Q.13 L.57 L.20 W.1

#161 (Cont)

Also see over

Please submit: Public Record - Hearings 2/24/82 Sacramento

Full Speed Ahead On Nuclear Sub Scuttling

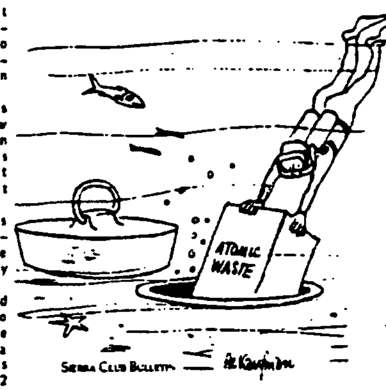
The Navy, undaunted by the protests of local politicians, environmentalists and fishermen,has set little- publicized hearings for February 24 in Sacramento on its plan to scuttle more than 100 decommissioned nuclear- powered submarines in the ocean off Fort Bragg.

Unresponsive so far to requests for extensions of a 90-day review period and pleas to have hearings on the North Coast, the Navy has scheduled a meeting on its Draft Environmental Impact Statement about the subs.

The DEIS, released two days before Christmas, recommended ocean burial over land disposal of the Polaris and other submarines for only one reason--lower cost.

The document admits that land disposal would enable the Navy to monitor and retrieve the subs in the event of leakage, but said at-sea burial would cost about $2 million less per sub (land disposal has a $7.2 million pricetag for each Polaris).

The Navy has claimed that the ocean off Fort Bragg is only being studied as a "generic" site, but papers pried loose by the Oceanic Society under the Freedom of Information Act indicate that the North Coast is viewed as ideal.



A $2 million study for the Navy says the site "is less impacted by shipping lanes, offers less opportunity for a productive fishery, appears to be characterized by smoother topography, and is a greater distance from major port activities and population centers" than any other tract studied.

The fishing industry disputes this conclusion, and spokespersons point out that just the rumor of nuclear submarines being sunk could make the whole fishery suspect.

It is thought that the Navy will try to keep tabs on the dead subs through its secret submarine listening post at Centerville Beach, just 50 miles north of the proposed burial grounds.

According to Gregg deGiere, aide to State Senator Barry Keene, "The reason the Navy wants to dump these subs off the North Coast is a political one. The Navy thinks that by scuttling them in the ocean, it will cause less of an outcry than burial on land. Quite simply, fish don't vote."

The Sacramento hearings will be held at the California Resources Building, 1416 Ninth St., at 9 a.m. and 1:30 and 7:30 p.m. on February 24.

The Navy said it will allow walk-in testimony by any individual for five minutes and any organization for 10 minutes during what it calls Sub Disposal Hearings.

Greenpeace Tips

Greenpeace has published an "Ocean Dumping Fact Sheet" full of information about the burial of nuclear wastes on the high seas.

Aside from data on ocean dumping, which was finally banned in 1970 but is threatening to be revived, the fact sheet contains the EPA regulations and provisions of the London Dumping Convention which established global protection for the oceans.

* For a copy, send a stamped, self-addressed envelope to Greenpeace Fact Sheet, c/o NEC, 1091 H St., Arcata, CA 95521.

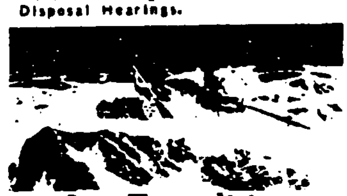
World Radwaste Ban Proposed By Keene

State Senator Barry Keene, in the forefront of opposition to Navy plans to bury spent nuclear submarines at sea, has recommended a worldwide suspension of ocean dumping of radwastes.

The London Dumping Convention, the international group regulating sea disposal, meets in London February 14-18 to consider a proposal by some South Pacific nations to ban all radwaste dumping. It is considered unlikely to win approval.

Senator Keene's proposed suspension would last until the next Convention meeting, probably late next year, and give world governments time to consider a permanent ban.

The Navy said it will allow walk-in testimony by any individual for five minutes and any organization for 10 minutes during what it calls Sub Disposal Hearings.



Icy Expedition

In 1977, six men set out on an epic 2,200 mile, 15-month journey by canoe and dog sled across the Northwest Territories.

After three months traversing waters from the Yukon through the Great Slave Lake heading for Hudson Bay,the expedition made international news in the treeless "barrens" of Canada by coming upon a piece of a Russian Cosmos satellite.

This month, one of the expedition members, Michael Mobley, will recount this experience twice in slide show lectures--on February 5 in Eureka at 8 p.m. in the County Office of Education boardroom and on February 6 at 8 p.m. at the Arcata Community Center.

The talks will serve as fundraisers for Project Challenge, a wilderness program within Youth Educational Services for troubled youngsters.

The admission will be $2 at the door. For more details, call Mary Struhs at 826-3340.

From: Newsletter of the Northcoast Environmental Center Arcata, Calif 95521 February, 1983 Vol. 13, #2

#161 (Cont)

Jan. 13, 1983 Peddler & Commentary Issue 202 16

Please submit into Nuclear Public Hearing record. - Sub-dumping issue.

hermit papers

a column of floating words
by: Ananda Seaweed

WORLDS WITHIN THE GREAT WAVES

In addition to the great beds of seaweed that are reproducing in our coastal waters, there are rich and complex populations of tiny, dwarf, shrimp-like animals known as plankton. There are also beautiful and abundant plants known as diatoms. About 20,000 varieties live in the world's oceans. Diatoms are smaller than tiny – and many are microscopic when fully grown. These plants are jelly-like protoplasms that gleam because they are made in part of glistening silica.

Diatoms are mainly cool water plants. We are familiar with diatomaceous earth, which is used in tooth powder, for insulating material, and as a flea retardant for domestic animals. However, diatoms are also a part of the intensely complex food chain existing in infinite perfection, whether known to landlubbers or not. They are one of many kinds in the world of creatures used for food by other creatures in the ocean deep.

In our world of conscious awareness, with regard to increasing populations, attention often turns to planktons and diatoms as possible food sources. Millions of people consume the millions of tons of marine animals caught each year. The fish eat the plankton and diatoms. Of the total world catch by fishermen (and women) about 40% is not edible and is used for fertilizer, fish oil, meal and bait. Directly or indirectly, everything that lives in the sea lives on plankton. Humans live on plankton too, since we eat the herring that eat the copepods that eat the diatoms and so forth. There are many experiments going on to test the feasibility of humans eating plankton directly.

But it is not specifically what we eat that I'm writing about here, rather, it's my need to share my concern for certain types of pollution in the food chain.

In addition to our efforts to halt nuke sub-dumping, oil drilling, oil spills, etc., we need to watch for certain types of chemical contamination that have been making their way into the food chain on both land and water.

Mercury, a valuable and beautiful liquid metal, is also a very dangerous substance. If it gets into our bodies in excess quantities it can destroy nerve and brain tissue with side effects of illness, and often premature death. In 1950, in Sweden, wild birds such as pheasants and partridges had a high death rate. It was traced to a seed-coating of methyl-mercury used by farmers as an anti-fungicide.

In an analysis of wild birds preserved and on display in museums, the mercury content in birds recently mounted was found to be 400% greater than in those killed and mounted in 1900.

It wasn't until 1967 that the Swedes discovered that mercury was making its way into the food chain because of industrial waste dumping into their streams and lakes. The waste mercury compounds were ingested by certain types of bacteria living on river bottoms, which in turn were ingested by plankton which was consumed by larger fish. The longer a fish lived and the larger it grew, the more mercury it collected. Fish like tuna and swordfish, close to the end of the food chain (the end being human consumption) might have very large concentrations of mercury in their bodies.

Research in Sweden and Japan has confirmed that methyl-mercury compounds from industrial by-products have made their way into our oceans. In 1969 the U.S. Food and Drug Administration began to investigate the mercury problem. It found a lot of contamination in the Great Lakes region. In 1970 the FDA halted the sale of vitamin pills containing material from the livers of seals caught in Alaskan waters.

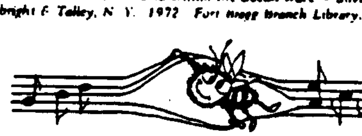
In that same year the FDA estimated that 23% of all tuna contained mercury in excess of official safety levels.

Also, in 1970 there was much publicity around swordfish mercury contamination. By May, 1971, over 800,000 pounds of swordfish were seized and the government issued a warning advising Americans to eliminate swordfish from their diets.

Micro-worlds teeming with life in myriad forms grace our planet. We are guardians of many creatures who are unknown to us. But survival of future generations is beginning to mean we must become educated on more and more levels. Continuous activity for prevention of further plunder of our fascinating planet is every person's job.

May all creatures be harmonious!

(Information from: The World Within the Ocean Wave – Silverberg, published by Weybright & Talley, N. Y. 1972. Fort Bragg Branch Library.)



HARMONIOUS

Peddler & Commentator, Fort Bragg Calif
Jan. 13, 1983

South Coast News

by: Marty Winslow

Ocean notes and thoughts as 1982 draws to a close: Several days' nice weather following a severe storm which wreaked havoc with local beaches and piers . . . Daily visits to the beach, observe the changes, and reflect . . . Rumors of whales beaching themselves with pierced eardrums on British Columbia shores . . . Stories of petroleum exploration done with sonic booms that can destroy a human swimmer's eardrum at five miles distance underwater. The whales' sensitive ears must respond to the noise and their navigation must suffer disturbance as they traverse the oil-searchers' neighborhood. Unable to verify through Greenpeace, but the rumor is food enough for thought.

Permits for oil exploration off California denied for one year – environmentalists' delight . . . but what good does the local ban do for the international community of whales who know no political boundaries, carry no passports, migrate through waters without differentiating whose shores they pass?

Manchester beach today – waves roll and crash without rhythm, vying with one another to outdo the last set for violence and height. The water is vibrant, translucent green with white froth, the sun glows dully on some yellowish patches of foam which float among the waves, and strange patterns of seapcastley stuff are left standing in clumps on the beach as the tide goes out. We walk closer, and stoop to pick up a handful of the unusual residue, marvelling at the crackly noise it makes as it disappears, bubble by bubble evaporating in the sun on our outstretched hands. The last bubbles pop and what remains on the hand is a glistening film with rainbow hues. The children are enthralled – "It's magic!" they exclaim, "how beautiful!"

Not beautiful, and not magic to me. I begin to remember the times I've seen such rainbows before. Tiptoeing through my mind come visions of lovely rainbows on Long Island Sound when, as a youth, I putted around in my father's outboard motor dinghy. The gas would leave colorful trails on the water behind the boat which even in those days of ecological naiveté seemed insidious in their beauty.

Then comes the association with the telltale streaks of rainbow on rainy gas station pavement – the same stuff! It is oil which makes the yellow patches of foam that float on the open ocean off Manchester Beach! Oil here, where we have so successfully (we thought) opposed offshore drilling these past years via constant vigilance and campaigning! What good is all the effort if the pollution already exists? Where does it come from? Passing ships? Distant oilwells? Santa Barbara? How can it reach us here on our pristine coast? No place is immune, I realize. The smallness and vulnerability of our world once again a reminder of how integral every act is. And then I am struck by the irony of that symbol's popularity these days. This is the age of the rainbow and the ominous symbol is everywhere – from shoelaces to windowpanes. We celebrate the beauty of the colors cast by crystals hung in the sunlight, and I am reminded of the oil on the beach. .

I remember the beaches of the Mediterranean Sea, black specks on the sand seemingly innocuous until you notice they stick in a layer to the soles of your feet. Public beaches have free kerosene receptacles – footbaths – you rub against a rollerbrush that rotates through the tub of kerosene and then scrubs the tarry residue off your soles. Everyone visits the footbath on route home from the beach; they line up at the exit where the tubs are located, waiting their turns. Many people even wear plastic sandals while swimming and beachwalking to protect their skin. A fact of life – taken for granted – the beaches are oily. Small comfort knowing that the Mediterranean is an inland sea, somehow more permissibly (though it is sad) polluted, its filth self-contained and condoned by the necessity of heavy ship traffic that plies the waters there, providing access to otherwise land-locked countries.

That same mental attitude of inevitability leads to the fact of the Pacific being polluted. Will we someday have kerosene baths on Manchester Beach? Is there any hope that we might be able to affect what happens by writing to our Congresspeople? Are these thoughts too pessimistic for the last week of the 1982? Sorry folks. On the bright side, I just read that leading environmentalists are voicing optimism re: the ecological impact of our new elected officials. They say that Duke and Pete will be too busy trying to bail the state out of its financial mess to put any energy into screwing up the environment. Isn't that cheerful news?

And, if winter chill is getting you down, drive out by the farms and see all the new lambs and calves that have been born. A promise of spring, and of life, to watch them on the green hillsides. Maybe their mommies know something we are too cerebral to realize. When I lie in the sun and soak up its warmth I feel it's going to be all right.

#161 (Cont)

Please submit to the Public Hearing Record.
re: proposed off-shore nuclear submarine dumping
2/24/83
Sacramento, Calif.

CAN WE UNDERSTAND THE POWER OF OUR WEAPONS?

What is TRIDENT?
TRIDENT is a nuclear submarine being built now
which will be able to destroy 408 cities or areas
at one time, each with a blast five times more powerful
than the Hiroshima bomb.
TRIDENT is 2,040 Hiroshimas.
One TRIDENT submarine can destroy any country
on earth.
A fleet of TRIDENT submarines (30 are planned)
can end life on earth.
How can anyone understand that?
Begin with a meditation:
To understand TRIDENT, say the word "Hiroshima".
Reflect on its meaning for one second.
Say and understand "Hiroshima" again.
And again.
And again.
2,040 times.
Assuming you are able to understand "Hiroshima" in one second, you will
be able to understand TRIDENT in 34 minutes.
That is one TRIDENT submarine.
To understand the destructive power of the whole TRIDENT fleet,
it would take you 17 hours, devoting one second to each "Hiroshima."
Your meditation is impossible.
To understand "Hiroshima" alone
would take a lifetime.

(from Lightning East to West, by Jim Douglass)

Submit – evidence of falsified reports, misinformation, lies, bias – U.S. govt.

from: A Periodical for the People
220 High St., Calistoga, Calif

Our Nuclearized Pacific

The nuclear age was born in the Pacific when a U. S. plane took off from Tinian Island to drop its 13 kiloton atomic load on Hiroshima. Three months later plans were underway in Washington for the first of what became 66 nuclear and hydrogen bomb tests in the Marshall Islands between 1946 and 1968.

Would the Chief of Bikini Atoll, the site of the first nuclear test, have given his consent to the relocation of his people if he could have known what would be their fate? Did he have a choice? The American military governor had told him the tests were "for the good of mankind and to end all world wars." And he and his people could return home when the tests were over.

In 1947 the islands of Micronesia, captured from the Japanese during World War II, became a United Nations Strategic Trust Territory, to be administered by the United States. In discharging this obligation, the U. S. agreed to: Promote the economic advancement and self-sufficiency of the inhabitants; protect them from loss of their land and resources; protect their health and uphold their rights and fundamental freedoms without discrimination. How well has the U. S. discharged this trust?

The people of Bikini, exiled to a small, uninhabited island with few resources and with no familiar lagoon to fish, existed on the edge of starvation for the next 20 years, dependent on Trust supply ships that were often long overdue. The people of Enewetak, site of the first hydrogen bomb blast and 43 other nuclear tests, suffered a similar fate. Things they required for self-sufficiency, such as sailcloth for their canoes, fishing equipment, regularly failed of delivery. They, too, became dependent for food and basic needs on the undependable Trust supply ship.

Nuclear testing has left the Marshallese with many health problems. Many islanders were exposed to heavy fallout. On March 1, 1954, the day of the 15 megaton "Bravo" test, the evacuated people on Rongelap Island, unwarned and unaware of the need to take precautions, stood on the beach and watched the colorful sky as radioactive ash fell on them.

Medical followup of Marshall Islanders has been inadequate. Islanders who received lesser doses of radiation were refused attention. Nelson Anjain, a relocated islander, voiced the feeling of many Marshallese when he told U. S. scientists: "For me and the people it is life that matters most. For you, it is facts and figures. We want our life and health. In all the years you've come to our island you've never once treated us as people."

An American doctor visiting the Marshalls in 1980 said: "Basic rights of a patient have been in large part ignored. I found very few Marshallese who were acquainted with the nature of their pathology. I firmly reject the thought that the people were too primitive or uneducated to absorb such information."

After a massive cleanup of radioactive test debris on Bikini Atoll the Atomic Energy Commission's statement that there was "virtually no radiation left" was changed to state the island was "hotter" than expected some three years later. Forced by a lawsuit filed by the Bikinians, the U. S. finally conducted a complete radiological survey of Bikini and the northern Marshalls. Bikini was declared uninhabitable for at least 30 years, although a few families had been permitted to return.

#162

202 Alder Street,
Brookings, OR 97415
24 February 1983.

Captain Edward F. Wagner, U.S.N.
Office of Chief of Naval Operations
Department of Navy, Washington, D.C.

Dear Captain Wagner:

I request that this statement be included in the hearing record on the Draft Environmental Impact Statement on Permanent Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

STATEMENT

I support the burial of decommissioned nuclear powered submarines
on Department of Energy land burial sites as opposed to placing them
on the ocean bottom. I believe, however, that both methods of disposal
are extremely crude. It is a sad commentary on the state of science
L.36 and technology that a method of disposal which would pose no potential
threat to man or his food chain has yet to be found.

While these thoughts temper my support for the land burial option,
I strongly oppose placing the submarines on the ocean bottom. In the
1970's, PCB's (poly chlorinated biphenyls) were discovered in fin fish
in the lower Hudson River nearly 200 miles beyond the points where the
pollutants entered the river. Commercial fishing in the area was banned
L.14 for several years and sportsmen were cautioned not to eat their catch.
L.36 Should the ocean bottom plan be adopted and any fin fish or shell fish
be as a result contaminated this scenario could well be repeated.

If, indeed, the ocean dumping plan is chosen, it should, at the
very least, be accompanied by the establishment of a 'superfund' to
L.53 mitigate any resultant economic losses suffered by the commercial
fishing industry and the coastal communities.

Fred C Hummel

Fred C. Hummel

#163

6202 Lubao Avenue
Woodland Hills, CA
91367

February 22, 1983

Capt. Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, DC 20350

Dear Captain Wagner: Re Legal Notice – Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

When the time comes and you think DISPOSAL, before destroying these decommissioned nuclear-powered no-longer-useful ships, think how much each one cost to acquire.

While thinking of burying or drowning the ships and perhaps polluting the sea and earth, why not store them in mothballs. When more nuclear submarines are needed, these could be refurbished quickly and used [illegible] not in time and money. The [illegible] If at-

It would make a good tourist attraction. Create a museum or graveyard housing the nuclear submarines would show the people their tax dollars at work. When the museum or graveyard became filled to capacity, perhaps it would occur to the powers that be that we are spending too much for defense material which becomes obsolete by the time it is delivered.

Sincerely yours,
Jeanne Groner

G.3

#164

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington D.C. 20350

February 24, 1983

Dear Sir,

I was unable to be at the hearing in Sacramento, California today concerning the Navy's problem of safely disposing old submarines. Nor have I read the Draft EIS. I read about this in a notice in the Point Reyes Light, January 27, 1983.

I too am very concerned about the build up of nuclear waste. I thought one of my solutions might interest you:

H.2 Dig very, very deep holes 20,000 feet or so with oil well equipment (but not anywhere that there is a possibility that oil might be found); cut the submarines up in pieces or melt them down; put the pieces at the bottoms of the holes and fill the holes with concrete. Make sure that the pieces are at least 15,000 feet below the surface. This would be tedious and expensive but I believe it would put the waste away from humans and beyond possible contamination of any water supply.

I think that it is very commendable of the Navy to take such problems to the public and I hope that you get some good ideas.

Thank you.

Sincerely,

Betty Rader

Betty Rader

17 Alta Street San Francisco 11 California Exbrook 2 0227

#165

MICHAEL HORAN

1190 South Winery Ave.
#215
Fresno, CA. 93727
20 February, 1983

Captain Edward F. Wagner
U.S. Navy
Office, Chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
Washington D.C. 20350

Dear Sir:

SUBMARINE REACTOR PLANTS DISPOSAL
Federal Register, Vol. 47, #246
Draft EIS

Please enter this letter in the formal hearing record.

I am against sea disposal for the submarine reactor plants and I don't feel the United States should leave a legacy of destroying the world's oceans.

Enclosed is an editorial I read on this subject in the No. 2, 1982 issue of OCEANS magazine, published by the Oceanic Society, Ft. Mason, San Francisco.

I believe we should have land disposal in this country for these waste plants.

Thank you for your consideration.

Yours sincerely,

Michael Horan

Michael Horan

Fresno, California

SEA SENSE

OCEANS
#2 1982

SOME LIKE IT HOT

Reactivating Radioactive Waste Alternatives

THE YEAR IS 1970. It is the end of an era. During the preceding quarter century, nearly 100,000 containers of radioactive waste has been dumped off the Pacific, Atlantic and Gulf coasts of America. A brief review of disposal practices reveals that

- Recordkeeping was at best incomplete and, until recently, spread throughout the files and archives of numerous federal and state agencies.
- While permits dictated disposal in tightly specified dumpsite locations, numerous instances of "short dumping", aerial dumping without permits, and disposal at unauthorized locations have been documented, and
- Despite regulations restricting legal ocean disposal to low-level waste, documents recently obtained under the Freedom of Information Act indicate that hundreds of containers of high-level wastes were dumped in both the Atlantic and Pacific oceans.

The extent of bad management of these nuclear disposal programs has only recently become evident. Until 1979, government records indicated less than twenty sites had been used for sea disposal of radioactive wastes. Since then, the research of one public interest group, The Committee to Bridge the Gap, has discovered more than fifty sites through government documents obtained under the Freedom of Information Act.

The absence of accurate records has complicated efforts to study the ecological impact of nuclear waste disposal at sea. To date, limited research has been conducted at a few of the larger sites off the American coast. Although this research has yet to reveal levels of radioactivity reflecting dangerous threats to human health, the data have documented migration of radioactivity from containers to bottom sediments, organisms and fish caught in the area.

But in 1970, things started looking up. The now defunct Atomic Energy Commission (AEC) stopped issuing permits for sea disposal of nuclear wastes. Environmental consciousness grew across America. The U.S. Council on Environmental Quality suggested ocean disposal be viewed as a last resort for radioactive waste disposal. That proposal became government policy.

The year is now 1982. It is the beginning of another era, or perhaps it is but one pendulum swing of history. Now the byword is deregulation. Environmental laws, as well as the agencies charged with their enforcement, are under vigorous attack, with deregulation occurring on many fronts. Many of the new political appointees, before coming to our nation's capital, adamantly opposed the laws that they are now charged with enforcing.

Their move toward deregulation and away from environmental protection is clear in the radioactive waste arena. After a virtual twelve-year moratorium on ocean disposal of nuclear waste, growing pressure for politically acceptable ways to get rid of high- and low-level wastes is creating pressure to reopen the ocean alternative. For without a "final solution" for radioactive waste, the current federal administration will have a hard time selling its effort to increase America's commitment to nuclear power.

Today this pressure is reflected in

- moves by the U.S. Environmental Protection Agency (EPA) to draft regulations permitting disposal of nuclear waste in the marine environment;
- efforts by the U.S. Navy to scuttle at sea some 100 nuclear submarines during the next three decades; and
- continuing federal support for a multimillion-dollar study of prospects for emplacing high-level nuclear waste in the deep seabed.

Last September, the EPA completed its latest draft of proposed revisions in regulations governing ocean disposal of dangerous wastes. If approved as currently written, these rules appear to make possible legal disposal of both low- and high-level wastes in the marine environment. Although these proposals have been revised several times without the benefit of public discussion or debate, the language of the initial draft sets up procedures for ocean disposal of both types of waste.

The draft EPA proposal would also establish a system for review of permit requests on a case-by-case basis. This could substantially weaken the more traditional approach of setting quantitative criteria for use in considering all permit applications, allowing an unprecedented degree of flexibility in processing disposal applications. For example, a powerful nuclear dumper (e.g., a government agency or defense contractor) could lobby more effectively for special considerations than is possible when set criteria are the basis of regulatory review. The "floating criteria" currently contained in the EPA draft provides a potential field day for special interests seeking a quick and easy solution to the nation's growing nuclear waste dilemma.

As the EPA moves toward formally issuing draft regulations this March or April, the navy is proceeding with consideration of sea disposal of decommissioned nuclear subs. The first step in this effort is development of an environmental impact statement (EIS) which examines the options of sea and land disposal of radioactive reactors from old atomic submarines.

While all fuel would be removed from the reactors before disposal, navy sources say each sub would contain up to 50,000 curies - more than all the radioactivity already deliberately dumped in either the Atlantic or Pacific oceans. Cobalt 60, with a half life of 5.3 years, is expected to be the predominant radioactive isotope lingering in the "defueled" nuclear reactor, although other isotopes such as nickel-59 are proving troublesome to the nuclear industry as it faces dismantling and disposal of land based power plants.

The navy plans to complete its draft EIS within six months, making the document available at approximately the same time as the revised EPA regulations. Preliminary oceanographic research conducted through the Office of Naval Research suggests two sites for scuttling these subs. One is approximately 160 nautical miles southwest of Cape Mendocino, California, in 4,200 to 4,500 meters of water. A second is some 200 miles southeast of Cape Hatteras, North Carolina, in approximately 5,000 meters of

by Michael J. Herz

#165 (Cont)

water An alternative would be to bury the sub's reactor compartment at an existing land disposal site such as the Hanford Reservation in southeastern Washington state or the Savannah River Plant in South Carolina

To date, five nuclear powered submarines have been defueled, decommissioned and placed in storage at U.S. Navy shipyards. International arms limitation agreements are exerting pressure on the navy to decommission some of its old Polaris submarines to make way for seven new Trident subs—each with twenty four missile launchers—to join the fleet in the next four years. During the next thirty years, some 100 atomic submarines are expected to be retired by the navy.

A lesser known proposal is said to be coming from the Department of Energy (DOE) relating to "fustrap", or low-level wastes from old AEC operations such as the "Manhattan Project". A particularly disturbing aspect of this proposal is DOE's efforts to have the EPA regulations written to accommodate these wastes in non-containerized form

Perhaps even more disturbing is a preliminary conclusion from EPA that the proposed regulations and the dropping of a twelve-year moratorium policy will *not* require any environmental impact statement.

Against this background, the General Accounting Office (GAO) released an October 1981 report claiming concerns raised by past dumping practices have been overemphasized. Despite the admission that the "Federal government has no complete and accurate catalogue of information on how much, what kind, and where low-level nuclear waste was dumped," the GAO report recommends EPA proceed with "developing regulations governing future use of the ocean as a low-level radioactive waste disposal medium."

In a more important inconsistency, the report seriously misrepresents the Oceanic Society's Ad Hoc Scientific Advisory Committee as concluding in testimony before the House Subcommittee on Environment, Energy and Natural Resources last fall that further monitoring of past dumpsites is not needed. On the contrary, it was precisely because of the incomplete assessment of prior dumping and its effect on the marine environment and seafood that the Oceanic Society Committee called for a systematic evaluation of these disposal locations. Further, the Committee recommended continued monitoring of food fish throughout the country to protect the public health.

The GAO report also misconstrues the positions of other public interest organizations—including the Natural Resources Defense Council, Union of Concerned Scientists, Scientists Institute for Public Information, Greenpeace, Committee to Bridge the Gap and the Center for Law and Social Policy which have raised concerns about the safety of sea disposal for nuclear wastes. In some cases, to promote this nuclear waste disposal solution, the GAO glosses over serious objections to the "ocean alternative" voiced by some of these groups

Since 1973, the federal government has been quietly supporting research focused on the feasibility of emplacing nuclear wastes in the deep seabed. This program, with a current annual budget of $6.2 million, is being conducted by the Sandia National Laboratory in Albuquerque, New Mexico. The study has identified likely sites in the eastern Pacific and developed procedures for packaging and emplacement. Despite this, relatively little public debate has focused on sea disposal of either low- or high-level wastes

In fact the Oceanic Society's public policy forum "Nuclear Waste Management: the Ocean Alternative" is one of the few times public discussion has centered on this important marine topic (see box)

Based on this history of bad management of past disposal practices as well as the absence of coordination among proposed programs, the Oceanic Society proposes that the federal policy prohibiting disposal of radioactive wastes in the marine environment continue until

1. A single, coordinated, comprehensive nuclear waste management program is established by the federal government in one agency

2. An increased program of scientific study, evaluation and continuing monitoring is launched to determine in definitive data-based terms the impact of past radioactive waste disposal on the marine environment. This effort must include monitoring of food [illegible] taken in the ocean and from the retail markets to test for radioactivity and toxic contamination

3. Criteria are established for marine disposal of nuclear waste that include as high priorities provisions for continued monitoring of disposal at new sites as well as measures for monitoring past dumps and retrieval

4. Federal regulations mandate the best available technology for packaging, transport, and disposal of these wastes

5. Marine disposal of nuclear wastes is considered only as a last resort once all terrestrial disposal options have been explored, utilized, and exhausted

Otherwise this new era may come to haunt us

NUCLEAR WASTE MANAGEMENT
THE OCEAN ALTERNATIVE

Published in association with Pergamon Press, this hardcover book contains the proceedings of the Oceanic Society's public policy forum of the same name. Contains a brief history of nuclear waste disposal at sea, as well as Ambassador Elliot Richardson's principal address on the ocean alternative. Available for $15.00 from Oceanic Society Publications/Media, Magee Avenue, Stamford, CT 06902 (203) 327-9786.

"Sometimes I think we're all just working for the oil companies"

(Courtesy San Francisco Magazine)

#166

Laura Danae
P.O. Box 832
Pt. Reyes Station, CA.
94956

February 20, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22) Department of the Navy
Washington, D.C. 20350

Dear Sir:

I am writing in regards to the disposal of decommissioned nuclear submarines. I understand that it is my right that this statement be included in the hearing record regarding this matter on February 24, 1983. It is of utmost importance that the Navy realize the weight of the decision it must make in this matter.

L.20 I do not profess to know the technical aspects of a nuclear submarine. I do, however, know that residual radiation is deadly for thousands of years. Considering the life-span of one nuclear submarine in comparison to the deadly longevity of it's inherent parts, it seems to me quite insane to ever have built one.

Keeping this in mind, I hope you will dispose of these horrible weapons in a way which is safe not only to our generation, but to, hopefully, the many generations to come.

Sincerely,

Laura Danae

Laura Danae

cc: Pt. Reyes Light

#167

FRIENDS OF THE SEA OTTER

P.O. BOX 221220, CARMEL, CALIFORNIA 93922

Department of the Navy
c/o California Water Resources Building
1416 9th Street
Sacramento, CA 95814

Re: Hearing on Radioactive Dumping
February 24, 1983

February 21, 1983

Friends of the Sea Otter opposes the Navy's plan to scuttle
nuclear submarines off the coast of California. Previous ocean
dumping of radioactive wastes reveals that our knowledge about
the behavior of radioactive materials in the marine environment
and about the potential effects on public health and safety is L.6
inadequate. Data from nuclear wastes dumped at the Farallon
islands indicate unexpected persistence of radioactive material
in the sediments rather than the expected dispersion of these
materials in the water. Further evidence suggests that radioactive L.36
substances have been accumulating in the food chain, and may present
a serious hazard to wildlife, to the important commercial and L.14
recreational fisheries of the state, and to the public.. L.53
Monitoring efforts and scientific study of radioactive material
already disposed of at ocean sites have not been sufficient to
dismiss these threats. There is no way to retrieve these materials
after they have been dumped should such problems be verified. W.1
Because of their long half-lives, many radioactive materials will
persist in the ocean for thousands of human generations. L.20
Friends of the Sea Otter therefore opposes the ocean dumping
of nuclear materials until further reliable scientific studies
have been conducted to assess the hazards to the marine environment L.1
and to public safety, and until alternatives to ocean dumping have
been adequately explored.

Sincerely,

Natasha Atkins

Natasha Atkins
Staff Biologist

#168

February 7,1983

Capt. Edward P.Wagner
U.S Navy office of the
chief of Naval operations
(OPNAV-22) Dept of the Navy
Washington D.C. 20350

Dear sir:
After reading your legal notice in the San Francisco paper concerning environmental impact statement for permanent disposal plan of decommissioned defueled naval submarine reactor plants.

It would obviously be disastrous to bury them on the deep ocean bottom, or under ground. And it could lead to a most shocking experience, we in life can't afford.

I who am a nature loving citizen of our society, have an idea,that may not be the most innovating but deserves merit to look into and to be included in the hearing statements.

H.7 Therefore I recomend that you would study if it could be feasible to dump these reactor plants into Mt. EREBUS." the only active volcano in the Antartica, which rises I2,448 feet above Ross Island on Mc Murdo sound in the Ross Sea.

With modern technology you could mix them with chemicals or explosives to sink those reactors into the molten hot lava where they would go deeper into the earths interior. And if the volcano would erupt, the radio-active material would freeze with lava among it's slopes.

This island shall then be made off-limits to the rest of the world.

Truly yours Johnny K.O.Malin

100 Welle Rd Crockett, CA 94525

#168a

April 7, 1983

Captain Edward P, Wagner
U.S Navy office of the
chief of naval operations
(OPNAV-22).Dept of the Navy
Washington, D.C. 20350

Dear Sir:
I would like to add this comment to my earlier letter written on February 2, 1983. to your office.

My plan is to dump the reactor plants into Mt. Erebus, on Ross Island in the Antarctica. H.7

In 1959, I2 nations signed a treaty delaying settlement of claims for 30 years. These nations also agreed that Antarctica would be used only for peaceful purposes.

Dumping of the nuclear waste in a safe manner for all nations could be achieved. Therefore Mt,Erebus area should be declared off limits to the entire world. Unsuitable and unsafe for any specific use.

The possible presence of unwanted radioactive matters should disolve into the hot molten magma and settle inside the earth core. The molten lava would shear all short-lived radioactivity.

If any seismic activity should occur, the potential danger of active geological phenomena such as eruption of the volcano, should be minimal if any at all.

To minimize hazards for safe operations at the site, the submarine reactor compartments could be deactivated in Honolulu, and transported from the shipyard to a disposal site. At the Hut Point on Ross Island, these could be air-lifted by a helicopters up to Mt.Erebus, and dropped into it.

The Mc Murdo sound with the Hut Point on Ross Island, could also have a dry-dock during the warmer months, to do the deactivating if so desired.

The radiation level can be detected by radiation survey, leaving instruments around the slopes of Mt.Erebus.

Final comment; We'll bury those reactors deeper and cheaper this way. and above all, safety comes first for the future. N.3

Sincerly,
Johnny K.O.Malin
100 Welle Rd, Crockett
C.A 94525

#169

The Outer Banks Chamber of Commerce
Post Office Box 90
Kitty Hawk, North Carolina 27949
Telephone (919) 261-[illegible]

February 7, 1983

Captain Edward F. Wagner, US Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

The Outer Banks Chamber of Commerce would like to reiterate its opposition to the disposal of nuclear submarines off the North Carolina coastline.

Basically our business community depends upon either commercial fishing or tourism for its life blood. We can see no benefit or advantage from the disposition of nuclear submarines off our fragile coastline.

L.53

At the same time this disposal could be potentially harmful, both environmentally and psychologically. Even if we could be assured that the disposal would have no environmental effect, we still see a real danger in misinterpretation which could lead people to choose seafood caught elsewhere over that caught in North Carolina waters near nuclear submarines. Similarly, this same philosophy could cause vacationers to choose alternate vacation sites.

0.34

Again, in the absence of any real clear-cut advantage and conversely, much potential harm, the Outer Banks Chamber of Commerce would like to reemphasize its opposition to the nuclear submarine disposal off our coastline. A poll of our business community showed overwhelming opposition to such disposal.

An alternate site, less dependent than our own on commercial fishing and tourism, and more dependent on industrialization and/or perhaps oil production, should be found if ocean disposal is the only answer to this complex problem.

For these reasons the Outer Banks Chamber of Commerce encourages the Department of the Navy to reconsider the plans for ocean disposal of nuclear submarines off the North Carolina coast.

Sincerely yours,

S. Chris Payne

S. Chris Payne, President

#170

20 February, 1983

An open letter with respect to Nuclear Submarine Disposal to:

Captain Edward F. Wagner, U. S. Navy
Office of the Chief of Naval Operations
Washington, D. C. 20350

Dear Captain Wagner:

I wish to register my complete opposition to the present plan to dispose of decomissioned nuclear submarines. Of many important reasons I choose to emphasize the following two:

1- Planning

N.12 The Navy is now using a third level of nuclear submarine. Since the life of these vessels turns out to be less than 25 years, the Navy is no doubt planning replacements for Trident. I am unaware of accompanying long term plans for decomission and disposal. With our present uncertain knowledge of disposal methods and risks, I suggest that every plan for construction should be accompanied by a plan for later disposal by publicly and scientificly accepted criteria for disposal of nuclear wastes. Present plans, as I have seen them presented, appear casual, hasty, and irresponsible. These plans appear as an effort quickly to get rid of a difficult problem before these difficulties are widely recognized.

I think of officers I had in the USAF in WWII who hated Russian Communism but expressed a longing for the disciplinary powers exercised by communist officers. I see in the Navy's action a similar wish for authoritarian action instead of action by the democratic process it is pledged to guard and protect.

2- Research and Development

Usually many discoveries are quickly made in a new field. Later discoveries tend to be fewer, further apart, and often trivial. Some later discoveries, however, are signigicant and may even lead to new fields of study. Atomic research has followed this pattern. Early development was rapid. Later development was slower and more pedestrian but contained major surprises such as the magnetic pulse, and the recent discovery that nuclear reactors end up contaminated with isotopes having a much longer half life than expected which makes decomissioning more difficult than ever anticipated.

The accompanying field of nuclear waste disposal has not followed that same pattern. Results appear few and fumbling. This is partly because most research results have had negative implications, and is partly because of the mix of social and technical problems affected. It appears that future studies will continue to show results of harmful social import.

F.10 An eight nation study and research group, which includes the United States, has studied ocean dumping of nuclear wastes. Among these studies are some which present criteria for suitably safe dumping in the ocean bed. (Science, 1981, v. 213, pp1321-1326). Among requirements for presently accepted approaches are the following:

1- Wastes be contained using containers of Ticode 12 alloy.
2- Containers to be inserted into abyssal red clay fields and covered.
3- Fields for disposal to be away from areas of seismic and volcanic activity. To assure that fields are quiet they should not show any evidence of activity for the past 100,000 to 1,000,000 years.
4- Fields to be away from areas where ocean currents meet, or other areas of upwelling and enrichment where fishing is of great importance.

Unacceptable are dumping in ocean waters (solution or dispersal) or dumping on the ocean bottom without burial in the clay sediments.

-2-

The above conclusions repeat those from other fields of pollution disposal. On a finite planet, the acceptable solution to pollution is strict containment — dilution is not an acceptable method.

Navy plans do not appear to meet the criteria given. J.9

The Tufts Abyssal Plain, about 20° NNW of Cape Mendocino, is a meeting place where the warm North Pacific Current meets the cold Subarctic Current, and is a salmon production area.

The area is somewhat north of the Mendocino Fracture Zone, but I have not seen nor read in the media that the Navy has cored the area to determine past activity

I have not seen that the wastes are to be contained. While it may be argued that the submarine vessel is the container, heat generated by the wastes under abyssal conditions results in high acidity than corrode steel at the rate of 25 inches a year as compared to the 2to 3/ 10,000 ths of an inch per year for Ticode 12 alloy. Steel provides no long term protection. L.20 F.10

Lastly is burial. There are no indications that plans include burial within the sediments, nor that experiments are in progress to determine how to open and close a submarine grave in sediments a mile deep.

To repeat, there has not been much growth in the field of nuclear waste disposal, but the Navy appears determined to ignore even that technology which is available. That is irresponsible and intolerable. F.10

Summary

Nuclear waste disposal in all forms should be based on long term plans consistent with democratic ideals. Disposal should be based on containment of wastes. Disposal plans should be pessimistic with respect to new research information developed in the future. I consider the present plans of the Navy not to be well thought out, not to be consistent with reseach studies available, but rather as an evasion of democratic responsibility. F.10

I should like to hear assurances that the submarines will be buried in abyssal clays — not just dumped on the ocean bottom — and that adequate burial methods will be developed in advance of disposal so that burial can be witnessed and attested to by an international commission. F.10

Thank you for your attention,

Respectfully,

John H. Madison,
Professor Emeritus
University of California, Davis

32500 S. Highway 1
Gualala, CA 95445

#171

A RESOLUTION

WHEREAS, the U. S. Navy has announced that it is currently examining the question of what to do with decommissioned nuclear submarines, and

WHEREAS, on December 22, 1982, the U. S. Navy published a notice in the Federal Register (Vol. 47, No. 246, pages 57085-57087), announcing a draft environmental impact statement (DEIS) to assess the environmental implications of alternatives that could be used to permanently dispose of decommissioned, defueled Naval submarine reactor plants of both land and sea alternatives, and

WHEREAS, feasibility studies have been conducted of burying the defueled reactor plants in Department of Energy land burial sites in South Carolina (Savannah River Plant) and Washington State (Hanford Site) or placing them on the deep ocean bottom, and

WHEREAS, the disposition of decommissioned nuclear submarines or decommissioned defueled Naval submarine reactor plants on land burial sites of the Savannah River plant or the storage of same at nearby facilities could be hazardous to the health and welfare of citizens of Beaufort County in the State of South Carolina.

NOW THEREFORE, be it resolved by the County Council of Beaufort County that it strongly opposes the disposition of such proposed decommissioned nuclear submarines and/or decommissioned, defueled Naval submarine reactor plants at the Savannah River Plant or any other nearby site.

ADOPTED this 14th day of February, 1983.

COUNTY COUNCIL OF BEAUFORT COUNTY

William L. McBride, Chairman

ATTEST:

Clerk to Council

#172

<<MR AND MRS T KUMARAN
32281 COAST HWY 1
GUALALA CA 95445

Western Union Mailgram

4-0440008052 02/22/83 ICS IPMRNCZ CSP WSHB
7078843111 MGM TDRN GUALALA CA 50 02-21 1159P EST

EDWARD F WAGNER
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINTON DC 20350

PLEASE ENTER IN HEARING RECORD. PRESERVE-- NOT POISON-- THE EARTH'S WATER SYSTEM. DON'T DUMP NUCLEAR WASTE IN ANY OCEAN. PLEASE ACT RESPONSIBLY IN THIS MATTER.

MR AND MRS T KUMARAN
32281 COAST HWY 1
GUALALA CA 95445

00:00 EST

MGMCOMP

TO REPLY BY MAILGRAM MESSAGE, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

#173

Mrs. Betty M. Beale
P.O. Box 235
Laytonville, CA
95454

Feb. 16, 1983

Captain Edward F Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV 22)
Department of the Navy
Washington, D.C. 20350

Dear Sir;

I protest the disposal of nuclear-powered ships in the ocean.
L.20 Even after the nuclear fuel is removed the submarines will leak radioactivity continuously for
L.36 more than a quarter of a million years. It could enter the food-chain with world-wide detrimental effects. What may seem to be the least expensive means of disposal would be a tremendous and completely unacceptable cost over such a long period of time.

We cannot continue to delude ourselves. Our actions *will* affect the future of the entire planet.

Sincerely,
Betty M Beale

#174*

Dear Captain Wagner,

I am writing to let you know of my strong concern at the possibility of dumping radioactive submarines off California's coast.

*W.1 I am completely against any such dumping, as the submarines are irretrievable, once dumped, and because of
L.20 the great danger of leakage of radioactivity from the subs. Such leakage could
L.36 cause great harm to humans
L.14 and animals -- perhaps also to plant life.

(over, please)

I hope you will exert whatever influence you have to make sure that such a catastrophe doesn't occur.

Thank you very much for your consideration.

Sincerely,

Marcia Jackson

4201 MUIR MILL RD.
WILLITS, CA
95490

*Other issues discussed by Ms. Jackson are side barred in Exhibit 597.

#175

As a nation we have chosen nuclear weaponsto defend us. Somehow we feel there is a threat more horrible than the threat of extinction of all life on earth. Or, in order to keep off the threat of extinction we must make larger threats and back these up with facts, with weapons. I don't know if anyone is quite sure which reasoning sustains us, but the fact remains that we have made nuclear weapons, we continue to create them and are planning to continue to do so.

I live on the coast of Mendocino in a town called Elk. I chose to live here because I wish to live a full life. And then, the question, Full life? What is a full life? Of all the sources I have come across, nature has been my best, and sometimes all too honest instructor. The sea, among other things, has taught me that there other communities to which I belong ~~other~~ than that of "nation". The Pacific Ocean directly affects not only the Mendocino Coast, but all of the coast of California. Washington. Oregon. Canada. Mexico. Guatemala. Nicaragua. Costa Rica. El Salvador. Panama. Colombia. Ecuador. Peru. Chile. Soviet Union. China. New Guinea. Korea. Australia. Japan. The Phillipines. Hawaii. New Zealand. Vietnam. The Pacific ocean is a very important common denominator to the humans living in these countries. Besides connecting life by a common bond, the ocean is itself a vast complex relationship of interconnected communities, varying in size from the one celled algae to the multi-celled sperm whale. These communities we call "ocean", have a major influence upon the life support systems of the entire earth. It is ludicrous for our government to prepare an environmental impact study for the review of the citizens of this state and of this nation when many, many more are affected by the ramifications of this proposal.

It is morally criminal that we (and I do mean you and I) jeopardize the lives of inhabitants off the coasts of the Pacific, the very life of the ocean itself, and the balance of our whole earth because we, as a nation have decided this to be the best place to dispose wastes of weapons that defend our particular, national way of life.

The weapons are our weapons. The"war"is our"war." The waste is ours. Each state should take responsibility for disposing portions of it, in their own boundaries.

I have asked Jane to read the following poem by Robert Hass. I don't mean for it to be read in a didactic manner, nor in a superior tone. Rather, I ask her to read it quietly and that I pray it can give us all the courage we will need to face ourselves, our nations, the creatures we are, and are not - and give us insight into life lived beyond our own political system. Thank you for this short time, it has been difficult to put the essence of why I try to live as I do, think as I think, in just this short comment. I also wish it weren't so general, but a minute is a minute.

Kate Dougherty
Box 70
Elk, California 95432

#175 (Cont)

-3-

On the Coast near Sausalito

1.
I won't say much for the sea
except that it was, almost
the color of sour milk.
The sun in that clear
unmenacing sky was low,
angled off the grey fissure of the cliffs,
hills dark green with manzanita.

Low tide: slimed rocks
mottled brown and thick with kelp
like the backs of ancient tortoises
merged with the grey stone
of the breakwater, sliding off
to antediluvian depths.
The old story: here filthy life begins.

2.
Fish-
ing, as Melville said,
"to purge the spleen,"
to put to task my clumsy hands
my hands that bruise by
not touching
pluck the legs from a prawn
peel the shell off,
and curl the body twice about a hook

3.
The cabezone is not highly regarded
by fishermen, except Italians
who have the grace
to fry the sweet, almost bluish flesh
in olive oil with a sprig
of fresh rosemary.

The cabezone, an ugly atavistic fish,
as old as the coastal shelf
it feeds upon
has fins of duck's-web thickness,
resembles a prehistoric toad,
and is delicately sweet.

Catching one, the fierce quiver of surprise
and the line's tension
are a recognition.

-4-

4.
But it's strange to kill
for the sudden feel of life.
The danger is
to moralize
that strangeness.
Holding the spiny monster in my hands
his bulging purple eyes
were eyes and the sun was
light tangent to the planet
on our unsteady coast.
Creature and creature,
we stared down centuries.

from _Field Guide_
Yale University Press 1973

#176

MAILGRAM SERVICE CENTER
MIDDLETOWN, VA. 22645

Western Union Mailgram

4-0519460054 02/23/83 ICS IPMMTZZ CSP WSHB
2029660093 MGM TDMT WASHINGTON DC 56 02-23 0616P EST

CAPTAIN EDWARD F WAGNER, USN
OFFICER OF THE CHIEF OF NAVAL OPERATIONS
OPNAV22 DEPT OF THE NAVY
WASHINGTON DC 20350

WE PROTEST THE CONTAMINATION OF THE PACIFIC OCEAN BY SINKING OLD NUCLEAR SUBMARINES OFF THE COAST OF NORTHERN CALIFORNIA.
MR AND MRS JOHN O HULL

18:17 EST

MGMCOMP

TO REPLY BY MAILGRAM MESSAGE, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

5241 (R 7/82)

#177

DARRYL L WEST
2356 HAREWOOD DR
LIVERMORE CA 94550

Western Union Mailgram

4-0499610054 02/23/83 ICS IPMRNCZ CSP WSHB
4159263024 MGM TDRN BERKELEY CA 39 02-23 0550P EST

CPN EDWARD F WAGNER US NAVY
OFFICE CHIEF NAVAL OPERATIONS (OPNAV-22)
DEPT OF THE NAVY
WASHINGTON DC 20350

DO NOT SCUTTLE NUCLEAR SUBS, ABSURD PROPOSAL. THEY WILL RESURFACE IN A FORM NO ONE WISHES TO CONTEMPLATE.
DARRYL L WEST

17:52 EST

MGMCOMP

TO REPLY BY MAILGRAM MESSAGE, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

5241 (R 7/82)

#178

1)

Thomas D. Brown
30150 Sherwood rd.
Ft. Bragg, Ca. 95437
6 year resident of the
Menocino Coast

Dear Sirs,

I plead to you for the future generations of the earth, that you don't dump these reactor cores into our oceans. To put such deadly, corrosive materials into our oceans (a vast source of food, O_2, & a habitat for millions of animals) is a terrible mistake & crime, that will have grave repercussions.

I can't give you any statistics or high tech. scientific data backing my concerns but, I do have strong feelings and convictions backed by common sense and simple logic.

A.16 It these cores are unharmful?
Then why the concern about suitable dumping ground anyway. Put them in your back yard. Why not off the San Diego coast or in the Potomac River?

If they are dangerous (which I think
W.1 they contain some of the most deadly sub-
J.76 stances known to man) then why put them
L.20 in the oceans, where they can't be retrieved, monitored, or controlled in any way.

It's like the old story of the little girl who swept the dirt under the capot. Then that night she couldn't sleep because the howling & moaning of the dirt haunted her.

Just a story but, a valuable lesson & a very basic & important one. Will you have to learn like the little girl? but, on an infinitly larger scale dealing with the
L.36 extremely delicate food chains & eco systems

(2)

of our mother [redacted] oceans.

You cannot make me believe for
one instant that if you dump these cores A.16
into the ocean, that they will not cause
irreparable damage. For these contamin- L.20
ents will out live us and ten generations
to come. Who are you to say that thousands L.39
of years from now that this won't be a mistake or sin for that matter.

A sin; this nuclear madness is the forbidden fruit talked about in the Bible. The dumping of toxic waste in the ocean is yet another bite of the apple leading to the destruction of this Eden. Face it this world may not be the idealist biblical paradise but, it's the only world we have and it must be preserved from nuclear contamination.

What of the fisheries off the coast. L.53
They are some of the best in the world. To endanger these waters or even gamble on endangering them is incredibly sick.

"What about the underwellings?" a
friend of mine asks. He tells me of
places like Mariana Trench where you could J.17
sink the cores & the continential shelves over lapping will ingulf them. Shurely your scientist must know something about under wellings.

I think the land storage idea is the best way for now. They can be protected and monitored. Shure it will be more expensive but, what is money when you

#178 (Cont)

(3)

are dealing with the health & well being of all life on earth.

Haven't we spilled, spewed, and spoiled enough land & waters already

#179

To USN

To captain Wagner, and all the other fine officers of the USN who found more important tasks today & couldn't be with us, I would like to present a proposal on how this problem of ocean sub dumping can be resolved. An idea that perhaps we can all live with.

I personally volunteer, & I'm sure some of my friends here today would join me to come to your house and the homes of 99 other high ranking Navy officials, and free of charge dig large holes in your yard. All you have to do is have a decommissioned sub delivered to your home and pushed into the hole. We will be more than happy to cover it up.

You Captain Wagner and the USN are threatening the very life cycle on this planet, a cycle that permits humankind to be here in the 1st place. We from Moonstone Alliance ask the USN to forgo this incredulous idea of ocean waste disposal and seek a more logical method of sanitation, if indeed one exists at all. Or better yet quit producing nuclear waste altogether.

Eliot Diamond
Moonstone Alliance
Cambria, Ca.

THE DAILY DIGEST — Willits, Ca. 95490 — Tuesday, January 18, 1983

The Marshall Islands; Vandenberg and You

By Louis Korn

On January 12 at Ukiah's Methodist Church, an audience of about one hundred listened to Darlene Keju, a young Polynesian nurse, tell of 35 years of U.S. atrocities committed and continuing on her people. Ebeye is the most crowded island in the world, as densely populous as Manhattan Island with its many multi-storied tenements to vertically house its population. Ebeye has only ground dwellings, squeezing thirty people to a room. Ebeye is an atoll of the Marshall Islands, a chain of coral islands enclosing lagoons, once celebrated as paradise in James Michener's TAILS OF THE SOUTH PACIFIC.

These island people lived on breadfruits, coconuts, fish, crab that grew in lush abundance. Their vocabulary had no word for enemy. Strangers were friends, lovingly welcomed.

Such a place, atolls extending over an ocean area as large as continental U.S.A., and such a people existed when I was a young man. Now these islands are uninhabitable, its people concentrated on the island of Ebeye, sick with malignancies, bearing dead babies who have no resemblance to human beings or anything living.

They are victims of the U.S. Strategic Protectorate, human guinea pigs of our Pacific nuclear tests whose islands are still targets of our missiles aimed from Vandenberg Air Force Base. Parenthetically, the U.S. Navy prepares to dump highly radioactive nuclear submarines off our coasts, ignoring the horrible results of radiating the Marshallese.

Ms. Keju noted that our government disclaims responsibility even for its own soldiers sent to these islands to gather test data — becoming data themselves — dead or dying of cancer. Born years after the atmospheric tests ended, she has several tumors now.

Genocide of the People of Paradise, extinction of a whole Pacific culture, is only part of our government's work. She came to warn us that we, too, will be its victims, that governments drunk with invincible power lose all humanity. They are driven to holocaust.

Irony names our weapons, and our President's name is chilling coincidence. The destabilizing MX Missile, whose mere possession incites both sides to pre-emptive war, is called "The Peace Keeper". "Corpus Christie," Body of Christ, is a Trident submarine with enough nuclear warheads to kill every human being in every large Russian city. Ronald Wilson Reagan is a name of three words, each having six letters. In Revelations (13:18) is a passage about the anti-Christ, a great deceiver, leading nations to destruction. Referring to "the number of its name,": "... let him who has understanding reckon the number of the beast, for it is a human number, its number is six hundred and sixty-six."

For me, biblical truths are allegorical, not literal. Yet I shuddered reading it. But dire prophecy succeeds when it fails. Its purpose is to arouse preventive action. In his published memoirs, Nixon states he could have won the war in Vietnam using a nuclear bomb, blaming the effectiveness of peace agitators who had made this option too unpopular. Massive resistance can still prevent holocaust. But only a hundred came to hear her in a city of twenty thousand.

After the holocaust of WW2, the German people said they did not know about the Nazi concentration camps. It is true they had little publicity. Nor is genocide of the Marshall Islanders publicized now. Great crimes always bloom under censorship and conspiracies of silence.

In times past, momentous lessons of history rarely recurred in one's lifetime. Buried in books few read, they were repeated by new generations. But the intervals between calamities grow shorter. I have witnessed a pattern repeated: calls to arm against the enemy, moral justifications to plunge the world into incomprehensible suffering and irretrievable loss that few could profit from, the few who call to arms. And in my lifetime I have seen that the few who profit from wars are the same who plunder the environment.

Oppression consists of giving over control of your life to others, for their — not your — purposes. Oppression requires consent to be oppressed, rather than risk unacceptable punishment. But what punishment is greater than losing one's will, one's purpose, one's reason for being? Conscription and taxation are forms of oppression. Oppressors value neither will nor life. Only power. Power that is fed by our taxes for our bodies under arms.

Reclaiming one's will is a joyful experience. From Jan. 21-27 peaceable people will converge on Vandenberg to oppose the continuing militarization of our country, already the mightiest armed force that ever existed. Reclaiming ourselves, we stand between holocaust and a liveable world. Won't you join us? (707) 462-6390 — (415) 644-3031

#180

Feb. 23, 1983

To Everyone Concerned -

I regret being unable to attend this meeting
personally and appreciate being able to let the
feelings of our family be known.
We are deeply concerned about the use of
nuclear energy for both weapons and peaceful
use. While in many ways this energy source
may seem ideal, we can't ignore the fact that at
the present time there are no safe ways to dispose
of or store nuclear waste.
This brings us to the issue of today's meeting -
the proposed dumping of nuclear subs off the
Mendocino Coast. This may at face value seem
to be a good solution to the problem of how to
dispose of the submarines, but if we look past
L.39 today and into the future we see that we are
leaving our children and future generations a
possible problem that will be without solution.
W.1 How can you re-gather nuclear contamination once
it has escaped into ocean waters, the food
L.36 chain and our bodies? The physical problems
that nuclear contamination reeks on our bodies
and the gene pool is fact. Why risk it - either
L.53 off our coast or anyone else's? Especially
why risk it off a coast that supplies fish eaten
locally and in many other places too.
We propose that more research be devoted to
this very real problem of nuclear storage and
disposal, that we keep production of new wastes
at a stand still or bare minimum and

that we strive for answers that will serve
the children of the future and not just
our present needs.
Thank you for your time and attention.

Respectfully submitted,

[signature] - Dawi S. Moyer
Box 313 Comptche Ca 95427

[signature] Marcia L. Douglas
Box 165 Comptche, CA 95427

[signature] Douglas R. Moyer

[signature] Gail R. Golloor
PO Box 203
Comptche, CA 95427

P.S. We would appreciate future meetings to be held nearer to our area. Thank you J.15

472

#181

February 24, 1983

Captain Edward Wagner, U.S.N.

But what is the Good Life? Is all this glut of power to be used for only bread an butter ends? Man cannot live by bread, or Fords, alone. Are we too poor in purse or spirit to apply some of it to keep the land pleasant to see and good to live in?

By Aldo Leopold

"Good Management" 1931

Note 1931, a date prior to the Nuclear Explosion. Mr. Leopold would no doubt have included the ocean as well as the land.

Jean Battenburg

A concerned citizen.

Public Hearing - Sacramento, CA

#182

Capt. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington D.C. 20350

Dear Mr. Wagner,

I'm ten years old. I live in Mendocino, California.

Please don't dump nucular subs off

L.36 the coast of Mendocino (or any where else). I eat fish alot and I to young to die. If a fish got nucular power in them and I eat that fish I could die and if get nucular power in them they would die and things that eat them will die. If I eat a fish that is all sick and I have a kid it could have a defect.

I know a kid who's hand is all weird looking and that is from the bomb drop on Hiroshima.

I might not have a kid Just becaus I don't want to bring some body into a world that you can't even eat yumy fish

Please Don't,
Emilie Ferris
P.O.B. 333
Mendocino, Ca
95460

473

#183

Capt. E. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington D.C. 20350

Feb. 16, 1983

Dear Mr. Wagner,

I am 10 years old. I live in Mendocino Co. I am very upset about nuclear sub dumping. I don't like it. It will effect my family because my dad is a fisherman we eat fish alot. It will also effect the food chane. L.36 L.53 Birds, fish and marine life will die. Last January my grandpa died of cancer he had been working for a componey that handled alot of radation. I am only 10 years old and look how it has efected me. I don't want that to happen to my children.

Sinserly yours,
Kei Murrell
30150 Simpson Ln.
Fort Bragg Ca. 95437

#184

L.36

Dear Capt. Wagner, I'm ten years old from the mendocino [illegible] school the reason why I'm telling you this is because I live in a small town off the coast of calfornea the navey wants to dump nuckluer submaring of the coast of mendocino and the fish will eat the radission and thet we and we will eat the fish and we will get sick and die

from

Kyla [illegible]

Mendocino CA 95460
Po Box 835

#185

captain wagner
office of the chief of the
naval operations
dept. of the Navy
Washington D.C. 20350

2/15/83

dear m.r. wagner

I am ten years of age and I come from the mendocino grammer school

I am very upset about the subs being dumped off the mendocino coast

there is not adequate information on how the radiation from the subs will affect the people and food of mendocino. L.1

Sincerely

Daniel wells #415 little river california

#186

2/15/83

I do not like what you are going to do of the coast of mendocino.

Heather smith

#187

2/15/83

L.20 | L.14 | L.52

I disagree what you are doing scuttle 100 submarines off the cost of fort Bragg because if the subs leaks it will kill lots of fish!!!

Virginia Citrino

#188

I really disegree about Scuttling the 100 submarines off the cost of Fort Brag, because if the radioactive wast was to leak out it would kill lots of sea live. 2/15/83

L.20 | L.14 | L.52

Sincerly,

Paulo Ibañez

#189

February 14 1983

Honorable John Lehman
Secretary of the Navy
Department of Defense
Washington DC 20301

Dear Mr Secretary

My husband and I wish to express strong opposition to the plans of the Navy to scuttle radio active nuclear submarines off the northern California Coast.

We will be unable to attend the hearing in Sacramento this month but wanted you to know our feelings that no submarines should be discarded in an area where
W.1 | they would be irretrievable and
L.53 | Constitute a menace to fishing and
our north coast environment for generations to come —

Sincerely

Betty Crum Beth
Warren A. Beth
Lt. Colonel USAF Ret.

Mr and Mrs Warren Beth
Box 1692
Fort Bragg CA 95437

#190

Mr. Lelman,

I don't think that Sacramento is a fair place to hold a hearing as to where the nuclear sub-marines should be dumped. I've read the environmental impact report submitted by the navy and I've come to the conclusion that the decision of wieghing environ-mental costs with the fact that dumping in the ocean is simply cheaper and more convenient is the result of greed and down right ignorance on the part of
L.14 decision makers. The decision doesn't seem to take into acount the marine live (which will even-
L.53 tually be poisened), the SCUBA diving enthusiasts, (who will eventually be poisened), and the fishermen and seafood
L.36 eaters, (who will also eventually become poisened). THINK!!!
J.15 So; I request that you be fair enough to hold a hearing in Eureka or Fort Bragg where the intial contamination will be felt (not Sacramento or the Pentagon).

Over please

Lastly; if you would, please reply and tell me who gave the right or permission to ruin the future for so many living things?

David Martinovich

David Martinovich
1505 Charles Ave.
Arcata, Ca
95521

#191

L.36 | I am strongly opposed to dumping nuclear waste in the ocean, Anywhere!, but especially off the Cape Mendocino or Northern Calif. Radioactive waste goes into the food chain much easier in the ocean than when dumped in a land locked dump. Contaminating the food chain, effecting everyone even the Navy! There are better alternatives. I am only one of hundreds of people who feel this way and I vote by issues which are vitally important to everyone like this one.

Rick [illegible]

#192

2-19-83

Dear Friend -

I am adamantly opposed to dumping nuclear subs off our coast or in any waters anywhere on the planet. Please reconcider the alternatives!

Sincerely
Steve Satzmer

#193*

8 Feb, '83

Dear Sir,

As a commercial fisherman, I wish to ask you to please do all that you can to stop the nuclear submarines from being dumped off of our coast. | L.53*

I feel this would be a threat to public safety and health, and to attempt it would provoke enormous public outcry. | L.36

Thank-you,

David R. Gurney
P.O. Box 279
Comptche, Cal. 95426

*Other issues discussed by Mr. Gurney are side barred in Exhibit 133.

#194

FRIENDS OF THE EARTH

1045 Sansome Street San Francisco California 94111
(415) 433-7373

February 23, 1983

Captain Edward F. Wagner
United States Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

L.36 Q.13 F.22 W.1 J.76 F.10 The proposal to bury obsolete nuclear submarines in the ocean floor is of great concern to Friends of the Earth. We believe the ocean option is the least wise of the choices you have before you: The probability of leakage into the biosphere is higher with marine storage than surface storage and current understanding of the pressure effects, corrosion rates, mobilisation, and geologic action is far inferior to our knowledge of those phenomena on land. Further, adequate techniques for monitoring leakage of radioactive materials under the ocean and clean-up of escaping radioactivity will be extremely difficult if not impossible. The application of civilian criteria for high level waste disposal to the technique being proposed by the Navy would disqualify this dumping procedure.

O.12 Burying nuclear submarines on the ocean floor may temporarily "solve" our generation's problem of what to do with our legacy of radioactive waste, but it is hardly a fair legacy to bequeath to our children and those who follow them. Some radioactive materials remain dangerous far longer than the United States or even human's civilisation has been in existence.and we must broaden our vision from one lifetime to that of many.

G.2 We recommend that nuclear wastes of all kinds be stored on sites already contaminated with such material until safer alternatives are found. We support efforts to find the safest permanent storage methods that can be developed. Our view is that such methods will probably be land-based. The proposed inexpensive scuttling of nuclear submarines will foreclose such options.

O.12 The ocean-bottom alternative that appears financially cheaper for the moment is likely to become costly in monetary terms and in irreparable damage to the oceans, their life, and, perhaps, the well-being of the human species. It is our responsibility to assure that the costs of our waste not be laid on the doorsteps of generations to come.

Sincerely,

Jim Marotta-Jacnecke

Jim Marotta-Jacnecke
Assistant to the Chairman

cc. Submitted at Sacramento hearing; Feb. 24, 1983.

Committed to the preservation, restoration, and rational use of the ecosphere

100% Recycled Paper

#195

2149 Danbury Way
Rancho Cordova, California
95670

January 7, 1983

Department of the Navy
Office of the Secretary
Washington, D.C. 20350

Dear Sirs:

This letter is to serve as protest against dumping of radioactive material into the ocean.

I am particularly concerned regarding marine life and the long term effects of radioactive dumping. L.14

Very truly yours,

Kevin Scotti

Kevin Scotti

#196

2/15/83

Pleas Dont Dump the subnarines what if it leaks ? L.20

Sinsearly,

Pearl childs

#197

Box 17
Caspar, Ca 95420
February 22, 1983

Capt Edmond Wagner
Chief of Naval Oper.
Dept of the Navy
Wash, DC 20350

I am deeply concerned that the Navy is considering dumping their decommissioned nuclear subs in the ocean.

W.1
L.39
This is an unforgivable act & all the ramifications have not been investigated. You will be risking the continued existence of this great nation & its people. Please stop & consider what you might be doing.

Sincerely
Edward Luber

#198

2/22/83

Dear Capt. Wagner;

We are writing to protest any dumping of nuclear substances off the Mendocino Coast - California. This is a fishing community and we are convinced that this act would result in irreparable damage, not only to the fishing industry and our economy, but more importantly to the environment as a whole. L.53

Again - we say "no" to any nuclear dumping.

Sincerely,
Donna Joyce
Donald A. Joyce

117 S. Harrison St
Ft. Bragg, CA 95437

#199

RESOLUTION NO. 118

RESOLUTION OF NOYO HARBOR DISTRICT
OPPOSING OCEAN DUMPING OF NUCLEAR WASTES.

The Board of Commissioners of Noyo Harbor District does hereby RESOLVE:

WHEREAS, the United States government proposes to dispose of nuclear waste from discarded nuclear submarine engines and other sources by dumping such materials in the Pacific Ocean off the coast of Mendocino County, California; and,

L.53 WHEREAS, such ocean areas are vital fisheries, important not only to the Mendocino Coast, but to all of California and the nation as well, and could be contaminated by such waste material;

NOW, THEREFORE, the Noyo Harbor District hereby records its opposition to such nuclear waste dumping, and urges the United States government to abandon its plan to so dispose of nuclear wastes.

PASSED AND ADOPTED this 10th day of February, 1983.

AYES: Commissioner ARMITAGE, BRADLEY, CAITO, MAAHS AND STAMPFLI

NOES: Commissioner NONE

ABSENT: Commissioner NONE

[signature]
Chairman

Attest: [signature]

NOYO HARBOR DISTRICT
NOYO MOORING BASIN
19101 S. HARBOR DRIVE
FORT BRAGG, CALIF. 95437

482

#200

3700 Old Pfafftown Road
Winston-Salem, N.C. 27106
27 February, 1983

Captain Edward F. Wagner,
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I am writing to express an opinion on the Navy plan to bury radioactive submarines at sea off of the NC (or Calif.) coast. I think that the Navy is incorrect and irresponsible in considering such an option and hope that you will reconsider it.

F.13 The technology does not exist. The technology to bury the subs is inadequate; the
W.1 technology to bring them back up, should there be problems, probably never will.
L.20 If barrels dumped off the East coast (with radioactive wastes in them) are corroding, opening, and leaking, then what will keep the subs from doing the same over a matter of years? What will you do then?

L.6 The science is inadequate. The Environmental Protection Agency has not studied — and is not budgeted to study — what happens to areas where radioactive waste has been dumped on the ocean floor. The only study I have heard of ("Hudson Canyon" L.36
by a Professor Schell I believe) showed radioactive concentrations in rattail fish. It is highly L.39
irresponsible to proceed without even knowing what is going to happen.

The cost cannot override safety. To say that N.3
ocean burial will have "negible" impact on the environment is a falsehood. To use this to justify the cheaper, ocean option is a distortion of the situation. The fact that the W.1
subs cannot be recovered overrides the immediate cost of their disposal.

I appreciate the fact that these submarines are a problem for you. It is not right to try to put them "out of sight, out of mind" by putting them in the ocean, [illegible]
some of them can be tied in Navy yards G.2
(since they are not dangerous), and the majority can be disposed of in land sites where they can be monitored. But while I appreciate your problems, I cannot appreciate your motives or your methods - because either you are willingly ignorant of what this plan involves, or you are deeply cynical about the people it is your job to protect. Either way, I am disturbed, frustrated, and cynical myself.

Sincerely,
Carolyn J. Christman

#201

GERALD K W JOHNSON
3017 ONEIDA ST
PASADENA CA 91107

Feb. 27, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations [OPNAV-83]
Department of the Navy
Wash. D.C., 20350

Dear Sir:

Re your ad in the L.A. Times of Feb. 13, 1983, about Disposal of decommissioned Defueled Naval Submarine Plants.

In the L.A. Times of Feb. 27 1983 the Fluor Engineers, Inc, Irvine Calif, has received an environmentally oriented award for
H.10 a calcining method that safely converts radioactive liquid wastes generated during the processing of nuclear reactor fuel into a granular solid form which can be stored up to 500 years.

Perhaps they have solutions to the disposal of Reactor Plants?

Sincerely yours,

Gerald K. W. Johnson

P.S. Applicant to Mare Island also.

#202

The proposed sinking of nuclear submarines off the Coast of Mendocino is an idea that shows a serious lack of foresight.

If the claim is made that all is safe; no leakage can occur, then I propose that the subs be safely L.20
stored where that can be proven, at a monitered site. G.2

If the subs are called junk, then who has authorized the ocean to be called a dump?

The ocean is a home to organisms who contribute oxygen to the air we share. We are talking about this one planet under our care.

As a resident of Southern Humboldt County, I strongly protest any storage of nuclear submarines in such an un-monitorable and dangerously unstable site. J.76

Respectfully yours,

Linda Childs

P.O. Box 511
Miranda, Ca. 95553

#203

Mr. Wagner,

I am very concerned about the
navy's plans to dump decommissioned
nuclear submarines in the ocean
off of the Mendocino coast. I
do not believe that these subs
are harmless. I believe that the
corrosive effects of saltwater
L.20 coupled with electrolosis will
eventually render any container
leaky. I do not want any
more radioactive wastes dumped/
or added to our ocean environment
The proposed plan states that marine
populations near the dump site are
J.12 small. This is not true! I am
a commercial fisherperson and have
fished on the very site you are
speaking of. It is teeming with
marine life as is most of the ocean.
I propose that the navy put
these wastes on land where they
can be monitored and retrieved
at some point in the future. As
we may find a better way to
store radioactive wastes as our
technology advances. If these
subs were put on land they could W.1
be retrieved; not so in the ocean.

Please listen to my voice of
opposition to the navy's plan,
and to the voice of millions
of people who want to keep our
ocean healthy.

I realize the navy has done
an extensive Environmental Impact
Report, and I have read it well.
I do believe there are some grave
misconceptions in this report. I
believe they do not care as much N.3
about contamination as they do
about cost. Ocean dumping indeed
is cheaper. But please, lets take
off our blinders and look into
the future. Lets have some concern
for the very ocean that provides L.36
us food- and not spoil it!

Thank You,

Alice Berg
P.O. Box 595
Fort Bragg Ca 95437

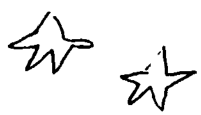
#204

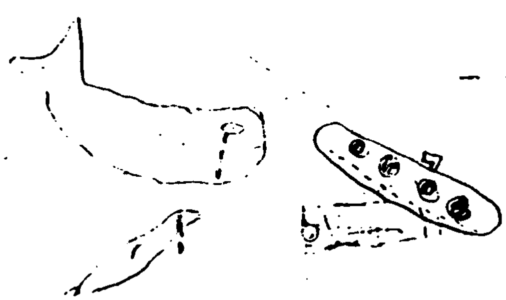
Dear Capt. Wagner,

[illegible]
[illegible]
[illegible], Calif. [illegible]

I. hope you won't dump the atomic Sub. It will only spoil the ocean.
L.53 | Nobody will be able to swim in the
L.14 | ocean and the animals that live in it will die! I dont want the whales, dolphins or seals to die. So dont dump the sub!

P.S. I am 9 year's old and my name is Sean (Fannin)





#205

Capt. Edward F. Wagner
U.S. Navy
Office of The Chief of Naval Operations (OPNAV-22)
Department of The Navy
Washington, D.C. 20350

Dear Sir:

We are residents of Petaluma, a small Northern California city located near the Ocean. Since we were unable to attend the public hearings in Sacramento on Feb. 24, we respectfully request that you consider our feelings on the issue of ocean disposal of obsolete nuclear submarines in the form of this letter.

Since the ocean is the source of all life on this planet, we feel very strongly that not even the slightest risk of contaminating it with radioactivity must be allowed. Therefore, we are very much opposed to the plan to dump decommissioned nuclear subs in the ocean.

Anyone whoenjoys walking along the beach, getting splashed by waves ... anyone who has ever caught a fish or eaten one ... anyone who has ever sailed on the sea... anyone who has a child who must live in the world we leave to him... anyone who has ever smiled at a dolphin or watched grey whales migrating ... anyone who loves and respects life in any of its myriad forms... | L.14
should be against this proposal.

Because the long term effects of nuclear waste dumping is not known at this time, 19 nations of the world have | L.39
signed a moratorium on ocean dumping. We hope the United States Navy will respect this worldwide concern.

The affects are too unknown and the consequences are too grave. We urge you to abandon this plan.

Thank you for considering our views,

Sincerely,

Carol Wilson
Carol M Carver
[illegible]
Jane [illegible]
Susan Cross

Linda D [illegible]
Pamela [illegible]
Rick Mason
Diane R. [illegible]
[illegible]

#206

216 Bayview St
San Rafael CA
94901
Feb. 28, 1983

Offc. of the Cheif of Naval Operations (OP-22)
Dept. of the Navy, Washington DC 20350
RE: Comments On Draft Environmental Impact Statement

Dear Cpt. Wagner

I'm writing to express my opposition to the
scuttling of Nuclear Submarines off any
coast as a cost-effective means of
disposing of them.

I am not convinced that it is "cost
effective" to dispose of dangerous
N.3 | wastes in anything other than the
safest way. If even the Navy admits
that there are safer though more
expensive ways to dispose of the
submarines. In the cases of toxic
waste contamination we have
clearly seen that it is not truely
O.12 | cost effective for taxpayers to
put out $50,000,000.00 to clean
up what it would have taken a
million dollars to dispose of properly
in the first place, when it comes
to nuclear waste it may not even be
possible to clean up later.

Sincerely, Sharon Ryals

#207

Feb. 25, 1983

Mary Toner Phillips
2116 Roosevelt St.
Berkeley, CA 94703

Capt. Edward F. Wagner
U. S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept. of Navy
Washington, DC 20350

Dear Captain Wagner,

I am writing to you to protest against the Navy's plan to scuttle nuclear submarines off the coast of Northern California. This is a dangerous solution, and if it is handled in this way, the results could be uncorrectable. Most Californians are already uneasy about the radioactive barrels that were dumped here in the '40s, almost all of which are now said to be leaking and have giant sponges growing on them. | W.1 L.6 L.20

I hope that you will use your influence to help the Navy to seek out some other ways to get rid of their outdated subs. It will be on all of our consciences if the environment is damaged further because of this.

If there is nothing you can do please forward this letter to the appropriate people.

Sincerely,

Mary T. Phillips

P.S. I have much respect for the Navy. My father was a Lt. Commander in the Coast Guard. He came up through the ranks and was in the C.G. for 33 years when he retired. I had one brother in the C.G. and one in the Navy, and my son is in the Merchant Marines. I think they would all share my horror about this situation. Please do what you can.

Mary Phillips

#208

February 20 83

To: Stop Nuclear waste off the [illegible] Coast.

I am against it

L. Cox

#209

from the desk of JEANE L. HEARD
PO Box 615
Greensboro
North Carolina
27402

February 28, 1983

Captain Edward F. Wagner
United States Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

I am writing you with regard to the Navy's current proposal to dispose of decommissioned nuclear submarines off the coast of North Carolina. I am strongly opposed to this proposal.

I am concerned about the bottom currents and artificial reefing, among other things. The knowledge or lack thereof regarding these items and the prolonged effect on marine life cycles and marine food sources is of great concern and needs much more research before this project can be labeled "safe". It seems to me that methods of monitoring these dangerous wastes would be much easier as well as much more realistic were they to be buried in the ground, as opposed to at sea. It also seems unthinkable to retrieve any spill or leak or other danger, should something go awry, with this waste at sea. J.28 L.55 L.14 L.13 L.36

The practice of "burial at sea" may be less expensive than land disposal, but at the moment, land disposal appears to be the safest, most reliable method we have to deal with this problem, and at the cost of many lives (including our mainstay of marine food supply and many jobs) I don't feel a real parallel can be drawn, with respect to "cost-effectiveness". W.1 N.3 L.53

For the record, I feel this issue needs to be researched in depth during the moratorium period allowed for the Environmental Protection Agency to prepare a true and adequate Environmental Impact Statement on marine life and marine life cycles, before <u>any</u> decisions are reached. I would also ask that the public comment period be extended and public hearings be held in the state of North Carolina, paricularly in the area of Greensboro and Guilford County. J.15

I would hate to see a precedent set by the Navy that might expand nuclear waste producer's options for disposal of their waste in our mighty sea, particularly with the military's current nuclear arms race producing more radioactive by-products. L.9

Thank you for your time.

In struggle,

Jeane Heard

JH:rlf

#210

February 28, 1983

Captain Edward F. Wagner
U.S. Navy
Office of Chief of Naval Operations
Dept. of the Navy
Wahington, D.C.
20350

Dear Sir:

I was unable to attend the hearing on the dumping of submarine nuclear reactors that was held on Feb. 24 in Sacramento due to work and the four-hour drive to the hearing location. Nevertheless, I want to indlude this statement in the hearing record.

1) It is absolutely unacceptable for any one nation to radioactively and permanently contaminate the globally-shared oceanic eco-system. To most countries of the world, such an action would constitute a deliberate international crime.

L.6 2) The only previously-tried and monitored oceanic dumping of nuclear waste (the Farallon Islands site) has proved to be a disaster of leaking and burst containers.

L.20 3) There is no proven safe method of "disposal." If officials and engineers of the Navy believe they do know how to safely contain nuclear waste for tens of thousands of years, then, fine, why not demonstrate this assurance to the public by burying the reactors beneath the Dept. of Navy Building? or in the backyards of the Admirals? If we could all see your own children, Captain Wagner, clambering over "safely" contained deadly radioactivity, then we might believe your D.E.I.S.

J.15 4) Before proceeding with consideration of the Mendocino site, you <u>must</u> hold a public hearing in the area directly affected, i.e, Mendocino County. You only saw the tip of the iceberg in Sacramento: come to Mendocino if you really want to know where the people would like the Navy to shove their nuclear subs.

Gary W. Owen

Gary W. Owen
881 East Hill Rd.
Willits, California
95490

#211

STATEMENT for HEARING in Raleigh, NC, Feb 14, 1983

GREENPEACE U.S.A.

[illegible] R St N.W.
Washington D.C. 20009

Tel (202) 462 1177
Tlx 89 2359

March 4, 1983

Captain Wagner
U.S. Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington D.C. 20350

Dear Captain Wagner,

Please find enclosed a letter given to me for submission as written comments on the Navy's DEIS. This person missed attendence at the Raleigh, North Carolina public hearing.

Thank you for acceptance of these additional comments from Edith Webber of Greenville, N.C. I hope you enjoyed your experiences at the four DEIS public hearings & I look forward to seeing the hearing record.

Sincerely yours,

Joyce

Joyce Rosenthal

[illegible] S. Elm Street
Greenville, N.C. 27834
February 12, 1983

Capt. Wagner, US Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Oops! A mailing received today tells me that the hearing on disposing of decommissioned submarines off the U.S. coast is only two days away. The city library has no copy of the EIS, and the university library has no one with time to dig it out today (supposing that they do have it). So I will have to write my concerns without seeing the official report -- and hope I can get a messenger to deliver my letter on February 14.

1. The government record for estimating the danger of radioactivity is not good. This time, as in the past, the interest of those making the studies seems tilted toward the convenience of nuclear users. I understand that the same man who supervised the drawing up of the EIS is now in the position of evaluating it.

2. The gamble might pay off, and our descendants might never have to cope with dangerously radioactive oceans. But even if the odds should heavily favor this happy outcome, the risk of putting such waste where we can't clean it up in the event of losing the gamble is too great to take. W.1

3. Remember that radioactivity turned up in fish in the area where waste was dumped into the Pacific, not more than fifteen or twenty years before (to the best of my recollection). Remember that what went into the ocean then was hotter than what was legal. L.6

I feel no joy in the prospect of disposing of radioactive waste on land, but at least then we can monitor it better there.

The newspaper reported an official statement (presumably from the EIS) that the environmental impact would be "negligible" whether the submarines were disposed of on land or in the ocean. Irresponsible! If it's so safe, why don't they recycle the valuable metals from the ships as ordinary citizens recycle cans, newspaper, bottles, even garbage. To make a ship a canister for a bit of low-level (they tell us out of one side of their mouths) waste is typical military extravagance. O.10

Edith Webber

Edith Webber

#212

February 15, 1983

Captain Edward Wagner
Office of the Chief of Naval Operations
Department of the Navy
The Pentagon
Washington, D.C., 20305

Dear Captain Wagner:

I write on behalf of my family of four, our relatives, our neighbors and our friends, all of whom encourage me to plead with you not to make the ocean bottom a dump for submarines filled with nuclear wastes. We all know that once there the scuttled subs would be neither monitorable nor retrievable. J.76 W.1

We owe it to ourselves and to the future to take the long view. Surely you men of the Navy must have a special feeling for the oceans. Beware of Neptune's wrath!

Until a better solution is found, why not make museums of all the old submarines--that is, if they can be decontaminated. As for the wastes, we don't want them on land either. If only one could believe in another hell than that we have made here on earth, it would be comforting to think of the possibility of sending all that awful and awesome mess there!

I thank you for giving this request and the thousands of others that will be reaching you and/or our congressmen every consideration.

Sincerely yours,
Estelle V Mueller
Ms. Estelle V. Mueller
8014 S. Lawler Av.
Burbank, Il. 60459

#213

March 1 1983

Captain Wagner
OP Nav-22
Dept of the Navy
Washington. D.C 20350

Re: D.E.I.S. on Disposal of Decommissioned Submarine Reacter

Dear Captain Wagner:

I am requesting there be no action other than resposible "mothballing" and temporary storage at this time of the decommissioned subs including monitoring and study of safer ways to dispose of radioactive waste materials. A hasty out of sight out of mind action now will create havoc on all out safety in the future! G.2

The ocean dumping option by common sense and by scientific analysis is the LEAST WISE decision avaiable for the following reasons:

1. We have no way to adequately and effectively monitor the situation at 2½+ miles under water J.76
2. Cumulative affects of radioactive materials are now known to be hazardous. L.7
3. The corrosion factor: Most materials corrode under water in time making containing the radioactive waste over a long period of time highly unlikely. It is not desirable and is dangerous to spread radioactivity even at low levels into the oceans any more! Q.13
4. The subs would not be retrievable or accessaibe from an ocean dump in case of problems. W.1

LAND STORAGE in temporary monitored sites while studying better ways to deal with this problem is the most intelligent option at this time. Land disposal must be far away from any oceans, rivers, streams or water table. G.2

The financial factor seems irrelevant when considering contamination of the enviornment. As questions are raised it seems possible that the ocean dumping alternative could easily cost more than land disposal in terms of costs of monitoring, and economic impact on the local fishing industry at Cape Mendocino for instance, not to mention costs of problems ocurring at such depths. Also reported upwelling at the Cape Mendocino site and the fault location are not acknowledged accurately in the D.E.I.S. With the artifical reef affect and the reported high levels of marine life in that area, entry of radioactivity into the food chain making pathways into human food sources is a critically important reason not to further contaminate any part of the ocean any further! N.3 J.76 O.12 J.31 L.55 J.9 L.36

Finally, the direction we must be going now is to STOP CREATING

#214

Dear Sir

Protect our oceans and our Environment. Please don't dump nuclear power submarines into the Mendocino-Humboldt Coastal region. Nuclear wastes must

J.76 be disposed of in a way that they can be guarded.

Sincerely yours

Marie Lee
5768 Moonstone Beach
Cambria Calif 93428

#215

Dear Sir:

In the interest of our environment and our precious Pacific Ocean, we beseech you: Please don't dump nuclear waste and nuclear submarines in the Mendocino Humboldt coastal area.

Sincerely, Ralph L. South
Neva M. South

492

#216

Rev E Straatsma
1748 Deer Canyon
Arroyo Grande Ca.
93420

Dear Captain Edward F. Wagner.

I most strenuously object to dumping any radioactive substances anywhere in the ocean and particularly off the California Coast.

You were commissioned as an officer and taught to defend this land and her people from all enemies. Now you are trying to poison the people of the

L.36 U.S.A who eat the fish that come out of the ocean and by doing this you become the very enemy you were taught to defend this country against. If you really feel these radioactive hulks are so safe, why don't you dump them in your backyard swimming pool? That way, it would be easy to monitor them and your water heating pool bill would go down considerably. If they all don't fit in yours, give them to other generals, admirals and politicians who are so intent on hiding these wastes from the public eye.

Sincerely Rev. E Straatsma

#217

Box 1333
San Luis Obispo
Calif. 93406

March 4, 1983

Captain Edward F. Wagner,

I am responding to the proposal to dump used nuclear submarines near the coast of Cape Mendocino. If defense spending is aimed at protecting the people of our country, what is the use of endangering our marine environment when dumping waste? If the military forces were unable to safely dispose of such containers, these nuclear devices should not have been constructed in the first place. How about some responsibility and accountability in your efforts? What can be more ironical than careless refuge that can hurt the very people the original weapons were meant to protect?

Out of sight does not mean harmless.

Sincerely,
Julie M. Watson

#218

PO Box 20
Laytonville Ca 95454
March 4 1983

Captain Edward F Wagner
USN Office of Chief Naval Operations
OPNAV-22,
Dept. of The Navy
Washington DC
20350

Dear Sir.

I am one of the many hundreds of concerned California citizens who was unable to attend the recent hearing on the Navy's proposed dumping of radioactive subs off Mendocino.

I trust you have carried the message of those who did come to the hearing. I trust it is known to the Navy now just how much we oppose the dumping in the waters — just how much, indeed, we oppose the building and use of such subs as well.

J.15 I would like to add my voice to those who have requested another hearing, this one in Mendocino County. It would be fair to hold it on a weekend so that people find it easier to attend than the last one. It must have been wearing to listen for 14 hours — perhaps you can arrange to have the next hearing cover a span of 2 or 3 days — it will still be very heavily attended and that way you could have a shorter work day and still everyone would have a chance to speak. Sincerely,

Lark Savides

#219

3/5/83

Captain Edward F. Wagner, U.S.N.
Office of the Chief of Naval Operations (OPNAV-22)
Dept of the Navy
Washington, D.C. 20350

Sir,

I am writing this letter in the hope that the Navy will reconsider its proposal to sink many decommissioned nuclear submarines off the Pacific coast of the U.S as a means of disposal. A

L.39 major concern among many people is the long

J.76 term consequence of such action. Many questions arise as to how the radioactivity will be monitored,

W.1 and how it could be controlled if it is determined that damage is being done. Because of these doubts, it seems a better course might be to dispose

G.2 of these ships on land. At least until a more complete study can be done.

Sincerely,
Ronald E. Martin
1338 Royal Way
San Luis Obispo, Ca 93401

#220

Sunday 27 Feb. '83

Dear Sir

I am a resident of Northern California.

I do not want the dumping of nuclear submarines off our coast or any coast.

Sincerely,
Walter A. Reis

W. REIS
P.O. BOX 136
Myers FLAT, CA.
95554

#221

March 9, 1983

Captain Edward F. Wagner
Office of the Chief
of Naval Operations
OPNAV-22
Department of the Navy
Washington, DC 20350

RE: Nuclear Submarine Disposal
off North Carolina Coast

Dear Captain Wagner:

L.39 The proposal to dump nuclear submarines off the North Carolina coast concerns me and I don't think we should do this until we can be sure of the possible long-term effects this ocean disposal would
W.1 have on the marine environment. Radioactive contamination, as you know, is irreversible. Whether or not contamination would actually
L.53 occur, the area's fishing industry might be placed in jeopardy simply from the mere mention that the waters have been used as
O.34 a nuclear waste dumping site.

Therefore, I would like to see the reactors placed on land until it is proven, without a doubt, that ocean dumping is a safe long term means of disposal.

Sincerely,

Victor G. Taylor

Victor G. Taylor
Captain, USNR
Wilmington, North Carolina

VGT:lw

1994 Eastwood Road
Wilmington, NC 28403

#222

TODD M. SCHAFFER: General Agent
Plaza East Office Suites
1994 Eastwood Road
Wilmington, North Carolina 28403
919 256 4887 · Res 919 392 6046

March 7, 1983

Dear Captain Wagner,

This letter is to inform you that I strongly oppose of the navy's proposal to dump decommissioned nuclear submarines off the north carolina coast.

Please reconsider!!

Thankyou

Sincerely,

496

#223

Captain E.F. Wagner
U.S. Navy
Office of Chief of Operations
OPNAB - 22
Dept. of the Navy
Washington D.C. 20350

March 3, 1983

Captain Wagner;

D.5 I assume that you cannot sell these nuclear subs in question or you would have. So I then assume that these subs must be dangerous and that you now need some way to put them out of commission.

I am sure you can understand the frustration and fear of the general public that watches our scientists and armed forces come up with all these incredible techniilogical weopons that wreak tremendous devastation in order to keep "us" safe from our so-called enemies and then watch these same brilliant men and women throw their hands up in the air when it comes time to rid ourselves of our dangerous techniilogical WASTE !! How

L.36 ironic that these powerful machines designed to protect, will, if you have your way, end up polluting our oceans, our food, and coming back someday to destroy us all.

I strongly urge that these highly educated people who create these machines come up with someway to a deactivate their

Captain E.F. Wagner
U.S. Navy continued...

March 3, 1983

creations before they are ever built and even, dare I say it, Stop building them !!!

How long can we go on dumping our mistakes and problems in and on our own beautiful earth before it all blows up in our faces. Please Captain Wagner, I urge you to stop this insanity.

With great concern;

Ms. Deborah DaPron
P.O. Box 595
Garberville, California 95440

DD/dd

#224

Captain E.F. Wagner
U.S. Navy
Office of Chief of Operations
OPNAB - 22
Dept. of the Navy
Washington D.C. 20350

March 5, 1983

Dear Sir;

L.53 I am adamantly opposed to the dumping of nuclear subs off the coast of California. I feel it is an irresponsable assumption of the Navy that these subs will be harmless to the envirement. It is a fact that sea life picks up varying amounts of radioactivity. Being an active member of the Fishermans Association of Humbolt Bay, this greatly affects our business.

I have studied and worked in the field of Child Development for eight years now, and am now the mother of three children. It frightens me to think that you could take such measures as to jeopordize our lives, the lives of our children and our country.

With great concern;

Angela Gifford
Star Route
Redway, California 95560

AG/dd

#225

[illegible] Augusta Street: Apt. 3[illegible]
San Luis Obispo, CA 93401
March , [illegible]

Captain Edward F. Wagner
U. S. Navy
Office of the Chief Naval Operations
(OPNAV-22) Department of Navy
Washington, DC 20350

Dear Captain Wagner:

This is the first time I have written a letter of this nature to an elected official. The reason I'm writing is that there is an issue that is currently in process to which I am opposed, and I wanted to express my opinion in hopes that you would vote accordingly.

My concern is as follows:

I am opposed to the Navy's plan to dump spent nuclear submarines in the ocean. The reasonable thing to do is to land base them where they can be monitored at least until technology catches up with the problem. J.76

Thank you for your attention to this matter. Do what you can.

Sincerely,

Larry Coolidge

498

#226

Captain Wagner.
I DO NOT want Nuclear submarines in my ocean. I am a native Californian who loves the ocean & wildlife. Too many chances for "accidents" with your nuclear "toys"! I DEMAND my rights, as a citizen, to SAFETY & PEACE on my own coast. NO NUCLEAR SUBS or NUCLEAR anything in Mendocino, the Pacific ocean or for that matter anywhere!! Our children deserve Better! I will work AGAINST any attempts made towards bringing in the subs.

Sincerely, Connie Petty

#227

March 8, 1983.

Dear Captain Wagner:

This is to notify you that I am opposed to the dumping of decommissioned submarines (nuclear type) off the coast of Northern California or, for that matter, in ANY ocean.

L.39 At this point, the enviornmental effects of such disposal are largely unaccountable at best and at worst represent a potential for great

L.36 health effects - damage to both

L.14 man and other species of life.

I would suggest as an alternative to sea disposal, land disposal - possibly at the Hanford, Washington nuclear disposal site. At Hanford, the submarines could be monitored and possibly fitted with some form of shielding if excess amounts of radiation exist. With sea

W.1 disposal, there will be no way to retreive a submarine in deep water should it be found that radiation

L.36 is showing up in the food chain - fish and other sea food.

(please turn over)

In closing, I ask you to consider the situation not simply from the standpoint of "what is expediant at present" but rather what will produce the least danger to the enviornment - N.3 NOW AND IN FUTURE times. Certainly, the costs are higher for land disposal. However, the Department of Defense has, as you must know, incredibly large amounts of money in its coffers. It is up to you to truly "invest in the future": Spend more now so that man and other forms of life will be safe in years to come.

Please send me any data concerning this proposed plan if possible.

Thank you.

Sincerely,

John K. Bermel,
P.O. Box 602,
Cotati, Calif. 94928.

#228

March 9, 1983

Captain Edward F. Wagner
U.S. Navy, OPNAV-22
Department of the Navy
Washington, D.C. 20350

Re: Comment on Draft Environmental Impact Statement

Dear Captain Wagner:

I have read the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, and have the following comments to make regarding the option of sea burial off of the California coast.

F.22 1) Referring to page 3-11, which describes the Pacific study area, it is noted that the area is 40 miles south of the seismically active Mendocino Fracture Zone. I have felt earthquakes which were centered more than forty miles away. The report does not show that any studies were done on the potential magnitude and effects of an earthquake occurring at the Mendocino Fracture Zone. As a strong earthquake could realistically do some damage to a container and release radioactive material into the water, this aspect must be further addressed.

J.28 2) While bottom and surface current measurements were referred to on page 3-11, these were average figures. Due to the fact that we are concerned with a spread of radiation during a worst case scenario, it is important to indicate the extreme currents which exist during the year. I am sure that during the midst of a winter storm, the surface water is moving in a south easterly direction (towards the populated land) at a fairly rapid rate. As a surfer, I have been in the water during such times and realize that the currents vary daily. The report needs to reflect these daily variations, even if this necessitates daily observations over the span of a year, so that we can know what the transport rate will be in a worst case scenario.

J.9 3) It is admitted on page 3-11 that the biology of the area is little known at present. As any radiation that leaks will most probably enter the food chain at this area, it is crucial that the study more explicitly explore the biology of this area before proposing using it as a dumpsite. In making such a study, it is important to note that fish are a migratory species, and that the range of the fish in the area should be documented.

J.12 4) It is admitted that commercial fishing is carried out in the area of the Pacific study zone. The report seems to discount the intensity of the fishing that occurs in this area. I personally believe that a fair amount of fishing goes on in this area, and would like to see more documentation of the intensity of fishing in the zone (i.e. type of fish caught, net tonnage per year, etc.)

It was noted that the productivity in terms of "fish catch per unit effort" was low in the area. However, we need not speak in relativistic terms here. If toxic quantities of radioactivity enter the food market through fish, it does not matter if one fish or one hundred fish per day are caught. This area needs to be studied with more specificity. L.36

In sum, the data on the Pacific Study Zone are much too general and sparse to be of any use in an analytic sense. Why go to the trouble of preparing a report with "scientific" studies when the background data which is crucial to all of your analysis is lacking? While a great deal of time is spent discussing salinity and the effect that this will have on corrosion, no mention is made of seismicity and the more devastating immediate release effect that a major earthquake in the area may have. What is needed is realism, not numerical obfuscation. F.22

As a more general comment, I note that the report comments that one disadvantage of the sea disposal option is that retrieval of the subs in the event of an accident will be impossible. I think that this is a serious factor which should be given more emphasis in the advantages vs. disadvantages section of the report. W.1

The report mentions that monitoring can occur at the ocean site. However, I think that the report should more fully stress that, in the event that monitoring reveals leakage at the site, there is nothing that can be done to retrieve the reactors, and that the only course to take will be to alert humans to the presence of radioactivity in their food and their environment. L.20 W.1

The problem which now faces the Navy is a serious one. I personally feel that you should proceed with the land based temporary storage plan until some type of safe solution is reached. I am skeptical that any safe solution will be found in the short term, but I know that the idea of scuttling the subs off of the populated California coast is neither safe nor politically wise. It will be met with some concentrated opposition, I can assure you. G.2

A major problem with the entire development of the nuclear industry is that nobody has ever figured out how to take that last step. How do we dispose with waste that will outlive our children by thousands of years? At each step along the line, we have said that when disposal becomes a necessity, technology will have come up with the answer. Well, disposal has become a necessity, and I do not feel that the answer is upon us yet. As such, I propose that you do some serious thinking before building any more of these submarines. I further propose that you expend some money and energy into working on this problem, and that you exercise the intermediate storage option in the meantime. And, most importantly, do not use the coast of California as the site of a hazardous dumping ground simply because it is the most inexpensive and expedient solution. N.3

Sincerely,

[signature]

Dwight Donovan
1961 Pine St.
San Francisco, CA 94109

#228 (Cont)

Addendum

The report at Appendix C deals with Dose Commitment Estimates of Nickel, which has a half life of 92 years. I would like to see similar studies done of the more long lasting radionuclides, sudh as Nb-94 (half life of 20,000 years) and Tc-99 (half life of 212,000 years). I would also like to see a discussion of the tendencies of any of these radionuclides to concentrate in marine creatures. Are some more likely than others to be ingested and retained by fish, or is the probability of one's occurrence equally as likely as the other? Do any of these radionuclides pass through the fish, or are all concentrated in the tissues permanently? I would like to see a more thorough breakdown of the effect of each radionuclide, rather than a general comment on 'radioactivity."

T.32

Thank you very much for your time, and I look forward to receiving comments on the matters contained in the enclosed three pages.

502

#229

SIERRA CLUB
Redwood Chapter
North Group

ARCATA CALIFORNIA

March 8, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I have been directed by the Executive Committee of the North Group to write this letter of opposition to the Navy's proposal to dispose of decommissioned nuclear submarines in the ocean off Cape Mendocino, California.

After reviewing the Draft Environmental Impact Statement, it appears that the safety advantages of land disposal outweigh the economic advantage of ocean disposal. Having the reactor compartments on land where they will be far less subject to corrosion and be under "complete control" is preferable to dumping in the ocean which is a kind of "out-of-sight-out-of-mind" situation where no surveillance or control is possible.

L.20 L.14 L.36 F.8

We are, of course, concerned about the release of radioactivity into the ocean and the long-term implications of such contamination on the ocean and its life-forms and human populations connected with the marine environment. The current proposal deals with a specific number of submarines (120), but it does not discuss the effects that resolution of the disposal problem will have on future disposal by this country or other nations, or the proliferation of nuclear power which we believe poses totally unacceptable risks to life on this earth.

We will appreciate consideration of these comments.

For the Executive Committee,

Susie Van Kirk
Susie Van Kirk,
Conservation Chairman

#230

March 10, 1983

Captain Edward F. Wagner
U. S. Navy
Office of the Chief "al Operations

Dear Sir;

W.1 J.76 G.2

We would like to voice our objections to the dumping of 100 used nuclear submarines off Cape Mendocino. Since there is no way as yet of monitoring or recovering these submarines in case of an accident, we would like to recommend that these submarines be land based and monitered until technology has caught up with the problem of disposal of nuclear waste.

F.2

We would like to note, also, that a two year moratorium on offshore dumping was encacted by the Anderson Amenendment which was a last minute addition to our five cents gas tax bill.

Sincerely,

M. R. Crook
Robert Crook

M. R. Crook
Robert Crook
Los Osos, California

M. R. Crook
1441 Eighth St.
Los Osos, ca. 93402

#231 *

March 11, 1983

Captain Edward F. Wagner
Office of the Chief
of Naval Operations
OPNAV-22
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

*O.12 W.1 L.53 O.34 L.9 My husband and I are both concerned about the dumping of decommissioned submarines off the North Carolina coast. Is this really the least costly alternative when you stop to think of the "cost" of the effects of possible radioactive contamination of organisms in the vital food chains in our oceans? Also the retrievability and cleanup, should this be a mistake, is virtually impossible once this has been carried out. Just the mere mention that the waters have been used as a nuclear waste dump site could have a devastating impact on our area's fishing industry. Once a nuclear waste site is designated it would seem likely that other nuclear waste producers would utilize the area as well.

G.2 Therefore, we would like to see the reactors placed on land until it is proven that this type of nuclear waste disposal is a safe long term means of disposal.

Sincerely,

Don and Linda Weber

Don and Linda Weber
Wilmington, North Carolina

cc: The Hon. James B. Hunt
Governor, North Carolina

3411 Osprey Lane
Wilmington, NC 28403

*Other issues discussed by Mr. Weber are side barred in Exhibit 242.

#232

JOHN M. CAFFIN
48278 FISH ROCK ROAD
GUALALA, CA 95445
3-13-83

CAPT. E.F. WAGNER
DEPT. OF NAVY
WASH., D.C.

DEAR SIR,

I MUST OBJECT TO THE ILL-ADVISED AND DANGEROUS PROPOSAL TO SCUTTLE NUCLEAR SUBMARINES OFF THE COAST OF CALIFORNIA.

TO PROCEED WITH THIS THOUGHTLESS SCHEME IS TO ENTERTAIN UNACCEPTABLE RISKS

SINCERELY,

[signature]

JOHN M. CAFFIN
48278 FISH ROCK ROAD
GUALALA, CA 95445

504

#233

3/2/83

Dear Captain Wagner,

I wish to express my opposition to the ocean dumping of nuclear wastes by the navy. These hazardous materials are better kept on land where they can be monitered.

J.15 The Navy should schedule hearings on this matter in Fort Bragg and Eureka to allow citizen input on this vital issue.

Respectfully, [illegible]

#234

Please - don't dump old radioactive material & subs in The World's Oceans! The whales - the fish and nature are innocent victims of Man.

LUCIENNE BLOCH DIMITROFF
Star Route 2
Gualala, CA 95445

through the Golden Gate, the beautiful city in the ... natives and visitors

Photo by Sandor Balatoni
San Francisco, Calif. 94103

Capt. E.F. Wagner
Office of Chief of Naval Oper.
OPNAV - 22 Dept. of NAVY
Washington D.C.
20350

#235

3-9-83

Jeanie Lopez
4500 San Jacinto
Atas. Ca. 93422

Captain Edward F. Wagner
U.S. Navy
Office of the Chief Naval Operations

I have just finished reading of your plans to dump used Nuclear Submarines off Cape Mendocino.

J.76 If, as I understand, you have no technalogy to manitor these, and also no way of retreiving them should

W.1 a prablem arise, then I question your logic in this Choice of a solution to this prablem.

It seems logical to me to put them where they can be manitered.

I urge you to re-consider

Jeanie Lopez

506

#236

South Carolina Department of Health and Environmental Control

2600 Bull Street
Columbia, S.C. 29201

March 9, 1983

Captain Edward P. Wagner, USN
Office of the Chief of Naval Operations (OP-22)
Department of the Navy
Washington, DC 20350

Re: DEIS on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants

Dear Captain Wagner:

The South Carolina Department of Health and Environmental Control is responsible for monitoring air and water in the State for compliance with applicable standards. This responsibility includes promulgation and enforcement of standards for concentrations of radioactive materials and conventional pollutants.

The DEIS addresses the environmental consequences of disposing of defueled nuclear submarine power plants either at sea or by land burial at one of two Federal facilities. One of the sea disposal sites chosen for discussion for purposes of illustration is located off the South Carolina coast. Likewise, one of the facilities chosen for the discussion of land disposal is located in South Carolina. While we realize that no specific action has been proposed at this time, a realistic appraisal of the options available to the Navy for land disposal convinces us that, as the DEIS points out, the only practical choices for land disposal are the Savannah River Plant and the Hanford Reservation. Because disposal of radioactive material in either location would involve transportation of the reactor vessel through South Carolina waters, and because such disposal would inevitably create the potential for ultimate release of radioactive material into pathways which could affect the citizens of the State, the Department has reviewed the DEIS to determine whether the concerns of the State are adequately addressed.

First, the emphasis on a final disposal plan is properly placed. We do not need another problem deferred for future generations to solve. However, it is equally important that the impact of the method chosen be minimized.

Our second concern is that no more radioactive material be brought into South Carolina for disposal than is absolutely necessary. It is common knowledge that the Savannah River Plant is already the storage site for 23,000,000 gallons of liquid high level wastes resulting from the nuclear weapons program; these wastes are presently in buried tanks which are continuously being replaced as they begin to leak, pending a decision on the proper methods of solidification and disposal. The normal operation of the Savannah River Plant results in the release of radioactive material into the air each year. We do not feel that disposal of submarine reactors at Savannah River Plant should be justified on the basis that the amount of material involved is only a small fraction of the amount of material which is already there. E.9

There is thirty years worth of engineering experience available at the Savannah River Plant with regard to the behavior of buried metals with the same characteristics as the reactor compartments. Has this data been taken into account in making the engineering estimates of the consequences of burial there? P.1

The shipyard activities which would be required to prepare the reactor compartments for disposal do not concern us, nor does the transportation of the reactors from the barge landing on the Savannah River to the burial ground, should that option be chosen. We are concerned about the possibility of an accident involving the reactor compartment during shipment through the near-coastal waters or on the Savannah River. E.20 It is pointed out in the DEIS that there is very little clearance for the proposed barge and reactor compartment combination along the Savannah River, particularly the passage under two of the bridges. In estimating the number of barge accidents which could be expected during the entire planned program on disposing of 100 reactors, historical data for barge traffic for the nation as a whole was used. Is this data valid for a river such as the Savannah, where experience with barge traffic is slight and the channel project depth "is not routinely maintained"? (DEIS, p. B-12). E.20 We feel that this question should be addressed with more care. In the event of an accident in Charleston harbor or in the Savannah River, how long would recovery operations require? I.16

#236 (Cont)

Captain Edward F. Wagner, USN
March 9, 1983
Page Three

F.8 Although ocean disposal is allowable under present regulations, the fact that no such dumping has taken place for several years together with the disfavor with which the European and Japanese ocean dumping programs are viewed should cause the Navy to take a very hard look at this option.

In the event that ocean dumping is chosen, we hope that locations are chosen for which site characterization studies will demonstrate that anticipated or unanticipated releases of U.7 radioactive material will have little effect on the coastal zone of South Carolina. In particular, the absence of any exchange mechanism between the abbysal waters and surface waters is essential. Once the disposal site is chosen, we expect that the details of the predisposal monitoring program will be published for comparison with the subsequent postdisposal surveillance results.

Very truly yours,

Heyward G. Shealy

Heyward G. Shealy, Chief
Bureau of Radiological Health

HGS:SLF:bb

cc: Roger E. Davis, Assistant Deputy Commissioner
for Environmental Quality Control

#237

March 14, 83

Dear Navy;

Seems to me we've gone far enough in endangering this our planet and we've progressed far enough to intellegently solve our problems.

Personally I feel it is a mistake in your plan to dispose of 120 Nuke Subs. and hope you sincerly reconsider your original plan!

Thank you

a concerned being

J. Filarski
19721 Charest St.
Detroit, MI 48234

SANTA ROSA, CA
1983

#238

DR. RICHARD L. COMEN
1899 Cardiff Dr.
Cambria, CA 93428
805/927-3130

Capt. Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
Dept of Navy
Washington, D.C.
20350

March 12, 1983

Captain:

I wish to strongly protest the Navy's plan to scuttle its radioactive toys. The oceans belong to all mankind and provide a large part of our food chain.

L.36 | To propose this off the California coast on the continental shelf, among prime fishing grounds, is the height of folly.

Sincerely,

Dr Richard L Comen
PC

#239

Mar 14, 1983

Captain Wagner,

We want to express our strong opposition to the planned dumping of nuclear submarines off the Northern Calif. coast.

We recently moved here from Southern California, in part to get away from the increasingly deteriorating environment.

We surely did not come here to become victims of radioactive contamination.

What troubles us the most is our governments pell mell rush to turn out hazardous materials with no thought to the consequences of their disposal when obsolete.

Please do not permit the Navy to turn this peaceful, beautiful haven into a wasteland.

Thank you
Pat McAdam

Mr. Mrs D.N. McAdam
Box 731
Gualala, Calif 95445

#240

Jennie Barnhardt
P.O. Box 1821
Davidson, N.C. 28036

To: Captain Edward F. Wagner
United States Navy
Office of the Chief of Naval Operations
(OPNAV -22)
Department of the Navy
Washington, D.C. 20350

Comment on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

We, the undersigned, respectfully oppose the conclusion of the Draft
EIS, which favors the sea disposal option. We find it unacceptable
W.1 because of the irretrievability mentioned in Part II of Chapter 2 and
because of the precedent it would set for United States policy and
F.8 international policy. Sea disposal would open the way for the ocean
dumping of other nuclear wastes such as the U.S. Department of Energy's
L.9 Manhattan Project wastes and the Three Mile Island wastes. We favor
G.2 giving each submarine temporary storage status for at least twenty years
after being decommissioned --despite the extra cost-- so that further
L.14 scientific assessments can be made concerning unanswered questions such as
L.36 the extended effect on marine life and the food chain. The foreword of
the Draft EIS states that the guidelines of the Council on Environmental
Quality (CEQ) were followed. §1502.14 of the CEQ Regulations states that
an EIS should "sharply defin[e] the issues and provid[e] a clear basis for
choice among options by the decisionmaker and the public." If temporary
storage status were given to the submarines, this guideline would be
better fulfilled, and decisions on permanent disposal could be better
made.

NAME	ADDRESS	CITY	STATE	ZIP
Jennie Barnhardt	P.O. Box 1821	Davidson	N.C.	28036
[illegible]	PO Box 31501	Seattle	WA	98103
Bob Brice	PO Box 4283	Davidson	NC	28036
Susan J. [illegible]	PO Box 1134	Davidson	NC	28036
Claire M. Eckert	PO Box 2118	Davidson	N.C	28036
Sara Potts	PO Box 1026	Davidson	NC	28036
[illegible]	P.O. Box 3055	Davidson	NC	28036
[illegible]	P.O. Box 4205	Davidson	NC	28036
Anne W. [illegible]	Box 1682	Davidson	NC	28036
William [illegible]	Box 1147	Davidson	NC	28036
Donna Thompson	Box 1314	Davidson	N.C.	28036
Beth Gay	Box 1874	Davidson	N C	28036
[illegible]	Box 1524	Davidson	NC	28036
[illegible]	Box 4362	Davidson	N.C	28036
[illegible] S. McKeithen	Box 2102	Davidson	NC	28036
Catherine Durman	Box 1827	Davidson	NC	28036
Charles [illegible]	1303	Davidson	NC	28036
Bill Harman	Box 1187	Davidson	NC	28036
[illegible]	508 College Ave	Lenoir	N.C.	28645
Leslie [illegible]	508 College Ave	Lenoir	NC	28645
[illegible]	[illegible]	Lenoir	NC	28645
[illegible]	Box 1937	Davidson	NC	28036
Melanie Campbell	1012 E Mcalway Rd	Charlotte	NC	28211
[illegible]	Box 1688	Davidson	NC	28036
[illegible]	Rt 2 Box 57EL	Huntersville	NC	28078
[illegible] Pittard	Box 2284	Davidson	NC	28036
[illegible] Pittard	Davidson College	Davidson	NC	28036

510

#240 (Cont)

Aurella Brown Rt 2 Box 646, Mooresville, N.C. 28115
[illegible] Box 4257 Davidson N.C. 28036
Roderick R. Long Box 1937 Davidson, N.C. 28036
Mills Ausley Box 1416 Davidson, N.C. 28036
Stewart Crady Box 1815 Davidson College, N.C. 28036
[illegible] Box 3087 Davidson N.C 28036
CK Nichols Box 3012 DC, NC 28036
Julie Steinbaugh 448½ S Hawthorne W-S NC 27103
Melissa Gehrman 512 Corona St. Winston-Salem NC 27103
James Rozzelle Rt 14 Box 512-A Charlotte, NC 28208
R.L. Faulkner Rt 1 Box 45 Pineville NC 28134
[illegible] Rt. 7 Box 906 Mooresville N.C. 28115

#241

SUMMARY:

To begin my summary, I don't like the idea and I am not a fan of this nuclear-powered world to which we live. Yet in all reality it is here and inevitable.

It is apparent from tables c-1 and 4-4 that most of the damaging radiation would be delayed tell within 100 years at sea and 200 years on land. At said times the reactor compartments would be penetrated. At such times most of the radioactive sources would have decayed. I also realize that during the decomposing time some radioactive nuclide will be entering the environment.

On the assumption that the worse would come in 100 to 200 years. If the reactor was buried on land, you could retreive the compartment. I would like to see the reactor compartments buried on land and the ship scuttled at sea.

REASON:

H.15 Such as within the last couple of decades [illegible] Oil-eating bacteria, hopeful within the next 200 years, [illegible] find a radioactive [illegible].

L.36 The Sea is where all life began and begins. An average of 4,200 billion gallons of raindrops will fall on our heads each day in the United States. All of which comes from the sea, at least at start. One third of which will replenish lakes and rivers or soak into the ground water. Most will return to the sea to start the cycle again. Water carries minerals and other building blocks from the soil to the leaves of plants. Man eats plants either directly or indirectly. So water (Sea Water) is our life-blood.

If we allow contamination of the Sea, we may just all well allow contamination of our body and blood with drugs. Either way we'll come out the same DOA!

ENVIRONMENTAL IMPACT STATEMENT

Expected Radioactivity Release From One Ship SEA and LAND Disposal

FROM: Appendix C Page c2 table C-1
Chapter 4 Page 4-15 table 4-4

Nuclide	Sea Max. Release any year	Land Max Release any year	Approx time at which max. SEA	LAND	Sea total release	Land total release
NI 63	0.65	0.26×10^{-2}	100	200	65.2	[illegible]
NI 59	0.07	0.57×10^{-2}	1300	2800	119.9	1.18×10^{-2}
NB 93	7.2×10^{-4}	0.51×10^{-2}	100	200	0.01	0.83×10^{-2}
C 14	5.7×10^{-4}	0.39×10^{-3}	1300	2800	0.78	0.60
FE 55	2.9×10^{-4}	0.14×10^{-3}	1*	1*	1.3×10^{-3}	0.63×10^{-3}
TC 99	2.2×10^{-4}	0.16×10^{-2}	100	200	[illegible]$.1\times10^{-3}$	[illegible]
CO 60	1.1×10^{-4}	0.22×10^{-4}	100	1*	4.7×10^{-4}	0.17×10^{-3}
NB 94	4.0×10^{-6}	0.31×10^{-5}	1300	2800	6.0×10^{-3}	0.55×10^{-2}
Mn 54	6.5×10^{-6}	0.32×10^{-5}	1*	1*	1.2×10^{-5}	0.57×10^{-5}
CO 58	3.7×10^{-7}	0.18×10^{-6}	1*	1*	3.7×10^{-7}	0.18×10^{-6}
Fe 59	1.6×10^{-7}	0.79×10^{-7}	1*	1*	1.6×10^{-7}	0.79×10^{-7}
CR 51	5.6×10^{-8}	0.28×10^{-7}	1*	1*	5.6×10^{-8}	0.28×10^{-7}
S- 35	1.2×10^{-9}	0.58×10^{-9}	1*	1*	1.2×10^{-9}	0.58×10^{-9}
SC 46	1.3×10^{-10}	0.64×10^{-10}	1*	1*	1.3×10^{-10}	0.64×10^{-10}

*These early releases result from the radioactive material contained in the metal of exterior boundary and the assumption that the activity is uniformly distributed in metal.

Edward J. Larson
Davis, Il
61019

Edward J. Larson
Box 212
Davis, Ill
61019

#242 *

March 14, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
OPNAV-22
Department of the Navy
Washington, D. C. 20350

Re: Dumping of Decommissioned Nuclear Submarines

Dear Captain Wagner:

We are strongly opposed to the dumping of decommissioned nuclear submarines off the North Carolina coast.

*O.12 W.1 L.53 O.34 L.9

Contrary to popular belief, the issue of dumping decommissioned nuclear submarines off our coast has not been resolved. The latest Draft Environmental Impact Statement reports the Navy's view of disposing of these submarines off Cape Hatteras as the least costly alternative. Is it really?

Consider the cost of the effects of possible radioactive contamination of organisms in the vital food chains in our oceans. Also, the retrievability and cleanup, should this be a mistake, is virtually impossible once this has been carried out. Just the mere mention that the waters have been used as a nuclear waste dump site could have a devastating impact on our area's fishing industry. Once a nuclear waste site is designated it would seem like that other nuclear waste producers would utilize the area as well.

We ask that you do all you can to stop this before it gets started.

Very truly yours,

Don R. Weber

Don R. Weber

DRW/dhb

Don k. Weber
1029 Lakeshore Road, South
Denver, North Carolina 28037

#243

Captain E. Wagner, U.S.N. Mar. 19, 1983

I am very concerned over the proposed disposal of decommissioned nuclear submarine parts in the ocean.

It seems irretrievable, should all not go as planned. W.1

This is not a good idea.

We need more information from you and have our concerns to share with you. Please schedule a hearing in Fort Bragg. J.15

Respectfully
Daniel Brown
32700 Pearl Drive
Fort Bragg. Cal
95437

*Other issues discussed by Mr. Weber are side barred in Exhibit 231.

#244

Captain Edward F Wagner

I am very concerned about the Placement of nuclear submarines off Cape Mendocino. There is no technology for recovery or anyway of monitoring containers. My God what are we doing. Dumping in our own backyard. Stop nuclear madness before it stops us all. Please hear another voice against nuclear weaponry.

W.1
J.76

Thank you
Nancy [illegible]
P.O. Box 15[illegible]
Atascadero, Calif

Nancy [illegible]
P.O. Box #1516
Atascadero, CA 93423

#245

March 12, 1983

Captain Edward F. Wagner, US Navy
Office of the Chief of Naval Operations
(OPNAV - 22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

I am writing to let you know that I oppose the Navy's plan for scuttling decommissioned nuclear subs off the coast of North Carolina.

L.6 | Lack of sufficient data on the effects of ocean dumping on the environment and human health
F.8 | plus the key role that US policy on ocean disposal of radioactive waste would play on a global scale both indicate that the stakes in this matter are too high to permit quick, irreversible decisions based on political considerations and economic expediency.

Reading the Navy's draft environmental impact statement did little to satisfy my concerns about the full identification of radioactive elements involved
Q.13 | and their release rates; about the reliability of corrosion resistant materials used on the subs;
I.28 | about accurate data on ocean bottom currents or radioactive sediment and the food chain; about | R.1
proper monitoring of radiation levels both at | L.36
proposed dump sites and for radioactivity of fish | I.76
taken for human consumption and about standards | W.1
for retrieval.

The dimensions of the ocean dumping proposal strike me as being a little wild and certainly alarming especially in view of the mounting evidence on the mismanagement of radioactive
waste disposal in the ocean by the US between | L.6
1946 and 1970.

The rush to pump money into dubious disposal methods without first adequately funding studies
on the potential hazards to human beings disturbs | L.36
me a great deal.

Please give some responsible thought to the possible consequences of your actions.

Sincerely,

Jane Jarrett
2743 Melinda Drive
Winston-Salem, NC 27103

#246

To let you know that I am completely opposed to your proposed nuclear sub dumping in our waters. I am concerned about radioactive contamination of the ocean, contamination of the fish, contamination

L.36 of all of us living here. On so many levels this

L.14 proposed action seems <u>wrong</u>.

Judith Tannenbaum
Box 106
Point Arena, CA 95468

#247

Mr. 12, 1983
PO Box 1416
Mendocino, Ca. 95460

Capt. Edward J. Wagner U.S. Navy
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

Despite statements to the contrary at the Sacramento hearing on nuclear sub-dumping, it appears obvious to those of us who have studied this move that

there are many severe dangers, i.e. the increasing L.36

toxicity as radioactivity would make its way up

the food chain and the record of the navy's L.20

containers for radwaste *not* remaining intact.

Economically, the dumping would be dis- L.53

astrous to the local fisheries and no economic impacts have been provided.

Legislatively, the dumping plan would go against the 1983 London Dumping Convention

decisions and strong Calif. Coastal Commission disapproval. F.11

Please make plans for a 90 day extension

of the D.E.I.S. comment period and provide a J.15

local hearing(s) in Fort Bragg, Ca. and Eureka, Ca.

Sincerely,
Margaret Livingston

#248

P.O BOX 210
MENDOCINO, CA 95460
MARCH 13, 1983

CAPTAIN EDWARD F WAGNER, U.S. NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS (OPNAV-22)
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20350

I WISH TO MAKE A STRONG PROTEST TO THE PROPOSED
OCEAN DISPOSAL OF DECOMMISSIONED NUCLEAR
SUBMARINES OFF THE MENDOCINO COAST.
I FEEL THAT THE NAVY'S DRAFT ENVIRONMENTAL
IMPACT STATEMENT LEAVES TOO MANY CRITICAL
QUESTIONS UNANSWERED. WHAT ARE THE LONG TERM
L.36 EFFECTS OF LOW LEVEL RADIATION ON OUR FOOD
L.53 CHAIN + OUR COMMERCIAL FISHING INDUSTRY? AS A
PHYSICIAN I AM AWARE THAT THERE IS NO SUCH
THING AS A "NEGLIGIBLE" DOSE OR "SAFE" DOSE OF
W.1 RADIATION. IF THIS ACTION ULTIMATELY PROVES A
MISTAKE, THE DUMPING IS IRRETRIEVABLE. HOW DO WE
L.46 DEAL WITH THE RADIOACTIVE EFFECTS OF NIOBIUM-94
WHICH HAS A HALF LIFE OF 20,000 YRS?
I URGE A 90 DAY EXTENSION TO THE
DEIS COMMENT PERIOD TO ALLOW THE SCIENTIFIC
+ COMMERCIAL COMMUNITIES TO PREPARE
COMPREHENSIVE RESPONSES TO THIS REPORT.
J.15 I ALSO URGE LOCAL HEARINGS IN FORT BRAGG
AND EUREKA FOR PUBLIC INPUT.
THANK YOU.

Sincerely,
Larry Hauis, M.D.

#249

OFFICE OF THE CLERK OF
BOARD OF SUPERVISORS
CITY HALL

March 4, 1983

To Captain Edward F. Wagner

Office of
BOARD OF SUPERVISORS
Room 235, City Hall
San Francisco, Calif. 94102

Your attention is hereby directed to the following, passed by the Board of Supervisors of the City and County of San Francisco:

FILE NO. 178-83 RESOLUTION NO. 119-83

OPPOSING THE PROPOSED DUMPING OF DECOMMISSIONED NUCLEAR SUBMARINES AND THEIR REACTORS OFF CAPE MENDOCINO ON THE CALIFORNIA COAST BY THE UNITED STATES NAVY

WHEREAS, The United States Navy will hold public hearings on February 14, 1983 concerning the proposed ocean dumping of decommissioned nuclear submarines and their reactors; and

WHEREAS, Consideration has been given by the Navy to such dumping off Cape Mendocino in Mendocino County; and

WHEREAS, There is no assurance that dumping of nuclear waste off Cape Mendocino or the California Coast will not present a significant health and environmental risk to the people of California and San Francisco; and

WHEREAS, A responsible method of land disposal of these submarines and their reactors would pose a reduced health and environmental risk; Now, Therefore, be it

RESOLVED, That the Board of Supervisors of the City and County of San Francisco opposes the United States Navy proposal to dump decommissioned nuclear submarines and their reactors off Cape Mendocino or the California Coast; and

FURTHER RESOLVED, That a copy of this Resolution shall be sent to Captain Edward F. Wagner, Office of the Chief of Naval Operations; and

FURTHER RESOLVED, That copies of this resolution shall be sent to the President, Secretary of the Navy, and to the California Congressional delegation.

February 14, 1983
Britt

Adopted on date of introduction—Board of Supervisors, San Francisco, FEB 14 1983

Ayes: Supervisors Britt, Hongisto, Kennedy, ~~Kopp, Maher,~~ Molinari, Nelder, Renne, Silver, Walker, Ward

~~Noes: Supervisors~~

Absent: Supervisors KOPP, MAHER

I hereby certify that the foregoing resolution was adopted by the Board of Supervisors of the City and County of San Francisco.

Clerk

178-83
File No.

FEB 18 1983
Approved

Mayor

#250

March 15, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Sir:

Concerning the scuttling of the nuclear submarines off the coast of California........PLEASE DON'T PERMIT THIS TO HAPPEN.

I realize that this is the customary method of discarding vessels, but these are not the harmless masses of metal of the past!

I work with an ex-nuclear submarine man and have been informed, at length, of his teaching by the Navy on the subject of the dangers involved.

I ask that you re-examine the other expert opinions and intelligent arguments against this proposed action.

Once this dreaded act has been committed, many of our lives will be drastically changed.....and worst of all, the coming generations will reap the agonizing harvest.

Respectfully,

Evelyn Heckendorf

Evelyn Heckendorf
147 Mill Creek Court
Willits, CA 95490

cc: Senator Alan Cranston
Senator Pete Wilson

#251

March 12, 1983

Captain Edward F. Wagner

The possibility of deactivated but highly radioactive nuclear submarines 'disposed' off the Mendocino county coast is at best a nightmarish thought. The damage to the ocean waters, the sea life (our food chain) everything, would be poisoned. I urge you and your departments to come up with some better ideas like reusable non-radioactive submarines

L.36
L.14

I am a concerned citizen, Respectfully
Richard Jergenson

Richard Jergenson
P.O.B. 1577
Willits Ca 95490

#252

Box 664
Willits CA 95490
March 13, 1983

Dear Captain Wagner,

I oppose ocean nuclear dumping anywhere and especially off the California north coast!

Please use a land disposal method which is monitored carefully and can be retrieved if problems develop.

There is no amount of radiation, however small, which is not harmful. Radiation is anti-Life in any amount. It's natural function, deep within the earth, is to break down rock into soil, etc., necessary for life.

Nuclear power and weapons are both destructive to our civilizations and our home, the Earth.

Brent Sieloff

#253

Capt E.F. Wagner:

Please strongly consider canceling your plans for dumping nuclear submarines off the coast of Northern California. We feel the potential risks warrant much further study and considering of alternate plans. Thank you greatly.

Mieko W. Terhune / Jerold D. Terhune

520

#254

This letter was written in to the [illegible] and Radio K.K.O. San Francisco. [illegible] you can see it is about a [illegible] [illegible]

2670 Greenwood Ave,
Morro Bay, Calif, 93442
March 10, 82

I was listening to the first 20 minutes of your night talk program on Radio KGO. The idea [illegible] certain [illegible] back in Washington D.C. to allow about 100 old Nuclear radiated submarines to be sunk off the Mendocino coast, is actually preposterous. I have written to you before concerning Nuclear weapons of war and Nuclear Power Plants, serious dangers of radiation, etc. The greatest authority on the living sea that I know of is Jacques Cousteau, the world's greatest undersea researcher and for 40 years he has been doing this research. He says we risk poisoning the seas forever. What we are facing is destruction of the ocean by pollution and other causes. Anything done against the seas is a crime against life. The water system has to remain alive if the human race is to remain alive on this planet. The field of damage done by pollution of the seas is immense. I am quoting from J. Cousteau's article in "Lets Live" magazine. I am a member of the "Cousteau Society" as I realize he is one of the outstanding important individuals on this Planet Earth. — The seas are the universal sewer. Most pollutants on land eventually reach the sea. The Mediterranean Sea is in bad shape because of pollution, so is the Black Sea and the Indian Ocean. Nothing must delay action if the seas are to survive and have meaning. I am absolutely certain that we have no time to lose, that we have a race against time and that we must all join forces to win that battle.

In the December publication of J. Cousteau "Calypso Log" magazine, Cousteau says: For the past several years the Cousteau Society has actively been preaching for the protection of future generations. — But how many generations will there be before a triumphant devil unleashes the abominable nuclear holocaust that the East and the West and the North and the South are feverishly preparing. Yes the Cousteau Society will struggle to save as much as possible of the natural heritage that could have meaning if there is a sound, decent environment. This goal only makes sense if: We defuse the threat of a Nuclear war. — If we better share the resources of the World — If we overcome the population explosion. — The Cousteau Society falls into the realm of education. We believe that enlightened humans can still act to prevent catastrophe whether it takes the form of nuclear fury or ecological disintegration. We believe that humanity must better educate itself about the exquisite and inexorable mechanisms of life on this planet — and how those mechanisms can be interrupted.

Dr. H. Kendall, a member of the Advisory Council of The Cousteau Society says: The nuclear power industry has fallen gravely ill from a host of ailments whose symptoms have been studiously ignored or suppressed for almost 2 decades by industry and the federal nuclear establishment alike. We are very much concerned that nuclear power is an economic error of immense proportions. Worldwide peace, indeed the survival of civilization, depends on the success of ourselves and other nations in halting the spread of these frightful nuclear weapons and nuclear power plants.

J. Cousteau says: For a long number of years I have been a bitter witness of the pollution and devastation inflicted upon our planet's oceans and seas and rivers and lakes and water tables. But today what I see and hear and touch and smell and read fills my heart with such anxiety that I plead for more understanding and righteousness in keeping the oceans alive for the benefit of mankind. As for myself I can actually say that J. Cousteau and I are like 2 peas in a pod. Because I have studied Ecology and the Earth's Environment since 1924, which adds up to 57 years of study, I gained a great deal of knowledge concerning what Nature means to this Planet Earth. — — Walter Cronkite says: This is the only planet we have and the protection of the diversity of species that nature put on it should be among man's most vital concerns.

I have an article written by Norman Cousins, who is very well known on the East coast and has a great deal of experience as a writer. He says that no nuclear nation can go to war against another nation without also going to war against the whole of the human race, including its own people. There is no way of keeping the radioactive debris from floating with the waters and riding with the wind. The longer the arms race goes on, the more likely it is that an international crisis will become the fuse of a nuclear holocaust. We need to focus the attention of the World's people on the danger that confronts us all. We need common sanity, he says.

To sink 100 Nuclear radiated submarines off the Mend. Coast would be a massive onslaught of abuse against the living Seas. Nobody who really understands the Natural World in every meaningful way would never dare to propose such a frightful, outrageous and dangerous piece of action. It would be a monstrosity.

Signed — Howard W. Demler

(Important) You will find that the enclosed article titled "Will Mankind Conquer Pollution or Will Pollution Conquer Man?" is one of the two Outstanding articles on Pollution that I have read since 1925.

By all means be sure and read it as its so informative and important to the whole human race on this Planet Earth. Over →

Its actually safe to say that only a very small number of the members of the United States Congress have studied Ecology and Environmental facts for more than 3 or 4 years. Most of them on those subjects studied very little. Compare that to my study of almost 59 years. What a huge difference. I have been a member of the "Cousteau Society" for quite some time. Its an outstanding Society. Its all to true.

H. W. Demler

The World can not keep on going on like I describe to you on these pages.

WILL MANKIND CONQUER POLLUTION?

or will pollution conquer man?

by Donald D. Schroeder

The global fight against pollution is being stymied before it has hardly begun. Yet the fact is, the battle [redacted] Not

SUDDENLY, mankind is at an environmental crossroads.

The fight against air, water and land pollution is being undermined by a host of economic, political, military and social crises in almost every nation.

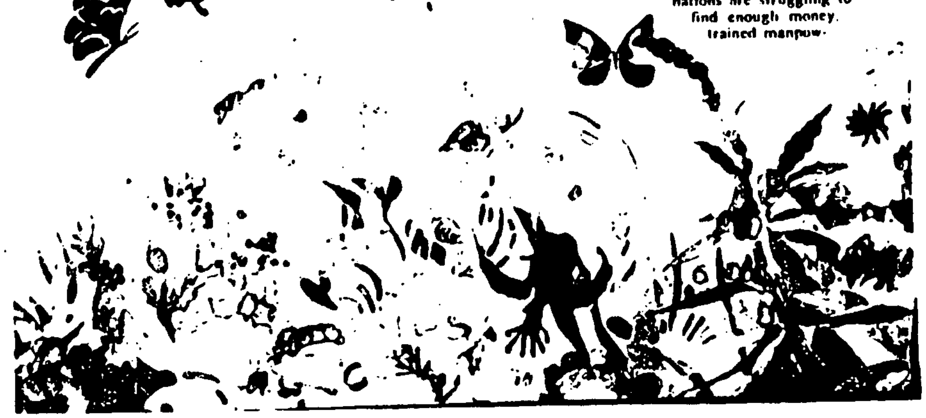
Just when intensive efforts must be made against massive outpourings of pollution and environmental degradation even extreme efforts in some cases—the battle in almost every nation has to be delayed or ignored.

Why?

Many do not realize that strong antipollution controls have been a costly luxury affordable mainly only by rich, developed nations. Developing nations have rarely been able to afford them

Luxury of the Rich Only?

Now, in these economically stressed times, strong antipollution efforts run counter to government and industry policies. Hence the growing downplay by many government officials and citizens who formerly supported them. Even the richest nations are struggling to find enough money, trained manpow-



II

er and resources to divert to environmental controls in the face of the cry for economic and industrial expansion to create new jobs. And to meet social welfare demands and energy and defense needs.

What a dilemma mankind is in!

Recovery from recession, and security needs are given priority over strong antipollution efforts. Heads of major industrial corporations around the world say stricter regulations will contribute to unemployment, curtail productivity and competitiveness, divert expensive energy and threaten to regulate them into bankruptcy.

Nations everywhere feel impelled to improve their industrial and technological capacity even if it means more rapid pollution of the environment. Yet failure to control pollution and destruction of the earth's life-sustaining environment in this decade could seal the fate of all humanity.

What many leaders, businessmen and citizens fail to grasp—or are blinding their minds to—is that new economic priorities are gambling with the lives of all humanity. Action against the onslaught of pollution must be taken now, or it will be too late!

Critical Decades

It's hard to believe. But it was hardly more than 10 years ago that leading scientists, environmentalists and government representatives gathered *for the first time* in a historic conference to confront the unprecedented threat of global pollution to humanity.

In June, 1972, delegates from more than 100 nations met at the United Nations Conference on the Human Environment in Stockholm, Sweden. There delegates faced grim facts about the earth's rapidly degrading air, water and land. The facts compounded into the inescapable conclusion: Even if nuclear war doesn't destroy mankind, rapidly escalating pollution and destruction of environment will achieve the same result in a few decades unless it is quickly reversed.

The delegates established the United Nations Environment Program (UNEP). Its purpose was to monitor humanity's progress in fighting environmental pollution and destruction.

In retrospect, that conference—man's boldest attempt to save himself from extermination in his own industrial and technological filth—achieved its planners' primary objective. For the first time in history, leaders of the world together faced the reality that we are polluting ourselves to death.

And yet, while this important conference objective was largely achieved, none of the laudatory resolutions for international cooperation, or for coping with international pollution problems, were binding, even on the governments that supported them.

Again and again at the historic conference, delegates bristled with hostility at any proposals that appeared to conflict with their short-term economic interests. Leaders of developing nations, short of cash reserves, said costly pollution controls were an obstacle to industrial development needed to pull them out of poverty.

How Far Have We Come?

How far has mankind progressed in the fight against pollution since 1972?

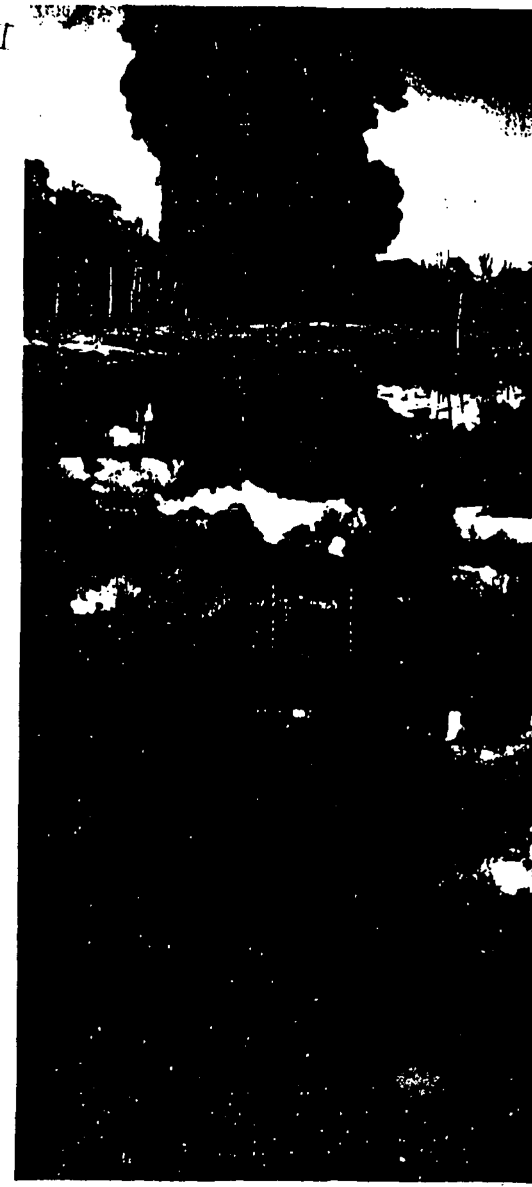
In all fairness, the Environmental Decade of the 1970s was a unique decade of widespread awareness of environmental destruction and of strong efforts to do something about it. Even many nations who said they couldn't afford strong antipollution controls felt impelled to do what they could within their means.

One could report numerous localized examples and amazing success stories in cleaning up polluted air and water and ruined land.

Environmental impact laws now temper runaway degradation in many areas where such laws did not exist before. Various industries have spent millions cleaning up their pollution.

In some areas, certain air pollutants have been markedly reduced. There have also been remarkable reverses of severely polluted rivers, lakes and streams on various continents. These experiences demonstrate to all what can happen when intensive antipollution measures are introduced into a region.

III



There have also been major advances, at least in primary research and development stages, in nonpolluting energy technology and in conservation technology. Amazingly simple and safe methods of generating power from solar and geothermal sources, biomass gases and wind have been designed and built. And concepts of tapping limitless ocean currents and waves for power have been put to design.

Simple waste water purification and recycling plants using aquatic vegetation or bacterial organisms and designed for home or small communities have been experimented with—and they work. The recycling of animal and vegetative wastes by controlled biomass reduction has proven to be a safe and feasible source of heat, fuel and fertilizer.

These and other nonpolluting technologies work in harmony with—not against—natural environmental systems. Much of this technology, known in decades past, if applied, could have gone a long way toward reducing man's degradation of his environment.

Today's Pollution Reality

But at the same time that mankind is making limited progress in methods to reduce pollution, most areas of the earth have seen no relenting of pollution, no progress in lessening degradation of environments. Just the opposite.

For most parts of the earth old pollution problems have worsened under the onslaught of concentrations of humans or animals, or from rapid and thoughtless applications of modern industrial technology.

"Out of sight, out of mind"

(Continued on page 27)

ASSAULT ON CLEAN SKIES—*Industrial man treats his life-sustaining air as an open sewer for increasing millions of tons of waste. But what goes up comes down, often on somebody else far away. Top to bottom: Burning off excess oil and brush in Sumatra, a chemical plant in Zimbabwe adds its share of pollutants, so does an oil refinery in heavily populated Southern California.*

#254 (Cont)

IV

Acid Rain From the Skies— An Immediate Global Threat

One would be strained to devise a more subtle, yet deadly and effective form of chemical warfare to destroy vast areas of the earth: rain, more acid than vinegar; mists and fogs that corrode machinery, buildings and paint; snow that when it melts kills aquatic life with concentrated toxic runoff. And, in addition, these tragic results: slowed timber growth, reduced crop production, soil leached of fertility, corroded metal pipes and increased toxic metal poisoning in drinking water.

It's all caused by acid precipitation falling from industrially polluted skies.

The pollution is carried by prevailing winds from city to city, nation to nation, and even continent to continent. It is a pollution time bomb already devastating many areas of the world's ecosystems. Many scientists and environmentalists regard acid rain as the world's most serious environmental problem.

"The acidification of land and water is perhaps Europe's most serious environmental problem in the '80s," said Mats Segnestam of the Swedish Society for the Conservation of Nature. "It is hardly an exaggeration to call it an environmental disaster."

About 4,000 of Sweden's lakes and more than 1,500 of Norway's have had all fish life destroyed. Thousands of other lakes are endangered. One authority estimates most of Sweden's lakes will be killed in a few more decades if nothing drastic is done. By then, groundwater will be undrinkable unless treated, and much of Scandinavia's forests will be destroyed.

The major source of pollutants causing acid precipitation over large areas of several continents is the vastly expanded use of fossil fuels—mainly coal and oil—by industry and motor vehicles since World War II.

Normal rain is slightly acid, containing carbonic acid formed from carbon dioxide occurring naturally in the atmosphere. Acid rain is created when sulfur and nitrogen oxides emitted by power plants, industries, motor vehicles and other sources combine with moisture in the air to form more dangerous sulfuric and nitric acids. About 90 percent of the sulfur comes from man-made sources. Scientists report rain and snow over many areas of the earth are many times more acidic than normal precipitation.

Vast Acid Scare

Areas most devastated by acid rain so far are North America, Scandinavia and other parts of Europe.

In West Germany deformed limbs and gray skeletons of countless diseased trees, victims of acid rain, resemble the defoliated forests of a battleground. One West German forestry expert estimates 30 percent of West German woodland is succumbing to airborne contamination. In Bavaria, more than 50 percent of pine trees are endangered.

This forestry expert believes the ground has been poisoned by decades of falling sulfur dioxide and heavy metals such as lead and cadmium. He feels such pollutants put trees in a state of permanent stress that weakens their resistance to drought, frost, fungi and bacteria.

Other biologists report acid rain can also eat away leaves, leach nutrients from soil, interfere with photosynthesis and affect the nitrogen fixing capabilities of plants such as peas and soybeans. In many places in Europe forest growth is slowing down. Forests in East Germany and Czechoslovakia are reported to have worse forest mortality than West Germany because of vast outpourings of industrial pollutants.

Source of Tensions

Acid rain is the cause of growing tensions between nations. Scandinavians claim they are being "bombed" with other nations' pollution and the destruction seems little different from battlefield chemical warfare. They claim British, West German and other European factories' polluted air converges in their areas. The Swedes claim 75 percent of their acid rain comes from pollutants originated elsewhere; the Norwegians claim 90 percent of theirs does.

United States and Canadian officials are up in arms at each other for failing to take proper action to reduce exports of industrial pollutants that turn into acid rain. Canada says it is worse off as it receives four times as many pollutants from the United States as winds carry from Canada to the United States.

Hundreds of lakes in Canada and the United States, particularly in the northeastern regions of each country, have had fish and aquatic life eliminated. Aquatic reproductive cycles and plankton have been destroyed. Thousands of other lakes, streams and rivers in North America are threatened. The acidic haze that sometimes hangs over Alaska is thought by some authorities to come from Japan.

It's ironic that the tall industrial smokestacks that were built in past decades to reduce pollution in areas surrounding plants are the major villains for spreading acid rain hundreds or thousands of miles away. These giant stacks merely spew pollutants higher into the atmosphere where they have more time to mix with moisture and fall as acid precipitation far away.

There is one ameliorating factor for some areas affected by acid rain. If soils are blessed with limestone in their composition or bedrock, the acid in rainfall can be somewhat neutralized. But if soil covering is thin and the underlying rock is acidic granite, there is little to buffer the acid corrosion.

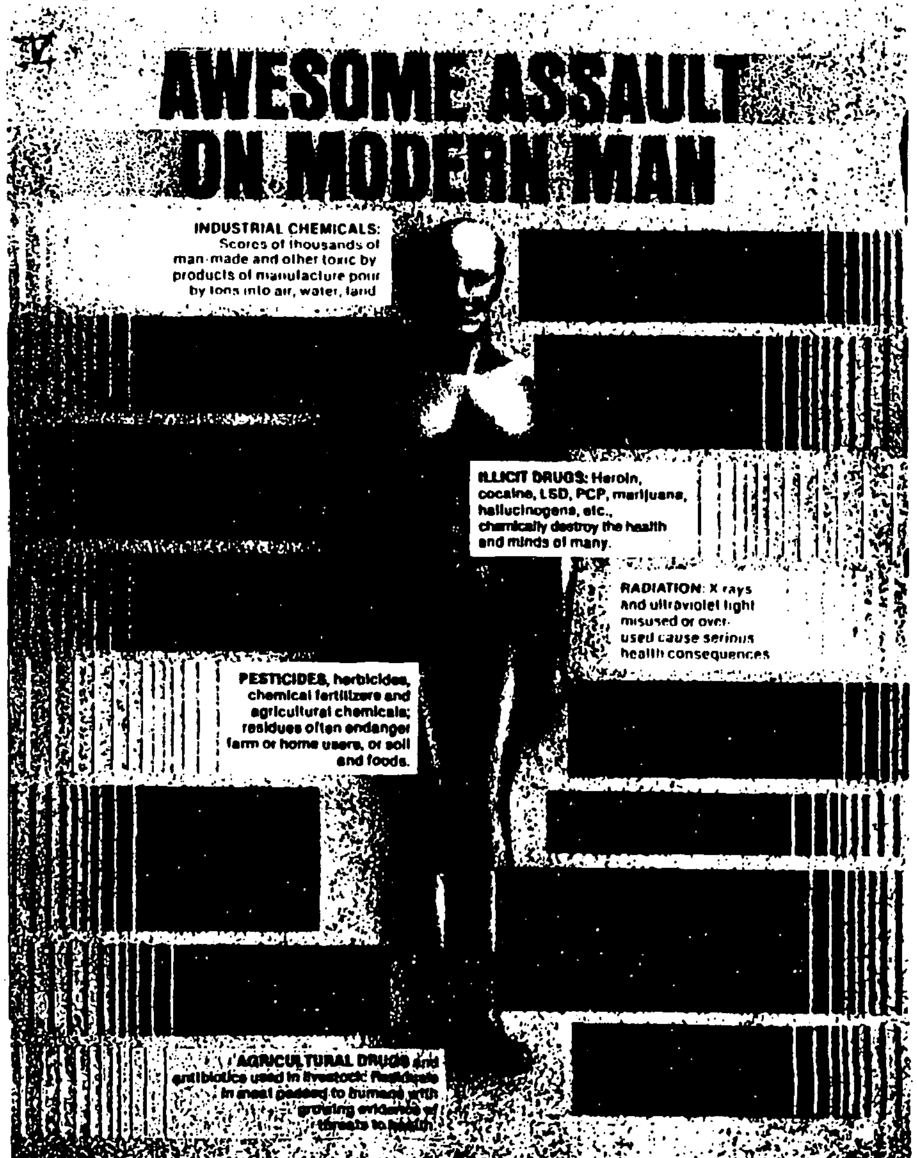
Energy and economic crises have worsened the prospects for quick action to solve the problem. To the contrary, more coal, and particularly more high sulfur coal, is being substituted for oil in more power plants and industries. Industrial and auto emission standards are being relaxed in some areas to reduce costs for industries struggling to cope with inflation and recession.

Although "scrubbers" can remove up to 90 percent of sulfur emissions in coal-fired plants, the costs of such equipment are staggering and prohibitive for many industries.

Yet to do nothing now means more nightmarish environmental disasters in the future.

Acid rain is becoming an international nightmare. It will require world cooperation and global changes in living patterns to solve it. But that cooperation is nowhere on the horizon.

IV



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VI

toxic chemicals have subsequently risen ugly heads from thousands of improperly used dumps and landfills around the world. Chemicals are leaching into water supplies and oceans or evaporating into the air. Experts tell us there is no quick technological bailout on the horizon to do anything about it.

Now with governments everywhere stretched to the limits to handle immediately pressing social and economic problems, many fear that the Environmental Decade of the 1970s may be the last environmental decade.

It is these developments that have produced the gloomy United Nations Environmental Program (UNEP) report on the past decade's overall achievements.

Speaking for UNEP, executive director Mostafa Tolba told more than 100 delegates meeting in Nairobi, Kenya last May that in the last decade, "on almost every front, there has been a marked deterioration in the quality of our shared environment." Man, he indicated, is not even holding his own against pollution, but is being overwhelmed.

Mr. Tolba warned that governments had this choice: "Take action now or face disaster." Lack of such action now, he said, would bring "by the turn of the century" - less than two decades away - "environmental catastrophe which will witness devastation as complete, as irreversible as any nuclear holocaust."

UNEP's gloomy report concluded: "The concepts for ecologically sound management have been imperfectly or too slowly applied. In some cases they have

(Continued on page 10)

INTERNATIONAL PLAGUE—Knowing no boundaries or playing no favorites, currents of polluted waters sweep from nation to nation wreaking havoc. Top, a Spanish coastal area befouled with human garbage and various flotsam, middle, a broken oil tanker off the Brittany coast befouls ocean waters with oil waste, an oil smeared victim of such waste in another far flung area of the world, a Magellanic penguin on the Valdes Peninsula, Argentina; and bottom, a reminder of pollution's ultimate ugly consequences.

VII

Our Dangerous Synthetic Environment

Of all the assaults bombarding mankind, none is more subtle yet more potentially devastating and difficult to control than the accelerating tons of toxic chemicals. We dump them into our air, water, land and food.

Pesticides, herbicides, plastics, synthetic food additives, drugs and thousands of chemicals now exist that were never experienced by former generations. Industrial Age man is now polluting his environment hundreds of times faster than the generation of even a century ago.

"We're fouling our own nest, and we can't survive if we continue," says Dr. Irving Selikoff, of Manhattan's Mount Sinai Medical Center.

In the last 50 years a revolution has occurred in the chemistry of the air we breathe, in the water we drink, in the food we eat and the places we walk, work and play. Modern chemists have developed the capacity for an infinite variety of man-made chemical compounds and for varying existing ones. For relatively few man-made chemicals do we know the long-term effects on health or at what levels they cause health problems.

As many as 1,000 new chemical concoctions come on the market every year. Around 35,000 of the 50,000 chemicals now available on the market have been classified by the U.S. Environmental Protection Agency (EPA) as either definitely or potentially hazardous to human health.

"The further chemists get from natural chemicals the greater the danger [of] environmental disruption] becomes," said one EPA chemist.

Many of man's chemical creations differ markedly from those found in nature. Many are not readily broken down (biodegraded). They build up in tissues of plants, animals and man and are passed in ever increasing concentrations up food chains to affect the health and procreation of all things.

By the time a chemical suspected of risk emerges from scientific scrutiny, its uses are often so entrenched in modern life that banning it is extremely difficult no matter how dangerous it might be. DDT, chlorinated hydrocarbons in pesticides and many plastics are examples.

What's worse, sometimes it takes several decades for the horrors of a particular chemical to show up. Chlorine, the widely used chemical to kill waterborne bacteria, for example, is now suspected of producing potential cancer-causing substances when it reacts with other chemical pollutants in water.

This points out an enormous dilemma. Many chemicals sometimes behave totally unpredictably. As compounded and intended for use they may be predictable. But when they come in contact with other chemicals in the environment some act synergistically—one chemical enhances the toxicity of another, or one interferes with the actions of another.

The World Health Organization has estimated that between 60 percent and 90 percent of all cancers are the result of "environmental factors." In the broadest sense this includes everything from chemical agents to radiation, to noise pollution and even human stress.

Scientists long worried about potential cancer-causing chemicals in

No Nation Has Escaped

There are few places on earth with growing populations that are not burdened down with worsening human or industrial effluent.

Most big cities in developed and developing nations alike are frequently smothered in noxious smog. Mexico City, Santiago, Chile and Caracas, Venezuela have as dangerous air as Tokyo, Chicago or New York.

Caracas was found to have a carbon monoxide level 15 times the danger level established by the World Health Organization.

In Ankara, Turkey, on a bad day chimneys and industries pour out lung-searing smoke which, say some experts, have the same effect as smoking 200 cigarettes. They predict the city will not be able to sustain life in a decade or so at present rates of pollution.

In Athens, Greece, carbon monoxide, lead and other pollutants far exceed international safety levels.

In Eastern Europe environmental problems abound. Forests are dying; industrial soot covers the cities. One Polish marine specialist, who did not want to be identified, said the Vistula and Oder rivers were "practically waste water channels into the Baltic."

Major seas and lakes in Europe are seriously polluted. The Baltic and Mediterranean seas are dying from human and industrial wastes. Lake Baikal in the Soviet Union is beginning to slowly recover only after decades of poisoning by wastes from pulp mills and industries was reduced.

Coastal waters of the South Seas are fouled by human and chemical wastes. Coral reefs are dying. Pesticides from Africa have been found in the West Indies.

The Zambesi River tumbling over Victoria Falls is fouled with the filth of five African nations. At least seven nations dump their wastes into the North Sea.

Soot from the industrial Ruhr in West Germany discolors snow in Norway. The Rhine is called "the sewer of Europe"—a slimy river of sewage, 2,000 chemicals, sediment, organic wastes and pesticides from agricultural runoff. Yet it is still a major source of drinking water for millions of Europeans.

All over Latin America many nations struggling to industrialize are strangling on the wastes of the very industries its leaders hope will pull their people from poverty. In Sao Paulo, Brazil and Buenos Aires, Argentina, nearby rivers have been turned into little more than black and fetid sewers. One river is covered with suds, another boils with chemicals, a third is so hot it steams. In Sao Paulo, the levels of sulfur dioxide, which impairs breathing and damages vegetation, are from two to six times higher

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VIII

the workplace and general environment, are concerned about another worry brain and behavioral disorders caused by chemicals

Known causes of mental and behavior disorders have been traced to excessive amounts of lead mercury, the pesticide Kepone, certain food additives and heavy metals What these findings mean is that a substantial proportion of future generations is highly vulnerable to learning and behavior problems because of toxicity from chemicals in our environment

A few years ago, a high official of the EPA said "We look back on the Middle Ages and we say, 'No wonder they had bubonic plague—they used to throw garbage in the streets.' Generations to come will look back on this generation and say, 'No wonder they had problems look at all the chemicals just carelessly introduced into the environment, uncontrolled.'"

than World Health Organization guidelines

Water samples from a river dumping into Jakarta Bay, Indonesia were found to have 62 times the international safety level for mercury pollution Industrial plants along the river introduced most of this toxic metal problem as well as other toxic metal pollution In many developing nations it is difficult if not impossible for governments to impose costly pollution controls on their industries without forcing owners to go bankrupt

No nation by itself can solve its pollution problems Pollution is international It is global It will take a global—not a piecemeal—solution Any measure short of that will lead humanity into global pollution disaster!

VIII

"Time Bombs" Coming Back to Haunt Mankind

Like awakening sleeping giants, lethal soups of thousands of different toxic chemicals, formerly thought harmless and disposed of "out of sight, out of mind"—are now beginning to seep from thousands of dump sites into water supplies Or bubble to the surface in ugly puddles, polluting the air and landscape Or in some cases, literally explode like ammunition dumps

"There are a lot of time bombs out there waiting to go off," said a senior U.S. Environmental Protection Agency official of chemical dumps in America

A study for the EPA found that 90 percent of the landfills in the eastern half of the United States are leaking toxic substances into groundwater

These "ticking time bombs" like forgotten land mines of bygone wars are only beginning to be associated with a variety of serious human health ailments "Toxic waste will be the major environmental and public health problem facing the U.S. [and we must add, other nations] in the '90s," said a health official

At least half of the wastes [in the United States] are just being dumped indiscriminately, says Gary Dietrich of EPA Anytime you put hazardous waste in the ground it will eventually leak into drinking water, say other health officials People living in a beautiful area may not realize their aquifer is being contaminated from a source 50 miles away

A few years ago the EPA estimated only 10 percent of U.S. chemical wastes are disposed of by properly controlled incineration chemical treatment, recycling or in landfills properly lined with impervious material to prevent leakage Of the remainder, 80 percent is dumped in nonsecure landfills, ponds or lagoons and 10 percent is incinerated without adequate controls (Improper incineration just spreads residual polluting agents invisibly over broad areas of the countryside.)

Chemical and toxic waste disposal in the past has been so haphazard that deadly mixtures of chemicals have simply been carted off to municipal dumps, or mixed with garbage or hidden in farmers' back fields for a price Some haulers have pumped liquid wastes into tank trucks and driven down rural roads with the cock valve open Or dumped them into the nearest sewer stream or lake The long term environmental or health effects on future generations?

They are not even considered

At one dump site thousands of rusting barrels of chemicals improperly labeled and left to deteriorate for a decade finally went up in an explosion and raging fire At another landfill a bulldozer operator hit a canister of phosphorus and was incinerated so quickly he died with his hand on the gearshift

Government officials investigating this site found a horrible arsenal of chemicals—some of which were so volatile they ignite when exposed to air Also found were wastes with high levels of lead, mercury and arsenic, plus dangerous solvents, pesticides, plasticizers and even picric acid, which has more explosive power than TNT

At another earthen dump site, sludges of paint and chemical oozes of benzene, toluene and naphthalene seeped from rusting barrels This caused a concerned citizen living nearby to say, 'Every time we have a thundershower, I pray, 'God don't let lightning hit out there.'

Unlike surface water or the air, groundwater is all but impossible to purify once it has become chemically polluted Normally the earth's surface is a natural filtration system a kind of geological "kidney" to cleanse naturally occurring wastes by water filtering through it But the system simply cannot handle or break down into harmless substances the toxic overload often poured upon it Many man-made chemicals cannot be broken down naturally and will be toxic and dangerous for hundreds or even thousands of years State and local authorities often refuse to face up to these problems

Even the vast oceans cannot continue to absorb and dilute all the dangerous wastes Many smaller seas are already dying from a variety of man-injected pollutants Some developed nations still dump low-level nuclear wastes into the oceans European nations burn dangerous chemical wastes on incinerator ships because pollution controls are less stringent at sea Pollutants nevertheless escape into the air and water we use

Poisoned sky Poisoned water Poisoned earth It will take a miracle to rescue mankind from millions of tons of carelessly disposed toxic wastes □

IX

been ignored entirely " Why, with, today's explosion in knowledge?

Haunting Dilemmas

More and more, scientists are discovering there is no careless disposing of human or chemical wastes that does not reap serious environmental penalties. All too many pollutants injected into the soil, water or air are coming back to haunt humanity

More and more it is being discovered that pollution engendered in one area often wreaks serious havoc and destruction far away—in some cases thousands of miles or even continents away Polluted air, water and land befoul not just populated or industrialized areas where it is engendered, but often are spread internationally by winds, rain and oceans

Acid rain is a major case in point Tons of toxic chemicals spewed into the air by one nation's industry and motor vehicles end up being dumped on other nations, nearby or far away, depending on prevailing wind patterns The tragic consequence is blankets of poisonous moisture and air moving from continent to continent killing off thousands of lakes, destroying many forest areas, vegetation and wildlife. "It is extremely unsettling to see rich soil and ample irrigation unable to produce a crop because the air cannot support the growth of healthy plants," said a U.S. congressman at recent hearings on ozone damage to agriculture

Pollution is international It will require a global—not just a local or national solution If only a few nations expend extreme efforts to fight their pollution but the majority of other nations do not—the battle will be lost with the same fateful outcome for humanity.

Is it too late to save mankind from destruction in his own toxic wastes?

Few seem to realize that pollution cannot be solved merely by [illegible] (cont)

THE CORRODED AND THE SCARRED—Top photo shows dramatic evidence of air pollution on some common construction metals Below, scars from strip mining Costly efforts must be made to contain polluted water runoff and to restore land for useful post mining purposes

The PLAIN TRUTH

525

#254a

Captain E. F. Wagner
Dept. of the Navy
Washington D.C.

2670 Greenwood Ave.,
Morro Bay, Calif. 93442

Important March 17, 82

Dear Capt. E. Wagner:

I have such a vast amount of knowledge concerning ecology and environmental facts, that I need to let you know that I began to study those subjects back in 1924 and for every year since then. So that makes almost 59 years of study for me. I am able to tell the truth about massive pollution dangers and environmental catastrophe.

Because its of extreme importance I need to say that nothing could be gained by any nation interested in starting an allout Nuclear weapons aggression offensive that would bring only horrifying destruction to this Planet. The facts are that the land, fertile soil, and water supplies could suffer ruination for a long number of years due to radiation fallout. Any nation that could see any gainfull accomplishment by starting a Nuclear War with the awesome hydrogen bombs that would result in the vast spreading of radiation fallout over the land, would actually be cutting their own throats. Any individual of a sound sensible mind could see that the above statements are true. Even the Superpowers would loose in a tremendous way as this nation or that nation, would be turned into a gigantic; super-collosal junk yard, and it certainly doesn't take a genius to figure that out. The losses on both sides would be so great it would be beyond calculation. Its all too obvious that a dependable individual; including others close to the White House in Washington D.C. must have a sound mind in a sound, capable body to engage in across table discussion and show how senseless and useless it would be for an offensive minded aggressor to actually cut their own throats and ending up with nothing except desolation, destruction and ruin. We just don't have a common sense minded; competent individual in the "White House" right now. Not by a long shot. The whole concept of war has been changed, and I do mean changed to an alarming degree all because of the introduction of Nuclear Bombs, missles and hydrogen bombs. In the "White House" we have this tremendous appetite for Bomb overkill. Such awesome destructive power has never been known before on this Planet Earth.

Scientist Linus Pauling-two time Nobel Prize Winner said it is the duty of Scientists to tell people about Nuclear Weapons madness. The U.S. government has lied to Americans for years in order to gain support for increased and unnecessary military spending. Pres. R. Reagan lies to the American people to win support through fear of the Soviet Union. One great problem is this Nuclear bomb + missle Overkill madness, says Scien. Linus Pauling.

Respectfully, H. W. Demler

#255

SIERRA CLUB
North Carolina Chapter

Regional Groups in North Carolina

BLUE RIDGE GROUP
P.O. Box 587
Boone, NC 28607

BROAD RIVER GROUP
P.O. Box 2281
Shelby, NC 28150

CAPE FEAR GROUP
P.O. Box 5093
Wilmington, NC 28405

CAPITAL GROUP
P.O. Box 12463
Raleigh, NC 27605

CENTRAL PIEDMONT GROUP
P.O. Box 6002
Charlotte, NC 28207

CYPRESS GROUP
P.O. Box 3735
Greenville, NC 27834

FOOTHILLS GROUP
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Winston-Salem, NC 27102

HORACE KEPHART GROUP
P.O. Box 1644
Fayetteville, NC 28302

PIEDMONT PLATEAU GROUP
P.O. Box 862
Greensboro, NC 27401

RESEARCH TRIANGLE GROUP
P.O. Box 1303
Chapel Hill, NC 27514

SANDHILLS GROUP
P.O. Box 36
Carthage, NC 28327

SOUTH MOUNTAINS GROUP
P.O. Box 652
Morganton, NC 28655

WENOCA GROUP
P.O. Box 16075
Asheville, NC 28816

March 1, 1983

Capt. Edward F. Wagner
U.S. Navy, OPNAV-22
Dept. of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

We have reviewed the draft EIS entitled Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants---December 1982. We commend the Department of the Navy for its production of a document which presents technical information in such a form that its major elements can be readily grasped by a reader having only marginal fluency in such disciplines as oceanography, nuclear engineering, radionucleide behavior in the environment, and economics. The appendicies provide more detailed documentation for those who require it.

It is our opinion that the draft EIS provides compelling evidence that ocean disposal of decommissioned vessels as described would constitute the most cost effective disposal alternative and would result in negligible environmental impact. While we can agree with these findings of fact, we remain hesitant to support the ocean disposal alternative. This reluctance is based primarily on the following considerations:

L.39 1) Although most available studies of metal corrosion, sediment transport, current pattern, and bioaccumulation do not indicate that release and dispersion of radionucleides will occur in any manner varying widely from DEIS estimates, the fact remains that dynamic aspects and rates of interaction among components of deep ocean ecosystems are poorly understood. Land storage/disposal would have the advantage that the chemical/physical/biological processes noted in the first sentence of this paragraph are better understood for terrestrial ecosystems. We do have a record of experience in attempting to manage radionucleids in terrestrial systems. Accessibility in the event that direct management is required is another advantage of land disposal, but this must be balanced against the enhanced probability of contamination of ecosystems which directly involve humans. The DEIS does not adequately indicate the vast difference in scientific knowledge and experience between the terrestrial and deep ocean ecosystems being compared. L.39

2) The DEIS does not consider the proposed deep ocean disposal of radionucleids in context with the political and environmental considerations which led to the 1970 moratorium on this practice. F.8 Many citizens believe that renewed ocean disposal as proposed in this DEIS, although in itself perhaps harmless, will open a floodgate of pressure from other producers of low level nuclear waste to do likewise. We are concerned that renewed ocean disposal will set a precedent of international significance. L.9 Even disposal of demonstrably harmless amounts of nuclear waste by our country will signal a major change in national policy.

3) The submarines issue is timely as it raises again the general problem of disposal of nuclear waste by a society that derives many comforts and advantages from processes that result in its production. F.8 If our national policy with respect to ocean disposal is to be changed then it should be done only after wide public discussion. Even then ocean disposal should be conducted under specific guidelines. In the interim, no ocean disposal should be permitted.

Cypress Group
Sierra Club

Vincent J Bellis
Conservation Chair

cc: Daily Reflector
Jim Dockery
Bob Deland
Dan Stroh
Donna Gauthier
Representative Walter B. Jones
Senator John East
Governor James Hunt
Thomas Jackson, Oceanic Society
Todd Miller

To explore, enjoy, and protect the wild places of the earth; to practice and promote the responsible use of the earth's ecosystems and resources ...

528

#256

2622 Pickett Rd.
Durham, N.C. 27705
March 21, '83

OPNAV-22
Dep't of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

We live on a "water planet". To polute our oceans with radioactive materials is, in the long range, suicidal.

The only "furnace" capable of recycling radioactive nuclear waste is the sun. Until we can send our waste into the sun to be recycled we had best not produce such waste.

I definitely protest the scuttling of defueled submarine reactor plants into the ocean. And strongly protest the action as outlined in DEIS. Land burial is not desirable either. But I consider it preferable at present.

Thank you for receiving my comments!

Marjorie C Jones

#257

6237 Trowbridge Rd
Wilmington, NC
March 16, 1983

Capt. Edward F. Wagner
Office of the Chief of
Naval Operations
OPNAV-22
Dept. of the Navy
Washington, DC 20350.

Dear Capt. Wagner:

I would like to express my opposition to the proposed dumping of decommissioned nuclear submarines off of the North Carolina coast.

N.3 Being the least costly method of disposal is not a good enough reason to risk possible contamination of the food chain contained in our oceans.

I hope that this matter will be reconsidered and an alternative endorsed.

Sincerely,
Gwendolyn Behen

#258

Dirk Van Zyverden
6003 Cossowary Lane
New Bern, NC 28560
919-638-3386

March 21, 1983

Capt. Edw. F. Wagner
Off. of the Chief of Nav. Oper.
OPNAV 22
Department of the Navy
Washington, D.C. 20350.

Gentlemen:

I strongly oppose the possible Dumping of decommissioned Nuclear submarines, and for that matter, all nuclear waste, in the Ocean of Cape Hatteras.

This is a very dangerous matter and is thought of much too lightly.

Trusting that this matter will be reconsidered, I remain

Very truly yours,

530

#259

CAPT. WAGNER -

WE PEOPLE ON THE NORTHERN CALIFORNIA COAST WANT TO KEEP OUR BLUE PACIFIC CLEAN, WE DON'T WANT IT TURNED INTO A DUMPING GROUNDS FOR THE MILITARY!

RON + GLORIA ANDREANI
32501 AIRPORT RD.
FORT BRAGG, CA. 95437

#260

19 march 83

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington D.C. 20350

Captain Wagner:

As a commercial diver, one who makes his living from the seas, I cannot urge you strongly enough to NOT bury the nuclear submarines, or any part of them, in the oceans. L.53

Already, the oceans have been used as the sewers of the industrial world. They cannot continue in this capacity.

The oceans are a source of oxygen for us--a more and more important source as we eliminate land based oxygen sources. The oceans are also a major food supply. A supply that is already showing contamination in some localities. L.36

The oceans can be a vital provider for mankind. Lets make every endeavor to keep them alive and healthy. Do not throw any more contaminents into them.

Thank you for listening to another salty dog.

L. Kyle McCarthy

L. Kyle McCarthy
348 W. Chevy Chase
Glendale, CA 91204

#261

Heidi McCarthy
348 W. Chevy Chase
Glendale, CA 91204

19 march 83

Dear Captain Wagner —

Please do not bury nuclear subs, or any part of them, at sea.

Our oceans are our only oceans, and already the wastes deposited in them are too much. The oceans

L.36 are a vital source of oxygen and food. We must strive to keep them clean.

Thank you — Heidi McCarthy

#262

3-22-83

Capt. Wagner

I would Hope that the Navy's Decommissioned submarines would NOT Be scuttled at sea. out of sight - out of mind just isn't going to work with Radio-active material forever. Life on this planet can not exist without our oceans. Enough is enough, Please Don't contribute to the poisoning of all Life on Earth.

Thank you
Greg Lashbrook
Glenn + Beverly Lashbrook
Sandra Fletcher

4790 Atkins Rd.
Port Huron, Mi.
48060

(313) 982-2809

532

#263

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV 22)
Department of the Navy,
Washington D.C. 20350

March 15, 1982

Sir,

I sympathize with your problem concerning the dumping of nuclear submarines. At present there seems to be no acceptable solutions yet they must be disposed. I find your proposal to put them in the ocean, off the coast of Mendocino, California particularily disturbing, for that matter in any ocean anywhere. Obviously, if they were completely safe they could be dumped in the Los Angeles harbor.

It is clear that no scientist can assure you of this safety 100%. You, as a military man, have been trained to take risks and responsibility. I can understand that in a military campaign you would take a risk and act on something less than 100% sure. Dumping nuclear waste material in the ocean if not 100% successful has far reaching consequences (of which I'm sure you are more aware of than I), more so than an unsuccessful military campaign. Can you accept the responsibility of even a 1% chance of radioactive contamination of our oceans? I don't imagine that that kind of moral, environmental, God-like responsibility, no matter your training, should be put on any man's shoulders.

G.2 Obviously, you can act best as a "keeper of dangerous materials" until the proper, safe dismanting procedure is found. A protected land site, where the material can be monitored offers this option. I would further suggest you initate the mechanism for a fund which would be used for a research unit to solve "our" nuclear waste disposal (including nuclear submarines) I assume you have quite a list of prospective donars from the mail you have recieved against ocean dumping.

Once again, my sympathies are with you for such an inhuman burden.

Respectfully yours,

Josephine Silva

3 Troll Ridge Road
Willits, California 95490

#264

St Patrick Day

Dear Capt Wagner

We all Submit our request With understanding and complete appreciation of all Circumstances involved - Hope a way can be found that will be useful and Concentrate of all facts that are involved.

Regards

Mrs B. C. Andrews

Greensboro

N. C.

MRS. B C. ANDREWS
RT #2 Bx 111
GREENSBORO, N C. 27405

DUMPING OF RADIOACTIVE WASTE MATERIAL OFF NORTH CAROLINA COAST

Captain Edward F. Wagner
Office of the Chief of Naval Operations
OP NAV-22 Department of the Navy
Washington, D. C. 20350

March 12, 1983

I am an opponent of a proposal made by the U. S. Navy to dump decommissioned nuclear subs off the North Carolina coast as I believe it would open the area to general radioactive waste dumping. L.9

I believe the risk outweighs the savings cited by the Navy. O.12

Please give us an extension of the time accorded.

Mrs B C Andrews

DUMPING OF RADIOACTIVE WASTE MATERIAL OFF NORTH CAROLINA COAST

Captain Edward F. Wagner
Office of the Chief of Naval Operations
OP NAV-22 Department of the Navy
Washington, D. C. 20350

March 12, 1983

I am an opponent of a proposal made by the U. S. Navy to dump decommissioned nuclear subs off the North Carolina coast as I believe it would open the area to general radioactive waste dumping. L.9

I believe the risk outweighs the savings cited by the Navy. O.12

Please give us an extension of the time accorded.

Edith Andrews

#264 (Cont)

DUMPING OF RADIOACTIVE WASTE MATERIAL OFF NORTH CAROLINA COAST

Captain Edward F. Wagner
Office of the Chief of Naval Operations
OP NAV-22 Department of the Navy
Washington, D. C. 20350

March 12, 1983

L.9 I am an opponent of a proposal made by the U. S. Navy to dump decommissioned nuclear subs off the North Carolina coast as I believe it would open the area to general radioactive waste dumping.

O.12 I believe the risk outweighs the savings cited by the Navy.

Please give us an extension of the time accorded.

JACK RUFFIN

CAPTAIN EDWARD F WAGNER
OFFICE OF THE CHIEF OF NAVAL
OPORATIONS OP NAV-22 DEPT OF THE
NAVY. WASHINGTON D.C. 20350

I AM AN OPPONENT OF A PROPOSAL
MADE BY THE U.S NAVY TO DUMP DECOMM-
ISSIONED NUCLEAR SUBS OFF THE NORTH
L.9 CAROLINA COAST AS I BELEIVE IT WOULD
OPEN THE ARBA TO GENERAL RAIDO ACTIVE
WASTE DUMPING. I BELEIVE THE RISK OUT-
O.12 WEIGH[redacted] THE SAVINGS CITED BY THE NAVY.
PLEASE GIVE US AN EXTENTION OF THE
TIME ACOORDED.

PAUL SESSUM

CAPTAIN EDWARD F WAGNER
OFFICE OF THE CHIEF OF NAVAL
OPORATIONS OP NAV-22 DEPT OF THE
NAVY. WASHINGTON D.C. 20350

I AM AN OPPONENT OF A PROPOSAL
MADE BY THE U.S NAVY TO DUMP DECOMM-
ISSIONED NUCLEAR SUBS OFF THE NORTH
CAROLINA COAST AS I BELEIVE IT WOULD L.9
OPEN THE ARBA TO GENERAL RAIDO ACTIVE
WASTE DUMPING. I BELEIVE THE RISK OUT-
WEIGH[redacted] THE SAVINGS CITED BY THE NAVY. O.12
PLEASE GIVE US AN EXTENTION OF THE
TIME ACOORDED.

Jim Ross

#265

Captain Edward F Wagner U.S. Navy;

I am opposed of nuclear dumping.
My concerns are: The ocean becoming
L.53 a huge radioactive garbage dump.
The threat of radioactivity in the fish, for
the north coast is one of richest fishing
grounds in the world. etc.

As a mother I would like my children
to grow up in a radioactive free
world.

N.3 If it has to be done it should be
done safely.

Thank you
Julia Lerma

Julia Lerma
? Greenwood Rd
Elk Ca. 95432

#266

Box 63
Albion, Ca 95410
March 12, 1983

Captain Edward Wagner, U.S. Navy,
Dear Sir,

I am writing to you because I am deeply concerned about the dumping of submarines in the ocean I feel that this issue is of the utmost importance, the long term environmental impact is extremely hazardous effects of radiation. The ocean is key in the food chain.

Living on the coast I feel this to be a direct threat. The entire idea would set a poor precedent, opening the ocean to becoming a huge radioactive garbage dump. L.9 F.8

I feel that the hearings period, the comment time on the DEIS should be extended 90 days so more people can contribute evidence. Also hearings in Eureka and Fort Bragg would be very important.

Please consider this request, it is very urgent. J.15

Thank you
Tortuga Vine

#267

March 10, 1983

Captain Edward Wagner, U.S.N.
Office of Chief of Naval Operations
Dept. of Navy
Washington D.C. 20350

Sir:

As a resident of the Mendocino Coast, I am writing to urge you to comply w/ your responsibility to hold local hearings regarding ocean disposal of Decommissioned Nuclear Submarines, so that the people
I.15 most affected by this have an adequate chance to express their concerns.

The callous regard for the health of the populations
I.36 exposed to radiation which has been time and again demonstrated by the U.S. Military will/must come to an end.

Sincerely,

[illegible]

#268

4260 Brownsboro Road
Apartment B-15
Winston-Salem, NC 27106
March 16, 1983

Captain Edward F. Wagner
Office of the Chief
of Naval Operations
OPNAV-22
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

As a concerned resident of the state of North Carolina, I would like to register my opinion on the use of the waters off Cape Hatteras being used for radioactive dumping. I strongly oppose the dumping of the decommissioned nuclear submarines.

I have enjoyed vacationing at the coast for years and I don't want our beaches polluted and ruined by radioactive waste. I am also afraid that
I.9 if they start doing this, it might lead other military and industrial producers of radioactive and hazardous waste to want to start dumping in the ocean.

I would apreciate knowing of your position on this issue.

Sincerely,

Pamela Wooten

#269

DAVID BANKSTON
6712 BIRCHWOOD CT. N
SALEM, OR 97303
MARCH 15, 1983

CAPTAIN EDWARD F. WAGNER
OPNAV-22
DEPT. OF THE NAVY
WASHINGTON, D.C. 20350

DEAR SIR:

I AM STRONGLY OPPOSED TO DUMPING OLD NUCLEAR SUBS OFF CAPE MENDOCINO. WHY CAN'T YOU JUST REMOVE THE REACTORS FOR STORAGE ON DRY LAND, SAY IN SOUTHERN OREGON, FOR SAFE KEEPING TILL SUITABLE DECONTAMINATION TECHNOLOGY EXISTS TO ELIMINATE THE RADIATION HAZARD AND SEAL THE REMAINS OF THE HULLS FOR SCRAP? G.2

AT ANY RATE, I OBJECT TO THE PRESENT DISPOSAL PLAN.

SINCERELY,

David Bankston

#270

Mark Bunbury
27011 Albion Ridge Rd
Albion Ca.

Dear, Captain Edward Wagner,

Please help us here in mendocino and California's Coast. Don't let waste ("Nuclear") be put into are ocean, We need our sea life to exist - If the ocean life dies we die our new Generations will have a much harder times. L.14

Lets find away to do this job Right - If you need my help in doing so let me know - I'm willing to Volunteer in making this job be done right, Do it wrong without thinking may cause a diaster for man kind, please help us Captain Edward Wagner. Don't let them Reuin our world please lets take our time and make sure when we do what has to be done. that it's done right. I'm sure you can Relate - N.3

Sincerly
MARK Bunbury

PS.
If it's already out of hand, we can still stop this bad habit.

#271

19404 Shubert Drive
Saratoga, Ca. 95070

February 24, 1983

United States Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, District of Columbia 20350

Attention: Captain Edward F. Wagner

Subject: Disposal of Submarine Reactor Plants

References:
1) Your legal notice of public hearings on the subject, San Jose Mercury.
2) Telcon, W. Clark to Mrs Palmer requested a copy of reference 3).
3) Draft environmental impact statement on the disposal of decommissioned, defueled naval submarine reactor plants, December 1982.

Dear Captain Wagner:

Thank you very much for the reference 3) document which I received 7 Feb. 83 per my reference 2) request in response to your reference 1) notice.

From a nuclear stand point, your report shows that "we" do not have a radiation problem by ocean dumping - as the allowance radiation exposure is 1250 MREM/quarter year, 5 REM/year. The actual limits are higher for younger people (12 REM/year until the 5 times "age" - 18 value is reached. Discussion with Lynn R. Wallis of the American Nuclear Society (I took a "nuclear power and the environment" course from Lynn in 1975,6), also informed me that the Farlon Islands alpha radiation levels, based on 1975/1976 survey, were only 5 X 10 $^{-4}$ micro-curves plutonium with a trace of C-137. This radiation only collects in the bones of fish - not the "meat".

I hope that the navy is not influenced by the "emotional" types I saw on TV testifying at your Sacramento public hearing, ergo one that says we're going to have "3 eyed" fish.

D.7 What does the 1972 Salt I Agreements have to do with our sub disposal (deactivization)?

G.2 In spite of your "economics" showing "scrape" a higher cost, I would rather have the materials more accessable to future generations of Americans. Land storage would meet this need. Better "economics" would be to sell the subs in an operational status. I would bid $1.00 each for them.

Has the navy considered "mothballing" the subs in the Great Lakes? Humm how - about MX missile launching platforms? How about using the reactors for "commercial" electrical power source(s)? G.3

Do you have any data on radiation levels from Russian nuclear subs? Also, what material and of what thickness is your fuel cladding?

Thank you for your considerations.

Yours,

Bill Clark

William H.R. Clark

P.S. Sorry for the late mailing 3/4/83

#272

P.O. Box 51
Albion CA 95410
March 11, 1983

Captain Edward F. Wagner
US Navy
Office of the Chief of Naval Operations
OPNAV-22
Dept of The Navy
Washington, DC 20350

Dear Captain Wagner,

I believe that ocean dumping of old nuclear submarines is a non solution to the problem of what to do with nuclear waste. The Navy's ~~Draft~~ Environmental Impact Statement shows a lack of adequate and conclusive data.

There is a great threat to sea life, and
L.14 then to human life thru the food chain.
L.36 The Navy hasn't had success in the past
with dumping anything to the depth considered
L.20 without the Container leaking. When the
nuclear radioactivity starts leaking into the
W.1 ocean there is no way to stop it. Fish and
eatable ocean plants will be contaminated as well all water and possibly surrounding air. Now it is part of our food chain and irrevocable. In addition, if the
F.22 Navy felt that they could have indestructible containers under normal conditions, you could not guarantee that an earthquake would not ruin the containers and unleash radioactivity into the ocean.

This plan of radioactive dumping also L.9
sets a dangerous precedent. It would
open the ocean to becoming a huge radioactive F.8
garbage dump. This would be outrageous.

We were not put on this planet to destroy her life giving ~~forces~~ forces - food, air, water - with man made wastes. Do not make this decision to dump nuclear subs in the ocean. You do not "own" the ocean and therefore have no right to destroy her. Since you do not know that no harm will come - you have no right to try out your plan.

This plan needs more public input and more time for study. Please extend the DEIS comment period another 90 days.

Also, Eureka and Fort Bragg are very J.15
affected by this plan. I request that the Navy hold hearings in these locations so that the people who live there can make their feelings known.

Thank you
Karen Vakofsky

540

#273

E Bengtson
Po 340
Mendocino CA 95460

Elizabeth Bengtson
27011 Albion Ridge Rd
Albion, CA
(Mendocino County)
Mar 12, 1983

Capt Edward F Wagner, U S Navy
Dept of the Navy
Wash D C 20350

Dear Sir

I am a resident of Mendocino County and I strongly oppose the disposal of decommissioned, defueled, naval submarine reactor plants off of Cape Mendocino, ~~and~~ of any nuclear waste dumping in the ocean. I have studied the nature of nuclear waste and know for a fact that radioactive material would be irreperably damaging to the biological environments in the ocean. All human beings are dependent ~~of~~ on the ocean for its crucial role in oxygen production. Destruction of even a small part of the sea would result in unbelievable health problems. L.14

Please hear our pleas. We are concerned citizens, parents, people to whom you are obliged to listen.

In order that more people can be made aware of this extremely serious proposal and voice their horror, please put a 90-day extension on the DEIS comment period, and set up local hearings in Fort Bragg, Calif., and Eureka, CA. It is important that this government of the people make it possible for the people to say what they want and what they absolutely can't tolerate. L.15

Thank You Very Much,

Elizabeth Bengtson
Elizabeth Bengtson

#274

March 12, 1983

To: Cpt. Edward F. Wagner:

Dear Sir:

I appreciate your receiving the vast amount of testimony opposing the Navy's plan to dump obsolete nuclear subs in the ocean. I wish to add my voice after a very careful study of the DEIS and criticism of this report.

L.1 1. There is not sufficient scientific data to support the safe disposal of nuclear waste in the ocean.

G.2 2. Any chance of environmental hazard is sufficient cause to delay this action.

J.76 3 There appears to be inadequate provision to monitor the ocean dump sites.

W.1 4. Nuclear waste dumped in the ocean is irretrievable in case of accident.

O.12 5. The costs of ocean dumping can be inestimable in its consequences

I suggest further study to consider land based disposal sites. Also, that hearings be
J.15 held in coastal communities most directly affected.

Yours sincerely,
Ellen McCord
PO Box 534, Albion, Ca. 95410

#275

March 12th - 1983

Dear Captain Wagner,

As a commercial fisherman I am totally opposed to ANY Ocean Nuclear dumping. Why don't you dump those subs in the pentagon and encase the whole thing in Lead? L.53

Very Sincerely
Mark Bolin
F/V Rainbow
Albion California
95410

M. Bolin
Box 292
Albion ca
95410

542

#276

MENDOCINO

CAPTAIN WAGNER,

I implore you to reconsider the dumping of nuclear submarines. I am 16 years old and am scared of your power! YOU HAVE NO RIGHT TO DISTURB THE OCEAN! It is ours as much as yours! And we don't want subs in our ocean. WE WILL FIGHT YOU UNTIL WE CAN FIGHT NO LONGER. SURRENDER TO THE WILL OF THE PEOPLE OR BE PREPARED FOR A LONG BATTLE THAT YOU HAVE NO CHANCE OF WINNING. WE ARE MANY! THANK YOU GOD HELP YOU,

GRETCHEN SCHUBECK

#277

March 12 83
mendocino

Dear Mr. Wagner,

The dumping of nuclear subs would be the end of my life. NOBODY would ever buy a fish from Noyo or Albion and the fishing industry which is how I feed my family would die

Thank you

Alan Graham
27000 Albion Ridge
ALBION, CA 95410

L.53

#277a

March 21 1983
Mendocino Coast, Calif

Dear Capt Wagner,

I again beg you not to dump the radio-active submarines off our north coast of ~~[illegible]~~ Calif. I know it would devistate our fishing industry and destroy one of the richest fishing grounds in the world. L.53

Thank you

Alan Graham
27600 Albion Ridge
Albion, Calif
95410

#278

March 10. 1983.

Capt. Edward F Wagner, U.S Navy
Office of the Chief of Naval Operations
Dept of the Navy
Washington DC 20350

I am writing regarding the proposed disposal of nuclear submarines in the ocean off the Mendocino coast. First I would like to urge you to request a 90 Day extension of the comment period for the DEIS. I think it is of utmost importance that hearings be held on the coast - especially in Fort Bragg & Eureka which would be so closely affected by the proposed dumping. L.15

The entire issue has not been adequately thought out. The effects of radiation are Long term - some radioactive elements have a half life of 20,000 years or more! This means that in 20,000 years only half of the radioactivity has dissipated. We are talking about forever. You can't possibly believe that "hiding" these radioactive subs in the ocean will mean that they no longer exist. The potential for accidents seems unavoidable - It is hard to imagine a container not leaking within the next 20 to 40 thousand years! L.20

#278 (Cont)

L.53 The Pacific Ocean[2] is one of the richest fishing grounds in the world. This fishing industry would be devastated.

We can't afford to experiment with the health of ourselves, our children, our planet!!

Please save our ocean.

I urge you to come to Mendocino, visit our beaches and beautiful headlands - enjoy the beauty here - and reconsider.

Thank you

Helen Jacobs
Box 294
Albion Ca. 95410

#279

Joseph Schneiweiss
Box 181
Mendocino, CA. 95460

Captain E.F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Dept of the Navy
Washington, D.C. 20350

Sir,

I am astounded at the presumptuousness of the navy's plan to pollute the pacific ocean by scuttling defunct nuclear subs off the Mendocino Coast. The Navy, sir, does not own the ocean in which i fish, swim and dive, and the Navy has no right even to consider poisoning it. I suggest that these monuments to greed and stupidity be stacked on the lawn of the Capital Bldg., where our elected representatives can see what they've wasted our money on, and where the Navy can most easily monitor the effects of their radioactive emissions.

Sincerely

Joseph Schneiweiss

#280

Attn: Capt. Edward F. Wagner U.S. Navy March 12, 83

I want you to know that I am strongly opposed to the disposal of decommissioned, defueled Naval Submarine Reactor Plants.

I feel like the draft E.I.S. inadequatly addressed many serious questions.

I feel like there is no way to adequatly dispose of such a toxic waste. The ocean is a vast ecological community and it would be impossible to contain the

W.1 | radioactivity. There is no way to retrieve or turn back the clock once this monumental step is taken.

If the Navy or the powers to be ever moved in a way where people and the life force was regarded as important, perhaps things would be diffrent. As it is this means of disposal blantanly disregards any concern for life as we know it.

I will do everything in my power to insure that such a horrible crime is never committed.

Enclosed is a list of issues not adequatly addressed in the EIS.

I urge you to extend the DEIS comment period to

J.15 | 90 Days so that local hearings can happen in areas such as Fort Bragg & Eureka

Sincerly
Donna Feiner

Donna Feiner
PO Box 415
Albion Ca 95410

Here are some of the issues not adequately addressed in the Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, in regards to the ocean disposal method.

Environmental:
-- The long term, extremely hazardous effects of radiation. L.39
-- How radiation enters the food chain (pathways). L.36
-- The increase in toxicity as radioactivity makes its way up the food chain L.37
-- Transportation hazards, from shipyard to disposal site. F.15
-- How leakage will be prevented when one of the radioactive elements, Niobium-94 has a half-life of 20,000 years. L.20
-- Dosages - there is no such thing as a negligible dose or a safe dose of radiation.
-- The Navy's failure to ever dump anything to that depth and have the container remain intact. L.20
-- Irretrievability in case of accident. W.1
-- The North Pacific Ocean is one of the richest fishing grounds in the world. L.53

Economic:
-- Threat of radioactivity in fish would devastate the fishing industry. L.53
-- No economic impacts are given. L.53
-- Cost of monitoring the dumped submarines is grossly underestimated. O.27
-- Cost of escorting the submarines out to sea is not included. O.20
-- Refusal to monitor past dumpsites - such as the one at the Farallon Islands. L.6
-- Current albacore reports (1974-present) show this is an area of high albacore catches (the Navy used older reports for years which showed poor catches). J.12

Legislative:
-- Doesn't qualify under the Anderson Amendment to the Ocean Dumping Act (passed January 5, 1983) which calls for retrievability and a comprehensive monitoring program. F.2
-- Must be approved by state coastal zone management plan, and the California Coastal Commission has already expressed strong disapproval. F.11
-- Goes against the 1983 London Dumping Convention which calls for an international ban on ocean dumping of low-level radioactive wastes.

Other Objections:
-- Sets a poor precedent - opens the ocean to becoming a huge radioactive garbage dump. L.9, F.8
-- Not enough research is being put into finding a safe, permanent solution for radioactive waste disposal. L.1
-- Ocean dumping is a non-solution.
-- Draft Environmental Impact Statement shows a lack of adequate and conclusive data. J.20
-- Creating more weapons creates more wastes.
-- Manufacturers of nuclear waste should take responsibility for safe disposal.
-- We can't afford failures or mistakes.
-- Comprehensive monitoring of existing dumpsites should occur before any new dumping programs are considered. L.6
-- [illegible] dialogue with the Navy during this entire process. J.15

#281

McCISPES

Mendocino Co. Committee In Solidarity With The People Of El Salvador

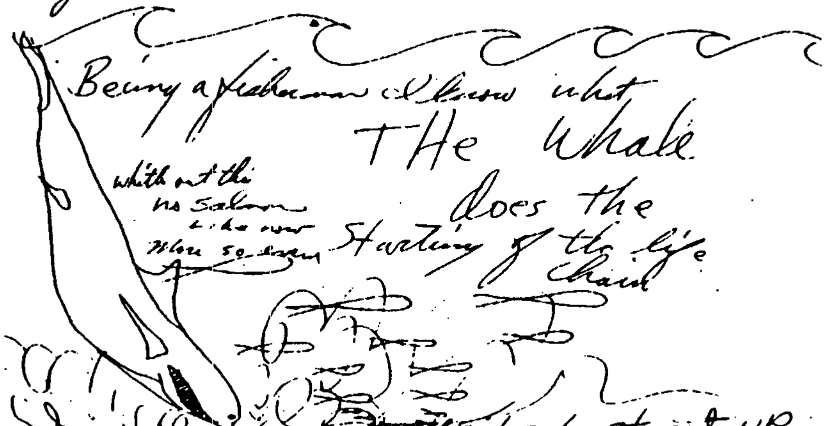
Ukiah Chapter: P.O. Box 766, Ukiah, Ca. 95482
Coast Chapter: 1056 Greenwood Road, Elk, Ca. 95432

I'm a fisherman I.L.W.U. 3

L.53 I would like to see them [dump] some some where else.

We need the Bottom for a

L.36 start in the food chain every year.



Bottom Needs to be stured up

Roy Harleman (Two Feathers Fishing Boat)
Box 995
Mendocino, Calif. # 95460

#282

March 12 1983

Dear Captain Wagner,

This letter is my statement about what I feel regarding the Navy's Environmental Statement on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants, in regards to the ocean disposal method.

I find the DEIS very inadequate and incomplete.

Among the numerous other areas that this report did not address, the one that holds much importance to me is the length of time that it will take to render some of these radioactive elements harmless is huge. Plutonium 94, as L.44 L.20

#282 (Cont)

but one example has a half life, not a full
harmless rendering, of 20,000 years. My information
says that the Navy has never dumped anything
L.20 in the ocean, and had it remain intact, and
that is only over a few hundred years span.

L.36 The leakage of these radioactive substances
into the ocean will enter the food chain, on its
lowest levels, and work its way up to reach the
fish and shellfish, that are our food. This will
L.53 result in the loss of a valuable food source and
the demise of an important coastal industry.

Another concern that I have is that
the opinion in the report (D.E.I.S.) state the area
has little to no life in it, which a number
of other sources refute.

To the best of my knowledge, the area
has organisms that commute from the low
depths, where the Navy proposes to dump the
submarines, to the higher depths, where they U.5
serve as food to other fish higher up the food
chain, many of these varietys being commercially
available in our markets.

With the above opinion taken into
account, add the fact that when anything
is dumped on the ocean floor, it promotes L.55
more sea life in the area as it adds objects
that the fish and other life, use as homes,
and protection from predators.

As very few people seem to know of these plans,
please extend the D.E.I.S. comment period 90 days, J.15
and hold them in Fort Bragg and Eureka, California.

Sincerely,

Warren Schmidt

Box 529
Albion, California
95410

#283

S. Enteen
Box 565
Albion Calif
95410

3/12/83

Captain,

Our oceans are not for toxic waste disposal, but to cover our earth with life and water.

Radiation will outlive us all. You will not continue fooling the american public that there is no danger in your plans. If you were at all honest with yourself, you would acknoledge that safety in nuclear technology (particularly waste disposal) is a contradiction in terms.

Please extend the DEIS comment period for 90 days, and allow for local hearings so that the public can express its feelings on the matter. J.15

I thank you for your consideration.

Sincerely,
Susan Enteen

#284

Captain Edward F. Wagner, U S Navy

Dear sir.

We feel that the Navy's draft environmental statement fails to address some very vital questions -:

When radiations get into the food chain, there is no way to stop or neutralize it. L.36 W.1

I support the 1983 London Dumping convention calling for an international ban on ocean dumping of low level radioactive wastes.

No agency or organization on earth should be able to threaten the welfare of present and future generations far beyond any political considerations.

We also understand that you have one of the heaviest responsibilities a man could have.

At the very least, let there be a 90 day extension of the DEIS Comment period, with local hearings, especially in Fort Bragg and Eureka. J.15

Sincerely,
Eleanor K. Lock
Mendocino Ca

#285

J. Edmondson
Box 549
Albion, CA 95410

Capt. Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Capt. Wagner:

J.15 We have asked for local hearings and a 90 day extention There are so many questionable contradictions, lacks of important data, and misleading statements in the Draft EIS that it is almost impossible to list them.

I'm sure you have "on public record" all the information you need to decide against dumping these decommissioned subs in the ocean. Our reasons may not seem "good enough" to you.

L.53 I'm sure the loss of the fishing industry in this high tech world of military and industrial expansion is a loss you do not mourn. the fact that the greatest amount of environmental impact will occurr in the future means nothing to the NAVY, since they plan to blow up the world with the ~~[illegible]~~ operating subs before the decommissioned ones will give us so much trouble.

However I just want you to Know that the opposition of the public goes beyond writing these letters and coming to distant hard to get to hearings. Environmental activists and others are determined to carry our protest as far as it has to go to stop you in this.

I am a nonviolent activist, from me you can expect no physical harm. But you can expect uncompromising action, you can expect radical action, We will not let you build more subs, pollute the ocean, make the last war. We are peaceful, but we are formidable opponents. Dont underestimate the power of a woman

J. Edmondson

#286

Dear Captain Wagnor.

I Support the Anderson Amendment - there is no safe level of radiation - the

L.55 environmental effects are numerous - Radiation

L.36 will affect ocean reefs, organisms accumulate, radiation in food chain -

I am totally opposed to sub dumping for there is no such thing as a negligible dose or a safe dose of radiation.

Sincerely,

Susan Ronis

Box 39

Albion, Ca.

95410

#287

March 12, '83

Captain Edward F. Wagner, USN
Office Of Chief Naval Operations
Dept. Of The Navy
Washington D.C. 20350

Dear Capt. Wagner,

I do not agree with the Navy's Draft Environmental Impact Statement on the Disposal of Decomissioned, Defueled Naval Submarine Reactor Plants.

Specifically, I do not agree with assertions made in pp 4-17, D-9, and other parts. F.13

Simply, the Navy does not have proven means for disposing of atomic submarines. Please do not experiment off the California Coast.

Please extend the DEIS comment period and hold local hearings J.15

Sincerely,

Richard Archambault

Cape Mendocino

CA

EXHIBITS 288 THROUGH 724
ARE CONTAINED IN
BOOK 2 OF VOLUME 2

EXHIBIT INDEX AND
AUTHOR INDEX ARE
LOCATED AT THE
BACK OF BOOK 2

550.a

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PB-90-193863

FINAL ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

VOLUME 2 OF 3

COMMENT LETTERS AND RECORD OF PUBLIC HEARINGS

BOOK 2

EXHIBITS 288 THROUGH 724

MAY 1984

United States
Department of the Navy

550-B

#288

March 12, 1983

Captain Edward F Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Sirs,

It is my feeling so strongly about the issue
of Disposal of decommissioned, Defueled Naval Submarines
Reactor Plants that brings me to write to you and express
my opinion that this plan is extremely dangerous to
all life that is here in California. The effects
L.20 | of possible leakage would pose an enormously unsafe
L.14 | situation and will be dangerous to sea life, and
L.36 | leak into the food chain posing fatal, painful
consequences to all life on the planet. It's seems clear
that those people who are concerned with the safety
of the children and future generations here on the
coast of Northern California must protest, speak
out, and perform direct actions to convince
the Navy, and those who are planning to dump nuclear
waste into the ocean that it is wrong. The
"garbage dump" of nuclear weapons. There will be no
future with continued production and dumping of
nuclear weapons and radioactive waste.

I was saddened to hear of no local
public hearings with the Navy here on the Mendocino | J.15
coast. The hearings in Sacramento while extremely
relevant were not really available to the people in the
community that will be affected first, if the plan to
dump waste in the ocean took place; which
I pray it won't. I also would like to request
a 90 day extension of the DEIS comment
period, to give people time to express their opinion. | N.3
There is so much already existing nuclear waste
and a safe solution, with consideration to the
protection of life, must be developed. I urge
you to work towards an end to all
nuclear weapons & plants, so in the future
there won't be a question as to where to
dump the radioactive garbage at all!

Yours Truly,

Sue Kaye
P.O. Box 590
Albion, California
95410

552

#289

12 March 1983

Captain Edward F. Wagner, U.S.N
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

It is hard to believe that after all we have learned in the last ten years about the long-term effects of radiation on living organisms — the way radiation accumulates in the food-chain, the links found with various degenerative diseases — that the U.S. Navy is actually considering disposing of decommissioned nuclear submarines by dumping them in the Pacific and Atlantic Oceans. We have reached the stage in American history when the military no longer defends the people but represents the single greatest threat both to our democratic traditions and to our very survival. What utter folly to go ahead with such a massive nuclear weapons build-up (i.e. the development of Pershing & Cruise missiles, the Trident submarine, the MX) when (1) we have an arsenal already

L.36

- 2 -

capable to destroying human civilization on the planet; when (2) the nuclear arms race only increases our international insecurity; and when (3) we don't even have a safe way of disposing of nuclear waste products!

The question many Americans are now asking is why we should continue to support men in business and government who so clearly jeopardize our peace and freedom. As a resident of California's north coast, I will do everything in my power to prevent the Navy from using the Ocean off Point Mendocino as a radioactive dumping ground for your own obscene weapons!

Sincerely yours,

Jonathan M Loising
POB 1521
Mendocino, CA 95460

#290

MEMBER STATES
ALASKA
CALIFORNIA
IDAHO
OREGON
WASHINGTON

PACIFIC MARINE FISHERIES COMMISSION

528 S.W. MILL STREET
PORTLAND, OREGON 97201
PHONE (503) 229-5840

EXECUTIVE DIRECTOR
JOHN P. HARVILLE
TREASURER
G. L. [illegible]

March 16, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, DC 20357

Dear Captain Wagner:

The Pacific Marine Fisheries Commission wishes to comment on the Navy's draft environmental impact statement (DEIS) on disposal of nuclear-powered submarines. The Commission represents the States of Alaska, Washington, Oregon, Idaho, and California on marine fishery issues of common concern.

At its 1982 Annual Meeting in November, the Commission adopted a resolution (attached) on ocean dumping of radioactive wastes which, among other things, requests a ban on scuttling of nuclear submarines and all other dumping of radioactive wastes in the Pacific Ocean until and unless future valid scientific studies prove it safe, and requests the Navy to hold public
J.15 hearings in Fort Bragg, California and other major West Coast fishing ports on the DEIS.

As an agency concerned with developing and maintaining productive marine fisheries, we are understandably alarmed at any proposed action which might
L.53, O.34 threaten the quality of the marine environment which is essential to the health of the fishery resources and the commercial and recreational industries which those resources support. These fisheries provide food, jobs and economic and social well-being to the region and the nation as a whole. Proposals to scuttle decommissioned nuclear submarines in ocean waters are ill-conceived and may have long-term negative consequences that are not worth the risks.

L.36 Our major concern is over the danger of contamination of food fish and the resultant devastating impacts that contamination would have on the West Coast fishing industry. What are fish consumers likely to do knowing that there is just a threat of radioactive contamination, aside from the possibility that
O.34, L.53 there may be actual contamination? Decreases in consumer demand for fish products will have a crippling effect on our fishing industry which we are working so hard to develop and maintain. The most frightening aspects of the
W.1 proposal to scuttle at sea are that the action would be irreversible and could lead to further, more dangerous dumping at sea. Once the submarines are sunk
L.9 in such deep water, it is unlikely that they can be retrieved if contamination is greater than the Navy estimates. The Navy contends that the ocean
J.76 scuttling proposal is cheaper than the land disposal option, but has not considered the full costs of the former. The total costs include costs of
O.27 monitoring the ocean for contamination and the potential costs to the commercial and recreational fisheries and consumers.

We request that the Navy hold hearings in Fort Bragg, California and other major West Coast fishing ports so that the individuals most knowledgable and most affected by the ocean scuttling alternative can express their concerns. J.15

We appreciate this opportunity to provide comments and request that you reconsider the ocean dumping proposal in favor of an option less threatening to the environment, the fisheries and the people.

Sincerely,

John P. Harville
Executive Director

JPH:dmw

Attachment

cc: Honorable Barry Keene, PMFC Commissioner
E. Charles Fullerton, PMFC Commissioner
Stephanie Revesz-Thornton, PMFC Commissioner
Nat Bingham, PCFFA
Zeke Grader, PCFFA
Donald Hodel, Secretary, Department of Energy
John W. Hernandez, Acting Administrator, Environmental Protection Agency
Joseph C. Greenley, Executive Director, Pacific Fishery Management Council

#290 (Cont)

PACIFIC MARINE FISHERIES COMMISSION RESOLUTION NO. 23

OPPOSITION TO OCEAN DUMPING OF RADIOACTIVE WASTES

WHEREAS, the oceans of the world are vital to all life on the continents; and

WHEREAS, the Pacific Ocean waters off the shore of the United States are the basis of the West Coast's commercial and recreational fisheries, which are a source of food for the people of the United States, which provide jobs for the people of the West Coast, and which are important to the West Coast's recreation and tourism economies; and

WHEREAS, the marine environment is a fragile ecosystem that may be significantly altered or contaminated by shortsighted disposal of radioactive wastes; and

WHEREAS, ocean disposal of radioactive materials would be irrevocable and would be impossible to correct if it later proves to be an erroneous practice; and

WHEREAS, radioactive wastes have been dumped in the coastal waters off the coast of California and Washington, at least, and some samples of ocean sediment have been found to be contaminated with radioactive materials, including plutonium; and

WHEREAS, the consequences of radioactive wastes in the marine environment are poorly understood and may pose a threat to the human food chain; and

WHEREAS, the United States Environmental Protection Agency has prepared a draft of regulations to encourage a resumption of ocean dumping of radioactive wastes, which the United States discontinued in 1970; and

WHEREAS, the U.S. Department of Energy is preparing an environmental assessment on its plan to dispose of low-level radioactive soil by dumping it in the ocean, and EPA has testified that it anticipates receiving a permit application from DOE by December 1982; and

WHEREAS, the U.S. Navy is preparing an environmental impact statement on its plan to dispose of more than 100 decommissioned but dangerously radioactive Polaris nuclear submarines by scuttling them, possibly in an area supporting commercial and sport fisheries and their attendant ecosystems or elsewhere off the West Coast of the United States; and

WHEREAS, the United States Senate is considering H.R. 6113 to extend and amend the Marine Protection Research and Sanctuaries Act, commonly known as the Ocean Dumping Act; and

WHEREAS, Representative Glen Anderson of California has proposed an amendment to the Ocean Dumping Act, approved by the United States House of Representatives, that would require any federal agency proposing to dump radioactive waste into the ocean to provide EPA and Congress with site-specific information about the full health, environmental and economic consequences of the proposed dumping; and

WHEREAS, the Anderson amendment also would allow either house of Congress to veto any permit that EPA issues for ocean dumping of radioactive waste;

THEREFORE BE IT RESOLVED, that the Pacific Marine Fisheries Commission respectfully memorializes the President and Congress to ban the scuttling of nuclear submarines and all other dumping of radioactive wastes in Pacific Ocean waters under the control of the United States until and unless future valid and reliable scientific studies prove it safe; and

BE IT FURTHER RESOLVED, that the Pacific Marine Fisheries Commission supports the Anderson amendment to the Ocean Dumping Act as a reasonable interim measure pending further scientific research and a congressional investigation of the effects of all radioactive contamination of the ocean from all sources to determine the effects of the contamination and to prevent repetition of radioactive waste dumping done without public notice or in violation of laws; and

BE IT FURTHER RESOLVED, that the Pacific Marine Fisheries Commission supports an international treaty to ban the disposal of radioactive wastes anywhere in the Pacific Ocean until and unless future valid and reliable scientific studies prove it safe, and respectfully requests the President and Congress to work diplomatically to oppose any dumping of radioactive wastes anywhere in the Pacific until and unless the treaty takes effect; and

BE IT FURTHER RESOLVED, that the Pacific Marine Fisheries Commission respectfully requests that the Congress, the President, the Environmental Protection Agency, the National Marine Fisheries Service, and the National Oceanic and Atmospheric Administration provide for regular monitoring of marine life in the vicinity of the existing radioactive wastes dumpsites off the West Coast of the United States, including those near the Farallon Islands, and provide full information from the monitoring to the Pacific Coast states; and

BE IT FURTHER RESOLVED, that the Pacific Marine Fisheries Commission respectfully requests that EPA provide Pacific Coast state and local governments with advance notice prior to publication in the Federal Register of any changes in existing ocean-dumping regulations, and conduct public hearings on the West Coast and consult with Pacific Coast state and local governments before adopting any changes in the regulations; and

BE IT FURTHER RESOLVED, that the Pacific Marine Fisheries Commission respectfully requests the United States Navy to conduct public hearings in Fort Bragg and other major West Coast fishing ports on the draft environmental impact statement on disposal of nuclear submarines; and

BE IT LASTLY RESOLVED, that the Pacific Marine Fisheries Commission transmit copies of this resolution to the President and Vice President of the United States, to the Speaker of the House of Representatives, to each Senator and Representative from Alaska, California, Hawaii, Idaho, Oregon, and Washington in the Congress of the United States, to the Governor and presiding officers of the Legislature of each of those States, to the Governor of each of the United States Territories in the Pacific, to the Administrator of the Environmental Protection Agency, to the Director of the National Marine Fisheries Service, and to the Administrator of the National Oceanic and Atmospheric Administration.

Adopted unanimously by the five Compact States of Alaska, California, Idaho, Oregon, and Washington on November 16, 1982 at Monterey, California

#291

John + Susanne Thurston
Box 345
Navarro, Calif. 95463

March 16, 1983

18950 Appian Way
Navarro, Calif. 95463

Captain Edward F. Wagner, U.S. Navy
Office of The Chief of Naval Operations
Dept. of The Navy
Washington, D.C. 20350

Dear Sir;

We strongly oppose the Navy plan to ocean dump nuclear submarines off Northern California.

We realize the Navy believes there is little danger + has submitted the appropriate report, but the span of time + unknowns involved makes such report guesses at best.

0.12 It's just too much of a gamble, especially since the dumping could adversely affect many generations to come. Please reconsider!!

J.15 We also feel the Navy has attempted to avoid local input by scheduling hearings in Sacramento - a full day's trip for coastal residents. Would you please consider an 90 extension of the DEIS comment period + have some local hearings, especially in Ft Bragg & Eureka? J.15

Sincerely,
John W. Thurston
Suzanne G Thurston

556

#292

Leah Williams
501 Rockspring Rd
High Point, N.C.
27262

To whom it may concern,
My name is Leah Williams, I am 12 years old. I am also very against the way you people in Washington think that you can dump Nuclear waste in a part of the ocean. When I go to the beach I like to play in the ocean and not have to worry about getting Nuclear shocks. I dont like the way you think that you can take advantage of North Carolina. I hope in making your decision about this, you will take my letter into consideration. I also hope that you can believe that why all N. Carolinians love our state coast and we dont want it to be ruined.

L.53

Sincerely,
Leah Williams

#293

DANIEL C. SHIVELY
335 South Sixth Street
Indiana, Pa 1570[illegible]

March 20, 1983

Capt. E. F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

Concerning the DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, I strongly urge land disposal: The reason is that not enough is yet known about the eventual consequences of ocean disposal, and there is so much radioactivity in each submarine. Land disposal can be monitored much more successfully, and corrective measures taken at a later time if necessary. L.39

Sincerely,
Daniel C. Shively

#294

1170 Third St.
Los Osos, CA. 93402
March 17, 1983

Captain Edward Wagner
U. S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I am terribly concerned about the Navy's proposed disposal of used nuclear submarines off the California coast. Too often in the past we have made decisions which were greatly regretted later, and for which alternative action was available at the time. We must answer to our children, to all our descendants, for the mistakes we make, and I think we ought to make as few as possible. Who would have contaminated so much land with Dioxin had they known what the consequences would have been--yet there were those even at the time of the contamination who knew there were risks not being taken into account. Those in charge didn't listen.

We know there are risks associated with disposal of nuclear weapons and power plants. We do not at present have the technology to reduce those risks substantially
J.76 nor even to monitor the degree of harm being done to our environment by such abandonments. If there exists a way--
G.2 e.g., "mothballing" or land-basing these submarines--to both keep a watch on them and keep them safe until we have solutions to the problems of disposal--then we ought to choose that course of action. To do other is entirely irresponsible. Wrongdoing begins with knowledge that one is doing wrong; and, in this case, there is a lots of evidence that simple abandonment is not the cleanest solution.

L.14 The rug under which you would sweep these submarines is our physical environment. They will make more than a lump--they may poison life for uncounted time. We must learn to take the consequences of creating potential hazards by working very hard to make certain we are at all times doing all we can to make the world as safe and clean as possible.

J.76 Please act responsibly in this matter, and preserve these vessels in a manner which will allow for monitoring, and will keep us--our environment, the life in our seas, and the health of our descendants--as well as we can manage with our present knowledge. Let's use all the available knowledge, with sources current and valid, and act in a responsible manner so that we --all humans, making human decisions, will have few regrets, knowing we have done what we could to save our world.

Torre Houlgate-West
Torre Houlgate-West
Citizen

#295

1170 Third Street
Los Osos CA 93402

18 March 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief,
Naval Operations
Dept. of Navy
Washington DC 20350

Dear Captain Wagner:

I wish to strongly object to the Navy's plan to dump 100 used nuclear submarines 25 miles deep off Cape Mendocino, California.

There is no technology existing to monitor these containers. Moreover, if something should go wrong, there is no technology existing to re-cover the containers. In short, the risk is just too great to future generations of Americans to justify dumping the subs. J.76 W.1

I strongly propose that the Navy land base the submarines until we have the technology to deal with the problem in a safe manner. Land basing may be expensive and cumbersome, but I would rather put more of my tax dollars to this use than to put our children and our children's children at risk because of pollution of the world's oceans. G.2

Yours sincerely,

Laurence D. Houlgate

#296

Capt. Edward F. Wagner,
and Navy Officers concerned -

March 18

I understand that the Draft Environmental Impact Statement on the disposal of decommissioned submarine reactors was released in December. It has also come to my attention that the disposal of each of the 100 submarines under review will equal half of the total radioactivity known to have been dumped in American waters since after World War II.

The U.S. Navy has long protected our waters and those of our allies. The health of the people of this country has been your foremost concern. I am sure that your love for the sea must be another priority. In the name and best interest of the American people, all other peoples, and the life of the oceans, do not ~~forget the unanswered questions~~ or scuttle the submarines at sea. There are too many unanswered questions.

Sincerely yours,

Paul Holmbeck

P.l Holmbeck
3004 Imperial Oaks
Rockford, IL 61111

#297

Dear Captain Wagner

I am a long time resident of the Mendocino Coast and am entirely opposed to the dumping of ANY NUCLEAR WASTE or SUBS off of our coast or any ocean for that matter. It is already quite evident what the dangers are and I am most immediatly concerned with the leakage | L.20
of radioactivity into the sensitive food chain | L.36
I am a major consumer of locally caught sea food and I hope that my plea will be heard

Sincerely

David Schlesinger

Box 1286
Mendocino Ca 95460

#298

Captian John Wagner
Office of the Chief
of Naval Operations
Department of the Navy
Washington, D.C.
20350

March 14,1983

Dear Captian Wagner,

We are concerned with the Draft Environmental Statement the. Navy has released recomending the ocean burial of decommissioned nuclear submarines. We are opposed to ocean dumping of radioactive and toxic wastes.

L.20 The EPA has tested 300 waste cannisters previously dumped in
the ocean and found 25% of them to be damaged in some way. In light
W.1 of these findings the irretrievable nature of scuttling radioactive
submarines is frightening. The convergence of the San Andreas fault
with the Mendocino fault at the southern end of the Gorda plate off
J.9 Cape Mendocino, makes the saftey of ocean burial particularly ques-
tionable due to the frequency of seismic activity there.

We feel ocean dumping of radioactive or toxic wastes will ad-
L.14, versely affect the marine life of our oceans and ultimately poison
us. The fragile Northcoast of California is an area of special bio-
L.36 logical significance. The "Lost Coast" is one of the few remaining
coastlines of California left in its natural state. The rich tide
pools and diverse marine life need to be preserved for educational
L.53 purposes and the valuable fiheries resources protected.

We appreciate the opportunity to comment on the DEIS and urge
you to continue to be responsive to the citizens who will be most
affected by the Navy's plans. We support the need for a 90 day
J.15 extension of the DIES review period and public hearings held closer
to the affected coastal communities.

Sincerely,

Gilbert J. Gregori
Cecelia A. Gregori
Gilbert J. Gregori
Cecelia A. Gregori
1901 Dutyville Rd.
Garberville, Ca.
95440

560

#299

Gisela Grossmann
POB 1295
Mendocino, Calif 95460

Nov. 9, 1985

To Capt Wagner
U.S. Navy
Washington, D.C. 20350

Dear Capt Wagner,

I am writing to urge the Navy strongly not to dump old Naval Submarine Reactor Plants into the ocean, anywhere.

L.53 I think this dumping would have a very detrimental affect on the tourist industry here in Mendocino County. This area is full of State Parks + Forests and is used by the population of greater San Francisco as a recreation area with the ocean bluffs as the main attraction, and where would the tourists be if the ocean, thru some accident becomes polluted?

L.36 And how could the food chain of ocean life not become polluted eventually? Even your environmental impact report admits that some radiation exposure in the immediate vicinity would occur, even if things go as planned. Therefore, the dumping would

L.53 be a total disaster for the fishing industry here!

I do think there should be no chances taken with the disposal of radioactive material. We cannot afford it!! It is not a solution just to dump the reactors out of sight into the ocean!!

I also feel hearings on this matter should be held in Fort Bragg and Eureka. Those are the areas affected. Why are the hearings then held inland, in Sacramento? J.15

I also feel input ~~on this matter~~ – the time period for input on this matter should be extended.

Sincerely,

Gisela Grossmann

#300

Dear Sir: ~~2540 CALIFORNIA ST.~~ BERKELEY, CA. 94703

March 15, 83

Your Navy's proposal to scuttle up to 100 nuclear submarines is tech-nically, politically and economically unsound.

L.6 I worked for the Western Region, of the National Parks Service, two years ago and have seen the lack of Marine life and damage to the eco-System due to the radio active seepage out of concrete slabs by the Faralone Islands, due west of San Francisco.

Having these subs out of site Doesn't put them out of mind - You are ignoring the build up of ocean radioactive contamination - please shelf that idea permanently - thank you - Laura Compton

#301

Rt. 4, Box 99A42
Pittsboro, N.C. 27312
March 9, 1983

Captain Edward F. Wagner, USN
Office of the Chief of Naval Operations (OPNAV 22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I have recently reviewed the Draft Environmental Impact Statement for the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants and as a concerned resident of the state of North Carolina would like to offer my comments on it.

Both major alternatives for the disposal of the decommissioned submarines, land burial and ocean dumping, appear to have insignificant health effects due to contamination of the environment associated with them. In addition, technology presently exists for carrying out either option. One must then look for other criteria in order to choose between the two. If cost is taken into account, it is predicted that land burial will be cheaper by about $2 million per submarine. However, the savings incurred must be weighed against what is lost. It has been over a decade since the U.S. has dumped radioactive wastes in the sea. We must not resume this ill-fated policy. The dumping of the subs over a 20 to 30 year period would probably inevitably lead to disposal of other radioactive materials in the oceans. The oceans must not be used as dumping grounds for radioactive wastes. Radionuclides can far outlive any containers we design for them under even the best of circumstances, and the ocean floor is hardly the best of circumstances. Radioactive contamination of our oceanic natural resources could become a major and irreversible problem. F.8, L.9 L.20 W.1

In addition, the area required to dispose of these subs would be 100 square miles of the ocean floor. This would put a huge area of the ocean off limits to any type of use for the long range future. The area required to bury the subs on land would only be about 10 acres. E.15

I urge you not to renew the policy of sea disposal of any type of nuclear wastes. Not only must we prevent our own coasts from being contaminated, the United States should be setting an example to the world of responsible handling of radioactive materials. F.8

Sincerely,

Keith Houck

Keith Houck

#302

Box 154
Elk, CA 95432
March 17, 1983

Dear Edward F. Wagner,

I am opposed to the dumping of nuclear submarines off the coast of Mendocino. I would like to see an extension til June 30 for the Environmental Impact report for public response.

An issue of this importance must be aired locally. We would like to have further hearings on the coast.
J.15 Eureka and Fort Bragg seem like important coastal centers.

Yours truly,
Jan [illegible]

#303

Bx 63 Albion
Ca 95410
3-12-83

Dear Sir

I feel very strongly, that ocean dumping is not a solution. Manufactures of nuclear waste should take responsibility for safe disposal. We cannot afford failures or mistakes. The fact that there hasn't been a a dialogue with the Navy during this entire process is absolutely antithetical to the democratic process. As part of the United States, I hope you will be sensitive to opinion of the people you will affect. Thankyou

Linda Weisman

#304

March 17, 1983
Elizabeth Lagergren
7610 Summitview #4
Yakima, Wa 98908

Capt. Edward F Wagner:
US Navy Office of Chief of Naval Operations
Dept. of Navy
Washington, D.C. 20350.

Dear Sir.

Having read the EIS of your proposal, my conclusion is that you feel completely satisfied that either disposal system is safe. I don't believe you can project the safety of the disposal of 100 nuclear submarines any better than I can.

L.39 We have not lived long enough with nuclear wastes to make any sound decisions as to what will happen to the sites in the future.

I.6 I live within fifty miles of the Hanford site. The base of that site is Columbia Basalt which, as you should know, is filled with cracks. The Columbia River is only 2 miles away and any drainage seeps through.

I am not any more pleased with the ocean burial.

The U.S. need not worry about the Russian nuclear bombs; we will be destroyed by our own nuclear and chemical wastes long before.

Sincerely
Elizabeth Lagergren

#305

To the Navy -

17 March 1983

I was unable to make it to the Olympia hearings concerning the disposal of old nuclear submarines, but I wanted to make my opinion known. I do not agree with your ocean disposal plan. Low level radiation would harmfully affect the ocean environment and thus the food chain, and high level radiation is fatal for many living things. Your action would affect generations for thousands of years... DON'T DO IT! You must devise a safe plan for the disposal of your waste. | L.36

Sincerely,
Sara Williams

564

#306

Warburton
30000 Timberline Ct
Willits, Ca 95490
3-12-83

L.36

Dear Sir:
Please save our ocean.
Please keep our food chain
from becoming radio-active.
Please don't dump those Atomic
Drums in our ocean off the
Mendocino Coast. Please help
us all! Don't DUMP!
Bury them!
Thanks!
The Warburton Family

Starke Edward
Dept of
Navy
301

#307

March 17, 1983

Captain Edward Wagner, U.S.N.
Office of the Chief of Naval Operation (OPNAV-22)
Department of Navy
Washington, D.C. 20350

Dear Sir:

Please support the 2 yr. moratorium on dumping radioactive materials in the ocean. It is critical to the health of our environment that we do not dump these hazardous materials in a way that will harm the living animals and plants in the ocean and then will work + concentrate these radioactive materials up the food chain eventually into our bodies on earth. | L.14 | L.36

Sincerely,
Linda Dietiker-Yolo

LDY
420 Foster Rd.
Napa, Ca. 94558

#308

Mendocino CA 95460
March 12 - 1983

Dear Capt. Wagner.

I am writing to you in regard to the ocean disposal method of Decommissioned, Defueled Naval Submarine Reactor Plants:

L.15 First of all, please conduct local hearings, especially in Fort Bragg and Eureka, so that the people most directly affected by this action (of dumping subs)

This is supposedly a democratic country, yet it appears we have no voice in these proceedings - there has been no dialogue with the Navy during this entire process -

There are many issues that are not adequately adressed in the Navy's Draft Environmental Statement, such as the following:

Environmental:

L.39 The long term, extremely hazardous effects of radiation.

L.36 radiation entering the food chain,

F.15 transportation hazards.

L.20, W.1 leakage - safe containers - irretrievability in case of accident -

Economic:

O.34 Threat of radioactivity in fish would devastate the fishing industry

No economic impacts are given -

L.61 refusing to monitor past dumpsites such as The Farallon Islands

Also, it goes against the 1983 London Dumping Convention which calls for an international ban on ocean dumping -

It could open up the ocean to becoming a huge radioactive garbage dump. L.9, F.8

Ocean dumping is a non solution -

I hope you will pay attention to this letter, which expresses my concern and that of my friends in the Mother Bear Brigade - a non violent anti-nuclear group, here in Mendocino.

Sincerely

Rainbow Trout Cornelia
for The Mother Bear Brigade
P.O Box 333
Mendocino CA 95460

#308a

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, DC 20350

IN REPLY REFER TO

March 7, 1983

Dear Ms. Emilie Terris:

Your comments on the Navy's Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants have been received and will be included as part of the public record in preparation of the Final Environmental Impact Statement. Your interest in this subject is appreciated.

Sincerely,

Edward F. Wagner
Captain, U. S. Navy

Dear Capt. Wagner -
I am very distressed at the impersonal response as shown in this letter, to a very moving emotional letter my 10 year old daughter Emilie wrote to you' as if her concern for her future, her fear of not ever being able to bear children because of overal nuclear polution which might cause her to have children with birth defects if the nuclear waste becomes part (over)

L.36

of the global foodchain -
Understand that, no matter where the obsolete nuclear submarines get disposed of, they will cause environmental polution. So it is imperative that you put your energy into finding ways of solving that problem, rather than financing the building of bigger and "better" nuclear subs -

Please consider my concerns - they are not just for me and my children, but for you and yours, and for all the peoples on the planet.

We must find ways to save the planet from total destruction

Thank you for your time.

Rainbow Cornelia

Rainbow Cornelia
P.O. Box 933
Mendocino, CA
95460

#309

PO Box 1104
Mendocino, Ca 95460
March 12, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I am a Mendocino resident and as you know, Mendocino is located right on the Pacific Ocean. I am concerned about your plan to dump nuclear submarines in the Ocean off our Coast.

As was mentioned in your environmental impact statement, "it is not possible to be totally certain that no exposure would occur since corrosion would eventually release some radio-activity which might be transported to areas of human activity".

When lives & life is in question, we must be ~~sure~~ sure it is SAFE where we dump subs & the ocean coast is NOT safe. N.3
Please reconsider

Sincerely yours,
Joan Burleigh

#310

March 12, 1983

Dear Captain Edward F Wagner,

I'm writing to you to ask a request of a 90 day extension of the DEIS comment period and a request for local hearings, especially in Fort Bragg and Eureka. J.15

I am against any nuclear waste being dumped into our ocean. I want you to stop creating weapons.

Your plans are against the 1983 London Dumping Convention which calls for an international ban on ocean dumping of low-level radioactive waste.

I'm in support of everyone who is trying to stop the madness.

Sincerely,
Sandra Solberg

Sandra Solberg
PO 455 Albion, Ca
95410

#311

CHRISTINE. HARMONY
P O Box 554
MENDOCINO CA 95460

March 12, 1983

Captain Edwart F Wagner,
U.S. Navy
Office of the Chief of Naval Operations (OPNAV U-22)
Department of the Navy
WASHINGTON, D.C. 20350

Dear Captain Edwart F Wagner,

I would like to present my opposition to the Navy's Draft environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants in regards to the ocean disposal method.
The North Pacific Ocean is one of the richest fishing ground
L.53 in the World; let's keep this environment clean and in
harmony. More research is needed to find a safe,
L.1 permanent solution for radioactive waste disposal
let's stop creating more weapons and so stop creating more wastes.

I Request a 90 day extension of the DEIS
J.15 comment period and a request for local hearings,
especially in Fort Bragg and Eureka

In love, light and Harmony

Christine Harmony

#312

207 Beechwood Ln
San Antonio, TX 78216

CAPT. E. F. WAGNER, U.S.N
OFFICE, CHIEF OF NAVAL OPERATIONS,
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20350

DEAR SIR:
THIS IS TO URGE THAT THE DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS, NOT BE DUMPED IN THE OCEAN, BECAUSE OF THE SERIOUS EFFECT ON THE ENVIRONMENT

VERY TRULY YOURS

DAVID JACOBSON

David Jacobson

#313

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Dear Sir;

I am extremely upset that the navy is considering ocean disposal of nuclear submarines. I am prepared to take whatever legal, political, or economic steps necessary to stop such blatant disregard for ecological balance. The navy has no demonstrated ability to insure against

L.20, W.1 possible leakage or to guarantee retrievability — let alone any ability to correct a damaged ecosystem.

I think that the matter of our national self-defense

L.36 is not sufficient to endanger the entire food chain.

I want you to enact a 90 day extension of the O.E.I.S. comment period & to hold local

J.15 hearings — especially in the Fort Bragg & Eureka communities.

Sincerely in the hope of world peace,

Jane Plankinton

#314

Shayne - Kashuk
attorneys at law
[illegible] Road
[illegible], California [illegible]
[illegible]

Frank Kashuk
Lynda Shayne

[illegible]

Captain Edward F. Wagner
U. S. Navy
Office of the Chief Naval Operation
Department of the Navy
Washington D. C. 20350

Re: Proposed dumping of nuclear submarines

Sir:

We at Shayne-Kashuk hereby register our adamant opposition to the Navy's Proposed plan to abandon twenty obsolete nuclear submarines in the waters of Humbolt County's Mendocino Bay, or any Pacific Coast waters for that matter.

We feel that such a measure poses a hazard not only to the inhabitants of the ocean environment but to all the residents of the area as well.

Your efforts to help defeat this dangerous proposal are sincerely appreciated.

Thank You,

Lynda Shayne
Lynda Shayne

F. Kashuk
Frank Kashuk

570

#315

Captain Edward F Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV 22)
Department of the Navy
Washington, DC 20350

Robert E. Ragland
998 Greenwood Rd.
Elk, Calif.
95432

Dear Sir, and fellow humanbeing of this planet,

In the name of God and Nature, for the safety of our children as well as all our people, and for the future of life forms on this planet: I urge you to reconsider your stand in regard to nuclear waste dumping and enlist your allegiance to nature, to life, to safety and the pursuit of a healthy environment. Come on, Ed, get with the times... get with the people... please. Listen to the voices that cry out in outrage and disbelief that such a proposal could be a possibility. Let your heart and soul be moved. We must work together.

It is my belief that you must feel there is no threat to the environment; that all will be well. Listen to your heart, trust your inner feelings, understand the obvious destruction of the health of our peoples of the Earth. Forget the stance of the Navy on this one issue.

L.39| Consider the long term, hazardous effects of radiation.
L.36| Radiation enters fish, through their flesh, muscle and bones. It therefore enters the food chain. I, for one, will not feed seafood any longer to my children and family. I am aware of the finds of Dr. Schell and other Marine Biologists in regard to the contamination of fish already. Many other people feel the same. You can well imagine what will be happening
L.53| to the fishing industry in the future, to one of the richest areas of fish.
F.15, L.20, W.1| other hazards include transportation, leakage, irretrievability

On the economic level, besides devastating the fishing
L.53| industry in the North Pacific Ocean, one of the richest fishing grounds in the world, the costs involved in dumping have not even begun to be realized. There is the cost of

escorting the submarines out to sea, over the protesting |O.20
bodies of non violent resistors. Then there are court costs for those arrested in blockading the folly of attempted dumping. There is the cost of monitoring dumped submarines, should any regrettably be sunk in OUR oceans. Having
been born in San Francisco, I feel highly offended by |L.6
the lack of monitoring at the Farallon Islands; offended that any dumping occurred there in the first place.

It grieves my soul as it hurts my heart that nuclear dumping should occur anywhere in our planet. I will protest to my last breath of life, my last drop of blood... and I will help organize others to follow.

|F.2
Dumping doesn't qualify under the Anderson Amendment
to the Ocean Dumping Act; remember retrievability and monitoring? |W.1, I.76
Hopefully the state coastal zone management plan and |F.11
the California Coastal Commission will never approve of the proposal you seem to have been defending. Cease your defense and attack this poisonous proposal. It also goes against the 1983 London Dumping Convention calling for an international ban of such dumping.

It sets a poor precedent... other misleaded countries |L.9, F.8
may follow our example, making the ocean a huge radioactive garbage dump. Why can't we lead the world in humanity, sanity, love, peace and safety? Why must we lead in technological warfare, weapons and pollution? It grieves my heart. Our budget is cut, so as to send military aid to oppressive, dictatorship, totalitarian juntas in Latin America and elsewhere. Therefore monies are not available for research, monitoring and alternatives.

#315 (Cont)

-3-

Creating more weapons creates more wastes. No Wasteland please!

Not enough research is being put into finding a safe, permanent solution for radioactive waste disposal and alternative energy sources rather than nuclear. Ocean dumping is a non-solution. Nuclear submarines and waste reactors should at least be stored, tested, analyzed, studied.

J.20 The Draft Environmental Impact Statement shows a gross lack of adequate and conclusive data.

L.6 Comprehensive monitoring of existing dumpsites should occur before any new dumping programs are considered.

I thank you for your time in reading this protest letter. We have to listen to your proposals, and be threatened by the bleak possibility of their implementation. I have three beautiful children to protect. I will not allow this dumping to occur without fighting it with all I have... love, peace, kindness, understanding, humanity, faith and all that is good. ~~Yo~~

You cannot succeed. The people will win! Long live dedicated, international humanitarians.

Change your heart and thinking,

Robert E. Rafond

#316.

RUTH VEST
P.O. BOX 62
WILLITS, CA. 95490

MARCH 18, 1983

CAPTAIN EDWARD F. WAGNER, U.S. NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
(OPNAV-22)
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20350

DEAR CAPTAIN WAGNER,

IN VIEW OF THE PROPOSED DUMPING OF USED NUCLEAR SUBMARINES OFF THE NORTHERN CALIFORNIA COASTLINE, I WISH TO COMMENT.

I AM AWARE OF THE GREAT IMPORTANCE OF HOW THESE RADIOACTIVE SUBMARINES SHOULD BE DISCARDED. THEIR RADIOACTIVITY WILL BE AROUND FOR CENTURIES TO COME. I AM SURE THAT YOU HAVE THE COAST RESIDENTS' SAFETY IN MIND, BUT I WISH FOR YOU TO IMAGINE FOR A MOMENT THE CONDITION OF OUR BEAUTIFUL COAST IN FUTURE YEARS; INEVITABLE POISONING OF ALL PLANT AND ANIMAL LIFE IN THE WATERS AS WELL AS ALONG THE BEACHES, ENTIRE COAST AREAS RESTRICTED FROM HUMAN HABITATION, CROSS-CONTAMINATION OF AIRBORNE LIFE (BIRDS, INSECTS) INLAND, INTO THE MORE POPULATED AREAS OF THE NORTH COAST COUNTIES. IT IS EVIDENT THAT MANY THOUSANDS OF PEOPLE WILL BECOME SICK IN YEARS TO COME AS A RESULT OF THE PROPOSED NAVY ACTION. L.14 L.36

YOU MIGHT WONDER WHAT I SUGGEST AS AN ALTERNATIVE TO THE PLAN. I SUGGEST THAT THERE IS FINALLY NO SAFE PLACE ON THIS EARTH IN WHICH TO DISPOSE OF NUCLEAR WASTE, NO PLACE WHICH IS NOT A PART OF OUR EARTH'S ECOSYSTEM. MY ANSWER IS EXTRAVAGANT, BUT NO MORE SO THAN THE USE OF NUCLEAR SUBMARINES: SEND ALL RADIOACTIVE WASTE INTO SPACE, INTO A FARAWAY AND ETERNAL ORBIT. THE SOONER THE BETTER! H.16

VERY SINCERELY,

Ruth A. Vest

RUTH A. VEST

#317

3/11/83

COMPTCHE CITIZENS FOR A SAFE ENVIRONMENT
GENERAL DELIVERY
COMPTCHE, CA 95427

CAPTAIN EDWARD F. WAGNER, U.S. NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
(OPNAV-22)
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20350

DEAR CAPTAIN WAGNER

WE "THE COMPTCHE CITIZENS FOR A SAFE ENVIRONMENT" WOULD LIKE TO EXPRESS OUR OPOSITION TO THE NAVY'S PLAN TO DUMP 100 RADIOACTIVE SUBMARINES OFF OUR BEAUTIFUL MENDOCINO COAST. YOUR "DEIS" HAS LEFT TO MANY UNANSWERED QUESTIONS. WE FEAR THAT RADIATION WILL EVENTUALLY ENTER THE FOOD CHAIN. WE FEAR FOR THE HEALTH OF THE OCEAN. WE FEAR FOR THE HEALTH OF OUR CHILDREN AND THEIR CHILDREN. WE SUPPORT A LAND DISPOSAL PROGRAM. *L.36

SINCERELY,
"COMPTCHE CITIZENS FOR A SAFE ENVIORNMENT"
[signature]
SECRETARY,

*Other issues discussed by Mr. Berkich are side barred in Exhibit 106.

#318

Albion, California
March 12, 1983

Gary Thompson
Box 301
Albion, CA.
95410

Dear Sir,

I live on the Mendocino Coast, California. I eat the fish in the Ocean. It is not right to contaminate this food source for me or future generations. L.36

You can put these old subs in Nevada at the bomb site where nuculer radiation is already present. H.4

Please don't kill the World!

Thank you
Gary Thompson

#319

Hawthorne, CA
12 March 1983

Captain Edward F. Wagner, US Navy
Office of the Chief of Naval Operations (OP-45-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Plans for the dumping of nuclear waste and the [illegible] of nuclear submarines off the Pacific Coast are the stuff that disillusionment with government is made of.

How annoying that I must sacrifice free time to petition against this. Fighting for the cause is not entertaining.

The DEIS comment period should be extended by 90 days. And the results should be carefully heeded.

Sincerely,
John White

John White
84 Andover Street
San Francisco, CA 94110

#320

March 12, 1983

Dear Sir:

I am writing this letter because I am a worried citizen. I don't believe it is a good idea to dump old nuclear submarines in the oceans. Down the line of time we will feel the effects of this poor program. The U.S. doesn't need any more waste programs that are dangerous. With all our knowledge a better plan can be found to dispose of decommissioned submarines. I would appreciate an answer to this letter. Thank You.

Sincerely,
Susan C [illegible]
40 Elmwood Dr.
Daly City, Ca. 94015

[illegible]

574

#321

March 19, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Dear Sir,

Please request the international ban at ocean dumping of low-level radioactive wastes.

I would like to request a 90 day extension of the DEIS comment period.
J.15 I would also like to request local hearings, especially in Fort Bragg and Eureka, CA.

Sande Mallin-Wright
PO Box 34
Albion CA
95410

#322

March 10, 1983

Capt Wagner,

I'm writing to protest plans for dumping off the west coast. The possibities are nauseating! It shows gross insensitivity to exclude locals from hearings and consequently I want an extended amount of time to allow public input especially in the affected areas.

Sincerely
Lee Hubbard
Lee Hubbard
1238 Church St.
SF Ca.

#323

12 March, 1983

Capt E F Wagner, USN
Office of CNO (OPNAV-22)
Dept of the Navy
Washington DC 20350

Dear Sir:

My family and I live in Mendocino, California
and would be directly affected by the proposed ocean
disposal of decommissioned naval submarine reactor
plants. I object to and oppose this plan abso-
lutely and I criticize the Navy's "Draft Environ-
mental Impact Statement" (DEIS). There is no
reason for any intelligent person in the world NOT
to question simply the idea of "Containment integrity."
L.20 Scientifically and practically speaking, we know it
is an impossibility.

At the present time I join thousands of
northern Californians whose lives and health are
threatened by this proposed plan of ocean dis-
posal. I demand, and rightly so, that there
I.15 be local hearings of this "D.E.I.S." at least in
Fort Bragg and Eureka. To make this possible
I urge you to fulfill your responsibility
in the office of the Chief of Naval Operations and
extend the so called "comment period" for at
least three months. We, who live so close
to the impending danger zone, feel very strongly
our responsibility to stop this ocean disposal
plan. We know it affects many, many more
lives than just our own & our own geographical
area. And we want you to be aware of our
feelings, our findings, our opinions, our
objections.

We hope to be able to communicate
face to face with you or your representatives
here in our own County very soon.

Sincerely,

Roberta Whiteside
10401 Kelly Street
P.O. Box 354
Mendocino, Ca 95460
707-937-5694
707-937-5896

576

#324

MARCH 12th P.O. BOX 547 JOHN PATCH
LITTLE RIVER CA 95456

Dear CAPTAIN EDWARD F. WAGNER, U.S. NAVY,

This letter is in regards to the proposed dumping of Defueled Naval Submarines. I think this is possibly the worst method of disposal, there can possible be. I believe the environment will suffer greatly by this irresponsible act. As a being, I'm a part of ~~this~~ environment as are you, and making our oceans a dumping ground for Nuclear Waste endangers everyone eventually, Also I just can't ~~believe~~ believe with all ~~the~~ ~~technical~~ knowledge available at your disposal, that a non-polluting method, could not be found. Now I think it wouldn't be fair just to criticize and not add a positive suggestion, But after giving it much thought on limited knowledge I find that Nuclear energy waste is extremely dangerous and "hard" ~~to~~ to get rid of, if not impossible, for what ever you finally decide to do, I think dumping off our California Coast is definitly wrong and I'm against it.

Sincerely
John Patch

#325

Box 252
Albion, CA 95410
March 11, 1983

Capt. Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

I don't think there should be nuclear subs dumped, because it wrecks the sea life and it would wreck our coast. I think you should pay attention to the good laws | L.14

Sincerely,

Aaron Ford

AARON F...

#326

Box 252
Albion CA 95410
March 12, 1983

Captain Edward J Wagner
U S Navy
Office of the Chief of Naval Operations
Department of the Navy (OPNAV-22)
Washington, D.C. 20350

Dear Capt Wagner:

Regarding the proposed dumping of decommissioned, defueled Naval Submarine Reactor Plants off the Northern California Coast, I would like to express my strong objections.

The long-term, extremely hazardous
L.36| effects of radiation on the food chain,
L.53| affecting the fishing industry and
the health of the populace has in
no way been adequately dealt with.

In addition, in light of the Anderson
Amendment to the Ocean Dumping Act,
W.1| calling for retrievability and comprehensive
J.76| monitoring, the proposed dumping
F.2| does not qualify.

In hopes of your serious attention,

I remain

Sincerely yours,

[signature]

#327

LEONARD COSKY
P. O. Box 219
Redway, California 95560

March 16, 1983

Capt. E. F. Wagner, USN
Office of Chief of Operations
OPNEV-22
Department of the Navy
Washington, D. C. 20350

Dear Sir:

In spite of the possibility of being labeled as a subversive for expressing my opinion, I do hereby voice my opposition to the dumping of any radioactive materials in our oceans, including old nuclear subs.

Having been associated with the nuclear industry, I am well aware of the danger that radiation poses to Living organisms. It is unconscionable to disregard the long term effects of radiation in our environment. |L.14

When radiation poisoning becomes an epidemic, it will be too late to do much about it. |L.36

Respectfully,

Leonard Cosky
Leonard Cosky
Concerned American

LC:tb

CC: Senator Barry Keene
Rep. Doug Bosco

#328

March 12, 1983
Box 1006 SUSAN HORCTTA
Mendocino Ca 95460

Dear Captain Wagner

I am writing to register my strong opposition to the Navy's sub-dumping plans off the California coast, or, indeed, anywhere at all in our oceans.

First of all such a plan is totally
F.2 illegal. We have just passed the Anderson Amendment which institutes a 2 yr. moratorium on dumping radioactivity in the ocean.
W.1 Also, any dumping must be retrievable.

Secondly, dumping radioactive wastes in the ocean is creating a health
L.36 hazard for all of us. Have any of your relatives died of cancer? Many of mine have, and it is now obvious to any person who cares to inform themselves that radiation causes cancer. We are part
L.37 of an INTERDEPENDENT FOOD CHAIN. Radioactivity increases as it moves up that chain. We ARE NOT ISOLATED, INDEPENDENT, INDIVIDUALS. We live in a world which grows smaller and more closely integrated each day.

No longer can we SAFELY pretend that our actions do not have an affect on others. We must all, including myself and including the U.S. Navy, change our past ways of dealing with our problems. There is no longer any way of sweeping these things under the rug. No more "out of sight, out of mind." If we do not face our problems squarely and deal with them SAFELY, it is our CHILDREN who will pay for it!

Do you have children? Grandchildren? I am convinced that you do not want to leave them a heritage of unsolvable problems to deal with. Certainly, as responsible parents, we must not leave them our own garbage to clean up and an inheritance of disease to deal with.

Logically, we must monitor present dumpsites, before creating more, so as to avoid the possibility of polluting our ocean. L.6

I am sure as a caring, logical person you will sincerely consider these questions and take the proper action for all of us, and our future generations.

Sincerely, Susan Horetta

#329

3.20-83.

Captain Edward F. Wagner
U.S. Navy, Office of the
Chief Naval Operations
(OPNAV-22),
Department of the Navy
Washington, D.C. 20350.

Sir:

Our nation now faces the greatest dilemma in modern times - how to deal with nuclear waste - The recent EPA investigations have now exposed the truth to the public - No safeguards are offered to the American people. To further dump nuclear submarines off the coast of California - only compounds more problems - The food chain especially:

L.36 G.2 Wouldn't it be wiser to tether these 100 used vessels - in a safe area - and monitor them - the or launder.

Add one more voice against dumping these kinds of waste - from a concerned citizen of California

Thank you
E. Rangeves

E. Rangeves
2180 Moonstone Beach Dr.
Cambria, Calif -
93428

#330

3622 Hastings Ave.
Winston Salem, NC 27107
March 16, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
OPNAV-22
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

As a concerned citizen of the state of North Carolina, I would like to register my objection to the use of our coastal waters as a dumping ground for decommissioned nuclear submarines.

Although ocean dumping may be a cost-effective, short term strategy; the long term effects on our precious environment have not been calculated. O.12 Ocean dumping by your department could cause a chain reaction of dumping by other operations. L.9 Please do not set this precedent.

Sincerely,

C A Collicutt

C A COLLICUTT

#331

321 E St.
Cayucos, Ca 93430
March 21, 1983

Dear Sir:

I wish to register our objections and strong opposition to the Navy's plan to dump 100 used nuclear submarines off Cape Mendocino. I will hope you consider our concern in your final decision-making process.

Sincerely,
Mr. and Mrs. Wayne Johnson

#332

Captain [illegible]
U S Navy
Washington, D C

Dear Sir:

Re: Sinking of Old Nuclear Subs.

Frankly I have been [illegible] fact and [illegible] concerning [illegible] of old Nuclear subs.

I am still concerned about [illegible] accurate data on radioactivity [illegible] over distances. Q.13

I am not convinced that the nuclear submarines have to be retired after a [illegible] number of years. G.3

I do not think the U.S. Navy has come up with a [illegible] year plan that is safe. N.3

The beached whale idea of land burial can only give rise to ideas for "Rube Goldberg" cartoons and no problems solved. Comment.

Hold off precipitous action; find a safe harbor! Stop justifications instead of doing your research. Don't dump off our coasts until you know. G.2

Yours,
Mrs. W R Phillips
[illegible] Winston Salem, NC

MRS W. R. PHILLIPS
[illegible] AVALON ROAD
WINSTON SALEM, NC
[illegible]

#333

George D. Noble
P.O. Box 932
Bolinas, Ca. 94924

Dear Captain Wagner,

I have just learned of the intention of Naval personnel to sink submarines which are contaminated by radioactive fuel materials off the California Coast. I ask that under NO circumstances this be permitted to happen. As an

L.1 engineer myself I know that we know too little about the results of this action to risk poisoning ourselves by contaminating the

L.36 food chain in the ocean. As I understand that there are already

F.2 treaties, which in effect prohibit such activity — Anderson amendment

W.1 on retrievability to ocean dumping act (1/5/83) and 1983 London Dumping Convention agreement calling for stringent monitoring of any dumps.

Please use your influence to grant a 90 day extension to the DEIS Comment period and arrange

J.15 for local hearings, especially in Ft Bragg & Eureka communities.

I believe we must find a way to recycle and render the materials of any technological endeavor harmless

L.20 or such projects must be disallowed. Isn't it true that Niobium has a 20,000 year half life? What container can we be certain will be safe for this time??

Thank you very much for your attention.

Sincerely, George Noble

#334

800 Newport Center Drive
Suite 500
Newport Beach, California 92660
March 22, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

Having grown up in North Carolina and now a resident of California, I am concerned about the potential sinking of decommissioned nuclear submarines off the coasts of these two States. I realize that the draft EIS released last December concluded that sea disposal would have negligible environmental impact, but I think that land disposal is a safer option at this time. More studies need to be done on the effects of radioactivity on sea life before the Navy takes the step of allowing radioactive waste to be buried in the ocean where retrieval is difficult. L.14 W.1

Sincerely,

Kay H. Upchurch

Kay H. Upchurch

582

#335

5512 Parkwood Dr.
Raleigh, N.C.
27612

Captain Edward F Wagner
Office of the Chief of Naval Operations
Washington, D.C.

Dear Captain Wagner:

I am depending on you to express to the proper people my concern for the burial of nuclear submarines off the North Carolina coasts. If we have men who are so smart to create these wonderful ships; then we must have a better solution for such disposal. All of the nuclear wastes presents such problems, and soon we will have no clean air, land or water. Are we not negating our so called progress?

I realize nuclear submarines are made for an event such as conflict, but how many wars have we really won!

Thank you for at least reading a letter from a conservation sixty year old.

Sincerely,
Rachel G Jeff

#336

NOYO WOMEN FOR FISHERIES
POST OFFICE BOX 137 • FORT BRAGG, CA 95437

March 6, 1983

Honorable John Lehman
Secretary of the Navy
Department of Defense
The Pentagon
Washington D.C. 20301

Dear Sir:

Our organization is very concerned over the
proposal to scuttle obsolete subs off the California
L.39 coast. No one knows the long term harm that could be
done if the ocean is contaminated from radioactive
wastes.

Please be advised our group strongly opposes ocean dumping of radioactive wastes.

Respectfully yours,

Marian Roden

Marian Roden
Corresponding Secretary

cc: Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington D. C. 20350

#337

March 12, 1983

Dear Captain Wagner:

Thank you for the Draft Environmental Report. I am reading it, however I have also received additional information, including the film made by the EPA in 1980 shown on 20/20 recently.

There is, as far as I can see, no reason to believe that dumping of radioactive materials can be accomplished safely under the plans you propose. I am aware
L.6 that the dumping off the Farallons was
not done irresponsibly, that attempts
were made to prevent breakage and
L.20 leakage. These were inadequate.
Once is enough for me. Fish and
L.14 all marine life are vital to
Mendocino County and the entire
country. We are all fish eaters and L.36
it is our food chain that is vital
to our nation's well being. Dumping
in the ocean is completely unacceptable
and I am committed to opposing it
until the idea is abandoned.

Sincerely,

Gailand Harris

P.O. Box 1051
Mendocino, Ca
95460

r issues discussed by Mr. Harris are side barred in Exhibit 153.

#338

March 17, 1983

Captain Edward Wagner U.S. Navy
Office of the Chief Naval Operations
Department of Navy
Washington, DC 20350

Captain Wagner:

I am against the dumping of old nuclear submarines off the coast of Cape Mendocino.

F.8 I feel the United States should not pollute our water with material mankind has not learned to control. We should set a better example for world responsibility.

Sincerely,

Darrell Bennett
515 Patricia Drive
San Luis Obispo, Calif 93401

#339

South Carolina Coastal Council

James M Waddell, Jr
Chairman

H. Wayne Beam, Ph D
Executive Director

March 22, 1983

Captain Edward F. Wagner
United States Navy
Office of Chief of Naval Operations
OPNAV-22
Washington, D. C. 20350

Dear Captain Wagner,

The South Carolina Coastal Council hereby submits its comments on the Draft
Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval
Submarine Reactor Plants. First, the Coastal Council recommends that the DEIS
be rewritten to improve its detail and accuracy. Recent and current studies on
ocean-dumping of nuclear materials should be included in the analysis, such as F.12
EPA's current study and the 1970 Council on Environmental Quality report.
Congress' two-year moratorium on the ocean-dumping of nuclear materials should
also be addressed. In general, the Coastal Council believes the ocean-disposal F.2
alternative should not be selected because of the irretrievability of the reactor W.1
plants, the biological uptake of radiation that would occur, the precedent such
disposal would set, and the relatively quick but sure disintegration of the L.36, F.8, L.9
reactor plants that will release the long-lived radioactive materials to the L.20
marine environment. The cumulative impacts of the disposal of approximately 100
such reactor plants cannot be accurately forecast nor, since they would not be L.39
retrievable, could <u>any</u> impacts be mitigated or removed. W.1

The Coastal Council suggests that the reactor plants be placed in an arid environment above ground where deterioration of the metal would be the slowest possible. Better monitoring can be achieved by use of this alternative, and the reactor plants could be moved should that become necessary because of unforeseen impacts. H.3

Thank you for the opportunity to comment.

Sincerely,

H. Wayne Beam
Executive Director

HWB:dms

cc: Senator James M. Waddell, Jr.
Mr. Duncan C. Newkirk

1116 Bankers Trust Tower • Columbia, South Carolina 29201 • (803) 758 8442

986

#339a

South Carolina Coastal Council

James M. Waddell, Jr
Chairman

H. Wayne Beam, Ph D
Executive Director

June 24, 1983

Captain Edward F. Wagner
U. S. Navy
Office of Chief of Naval Operations
OPNAV-22
Washington, D. C. 20350

Dear Captain Wagner:

The South Carolina Coastal Council maintains its position that the dis-
posal of decommissioned, defueled naval submarine reactor plants in the marine
environment is not an acceptable alternative. The biological up-take of
L.36 radioactive materials in the marine food chain and its potential effects on
humans, while not clear, are certain threats to the marine and human
L.14 environments. The highly corrosive nature of sea water would release the
radioactivity in a much shorter time than if an arid, above-ground site were
H.3 chosen. Further, the reactor plants and submarines would not be retrievable
W.11 once they were sunk. The risk of an accident and irretrievable disposal en
route in a valuable marine fishery habitat, recreation area or commercial
shipping lane also weigh against the ocean-dumping alternative. The precedent
L.9, F.8 of dumping such a massive amount of irretrievable radioactivity in the marine
environment would be dangerous to the growing reliance by humans on the
renewable resources of the sea.

The Coastal Council recommends that the marine disposal alternatives be
H.3 deleted from the Final Environmental Impact Statement and that an above-ground
site in an arid environment be chosen for the disposal site.

Thank you for the extension of time to review the complex technical, environmental, and social issues involved in the Draft EIS.

Sincerely,

H. Wayne Beam
Executive Director

HWB:vlp

Summerall Center, 19 Hagood Street, Suite 802 • Charleston, South Carolina 29403 • (803) 792-5808

#340

Office of the Governor

Atlanta, Georgia 30334

Joe Frank Harris
Governor

March 25, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Our technical staff has completed a review of the Draft Environmental Impact Statement (EIS) on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. We are pleased with the opportunity to provide input on this important issue. As you may recall, we worked closely with your office and, in particular, the Naval Facilities Engineering Command during the siting process for the Kings Bay Nuclear Submarine Support Base near St. Mary's, Georgia.

Whereas the Navy has done a highly commendable job in the preparation of the Draft EIS, we have identified a few areas in which you may want to give consideration to further strengthening the final EIS document. (See attached comments.) Again, we appreciate the consideration that the Navy has shown Georgia in the past and we look forward to working with you if further resolution of issues becomes necessary.

With kindest regards, I remain

Sincerely,

Joe Frank Harris

JFH:jsj
attachment

cc: J. Leonard Ledbetter, Director
Environmental Protection Division

REVIEW COMMENTS ON DRAFT EIS
"DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS"

by

STATE OF GEORGIA

1. Table 2.1 should be updated to reflect 10CFR61 as adopted (Federal Register, December 27, 1982, page 57446). Updating will not, however, change the classification of the waste. | X.1

2. In Section II, some type of permit for ocean disposal is implied: Additional clarification is necessary to indicate whether the Navy will actually obtain an EPA permit or just intends to comply with all possible permit conditions without obtaining such a permit. | F.6

3. On page 4 - 21, the EIS indicates that the use of concrete inside the reactor vessel was considered and scrapped. Was there consideration given to the use of filler inside the reactor compartment, but outside the reactor vessel? | L.52

4. In Section F.1, there needs to be some discussion regarding the type of analysis to be conducted to assure compliance with 10CFR71. It would be helpful to present a comparison of these analyses to those required of commercial NRC licensees. | E.31

5. On page C-3, there needs to be some explanation, regarding the calculation of dose due to ingestion of water, as to why the direct ingestion of contaminated groundwater before dilution was not considered. | P.5

6. On page C-16, Section VIII.C, it is stated that the total body dose conversion factor for ingestion of K-40 in drinking water is given in Appendix I, it is not obvious where this value appears, nor is the source identified. | P.15

7. Pages B.13 - B.31; the discussion about transportation by barge to the Savannah River Plant via the Savannah River needs to be expanded to include impacts on existing river users, resuspension of river sediments, and impact on aquatic life during low flow conditions. | E.21

588

#341

March 19, 1983

Captain Edward Wagner:

Do not scuttle submarines or make plans to scuttle submarines off the coast of California.

Radioactive material is life-threatening for an extremely long time and if re-encasement is ever neccesary, it would be
W.1 impossible to retrieve those materials from the ocean floor.

The proposed dumping area is also a rich fisheries
L.53 resource zone and it is absolutely contradictory to dump hazardous materials there.

The prevaling current would sweep materials down the coast towards San Francisco; all of the above area important fishing zones.

The U.S. Navy is charged with this nation's security. Dumping the subs here is counterproductive to that charge because such an action would endanger human
health through contamination of fish. L.36
It would also set a poor example for other countries that may F.8
dump even more haphazardly.

Sincerely, Janet Morrison
P.O. Box 122
Petrolia, Ca. 95558

#342

Captain Edward F. Wagner
Office of the Chief of Naval operation
Dept. of Navy
Washington, D.C. 20350

3-21-82

Dear Sir,

I appeal to you not to proceed with the plan to dump Nuclear submarines off our Mendocino Coast. It is clear to us all and to you all too, I'm sure, that the risks are not sufficiently well known, and the possibilities of reversing ourselves on this procedure too remote to justify embarking upon this plan. I appeal to your kinship and experience with the oceans and life of our planet to seek another way out of this disposal situation. Let us do the <u>best</u> we can — the dollar cost is more managable than the ecological problems that may face us, our children and our world of life with its heavy dependence upon the water and the water/weather cycle. You, Sir, can be a vital force in this most momentus issue — greater and more far-reaching than any Naval battle that has been waged in our lifetimes. It will be a great pleasure for you to act in the name of life, of wisdom, and of posterity.

It is with high hopes and the very best wishes that I address you Sincerely,

Roscoe Morris
2140 S. State
Ukiah, Ca 95482

Roscoe Morris
Ukiah, California

#343

March 24th, 1983

C. Thompson
P.O. Box 1031
Santa Ynez, Calif.
93460

Dear Sir,

I am writting because of my concern over the Navy's plan to dump used Nuclear submarines off of Cape Mendocino. I say no!

It seems America's biggest problem right now is the disposal of radioactive materials wheather military or civilian. We have created the ultimate pollution and we had better learn how to deal with it right now!

Can't you see that by dumping those subs in some unused spot in the ocean isn't the answer? If you were to figure out a way to recycle and decontaminate them you would be doing the whole world a service. I believe it is your responsibility since you (The Navy) built them, you should dismantle them!

Also by dumping nuclear waste we as the leading technological and military country, will encourage other countries to just dump their wastes without regard for the rest of the world.

I am adamant that America start being responsible for what we create and how we use it and where we use it. Please don't dump this horrible waste in our Mother ocean.

Yours in <u>non nuclear</u> Peace,
Chris Thompson

F.8

#344

Arlene Reiss
Box 431
Albion CA 95410

Dear Captain Wagner-

I am writing in response to the Navy's DEIS on the Disposal of Decommissioned Defueled Naval Submarine.

There are an overwhelming environmental, economic and legislative factors that have not been adequately addressed in the DEIS.

W.1 The question of retrievability in case of accident or failure and
J.76 the issue of monitoring are of primary importance. It is very irresponsible to take the risk that is involved in dumping these submarines in the ocean.

The Navy's report leaves as many, if not more, questions than answers in regards to safety and long term effects.

I am fully in support of
F.2 the Anderson Amendment and see the Navy's plan as illegal under this law.

the dumping of these submarines would set a very poor precedent - it may lead to other radioactive dumping in the ocean. L.9, F.8

Also, the report doesn't address the economic impact that the threat of radioactivity would have on the fishing industry - or what the cost of escorting the subs to disposal would be. L.53, O.34 O.20

I am in favor of more research being done on finding a safe, permanent solution for radioactive waste disposal.

I am very opposed to the proposal of dumping these subs in the ocean.

Sincerely,

Arlene Reiss
Box 431
Albion CA
95410

#345

MARCH 25, 1983

CAPTAIN EDWARD F. WAGNER
OFFICE OF THE CHIEF OF NAVEL OPERATIONS (OPNAV-22)
DEPT. OF THE NAVY
WASHINGTON, DC 20350

DEAR SIR:

PLEASE RECONSIDER THE DISPOSAL OF THE NUCLEAR SUBMARINES, THE OCEAN IS NOT THE PLACE! SURELY WE CAN FIND A SAFE WAY TO DISPOSE OF THIS WASTE. THOUGHTS OF THE DISPOSAL SHOULD HAVE BEEN CONSIDERED LONG BEFORE IT WAS TO TAKE PLACE.

WHAT IS WRONG WITH THE NAVY ANYWAY? DO WE WANT TO BE A WORLD OF MUTANTS?

WE SHOULD CONSIDER OUR OCEANS AS A FOOD SOURCE, NOT A DUMP SITE!

THANK YOU FOR YOUR CONSIDERATION IN THIS MATTER.

Joan Stallings Walker

CONCERNED HUMAN BEING

#346

MARCH 25, 1983

CAPTAIN EDWARD F. WAGNER
OFFICE OF THE CHIEF OF NAVEL OPERATIONS (OPNAV-22)
DEPT. OF THE NAVY
WASHINGTON, DC 20350

DEAR SIR:

PLEASE RECONSIDER THE DISPOSAL OF THE NUCLEAR SUBMARINES, THE OCEAN IS NOT THE PLACE! SURELY WE CAN FIND A SAFE WAY TO DISPOSE OF THIS WASTE. THOUGHTS OF THE DISPOSAL SHOULD HAVE BEEN CONSIDERED LONG BEFORE IT WAS TO TAKE PLACE.

WHAT IS WRONG WITH THE NAVY ANYWAY? DO WE WANT TO BE A WORLD OF MUTANTS?

WE SHOULD CONSIDER OUR OCEANS AS A FOOD SOURCE, NOT A DUMP SITE!

THANK YOU FOR YOUR CONSIDERATION IN THIS MATTER.

H Walker

CONCERNED HUMAN BEING

592

#347

March 12, 1983

Ms Adriane Nicolaisen
Box 1027 Mendocino Ca
95460

Captain Edward J Wagner US Navy
Office of the Chief of Naval Operations
Dept of the Navy
Washington D C. 20350

Captain Wagner,

As a citizen of the U.S. and a resident of the Coast of California I thoroughly disapprove of the proposed dumping of nuclear submarines in the ocean waters off the Coast of California - or any other coast for that matter.

I feel that the Navy's Environmental Impact Investigation was incomplete on many counts. In particular, the long term and extremely hazardous effects of Radioactive wastes was not adequately treated. How can anyone possibly predict the effects of leakage on the fishing grounds and the entire possibility of entering the food chain? These are serious matters for the U.S. Navy to consider. Isn't it the purpose of a Navy to protect the interests of its constituents - not to threaten them? L.36

Please take more time to study the matter and hear the opinions of the people of this country and the coast. It would be unacceptable for this matter to pass without hearings on the North Coast - Fort Bragg California + possibly Eureka. J.15

Thank you for considering the opinions of we the people.

Ms. Adriane Nicolaisen

#348

COASTAL RESEARCH & DEVELOPMENT

[illegible]

Captain Edward Wagner
Office of the Chief of Naval Operations
OPNAV-22
Department of the Naval Services
Washington, D.C. 20350

To: Captain Edward Wagner

Re: Environmental Impact Statement (Draft)

You may not scuttle nuclear submarines off the West Coast!!

These are the following reasons;

J.76, W.1 1) They must be stored somewhere easily monitorable and economically retrievable should re-encasement become necessary.

2) These nuclear radiation elements must be safely isolated from the bio-sphere for a very long period of time and to "dispose" of them in the universal solvent: water, is inconsistent with this goal.

L.53 3) The long term viability of the West Coast fishery is of increasing importance and can not be compromized for short term convenience.

4) The United States Navy is charged with maintaining the security of this country, and dumping dangerous material in the coastal waters would vilolate that responsibility!

In confidence that these major reasons are sufficient response to your Draft Environmental Impact Statement,

I am respectfully yours,

Randall Stemler
P.O. Box 122
Petrolia, California 95558

#349

March 24, 1903

Captain Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20150

Dear Captain Wagner,

Here is a comment on the D.E.I.S. of the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants: If a ship's propulsion reactor lasts 25-30 years and must be safely disposed of for hundreds of years, why are you still making and using them?

Also, if you don't know about the effects of radioactive waste on the ocean and all the life in it, then you have no business dumping it into the ocean. Burying it in land for hundreds of years is scarcely a better idea; there is neither a safe way to do it nor sate places for it.

This brings me back to the first point. The only practical and safe way to dispose of these ships' radioactive propulsion reactors is not to make them.

Sincerely yours,

Catherine Parker
2629 Fremont Avenue South
Minneapolis, MN 55408

P.S. How will you explain to your children leaving them a bunch of useless but still deadly radioactive propulsion reactors?

594

#350

Capt. Edward E. Wagner
Office of the Chief of Naval Operation
(OPNAW-22)
Dept of the Navy
Washington, D.C. 20850

Dear Mr. Wagner.

We do not believe in Neuclear dumping of any kind in the ocean.

Sincerely,
Marcella Long
THOMAS LONG
20413 Edmunton Dr
St. Clair Shores, Mi
48080

#351

P.O. Box 1366
Mendocino, Ca 95460
Mar. 24, 1983

Captain Edward F Wagner
US. Navy
office of Chief of Naval Operations
(COPNAZ-22)
Dept of the Navy
Washington D.C. 20350

Dear Captain Wagner,

With regard to offshore dumping: the matter is of great concern to thousands of local people - and to the multitudes of the world.

Therefore an issue of this importance should be aired locally - namely Eureka, Ft. Bragg & other local places. | J.15

Sincerely,
Cecile Cutler

#352

The Office of the Chief of Naval Operations
Capt E. Wagner. March 19, 1993

The idea of disposing spent nuclear submarines in the Cape Medecino area is inappropriate manner of dealing with disposal of toxic waste. This region is experiencing a decline in fisheries to the point of extinction. These fish are extremely sensitive to poisons and are a good indicator of the health of the ocean. L.14

Introducing another source of stress (nuclear waste) into the ocean system would aid in the decline of the fisheries of this area. L.53

This is an economic as well as environmental issue. Toxic waste should be accessible to monitoring for a long period of time. Once the subs are put into the ocean it would be difficult and expensive to keep track of their whereabouts. I.76

The ocean is an intergal part of the water cycle. By introducing nuclear waste into the ocean, we are introducing nuclear radiation into all parts of the biosphere.

Economically it would be more expensive than land dumping when considering the hidden costs and effects on the fisheries declines and contamination of the water cycle. O.12

I strongly urge you to not dump the spent nuclear subs in ~~the~~ any of the oceans waters. Thankyou Robin Rabens

Robin Rabens
2162 Heather #4
Arcata, Ca
95521

#353

March 21, 1983

Captain Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

The "Calypso Log," March, 1983, tells us that we may submit comments about nuclear waste disposal. I believe that no method is adequately safe for disposal of nuclear waste here on earth. Improved space technology has allowed us to build a reusable space shuttle. This same technology should be used to build indestructible containers to transport nuclear waste into space. These containers should not be sent into the sun to burn up, but should be sent out into the depths of space. Many decades into the future, these containers could be captured by deep, manned space craft and used for additional fuel. Deep space colonies could use them as a fuel source, too. H.16

This is obviously a farfetched idea, but I believe it deserves some merit.

Sincerely,

Robert Werner
1004 N. Davis
Helena, MT. 59601

#354

March 21, 1983
Roanne Withers
P.O. Box 92
Elk, Ca 95432

Edward F. Wagner
Captain U.S. Navy
Office of Chief Naval Operations
(OPNAZ-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner,

I am a Mendocino Coast resident and I am <u>against</u> the proposed nuclear submarine dumping along the West Coast.

The ocean is not a garbage can to be used as a convenient solution for life threatening nuclear waste. This area's income is directly and indirectly dependent on the ocean. An 'accident' will destroy this area economically if not our very lives and the lives of generations to come. L.53

I would like to ask for an extension for Public Response to your Environmental Impact Report and that further hearings be aired in Eureka and Fort Bragg. J.15

Please, please take time to reconsider the alternatives to destroying my home, my life and the lives of the people on the West Coast of the United States.

Thank you for your time and consideration.

Roanne Withers

cc/: Alan Cranston
Doug Bosco
Pete Wilson
Barry Keene

#355

March 24, 1983

Dear captain

I am writing to respond to the navys EIR on the dumping of nuclear subs off the caly mendocino coast

My family and I are totally opposed to this. The radiation that will pollute the mother ocean will engulf all of us causing irreparable harm to all life as the radiation works its way through the chain of life. We urge the navy to reconsider to protect the ocean that is vital to life, to heal our planet without the nuclear poison unleased in our ocean waters. L.36

We ask that public hearings be held on the north coast so we may speak to you directly - here in Fort Bragg, Ca. It would be good to advance the public input date till June 30, 83 J.15

Thank you for listening

Howard [illegible]
Bx 255
Little River, Ca. 95455

Bx 255
Little River, Ca.
95456

598

#356

Fort Bragg Cal
March 24, 1983

Capt. Edward F. Wagner
US Navy Office of Chief Naval
Operations
OP N.A - 22 Dept of Navy
Washington, D.C

Dear Sirs.
I am opposed of dumping nuclear waste off Cape Mendocino.

Thank you
Bernice M. Juhola

[illegible]
[illegible]
535 Oak St
Ft Bragg CA 95437

#357

Fort Bragg. Calif.
March 24, 1983

Captain Edward F. Wagner
U.S. Navy Office of Chief
Naval Operations
Washington. D.C

Dear Sir:
I oppose to the [illegible] nuclear waste dumping off the northern California coast; more specifically off of Cape Mendocino.

Respectfully,
Arnold Juhola

Arnold Juhola
535 Oak St
Fort Bragg, Calif.
95437

#358

P.O. Box 228
Comptche, Ca 95427
21 March 1983

Captain Edward [illegible] Wagner US Navy
Office of the Chief of Naval Operations,
Department of the Navy
Washington, D.C. 20350

Hello Captain Wagner:

Late in February I had the opportunity to go to Sacramento to the public hearings regarding the sub-dumping issue. Hearing the testimony furthers my former opinion that no one seems to favor the oceanic dumping of radioactive material by the Navy, except possibly the Navy. The long term hazardous

W.1 | effects of the radiation are irreversible; and I consider it disastrous for the Navy to cause any disturbance which would result in

L.36 | contamination of the food chain.

L.20 | I would like to know how leakage can be prevented when one of the radioactive elements, Niobium-94 has a half-life of 20,000 years!! I am not convinced that anything dumped

W.1 | could be retrieved, nothing has before.

L.53 | I do not want to see the gamble taken to threaten the rich fishing grounds in the northern Pacific Ocean or any ocean.

F.2 | This proposal doesn't qualify under the Anderson Amendment to the Ocean dumping act (passed Jan. 5, 1983) which calls for

W.1, J.76 | retrievability and a comprehensive monitoring program. It also goes against the 1983 London Dumping Convention which calls for an international ban on ocean dumping of low-level radioactive wastes.

I request a 90 day extension of the DEIS comment period and

I also request local hearings especially in Fort Bragg and Eureka. | J.15

I believe the production of NO more radioactive defense weapons.

I do not feel that the continuing production of waste will ease the problem of what to do with the toxic materials. To stop, it must STOP.

The people of this planet are in great danger if this type of proposal is allowed to be considered or acted upon. I am ashamed and angry that the US Navy is not apparently more interested in protecting the citizen rather than potentially destroying us.

Sincerely,
[illegible]
mother of 3!

009

#359

March 25, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D. C. 20350

Dear Capt. Wagner,

I urgently plead that you NOT scuttle nuclear submarines in the oceans! No doubt it's the easiest and most convenient... but it's an INSANE option!
Please resign them to the depths of isolated salt mines until there is knowledge of recycling nuclear waste.
Our 40 years of luck cannot continue indefinitely. So easily we could proceed until it's too late. We invite doom to use the seas as our sewer. SO EASILY we could be mesmerized by scientific "knowledge" assuring us that "the oceans of the world are still within safe limits". Why wait for irreversible mutations and chemical imbalances to begin!

Common sense, LOVE of our planet, and wisdom...make me know that we must discontinue disposing of deadly materials... into our awesome, wondrous, nurturing seas.

Yours thoughtfully,
Margaret Parmelee Dexter
* for my family and future generations.

*Founding member of the Cousteau Society.

Mrs. George Stillman Dexter
14 Parker Drive, East Lyme, Connecticut 06333

#360

March 22, 1983

Captain Edward F Wagner
U S Navy
Office of The Chief Naval Operation
Department of Navy
Washington, D.C. 20350

Dear Captain Wagner:

It has come to my attention that the U.S Navy plans to sink old nuclear submarines off the California Coast. I understand that my letter objecting to this proposal will be put on record and certainly hope this is the case.

My family lives in coastal towns from Puget Sound to Laguna Beach. We live, work, fish and play by and in the Pacific Ocean. I have parents and a grandfather ages 74, 76 and 93 as well as a husband, two daughters, two sons-in-law and a granddaughter age 2. Five generations of us live by the sea.

I urge you to give this action further consideration. How could you monitor the subs at that depth? Can't they implode 2½ miles down? Please don't do this. It cannot help but pollute our beautiful ocean, the fish, birds and animals and ... us. Some radioactive isotopes remain usable for thousands of centuries. Let's make sure the future is safe for our children and their children.

Sincerely

Anna M Pinkey
528 Dorset St
Cambria, CA 93428

J.76
Q.13

#361

3/26/83
Mitch Mayer
Box 220
Willits, Ca. 95490

Dear Captain Wagner,

I wish to strenuously object to any dumping of nuclear subs off the coast of California.

Thank you.

Yours truly,

Mitch Mayer

#362

March 23, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Sir:

I am writing to comment on the Navy's DEIS, on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

It is my understanding that each submarine would represent half of the total radioactivity known to have, been dumped in our waters since the end of WWII. Since we have no way of knowing whether there is any safe level for our oceans to handle, it seems foolhardy in the extreme to take this step. Unacceptably high levels of radioactivity have been showing up in fish, and this is L.14
a dangerous sign. Furthermore, it is questionable how long human life would continue on this planet if we destroy our oceans, cradle of all life originally.

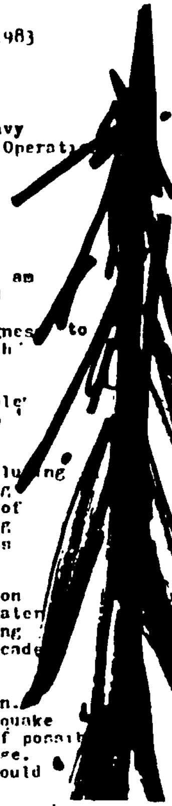
Sincerely,

Jean C Artman

Jean C. Artman (Mrs. V.E.)
4009 Flintlock Way
Anaheim, Ca. 92807

#363

SO-HUM



March 22, 1983

Captain Ed F. Wagner, U.S. Navy
Office of the Chief Of Naval Operati[ons]
(OPNAV-22)
Department of the Navy
Washington, D.C., 20350

Dear Captain Wagner:

I am writing as an individual, a citizen, a civilian. I am no stranger to non-violent demonstration, a good record in Hawaii at Kaneohe Marine Corp. Air Station and Third Fleet Pearl Island's Admiral Chang openness and willingness to negociate Native Hawaiian Religious Freedom rights with Tahuna Sam Lono, leaves me with a feeling of hope.

I believe at this time, that the safest, most monitorable disposal of nuclear contaminants is underground. To dump your 120 subs is outrageous to say the least.

I surf regularly at Shelter Cove and points north, including Cape Mendicino. I am a small business operator near Kingpeak Conservation Range. I eat fish yearly, caught out of the Cove or Eureka. In my opinion and concern, scuttling these 'HOT' subs in the immediate food chain corridor is asking for long term major problems. L.36

To further cite my conviction, I am for a total reduction of nuclear weapons, power plants and ships. Until a greater understanding of the health and environment of all living things, radiation, its affect upon the human race for decades to come, looms a grave threat.

Nine nuclear ocean dump sites already exist in Calif. In San Fran. 22 military and civilian reactors sit atop active earthquake faults. What California needs is to reduce the number of possib[le] life-threating situations which accompany the nuclear age. Until, we know how to dispose of the toxic waste, we should freeze all future production and reduce dependency on nuclear energy. No more bombs or reactors.

I know my comments to a military man might raise some hair,; you must understand while some Pentagon officals appear Hawkish as Hell to us civies, the nuclear instant death syndrone is real. Our communities' children worried to the extent to write the Kremlin and Washington, D.C..

HALL
PO B 107
Redway Ca. 95560

I really fear for the whole human race, not just America, an America I love just as you do and like in America, for different reasons, maybe and maybe not. Thank you.

Sincerely, John J. Hall
John J Hall

SOUTHERN HUMBOLDT FIREWOOD CO.
ETTERSBURG # ROUTE / GARBERVILLE, CA. 95440

#364

376 Singletary Lane
Framingham, MA 01701

March 25, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

I oppose the proposed dumping of decommissioned nuclear-powered submarines at sea because I fear the irreversible contamination of a resource so extensive and varied that as yet we do not even relize its vast benefits. E.15 We have too little certain knowledge to judge whether we can blithely continue to use the seas of the earth as trash cans without permanent deleterious effect; my growing concern is that we should not take any (more) chances with such long-range dangers as nuclear waste, even if we still take the easy out of pouring our other refuse into the ocean. L.39

It seems to me that as technologically advanced as we like to consider ourselves, we ought to be able to come up with a more civilized method of waste disposal. If we had the motivation to protect our future and that of our home, Earth, instead of grabbing always for immediate gain (in this case, the disappearance of old submarines), we surely could apply our far-ranging imaginations to such problems.

The ocean is not a medium we can abuse forever; it is a finite resource we must learn to use carefully. Its ability to renew itself is not infinite and cannot overcome the incessant polluting actions of men. We do not know just what we would be doing if we were to put all that radioactive waste (three or four submarines, or one to two times the radioactivity America has ocean-dumped in almost forty years - each year!) into the seas of our planet, but we can surely guess. L.39

Let us find a better, more viable solution; let our future be as safe as we can make it.

Sincerely,

Lynne Penney Janberg[?]
Member, The Cousteau Society

#365

March 24, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV -22)
Dept. of the Navy
Washington, D. C. 20350

Dear Capt. Wagner:

Before you procede with your proposal for ocean disposal of your nuclear submarine reactors answers to these questions are essenrial:

Q.13 1) How much material is to be dumped, and how much is already there?

2) How does the dumped material behave in the sea?

3) Can nuclear waste be "safely" be dumped into the ocean?

The disposal of <u>each</u> submarine will equal <u>half</u> of the total radioactivity known to have been dumped in American Waters since the end of World War II. Radioactive waste has been dumped in 12,000 ft. abysses, considered to be biological deserts and static regions.

L.36 Now we know that deep ocean waters circulate much faster that previously supposed. Nuclear wastes with long half-lives have a greater chance of coming into contact with the food chain in the upper layers..

Until we have some real answers to ocean behavior. I urge you to take a <u>responsible</u> position and delay dumping the 100 nuclear submarines in the ocean..

Sincerely yours,

S. Andres

S. Andres
1324 Arch St.
Berkeley, CA 94708

#366

ENVIRONMENTAL FORUM OF MARIN
P. O. BOX 74
LARKSPUR, CA 94935

A NON PROFIT CITIZEN GROUP DEVOTED TO EDUCATION IN MARIN COUNTY ON ENVIRONMENTAL MATTERS

March 21, 1983

Captain Edward Wagner
U.S. Navy
Office of Chief of Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

RE: <u>Disposal of Radioactive Wastes in Marine Environment</u>

Dear Captain Wagner:

The Environmental Forum of Marin supports the proposal of the Oceanic Society that ..."the federal policy prohibiting disposal of radioactive wastes in the marine environment continue until:

" 1. A single, coordinated, comprehensive nuclear waste management program is established by the federal government in one agency.

"2. An increased program of scientigic study, evaluation and continuing moritoring is launched to determine in definitive data based terms the impact of past radioactive waste disposal on the marine environment...... L.6

" 3. Criteria are established for marine disposal of nuclear waste that include as high priorities provisions for continuing monitoring of disposal at new sites as well as measures for monitoring past dumps and retrieval. J.76 W.1

" 4. Federal regulations mandate the best available technology for packaging, transport, and disposal of wastes.

" 5. Marine disposal of nuclear wastes is considered only as a last resort once all terrestrial disposal options have been explored, utilized and exhausted."

The Forum believes we cannot risk the serious radioactive contamination of ocean waters. Future generations will not be able to correct mistakes that we make now.

Sincerely yours,

Polly Smith

Polly Smith, President

604

#367

March 23, 1982

P.O. Box 324
Garberville Calif 95440

Dear Captain Wagner,

With grave concern in my heart I am writing this letter of opposition against the Dept of the Navy's plan of dumping nuclear submarines off the coast of northern California or for that matter any coast in the world. I feel it would set a terrible and dangerous precedent. Our world is in such a delicate balance that any such plan could develope into a disaster that could effect us all. L.9,F.8

I attended the hearings in Sacramento and listened to our local politicians and citizens voice their concern outrage and finally objection to such a plan. I read the DEIS and do not agree with its findings. I feel the only viable plan would be to contain the nuclear waste on the land so it can be monitored and we can learn something instead of dumping the waste out of sight but never, I repeat never, out of mind.

I also wish to urge you to grant Humboldt and Mendocino Counties request to have hearings in our own territory so this very personal and heated issue may be fully examined. Thank you, J.15

Elizabeth A. Stekinger
Concerned Humboldt Citizen

#368

CAPTAIN ED WAGNER, USN
OFFICE OF CHIEF OF NAVAL OPERATIONS
OPNAV-22
DEPT. OF THE NAVY, WASH. DC. 20350

CAPTAIN WAGNER

AS A RESIDENT OF THE MENDOCINO COAST, I STRONGLY OPPOSE THE SCUTTLING OF NUCLEAR SUBMARINES OFF OF CAPE MENDOCINO.

J.76 I CAN THINK OF NO MORE CAUSTIC AN ENVIRONMENT THAN BENEATH SALT WATER FOR EROSION OF THESE SUBMARINES. ALSO CHECKING AND MAINTENANCE OF THESE "GRAVEYARDS" WOULD BE FINANCIALLY PROHIBITIVE.

THE OCEAN, OR FOR THAT MATTER, THE ENTIRE PLANET SHOULD NOT OFFER AN EASY SOLUTION TO THIS PROBLEM OF NUCLEAR WASTES. AT LEAST WE SHOULD HAVE SOME SYSTEM THAT CAN BE CLOSELY MONITORED AND ADJUSTED, NOT BURIED AND FORGOTTEN.

SINCERLY,

GARY MORAN
PO BOX A
ELK, CA. 95432

copy sent to
SEN. ALAN CRANSTON.
SEN. PETE WILSON.
REP. DOUG BOSCO.

#369

Connecticut Audubon Society

Environmental Center
118 Oak Street Hartford, Connecticut 06106 Telephone (203) 527 8737

March 24, 1983

Capt. Edward F. Wagner
United States Navy
Office of the Chief of Naval Operations
Department of the Navy (OPNAV-22)
Washington, DC 20350

Dear Capt. Wagner:

I am writing on behalf of the Connecticut Audubon Society to request a 90-day extension (from March 31) on the comment period for the Navy's Draft Environmental Impact Statement concerning ocean dumping of nuclear wastes, and to request a public hearing on it in New England--preferably Boston. J.15

Due to the complex and technical nature of the DEIS, more time is needed if meaningful comments are to be made on it.

We realize that public hearings have been scheduled on the east and west coasts, but because of the extensive New England coastline and New Englanders' economic and recreational dependence on it and the ocean, we believe this important issue deserves a public hearing in our area.

Thank you for consideration of our requests.

Sincerely,

Karl J. Wagener

Karl J. Wagener, Director
Environmental Center

/ge

#370

March 24, 1983

Dear Captain Wagner -

I attended the Ocean Dumping Hearing in Sacramento on February 24th - but did not speak - so I wanted to write a letter to let my feelings be known.
I live in Mendocino County - though not right on the coast and feel very strongly that the ocean dumping of nuclear submarines would have devastating effects reaching far beyond the ocean waters where they would actually be dumped. I felt there were serious mistakes in the Navy's DEIS. Fish catches quoted
J.12 for the area were based on old data - new ways of fishing have increased catches in the area. I believe the fisherman who fish there who say there are a lot of fish and I believe them when they say there is upwelling in the area.

I feel it is morally & legally wrong for the Navy to dump submarines which they know
L.20 will break down and release radiation into the ocean - especially when they can't even
W.1 be retrieved! I don't think you can dump poison in the ocean & expect it to stay in
the place you dump it. Radiation can L.36
get into food chain in the ocean and radioactive water can be drawn up into clouds and deposited as radioactive rain anywhere in the world.

The Earth is a living organism and you can't affect one part of Her without affecting all of her.

I don't think the argument that ocean
dumping is more cost effective is true - and N.3
even if it were it is the poorest reason I can imagine to further degradate the environment and endanger the health of ourselves, our children and future generations.

I feel land dumping - though also dangerous could at least be monitored - and better contained.

Please don't dump nuclear submarines in our Ocean - or any ocean. They are all our oceans.

Thank you

Katherine Emerson
Box 866
Laytonville, Calif
95454

#371

CITY OF RICHLAND WASHINGTON

March 25, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of Navy
Washington D.C. 20350

RE: DRAFT EIS - DISPOSAL OF NAVAL SUBMARINE REACTOR PLANTS

Dear Captain Wagner.

The City of Richland, Washington has reviewed the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants issued by the United States Department of the Navy to determine what ecological impact, if any, land disposal at Hanford would make to the City of Richland. The Navy has considered all relevant physical, radiological and toxicological hazards during the water and land transport of the reactor compartment up the Columbia River to the Port of Benton barge slip, to its burial site at Hanford.

It is the opinion of the City of Richland that the alternative of land burial for the defueled reactor compartments is more favorable than that of ocean disposal. The ecological considerations are based upon knowledge and resources available at Hanford regarding the dis-
W.1 posal of radioactive materials and the fact that the reactor compartments would be easily retrievable if technological advances made in the future dictated changes in disposal methodology. Deep ocean burial would virtually negate retrieval at some later date and make routine radiation monitoring difficult and expensive. There is an
J.76 extensive environmental radiation monitoring program in operation at Hanford which would provide continual surveilance of the environmental impact from land disposal of the reactor compartments. The true cost differential between land and ocean burial becomes negligible when routine (perpetual) radiation monitoring costs are included.

The Department of Navy's Draft EIS does an excellent job in describing the alternative disposal options for the defueled, decommissioned nuclear submarines. The opinion of the City of Richland is that land burial is preferred to the other alternatives discussed by the Navy.

505 SWIFT BOULEVARD BOX 190 RICHLAND WASHINGTON 99352 509 943-[illegible]

The opinion is based upon.

1. Advanced technology and experience in land disposal of radioactive waste;
2. On-going environmental radiation monitoring programs at Hanford and Savannah River;
3. Potential for direct retrievability with land disposal;
4. Negligible long-range impact on natural radiation environment with disposal at Hanford; and,
5. Negligible radiation hazard to residents of Richland from transport or disposal.

We appreciate the opportunity to comment on the Department of Navy's Draft EIS.

Submitted for:

RICHLAND CITY COUNCIL
RICHLAND ECOLOGY COMMISSION

By. [signature]
HERB EVERETT
PLANNING SUPERVISOR

#372

JOHN SPELLMAN
Governor

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Mail Stop PV-11 • Olympia, Washington 98504 • (206) 459-6000

March 24, 1983

Captain Edward F. Wagner
United States Navy
Office of the Chief of
Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Thank you for the opportunity to comment on the draft environmental impact statement (EIS) for the "Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants." The Department of Ecology has no specific comments on this proposal. We did, however, coordinate the review of this EIS with the other state agencies, and their comments are attached for your information.

If you have any questions, please contact the appropriate agency or Greg Sorlie of this department at (206) 459-6237.

Sincerely,

Dennis L. Lundblad, Supervisor
Operation Management Division
Office of Field Operations

DLL:lpf

cc: State Agencies

Enclosures

JOHN SPELLMAN
Governor

STATE OF WASHINGTON
DEPARTMENT OF EMERGENCY SERVICES
4220 East Martin Way • Olympia, Washington 98504 • [redacted] 206/459-9191

February 28, 1983

RECEIVED
MAR - 2 1983
DEPARTMENT OF ECOLOGY
ENVIRONMENTAL REVIEW

Ms. Barbara Ritchie
NEPA Coordinator
Environmental Review Section
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504

Dear Ms. Ritchie:

The Department of Emergency Services has reviewed the United States Navy's Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

The department does not wish to make any statements regarding either method suggested for ultimate disposal of the reactor sections or the submarine vessels. However, we do wish to comment on the possible risks of transporting either the reactor section or the submarine vessels to the disposal areas.

If decommissioning work were done at the Puget Sound Naval Shipyard, it is possible that either reactor sections or submarine vessels could be transported on Puget Sound and the Columbia River. During transit the vessels or the barged reactor sections could be sunk, grounded or otherwise damaged possibly causing a localized hazard. The final environmental impact statement should clearly discuss these risks and any secondary potential radiation exposure risks due to sinking or grounding during transit. L.63

Please include this concern in your consolidated response regarding this draft environmental impact statement.

Sincerely,

James E. Hall for
James D. Thomas
Assistant Director
Plans and Preparedness Division

JDT:bf

#372 (Cont)

JOHN SPELLMAN
Governor

STATE OF WASHINGTON
DEPARTMENT OF SOCIAL AND HEALTH SERVICES
Olympia, Washington 98504

March 14, 1983

RECEIVED
MAR 14 1983
DEPARTMENT OF ECOLOGY
ENVIRONMENTAL REVIEW

Barbara Ritchie
NEPA Coordinator
Department of Ecology
Environmental Review Section
Mail Stop PV-11
Olympia, Washington 98504

Dear Barbara:

W.1,L.20 It is our position that the decommissioned nuclear submarines to be disposed of by the U. S. Department of Navy, not be scuttled and sunk in ocean waters. Once disposed of in this manner the submarines along with their radioactive materials inventory are assumed to be in permanent repository. Considering the proposed depth of sea disposal as 2.5 to 3 miles and with present technology the disposed submarines would be completely out of human environmental control. Is this truly the best way for disposing of this environmentally sensitive and controversial material? We do not think so.

Land disposal either at Richland, Washington (Hanford) and/or Savanna River appears to offer many environmental advantages over sea disposal. With land disposal the nuclear section of the submarine would be confined in an area of known disposal, and its exact location would not be a mystery. Disposal of the nuclear components in the dry sands of the Hanford area would not cause rapid deteriation of the non-radioactive protective metal surrounding the submarines reactor components. The integrity of the sealed reactor compartment would therefore, remain sound for an indefinite period.

E.8 Even though salvaging the metal reactor components from a shallow land burial location was not specifically mentioned in the DEIS it is a definite reality and should be considered. After approximately 600 years or 20 half lifes of radioactive decay for the irradiation and corrosion products the reactor components could be handled safely from a radiological standpoint. Salvage of the metals may someday be economically feasable. Who is to say how valuable metal of quality required to build the reactor components might become over the next 600 years. Regardless of salvage, environmentally, land disposal of the reactor components appears to be the only method for consideration.

We appreciate this opportunity to comment on the draft environmental impact statement regarding the disposal of decommissioned defueled navy submarines. It is hoped that we will be advised again in the future on such important environmental issues as the disposal of radioactive waste materials.

Sincerely,

E. Lee Gronemyer, Manager
Radioactive Waste Program

ELG:pn

610

#373

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Rockville, Md 20852

March 28, 1983 N/OMS:RK

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Sir:

A copy of the "Draft Environmental Impact Statement on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants," dated December 1982, was sent to me for peer review. The views expressed in this letter are my own. They should not be construed as necessarily being shared by any other individual or organization, including my employer, the National Oceanic and Atmospheric Administration.

The subject DEIS has all the features, characteristics, and technical depth for a pedogogic textbook on what constitutes a good environmental impact statement. It rationalizes very well that the disposal of the low-level radioactivity associated with the reactor systems of the Navy's 100 overage nuclear systems is of negligible risk to man or the environment, whether disposal takes place on land or at sea.

However, as with most textbooks, the deficiencies of the DEIS, when compared to real-life application, are not so much what it covers, but rather, what it does not cover. This is described below in three parts:

1. Capacity of the ocean to safely receive low-level radioactive waste worldwide

The DEIS limits the problem to be discussed to the 100 nuclear-powered submarines that the Navy no longer finds useful. Since only these submarines are the Navy's responsibility, the limited scope that the Navy has given to this environmental impact statement is understandable. But what about the disposal of the Nation's commercial power reactors and other low-level radioactive waste. For example, will the ocean disposal alternative proposed by the Navy, since they are first, preempt and therefore prevent the disposal of these other low-level wastes in the ocean? This question suggests that what is therefore needed is an analysis of the worldwide future growth of low-level radioactive waste, the maximum capacity of the ocean to absorb this waste without adverse effects to man or the environment, and the relative proportion of this capacity that the Navy's overage submarines will consume. Such an analysis would present the environmental impacts of the Navy's ocean disposal option in proper meaningful perspective. L.27

2. Institutional mechanisms to assure that disposal plans are implemented as proposed

As a result of past history, there is today a widespread lack of public confidence that the Federal Government will manage waste (particularly radioactive waste) safely and efficiently. Included in these doubts is the institutional capacity of the Federal Government to carry out the sustained effort to operate safely any disposal system that will handle large amounts of waste. The credibility of the Federal waste management effort appears too low for an open-ended "trust us" approach. In waste management, anything that has gone wrong in the past is likely to do so in the future, unless specific measures are taken to prevent it.

What is needed here is a national plan for low-level waste disposal that is acceptable and credible to the States, the public and industry. It should recognize that the current low credibility of the Federal waste management effect is based on (1) policy instability; (2) concerns about the institutional capacity of the Federal Government to implement a long-term plan; and (3) perceptions of a lack of trustworthiness.

Again this is not strictly a Navy problem, but the Navy's disposal plan will not be solved unless it fits into the above national plan and framework.

3. Research to enhance confidence in radioactive waste disposal impacts prediction

Finally, the Navy has not addressed the generally recognized scientific statement that, with regard to marine radioactive waste disposal, "our ignorance of its environmental effects exceeds our understanding." What is needed here is a multifaceted scientific research and monitoring program, both in situ and in the laboratory, that will enable predictions to be made with more confidence on the capacity of the ocean to receive radioactive waste, without risk to human health and the environment. L.1 J.20, L.39

Again, this is not solely a Navy problem, but is rather one that belongs to the community of Nations that generate low-level radioactive waste, and plan to dispose of it at sea.

Some minor comments are also applicable:

page 2-13: Retrievability of the hull of a nuclear submarine after marine disposal has doubtful value. However, the statement that this is not feasible with current technology is questionable. W.1

page 2-14: The Report by the General Accounting Office has controversial statements that do not make it a good document for quoting. F.34

page 2-16: The section on "Other Alternatives that were Eliminated from Consideration" appears to have been written without any real attempt to find and evaluate other alternatives.

Glossary p6: The glossary does not define "holothurian," which is the only word I looked up. (However, it is subsequently defined in one of the appendices.) X.1

Thank you for giving me the opportunity to review this DEIS. It is hoped that these comments are recognized as constructive, and will be useful.

Sincerely yours,

Robert Kay

Dr. Robert Kay
Office of Oceanography
and Marine Services
National Ocean Service

#374

March 30 1983

Dear Sir,

As a very connerned citizen of this country. I would like to express my concern on the dumping of sub marénes on the western coast.

I have read much about Nuclear power, the good that it dose and can do, and also the danger of it. Many of us know that there is no safe plase for disposal of this radioactive materàal.

G.2 My opinion is that the subs should stay where they are, until we can find a safer plane for them. I wouldnt want to see the subs dumped in the ocean and five or ten years from know hear that people are dying from it or even seeing our coast closed down because of con--temination. So please, you are the people we have up there to help us, not to distroy us.

Thank You

José L. Bruseno

JOSE BRUSENO
311 Torsard Ln.
UKiah, Calif. 95482

#375

917 Evelyn Ave.
Albany, CA 94706
March 24, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Re: Disposal of Nuclear Submarines

Dear Sir:

As it is important and necessary to shield highly radioactive materials from the natural environment for thousands of years, we must not dispose of nuclear submarines into the sea. These materials must be isolated to the best of our ability, on land, until future generations can safely decontaminate them. G.2

Yours truly
Paul Scala
Paul Scala

#376

3/28/83

Dear Captain Wagner
I am absolutely opposed
to the dumping of decommissioned
nuclear submarines off the
California coast (or any coast.)
This is an irresponsible method
L.14 of disposal which can adversely
affect living creatures.
I suggest the radioactivity
be separated and the metal
O.10 be recycled. I feel it is time
for people such as yourselves
to be accountable for the
ways in which wastes are
disposed. Previous dumpings
of nuclear wastes have proven
to cause radiation poisoning,
L.6 cancer, destruction of bodily
immune systems and a host
of other life-threatening
malaises.
Your careful consideration
is urged in this matter.
Very sincerely,
Judy Koretsky
3270 Kempton
Oakland Ca 94611

#377

March 29, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief Naval Operations
(OPNAV-22)
Deapartment of Navy
Washington D.C. 20350

Dear Sir:

I am writting to your office inregards to the dumping of retired nuclear submarines off the California cost. Your claim that there is little enviromental danger from the low level radiation emitted. In light of enviromental concerns, then why can't the submarines be cut up for srcap metal? The reactor core could be stored in a Class 1 dump. This would save alot of tax payers money in trying to defend your program. I am against dumping any more r radiation sources in our ocean. Your correspondence would be appreciated.

O.10 | A.16 |

Sincerely,

Michael Lowery

Michael Lowery

Michael Lowery
1730 Broderson St
Los Osos, Ca 93402

#378

29 Mar 83

To: Captain Edward Wagner, USN
Office of the Chief of Naval Operations (OPNAV-22)
Department of Navy
Washington D.C. 20350

Sir:

I write today to tell you of my strong opposition to the scuttling of old nuclear submarines of the northern California coast. California is my home and it is a very beautiful state. I am among those who have worked to keep it that way. The Mendocino Coast is among the most beautiful anywhere

Oceanic nuclear dumping is such a completely questionable activity that I believe we should not commit the possibly irreversible folly of sinking vessels in deep water out of salvage range. The costs of storing the hulls above water certainly cannot be large compared to the potential damage to the food chains and life systems of the lovely California Coast.

I appeal to you to exert your influence and energy to find an environmentally acceptable method of storage for these retired ships until science has found a truly safe way to deal with their residual radioactivity.

Respectfully yours

Kingsley H. Klarez
3320 [illegible] Dr.
Napa Calif 94558

| W.1
| G.2
| L.36

614

#379

"...take all necessary precautions to avoid pollution of the marine environment for future generations."
Report of the Stockholm Conference on the Human Environment, 1972

Total ban on ocean radwaste dumping proposed in London

Delegates to the Seventh Consultative Meeting of the Contracting Parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (familiarly called the London Dumping Convention, or LDC) gathered in February to consider a worldwide ban on the disposal of radioactive wastes.

Offered by the Pacific island nations of Kiribati and Nauru, the ban was proposed in the form of an amendment to the 1972 Convention. While not expecting the measure to pass this time, advocates hoped the proposal for immediate cessation might force compromise measures leading to phased discontinuation.

Representatives of 50 nations addressed the main points of the amendment:
• There is no centralized registry of radioactive wastes entering the ocean;
• There is no effective, on-site scientific monitoring of the impact of past and present dumping;
• There are recent radiological health data that may revise present human exposure limits.

The proposed amendment faced opposition from the present U.S. administration as well as the governments of countries that are now dumping "low-level" nuclear wastes or are planning to resume or begin such activities.

The U.S. delegates were in an ironic position. The United States dumped radioactive waste at more than 30 sites between 1946 and 1970, and Reagan administration policies encourage resumption. But in late December opponents of the practice hurried legislation through the closing hours of Congressional debate imposing a two-year moratorium and setting strict criteria to be met before any future dumping permits can be issued. The delegates to the LDC were thus left in the position of opposing an international resolution that their own nation has already enacted domestically.

Passage of the LDC amendment would require approval of an unlikely two-thirds of the participating countries. But just before the February meeting, compromise proposals began to emerge, sponsored principally by the Scandinavian nations, directed toward a phased cessation by 1990; they would forbid new sea dumping and require better monitoring of present activities.

The United Kingdom, which dumps most of the radwastes presently entering the ocean (Fig. 1), opposes both the ban and phased reduction, as do Belgium, Switzerland, and the Netherlands, which also engage in sea dumping.

Spain, located near the present dumpsite (Fig. 2), supports a total, immediate ban and will exert pressure for a compromise plan if the total ban fails. The Japanese joined the LDC primarily to justify their own proposed dumping in the Pacific and lobby strongly against any prohibition.

Final cessation of all oceanic nuclear waste dumping is not likely to result from the London meeting, but efforts will continue to involve more nations in the Convention, in an attempt to swing the balance at the next meeting, sometime within the next two years.

How much can the ocean take?

To determine whether something could safely be dumped into the ocean, one would need some essential information:
1) How much material is to be dumped, and how much is already there?
2) How does the dumped material behave in the sea?
3) How is "safely" defined and on what basis?

The inability to answer even one of these questions precludes the possibility of sound judgment and ought logically to delay dumping until these important gaps in our knowledge are filled. But such is not the case.

Who's keeping score?

No central registry exists of radioactive materials presently being dumped or discharged into world oceans.

Past U.S. nuclear dumpsite positions were inaccurately logged — in some cases wastes in cement-filled drums were randomly shoved out of low-flying aircraft. (Some of these drums have been located off San Francisco; the barrels were cracked and leaking, and nearby fish were somewhat radioactive.)

Hundreds of nuclear warships of several navies regularly discharge radioactive cooling water into the open sea. Exactly how radioactive the discharge might be, the sailors won't say, but the quantity is estimated to be in the millions of gallons.

Fig. 1 *Previous Atlantic Ocean radwaste dumpsites used by Great Britain in the past. Numbers show how many years sites were used.*

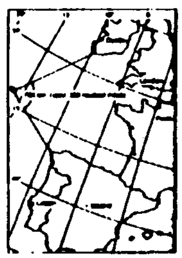


Fig. 2 *Location of the only currently active nuclear dumpsite, in the Atlantic, approximately 300 nautical miles from the English and Spanish coasts.*

Where does the waste go?

Until recently the 12,000-foot abyssal depths, where most radioactive waste is dumped, were considered biological deserts, essentially static regions where waters circulate so slowly that thousands of years would elapse before there could be much mixing of nuclear waste with surface layers of water.

Now we know that deep ocean waters circulate much faster, meaning that nuclear wastes with long half lives have a greater chance of coming into contact with the food chain in the upper layers. And although life is less abundant than in coastal regions, we know that bottom-dwelling creatures do inhabit the deep sea and do stir the bottom sediments which then attach to radioactive particles. These can be transported directly or via sea creatures that ingest them to larger animals in the faster moving currents above — and possibly to man, more directly, more rapidly than previously anticipated.

While we have acquired much new information about the ocean and its processes, no reputable marine scientist will yet testify that their theoretical models of ocean behavior have been proven totally accurate. We have no real answers.

But is it safe?

Some scientists believe that the amount of radioactive material already in the ocean is not enough to be harmful to man. Probably this is true. So far.

Others debate whether there is any safe threshold of human exposure to ionizing radiation in excess of naturally occurring "background" levels. Not just cancers but also more subtle genetic effects may be resulting from radiation emissions generated by human nuclear enterprise.

Very little conclusive research has been done, and significant results will be evident only after a generation of monitoring population health. It has been just 37 years since the victims of Hiroshima and Nagasaki began their involuntary participation in the only ongoing experiment evaluating the effects of human irradiation.

The amounts of radiation emitted by those bombs was never measured, only calculated. And recent analyses of the energies released upon detonation indicate that victims may have received less radiation than was previously believed — and that human exposure limits calculated from these tragic statistics are therefore too high, perhaps by a factor of ten.

How many questions did we answer?

It seems we haven't done very well. We know some things about the physical and biological characteristics of the ocean, but we're not yet certain what radioactive materials will do after we cast them to the irretrievable depths.

Health effects of human exposure to radiation is even less understood. Our only data come from that singular "human experiment" with atomic bombs, from which the emitted radiation was never measured.

And, most remarkably, nobody is keeping score of exactly how much radioactivity human enterprise is presently injecting into the world ocean. What more can be said about that?

Destructive testing of our water planet

The manufacturing industry uses a method of quality control called "destructive testing," in which samples are randomly pulled from the assembly line and stressed to the breaking point. Those who assert that the ocean has an assimilative capacity for radioactive and long-lived toxic chemical wastes, but who fail to acknowledge significant gaps in our knowledge about such activities, are engaging in destructive testing of our planetary ecosystem.

But there's not another sample on the line behind this one. We must protect the only one we have, by more intensively studying the ocean and its processes and the effects of radioactivity on human health, by searching for alternative waste disposal methods. We must encourage activities that decrease rather than increase the amount of nuclear material introduced into our global environment.

We cannot wait until someone finally begins to keep track of exactly how much radioactive waste is being dumped into the ocean—the totals may someday add up to "Too much."

Dick Farley

Navy considers disposal of nuclear submarines

The U.S. Navy's plans to dispose of as many as 100 of its nuclear submarine reactors are currently under review. In December the Navy released its Draft Environmental Impact Statement (DEIS) on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, and four public hearings were held in February.

At issue is whether the decommissioned submarines should be scuttled at sea or cut apart to allow for land burial of their radioactive propulsion reactors. Decommissioning of the subs, scheduled to begin in four or five years, would proceed at the rate of three or four each year.

If the "ocean option" is selected by the Navy, the disposal of each submarine will equal half of the total radioactivity known to have been dumped in American waters since the end of World War II. With insufficient information presently available to permit realistic evaluation of the health or environmental consequences, the Navy's proposal for ocean disposal of these submarines merits opposition.

The issue raised is just a fragment of the broader problem. What is to be done with all the radioactive parts of nuclear power generating equipment, as their 25-to-30-year lifespans come to an end?

The first commercial nuclear power plant, at Shippingport, Pa., is about to shut down. Its radioactive components must be "entombed" at the site for hundreds or thousands of years, be removed and dismantled for burial at some now undetermined storage facility, or be pitched into the ocean. It appears that the promise of "free electricity" that accompanied the selling of atomic energy to Americans in the 1950s is about to extract its true price from those of us living in the '80s and '90s.

The general public is invited to submit comments on the DEIS. Members wishing to review the draft may be able to obtain copies from public libraries in state capitals, coastal counties, or cities near existing land disposal sites. Although efforts are being made to extend the deadline, comments are now due by March 31.

Capt. Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

#379 (Cont)

Mr. Mark H. Remlinger
426 Ottawa Street
Columbus Grove, OH 45830

Dear Sir,

I wish to make a comment on Draft Environment Impact Statement (DEIS).

As instructed by me by Calypso Log there is a problem concerning the disposle of nuclear waste. Knowing nothing important about the subject.

H.16 Could this waste possibly be put in a spaceship and sent to the sun.

Citizen of the U.S.

Mark H. Remlinger

#380

206 N. Sanderson
Fort Bragg, Calif.
95437

3/21/83

Dear Captain Wagner -

The EIS on dumping the de-commissioned subs off of Cape Mendocino has been reviewed. It is riddled with contradictions or even states in places that radiation could leak into the ocean.

As a commercial fishing person & resident of the Mendocino coast, I'm strongly against the dumping of any nuclear waste into the ocean.

[illegible]
Fort Bragg, Calif.

People who leave comments here would really like local hearings next time.

#381

March 22, 1983

Dear Captain Edward Wiegner U.S.N

I am writing to you because of my concern for our welfare as human beings on this planet Earth. It is my understanding that the Navy plans to dump Nuclear submarines, that are no longer of service, in the Pacific Ocean about 160 miles off the California coast, due West of Fort Bragg. I live in the Fort Bragg area. I eat the fish that are caught off this coast.

Dumping the submarines may seem like an all too easy solution to the problem of nuclear waste. The waste will not just disappear miraculously. Everything ends up somewhere. I understand that the dumping of the decommissioned submarines in the
N.3 ocean is cheaper than land disposal. It gets right done to which is more important, human life or money.

Studies done by the Navy's Draft Environmental Impact Statement claim that the chosen dump site is topographically smooth, less impacted by shipping lanes, offers less opportunity for productive fishery and is a greater distance from major port activities and population centers than other tract studies. Certainly one can not assume that this safe guards
L.20 us from leaking and eventual contamination of surrounding waters. Area fisherman have also found that the
J.12 proposed site is in the middle of a rich albacore feeding ground.

All this means that radioactive particles will be getting into the food chain and eventually affecting
L.6 us. There is already evidence at the Farrallon Islands of radioactive leakage from rusting barrels. What is
L.20 there to prevent this happening with the submarines.

I urge you, as a fellow human being and a person with influence, that you take time to consider the grave consequences of the dumping of these submarines. This is a problem that needs to be solved. Land dumping seems to be an alternative if it can be safely done.

Sincerely,
Christine Bercher

Christine Bercher
P.O. Box 93
Caspar, Ca 95420

#382

3477 Twin Oaks Court
Napa, California 94558
March 26, 1983

Dear Captain Wagner and the Department of Navy,

I would like to go on record as requesting an improved Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

L.1 I oppose the sea disposal option as the information available to
us at this time is limited and inadequate. The enormous cumulative
L.7 effect of ocean dumping of radioactive waste, both proposed and
potential is of very great concern to me. I would like the following
issues to be addressed in the final Environmental Impact Statement.

The submarines will be scuttled in waters at a depth of 2-3 miles.
Q.13 The great pressure at that depth could cause the encasements to
implode, crack, or leak. Some of the radioactive materials found
in the submarines have a half-life of 20,000 to 30,000 years. Salt
L.20 water will corrode the encasements long before the submarines lose
their radioactive danger, again releasing radioactive materials into
the water. It is well known that the California coast has a complex
F.22 series of earthquake faults crossing the area. If, in fact, any of
the above occurs and radiation begins leaking from a ruptured
W.1 encasement, how does the Department of Navy plan to retrieve the
submarine in the 2-3 mile depth at the disposal site?

J.76 How does the Department of Navy plan to monitor the corrosion of
containers, keeping in mind that of the 47,000 barrels that were
L.6 dumped near the Farollon Islands from 1946-1970, only 147 could be
found in a 640 square mile area in 1977?. It was estimated that 25%
of these barrels had ruptures and were leaking radioactivity into the
water. Fish in the vicinity of the Farollons contain higher levels
of radiation than fish found in other areas.

A.19 Fish will also be attracted to the site as radiation activity heats
the waters. The impact on the food chain will impact life all
L.36 along the line to mankind. What is known about the cumulative
impact of radiation as it moves through the food chain? L.37

Finally, I'm concerned about the cumulative impact which the Draft L.7
EIS fails to evaluate. It seems likely that if permission is granted
to your department, pressures will become enormous to dump other L.9, F.8
nuclear waste into the ocean and also will open the door to every
other agency and department, both public and private to follow suit.

I would appreciate consideration of the above mentioned matters.

Yours truly,

Teresa Matta

Teresa Matta

cc: Senator Alan Cranston
Senator Pete Wilson
Representative Eugene Chappie
Representative Douglas Bosco

Senator Nielson
Assemblyman Sebastiani

#383

March 31, 1983

Caroline Draper Swift.
512 Neame Avenue
Alamo, CA. 94507

Capt. Edward F Wagner, US Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner,

I urge you to not proceed with the Navy's plan to dispose of 120 decommissioned nuclear submarines off of the coast of Northern California. This is a very short sighted plan, not taking into account the incredible length of time it takes for nuclear materials to lose their radioactivity.

I strongly urge you to consider a more reasonable way of disposing of the submarines, even if it costs a lot more. There is no justification for creating health and environmental hazards for all life forms on earth for centuries to come.

Very Sincerely,

Caroline Draper Swift

Caroline Draper Swift

#384

March 24, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Dept. of the Navy
Wash., D.C. 20350

Dear Capt. Wagner:

There is insufficient evidence L.1
available to prove that there is minimal danger to the ocean in dumping your nuclear submarines!

The healte of our peoples and the oceans are at stake and, though vast, are delicately balanced, providing us food. We do not want contaminated L.36
food or shorelines!

I vehemently oppose the "ocean option."

Sincerely,

Barbara Toohalis

Elkhart, I.N. 46514

Barbara & Gerald Toohalis
33601 Holly Drive
Elkhart, IN 46514

#385

March 23, 1983

Captain Edward R. Wagner
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington D.C. 20350

Enclosed are the names of several persons who object to your idea of creating a dump site out of the northern Californian coast.

We go to great lengths to properly dispose of any hazardous wastes we develope; we feel you should also take the time and the expense to do the same.

H.16 Space is infinite, Earth is not. Allough at present disposal in space is extremely expensive, costs will certainly become more and more tolerable if a program is instigated. Once open competition begins, prices for services also become quite competitive.

Please heed our objections to your present proposal and develope a better means of disposal. We know you are capable.

Sincerely,

Concerned Californians

P.S. Please arrange a local hearing so that we may discuss this issue further.

803 N. Humboldt, #303
San Mateo, CA 94401

To Mr. James Baker
Counsellor to the President
The White House
Washington, D.C. 20500

The Navy's plan to dump off the Northern California coast is outrageous and a violation of federal law. Surely you realize that there are safer and better ways to dispose of old radioactive subs than dumping them in coastal waters. Use your influence to stop this plan. It's our Navy isn't it?

Name GRETCHEN G. GRANT
Address 803 N HUMBOLDT #[illegible]
SAN MATEO CA 94401

To Mr. James Baker
Counsellor to the President
The White House
Washington, D.C. 20500

The Navy's plan to dump off the Northern California coast is outrageous and a violation of federal law. Surely you realize that there are safer and better ways to dispose of old radioactive subs than dumping them in coastal waters. Use your influence to stop this plan. It's our Navy isn't it?

Name ROBERTO [illegible]
Address 10470 DAVISON AVE
CUPERTINO, CA 95014

To Mr. James Baker
Counsellor to the President
The White House
Washington, D.C. 20500

The Navy's plan to dump off the Northern California coast is outrageous and a violation of federal law. Surely you realize that there are safer and better ways to dispose of old radioactive subs than dumping them in coastal waters. Use your influence to stop this plan. It's our Navy isn't it?

Name D. MARTINELLI
Address 3155 Payne Av. #17
San Jose, CA 95117

F.2

To Mr. James Baker
Counsellor to the President
The White House
Washington, D.C. 20500

The Navy's plan to dump off the Northern California coast is outrageous and a violation of federal law. Surely you realize that there are safer and better ways to dispose of old radioactive subs than dumping them in coastal waters. Use your influence to stop this plan. It's our Navy isn't it?

Name [illegible]
Address [illegible]
Sunnyvale, CA [illegible]

To Mr. James Baker
Counsellor to the President
The White House
Washington, D.C. 20500

The Navy's plan to dump off the Northern California coast is outrageous and a violation of federal law. Surely you realize that there are safer and better ways to dispose of old radioactive subs than dumping them in coastal waters. Use your influence to stop this plan. It's our Navy isn't it?

Name [illegible]
Address [illegible]
[illegible]

#386

15 South 32nd Street
Boulder, CO 80303

March 26, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

The problem of how to dispose of decommissioned, defueled naval submarine reactor plants is a very tough one. The need and desire for a solution is very pressing. However, the long-term impacts of dumping the reactors in the oceans is completely unascertainable. There have never been any long range scientific studies conducted on the environmental impacts of radiation in the ocean. Future generations will have to live with any harmful effects caused by a premature decision to dispose of the reactors in the ocean. We can only guess what effects this would have, but as custodians of our oceanic resources for future generations we have a duty to preserve the integrity of the oceanic environment. L.39

I strongly urge you to wait until another, more deeply researched method is found for disposing of the decommissioned submarine reactor plants -- a method whose long-term consequences can at least be predicted with some certainty. G.2

Thank you very much for your attention.

Sincerely,

Jane Kyle McCoy
Jane Kyle McCoy

#387

March 25, 1983

Captain Edward F. Wagner
Office of the Chief of Naval
Operations
OPNAV-22
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

As a citizen who makes his living from North Carolina's coastal areas, I wish to express my concern regarding the Navy's latest Draft Environmental Impact Statement.

If decommissioned nuclear submarines are disposed of off our coast this might contaminate the ocean's vital food chains, have a devastating effect on our fishing industry, and set a precedence for other nuclear waste producers to utilize the area once it has been established as a nuclear waste site. Ocean dumping, should it be a mistake, cannot be corrected. L.36, L.53 L.9 W.1

Therefore, I would highly recommend storing the submarine's nuclear reactors on land until a safer alternative is found. G.2

Sincerely,

Paul Clemmons

Paul Clemmons
1994 Eastwood Road
Wilmington, NC 28403

#388

Dear Capt. Wagner U.S. Navy

As a fellow veteran and a person who loves the sea I implore you to reconsider the dumping of radioactive submarines off Cape Mendocino I am a fisherman. I live, work and eat off the ocean. Would you eat a salmon caught from where you dumped the subs. .53

Sincerely Yours

Joseph M. O Brien
Box 572
Little River
Ca.
95456

#389

March 23, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Dep't. of the Navy
Washington, D.C. 20350

Sir:

At the urging of Jacques-Yves Cousteau + the Cousteau Society, of which I have been a member for many years, I am writing to add one small voice to those who oppose the dumping of nuclear submarines in an environment about which we know so little, that is, the oceans. Perhaps, at least, some people who live in or near San Francisco may be rather more aware of the dangers involved than most Americans, having received some information on the subject as a result of the dumping of radioactive materials off the Farallone Islands shortly after World War II.

It's unfortunate that the Cousteau Society's "Calypso Log" did not reach me earlier, as they advise me this letter must reach you by March 31, which doesn't give either of us much time to deal with a matter of such grave importance. However, I hope that you are familiar with the ~~work~~ research done at the Farallones by Project Tektite, a local environmental group (whose address I don't seem to be able to find on such short notice) with excellent scientific credentials. Mutated sponges got most of the publicity, but there were other, probably more important, findings. L.6

It's what research hasn't shown, and may never be able to show, that's scary. Hiroshima and Nagasaki were our big lessons on what radioactivity can do to us.

I'd like to suggest that the Navy seal those damned things in non-biodegradable plastic in the middle of some desert — say, the Sahara. H.3

Too much of our food chain originates in the oceans. And you don't know any more than I do what effect this "decommissioning" will have.

Please reconsider.

Yours sincerely,

Wm. J. Haber
3857 Clay St.
San Francisco, CA 94118

#390

Fort Bragg
California
March 21, 1983

Dear Captain Wagner:

From past experience of ocean nuclear dumping off the Farrallone Islands - where drums have corroded through, ruptured from pressure and are leaking - and off the Mendocino Coast at a sight which is apparently unavailable for monitoring due to the loss of records of the exact locations, I feel that ocean dumping of nuclear submarines is extremely counter productive. L.6

Please exert your influence to prevent the scuttling of the submarines.

Sincerely
John Teller

#391

83 03 29

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Captain Wagner:

I request that the following comment be made a part of the record of responses to the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (December 1982).

The socalled "permanent disposal" of naval submarine reactor plants (SRP) at sea proposed by the U.S. Navy in its draft EIS would be "permanent" only in the sense that the Navy might consider itself no longer responsible for the SRP after such "disposal". Any implication that the SRP somehow become of no concern as a result of such "permanent disposal" is unwarranted; neither the Navy nor anyone else can predict reliably all the eventual results of any particular "disposal" mode. The problem with throwing things "away" is that we've run out of "away". L.39

Evidently many people resent the proposed radioactive intrusion by the Navy on the commonly shared ocean resource, and certainly the Navy and others should be looking for ways to mitigate pollution of the oceans, rather than creating new insults to that part of the environment. The part of the ocean occupied by the SRP, at a minimum, would be made unuseable for other purposes if the Navy's proposal is followed. Dumping noxious waste, including radioactive waste, in the public domain is not a rational or responsible way to dispose of it.

Instead of fouling commonly shared resources with them, the Navy should retain the SRP on its own premises, with careful monitoring to avoid dispersal of radioactive material beyond boundaries of sites under Navy jurisdiction. In this way the Navy can show a sense of responsible commitment to taking care of the problem it has created; the alternative is for the Navy to arrogantly override the public's concern about the Navy's radioactive pollution of a shared resource. For the sake of its public image, the Navy should avoid the latter alternative. G.2

Sincerely,

H W Ibser

H. W. Ibser
(Prof. of physics, Calif. State Univ.)
2620 Kadema Drive
Sacramento, CA 95825

#392

March 23, 1983

Dear Capt. Wagner,

I strongly urge you to help the American people by opposing the disposal of submarine nuclear reactor plants in the ocean. Unfortunately, we have the technology to construct and use nuclear power, but still don't know how to safely dispose of it. As we continue to carelessly toss it into the ocean we don't

L.39| even know what effect it has

L.36| on the food chain or on the

L.14| ocean's inhabitants. Frankly, we still don't completely understand the effects of radiation on humans.

Please, for the sake of ourselves, our ocean, our planet, oppose the ocean dumping of nuclear waste

Thank you

Sincerely,

Susan Schafer
7051 Natal Dr #81
Westminster, Calif
92683

#393

March 29, 1983

227-39 143rd Road
Rosedale, NY 11413

To: Capt. Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, DC 20350

Re: Disposal of Nuclear Subs
(Discussed in Calypso Log)

As a former student of earth and environmental science, I realize that both options under consideration present their own problems, and both may potentially cause great harm to the environment and its inhabitants.

On balance, however, it seems to me that the possible effects of ocean dumping are less worth risking. Scientists know much about ocean currents and regions of turbidity and quiet, but with all this knowledge it remains impossible to predict with confidence any more than general oceanic events and patterns. For this reason it seems foolish to entrust radioactive waste material to the world's waters. |L.39

Another major consideration is the effects of introducing this radioactivity--more than is currently present in the oceans worldwide?--to ocean plant and animal life. Even without adopting a catastrophic standpoint, it is clear that some new kind of balance, if not a new kind of life, would have to form in the oceans to adapt to this change--with unknown consequences to man. |L.14, L.28

Land burial is not a guaranteed safe option, either. Continental crust is not static, certainly not in geologic terms, but also not for most terms longer than human life spans. Waste disposal containers are not immune to stress forces. And of course there are other factors I haven't even thought of.

But even if radioactivity were released--accidentally or otherwise--from land burial sites, the chances are that less of a percentage of Earth's population would be irrevocably harmed. If the oceans die, the planet is useless. If men destroy themselves and/or their environment, we should at least allow life to be renewed in the Earth's waters.

Diane Lehrenbaum

#394

Dear Captian Edwards F. Wagner,

I am a very conserned citizen of Northern California. I live on the Rich mendocino coast and fish ~~comercel~~ commericaley for a living. I can not believe that you and other high officales are so unconserned about dumping radio active waste in our Oceans! Please reconsider your actions Our furture generations depended on it, your granchildren depend on it. You must be very sick in the head to stand back and watch this happen I pray for all of us, and that you might change your way of life and stop killing us.

L.53

John U Citzen Jr.

John U. Citzen Jr.
P.O. Box 371
Albion, ca 95410

#395

Route 1, Box 82
Eureka, California 95501

March 28, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

It is with increasing alarm and anger that I am watching the
Navy's proposal to dispose of nuclear submarines of off the
coast of Northern California. I cannot bring myself to be
lieve that this plan is other than short sighted and danger
ous.

Rather than take your time with a long, drawn out exposition
concerning the hazards of dumping radioactive materials into
the ocean, Captain Wagner, let me briefly state my position
I hold a Bachelor of Science degree in Oceanography. One of
my areas of study was deep ocean circulation, both by Arctic
and Antarctic Bottom Currents and by other advective processes
In addition, I did some independent studies regarding canyon
circulation and turbidity currents. One can only conclude that
any toxic or radioactive material which is deposited on the
ocean floor will eventually be circulated into the waters of
the ocean, and from there into our food chain. L.36

The circulation of radioactive materials into the ocean's
waters can only have ill effects upon many facets of our lives
The Northcoast fishing industry will be severely impacted by L.53
the presence of radioactive materials in fish. Even more im
portant could be the impact upon our health, which I don't
believe that the Navy can successfully predict.

Therefore I am writing this letter so that I may be included
with the thousands of other voices to enjoin you to seek an
alternative method of disposal of submarines one that we
won't be regretting for thousands of years to come!

Sincerely,

Douglas M. MacDonell

Douglas M. MacDonell

#396

3/21/83

Dear Captain Wagner, (as a Mendocino County resident)

I would like to express great concern over the Navy's plans to dump decommissioned nuclear submarines off the Northern California coast. There are many questions that the Draft Environmental Impact Statement does not address. This is far too crucial an issue to rush into action with, for

W.1 | it irreversibly affects untold future generations of mankind. We simply know

L.39 | too little of the consequences; it would be grossly irresponsible to go ahead with these plans out of mere convenience. I get the strong impression that the Navy is taking an "out of sight, out of mind" attitude.

I was unable to attend the recent Sacramento hearings where much was said against ocean disposal, in terms of both factual scientific information and common sense. I am completely in agreement with the views expressed there, which were apparently unanimous.

Ocean disposal is not a solution to our nuclear waste problem.

Sincerely

Janet M. Oster

P.O. box 1331, Willits CA 95490

#397

I am greatly opposed to nuclear anything. The military's DEIS on disposal of defueled nuclear sub reactor plants is totally a summation of it's constant endeavor to kill life on planet earth, all in the name of peace.

You should be doing extensive research on how to detoxify what you've got not dumped haphazardly into our sea or shoot it into space. Take the expense & research the nuclear issue. Do not create anymore waste until there is a viable SAFE answer to this.

The military people in charge of creating bombs continually making people fear the "Russians" per se are the most dangerous humans alive. It is all of the military in all countries & all of the government that make wars for their own perpetuation of power who should be feared.

I opposed your DEIS i suggest you spend your money, 57¢ of every tax dollar i really [illegible] to all in the name of peace not War.

Sincerely

Pat Norman

Rt. 1

Lawrence K's 66044

#398

March 22 1983

Dear Captain Edward Wagner USN

Like you, your children and grandchildren like to eat food? I do. The oceans are on the bottom of our food chain, starting with plankton and ending up with
J.31 humans. There is a Pacific upwelling in the Mendocino
L.36 trench which feeds many of our Pacific fish, directly affecting the sea food for human consumption.

I know that sinking the nuclear submarines is cheaper in the short run, but in the long run it may be the end of the food chain, therefore affecting us. A land decommissioning could be monitored and who knows, maybe science will discover a way to deactivate nuclear waste. We will still have a chance to deal with
W.1 nuclear waste on land, but not at sea. Nuclear submarines dumped at sea are gone forever. It's good for the short
L.36 run, but may have irreversable reactions on the food chain for human food and the human race. I know you are for human life. Given as many facts as we know and some we don't know, I know you will make a responsible decision for human kind and the planet Earth we all live on.

The easy way out, sinking the submarines, is the wrong way and may cause the end of the food chain and human life as we know it. It is a good place, this Earth. I know together we can solve many of the problems we have created.

Respectfully

Michael Matthay

Michael Matthay
PO Box 93
Caspar CA 95420

#399

Dolphin
PO Box 556
Gualala
CA 95445

March 26, 1983

Dear Sir,

I would like to register my feelings of dismay & despair over the proposed dumping of spent nuclear submarines off the California coast. Even if I didn't live right at the ocean's edge I would still be utterly confounded by the short sightedness displayed by such a proposal. We have yet to devise a truly safe method for disposing of nuclear waste & to commit it to the depths of the ocean w/ an "out of sight, out of mind" attitude seems foolish to me. Our planet is largely water covered & its future as a beautiful place to live (or, indeed, any place to live) is very much dependent on the ecological health of the oceans. We must quit considering the seas as vast open sewers w/ the limitless capacity to absorb our wastes of all sorts, but, above all, nuclear wastes with such amazingly long time periods necessary for their degradation. Please make note of my family's grave concern & opposition to this proposal.

Sincerely,

James Dolphin

#400

3/18/83
503 S 25
Laramie, Wy
82070

Capt. Edward F. Wagner,

I would like to comment on the Draft Environmental Impact Statement (DEIS) regarding the proposed disposal of defueled submarine reactor plants. I believe it may be a grievous mistake to "scuttle" these in the world's oceans. The dangers are probably far more serious than we realize at this early point in our use and understanding of atomics.

I, therefore, urge utmost caution regarding the "trashing" of such systems. And, if you'll forgive me, I wonder why we are manufacturing such items when we have no clear idea of where to safely put them when we are done with them

Respectfully, Douglas L Baum

#401

March 16, 1983

Dear Captain Edward Wagner

I am very concerned over the Navy's proposal to dump 100
obsolete nuclear submarines in the ocean, over the next 30 years.
W.1 By the Navy's own admission the Subs would be irretrievable. If
the Navy's claims of Minimal Enviromental Impact are incorrect,
then no remedial action can be taken. This does not make sense.
Something as hazardous as Nuclear Wastes, need to be handled more
carefully.

If problems arise on a land disposal immediate steps can be
taken to rectify the situation. If they are in the ocean and it
L.20 turns out to be a mistake, they will be there leaking radioactivity
virtually forever.

There are other things to consider also. What will the in-
Q.13 fluence of the water pressure be, in terms of faster corrosion.
What about the fact that these subs have been irradiated for many
L.20 years? What happens when the stainless steel drums finally cor-
rodes? If it happens in 2 years or 200 years innocent people
are going to pay the price with their health.

The Environmental Protection Agency has proven studies that
L.36 Radioactivity does indeed enter the food chain. There is a large
body of data collected which indicates that Radioactivity has
migrated from waste dumps at older Radioactive Dump sites, into
bottom sediments and from there into bottom dwelling invertebrates
and fish. While the Radioactivity is not considered to be Health
Hazard Levels, do we keep dumping blindly in the ocean until
Health Hazard Levels are reached? Or do see the problem ahead
of time and STOP before Health Hazard Levels are reached.

We now know that Radioactivity does enter the food chain.
Many people depend on fish and seaweeds from the ocean as a part
of their livelihood and diet. Let us stop contaminating the ocean
now.

There is no place to "dump" Nuclear Waste. The best we can
do is land storage, with constant monitoring. Nickle 59 has a 1/2
L.20 life of 80,000 years. (Will the storage drums dumped in the ocean
hold up for 80,000 years with no leaks?) What a burden for fut-
ure generations. They will have to carry on with monitoring and
containing the Nuclear Wastes being generated today.

Let's not make the mistake of thinking that if the subs are
out of sight, (in the ocean) that they can also be out of mind.
Nuclear Wastes need to be In Sight, In Mind!

I am also very disturbed that the Public Hearings on this
matter are being held in Sacramento. I wonder why they aren't J.15
being held in Eureka or Fort Bragg. Cape Mendocino is under
consideration as a dump site. It is only fair and logical to let
the people who live in that area express their views. People
are very concerned, but they can't afford to travel to Sacramento
for these hearings. Please extend the 90 day review period on
the EIS. Please hold the Public Hearings in the Cape Mendocino
area.

Sincerely,

Ocean Wells

Ocean Wells
Box 724
Blue Lake, California
95525

#402

3/18/83

Dear Captain Wagner,

Rencently I learned of the Navy's plans to dump 100 Nuclear Submarines off or near the Mendocino coast.

W.1 If you do this there is no way of retrieving them if something should go wrong. Personally, nuclear anything scares the hell out of me and I feel people are much to careless with nuclear wastes,

Please don't dump them!

One of the many reasons I am opposed to this dumping is due to the potentional danger to marine life. L.14 We've all heard about horror story's concerning radioactivity. You know the one's where first the leaking starts getting into small organisms, then eventually into fish, then into man. (namely you) L.36

Listen sir, I don't know about you but I am a vegatarian (I eat only seafood + vegies) I don't

630

#402 (Cont)

want to worry about the fish I eat more than I do already.

So please, stop the dumping Don't Do it. If the people want it let them vote on it. Nuclear Wastes are dangerous.

Sincerely

Karin Humphrey
6267 Clive ave
OAKLAND, CA 94611

#403

Capt. Ed Wagner
Dept. of Navy
Chief of Naval Operations:

I am opposed to the dumping of nuclear wastes into the oceans.

The ocean is too corrosive, too full of powerful movement, and too unstable. Nuclear wastes can not be contained forever in such an environment. Radioactivity would eventually find its way into fish & into the human food chain. L.20 L.36

Put it back in the ground, where it came from.

Please do not dump old, used, nuclear submarines into the ocean.

Thank you, Margie Blake, Mendocino Cal.

#404

MARCH 24

CAPTAIN EDWARD F. WAGNER -

WE ARE VERY CONCERNED ABOUT YOUR PROPOSAL TO DUMP OLD NUCLEAR SUBMARINES OFF THE COAST. I HOPE

J.15 THE NAVY WILL SET UP A SERIES OF LOCAL HEARINGS BEFORE PUTTING ANY PLANS INTO ACTION. THE PEOPLE IN THIS STATE ARE VERY CONCERNED ABOUT THIS ASPECT OF THE NAVY'S BUSINESS, SINCE IT AFFECTS THE FUTURE OF US ALL.

THANK YOU FOR LISTENING.

ROBIN E. HUTCHENS
Robin E. Hutchens
100 DEVON AVE. #52
PLEASANT HILL, CA
94523

#405

DEAR CAPTAIN WAGNER,

IT IS BEYOND COMPREHENSION THAT ANYONE WOULD CONSIDER DISPOSING OF NUCLEAR SUBMARINES OR ANY RADIOACTIVE WASTE IN ANY OCEAN. WE HAVE ALREADY SEEN RESULTS OF PRIOR IDIOCY.

THANK YOU,

MARGERY M. BELT
P.O. BOX 1553
WELDON
CALIF. 93283

#406

March 22, 198

Captain Edward F. Wagner, USNavy
Office of the Chief of Naval Operations
Dept. of the Navy
Washington DC., 20350

Dear Captain Wagner,

I am writing to urge you to not allow any dumping of nuclear submarines in the ocean. The proposed ocean disposal of 120 nuclear submarines is outrageous. The ocean is our greatest resource on this earth. Even if we considered only our selves, and not the thousands of species that live within the ocean, it is unthinkable to consider polluting it so dangerously.

Cape Mendocino is being considered because it is an unpopulated area with no fishing industry. L.53
Well the hundreds of local fisheries and the sizable local populations don't agree.

It is outrageous to dump nuclear subs anywhere, but especially dangerous in the ocean. All nuclear development should be halted completely until a safe (100% garenteed) means of disposing (or reusing!) wastes and outdated materials is found.

Please do not allow ocean disposal of the navy's nuclear submarines.

Sincerely,

Deborah Ann Judd Rugoff
Deborah Ann Judd Rugoff
POBox 253
Leggett, Ca 95455

#407

3700 Old Pfafftown Rd.
Winston-Salem, N.C.
27106

March 21, 1983

Captain Edward F. Wagner
OPNAV-22
Department of the Navy
Washington, D.C. 20350

Dear Sir:

I am deeply distressed with the Navy's plans to dispose of decomissioned nuclear subs in the ocean. There are many problems with these plans that were not addressed in the DEIS.

F.19 ① There is no test data on actual sinkings. Evidentally, the controlled sinking of the Black Fin was not successful.

W.1 ② There is no mechanism discussed for retrieval of the subs if problems develop in the future.

L.7 ③ There is no discussion of the cumulative effect of the radioactivity that would be released.

L.57, L.58, L.63, F.15 ④ There is no allowance for increased chance of accidental dumping in rough seas. What if a sub was lost very near the shore. The seas near Cape Hatteras are notoriously rough waters.

⑤ There is no mention made of Mr. Sjoblom who ~~wrote the~~ worked for the Navy on the DEIS and will work on the regulations for the EPA. Conflict of interest?

J.18 ⑥ The dump sites are very near the 200 mile limit which may make the dump sites open for international dumping.

J.37 ⑦ There may be possible National Security compromises if a sub were recovered by an enemy nation.

L.55 ⑧ There is no mention made of the way artificial substances, like subs, act as reefs which may support marine life in areas where it may not exist otherwise. This effect also puts marine life in direct contact with the radioactive chemicals and radiation being released.

⑨ There is little consideration of the economic impact on fishing and tourism industries of the states involved. L.53

⑩ There is not enough information available from the Scorpion, Thrasher, and Sea Wolf. J.42

⑪ There is little or no consideration of the precedent that would be set for future ocean dumping of radioactive wastes. L.9, F.8

This is only a partial list of potential problems with the Navy's plans. I believe it shows that much more study is needed before any plans are finalized.

These problems are limited to the actual disposal of the subs. I realize that the Navy has a problem with these subs, but there is never a hint of scaling down production of more subs until an acceptable solution to this problem. H.12 At the least, the Navy should consider disposal costs as part of the overall cost of the ~~sub~~ so that cost of disposal should not be a factor in the disposal process. O.4

I strongly request an extension of the public comment period. I reject the argument that these dangerous machines are being manufactured to defend the United States citizens.

Sincerely,

Ron Shuler

#408

Dear Captain Wagner,
As concerned citizens and parents we
plead with the Navy to reconsider it's plans
to dump 100 nuclear submarine power plants
in the ocean (either Atlantic or Pacific). It is
our belief that to dump highly radioactive waste
J.76 | into the ocean without sufficient monitoring
L.1 | methods or sufficient knowledge of the effects
of radiation on the ocean environment would
be a grave mistake. We as people know very
little about the effects of radiation produced
by these power plants because they have not
been around for a long enough period of time
to study & determine just exactly what this
type of radiation does and we should not be
expected to make assumptions about what would
Q.13 | happen under such adverse conditions of pressure,
time and corrosion.
After reading the summary written by the
Navy we have become even more concerned. Most
of the Navy's "facts" are based solely on
assumptions and not concrete scientific data.
The report at it's best is fiction. The navy
seems more concerned with cost than human
N.3 | life or the ecology of the planet. Why are
the subs being decommissioned and trashed
in the first place? In this age of ever dwindling
resources and abounding pollution it would seem
the correct plan of action would be to restore
G.3 | and update these submarines to fit our current
needs. We cannot go on producing more of this
indisposable radioactive waste, why not redirect
the studies and research into recycling these
already radioactive materials. In this fashion
we would not have to worry about where
to put all of this highly dangerous waste.
If the subs are to be dumped we
would urge the Navy to use a land dispo
site so at least we could keep an eye on t
sites in case we ever needed to reinforce
storage containers to prevent leakage. There
would be no known way to retrieve t | W.1
subs on the ocean floor in such a ca
With the ocean being such an import
element in our food chain radioactive leakage | L.36
there would be a potentially greater risk to t
entire world.
Thank you for lending your ear
to this problem.

Kevin & Gretchen Crosson

3-22-83

634

#409

Mar 20

Dear Sir

Please — re-consider
fight along with us.
We resent it that our
government considers us
to be the victims who
are unfortunate to pay
the price for "progress".
We do not want our
ocean contaminated.

Sincerely.

Mr. & Mrs. Jos. Halleen

P.O. Box 197
The Sea Ranch
Ca 95497

#410

Janet I. Tatz
P. O. Box 779, Boulder, Montana 59632

3-21-83

Dear Captain Wagner,

I am writing to you today
to express my thoughts and
concerns regarding the DEIS
on the disposal of decommis-
sioned naval submarine
reactor plants. I feel that
L.39 there are too many unknowns,
L.1 too little and insufficient
information presently available
to allow for disposal of these
submarines into the ocean.
The health and environmental
consequences of such oceanic
dumping has not been fully
investigated or resolved. For
that reason, I am opposed
to the "ocean option" for
disposal of your 100 or so
nuclear submarine reactors.

Unfortunately, as you know,
there does not exist any safe
long-term storage (burial)
facility for these subs, either.
So the dilemma is compound-
ed. Obviously, it is too late
now for wishful thinking.
Without adequate & safe means
to dispose of these highly radio-
active subs, they never should
have been commissioned in
the 1st place. Be that as it
may, the problem now
lies in devising some safe,
sane, long-term disposal
site. Dumping these radioactive
subs into the ocean may
leave the problem out of

#410 (Cont)

Janet I. Tatz
P. O. Box 779, Boulder, Montana 59632

(2)

sight, but certainly not out of mind or out of danger. There is currently too many unknowns, too many life-threatening risks involved to opt for the ocean dumping option.

I hope you will reject the "ocean option" for nuclear sub disposal. Perhaps, in time, some safe, remote burial site will be prepared for acceptance of yours, and other's, nuclear waste. In the mean time, I hope no more nuclear submarines are built. Obviously the problem of disposal of these vessels is too complex and dangerous to the environment and humanity to allow for further production of nuclear waste producing vehicles.

For all our sakes, and the sake of future generations to come, I hope you will hold off dismantling and disposing of these vessels until a well-tested (burial) site is found. | G.2

Sincerely,

Janet Tatz

#411

3-22-83

DEAR CAPTAIN WAGNER,

I AM WRITING THIS LETTER TO EXPRESS MY DISPLEASURE AT THE POSSIBILITY OF DEPOSITING NUCLEAR SUBMARINES IN THE OCEAN NEAR MENDOCINO OR FOR THAT MATTER IN ANY OTHER AREA IN THE OCEAN. — I DO NOT CONSIDER MYSELF A DEVOUT ENVIRONMENTALIST BUT THE PRESIDENT OF A SMALL CORPORATION WHO SIMPLY ENJOYS THE OUTDOORS AND AM CONCERNED ABOUT MY INDIVIDUAL AND MY CHILDREN'S RIGHTS TO BE ABLE TO ENJOY A OCEAN FREE OF NUCLEAR WASTE. — I REALIZE YOU ARE IN A POLITICAL SITUATION BUT HOPE THAT YOU WILL DEEPLY SEARCH YOUR DEPTHS AS A HUMAN BEING AND BE COUNTED AS A MAN WHO STOOD UP FOR WHAT HE KNEW WAS MORALLY RIGHT.

THERE ARE ALTERNATIVES; NUCLEAR WASTE
G.2 COULD BE STORED IN TICODE 12 ALLOY CONTAINERS LOCATED IN CONCRETE BUILDINGS (ON LAND) UNTIL SUCH TIME AS WE FIND A PERMANANT SOLUTION TO DISPOSAL
W.1 — ONCE IN THE OCEAN THE SUBS WILL BE IRRETRETRIEVABLE.

I WILL CONTINUE TO GIVE MY FINANCIAL SUPPORT TO OPPOSE THIS OCEAN DUMPING AND HOPE I WILL HEAR YOUR VOICE ECHO OUT ON THE SIDE OF HUMANITY

YOUR SINCERELY

Michael Tuck

MIKE TUCK
502 EDGEWOOD RD
REDWOOD CITY, CALIF 94062

#412

Ellen & David Drell
6150 Hearst Rd.
Willits, Ca. 95490

March 22nd, 1983

Senator Pete Wilson
U.S. Senate
Washington D.C. 20510

Dear Senator Wilson, re: off-shore dumping of nuclear submarines

We urge you to protest the dumping of nuclear submarines off the coast of California, or in any part of the ocean!

Ocean dumping is an irresponsible and medieval solution to disposal of this highly toxic and massive form of waste. "Out of sight" in this case, will most probably mean not "out of mind" but in mind and in body inevitably via the food chain. L.36

Quite frankly, I don't know what we should do with these useless and toxic subs. But it seems quite obvious that the most dangerous place is out of sight and out of control in an ocean trench.

We urge you therefore to pursue all other possible methods of containment, for surely, if containment is difficult on land, it must be virtually impossible in the ocean. L.20

Perhaps total dismantlement and then equitable disbursement of tiny pieces to every household in America is the only just method of disposal until a scientifically proven method of containment is discovered, as presumably we have all reaped the benefits of this defense system.

Thankyou for your attention to this matter.

Sincerely,
Ellen Drell David Drell
Ellen & David Drell

cc: Senator Alan Cranston
United States Navy

638

#413

DEAR CAPTIN EDWARD WAGNER -

I'M CONCERNED ABOUT THE NAVY'S DISPOSAL OF SUBMARINE REACTOR PLANTS IN DUMPING THEM OFF THE COAST OF CALIFORNIA.

I FEEL BECAUSE OF THE TOXICITY OF NIOBIUM-94 OVER THE LONG RANGE WOULD BE THE MOST TRAJIC EVENT EVER TO HAPPEN TO THE HUMAN RACE, IN WHICH DEPENDS ON THE OCEAN FOR ITS FOOD. WE CAN NOT

L.36 EVEN TAKE A CHANCE OF CONTAMINATING OUR FOOD CHAIN.

AND UNDER THE ANDERSON AMENDMENT TO OCEAN DUMPING PASSED JAN. 5,

F.2 1983 IS IN A DIRECT DEFIANCE OF THE CONVENTION ON BAN FOR INTERNATIONAL OCEAN DUMPING OF RADIOACTIVE WASTES.

IF WE START DUMPING OTHER COUNTRIES WILL FOLLOW & WE CAN NOT

F.8 DEPEND ON THEM FOR CAREFUL CONTAINMENT OF THEIR OWN RADIOACTIVE WASTES.

LOOK WHAT HAPPEN OFF THE FARLON ISLANDS WITH THE DUMPS 30

L.6 OR SO YEARS AGO. THE OCEAN IS JUST TOO PRECIOUS & WE CANNOT AFFORD MISTAKES OF ANY KIND. NO MATERIAL IS RESISTANT TO THE

L.20
Q.13 OCEANS SALT WATER & ABRASIVE ACTION. WE MUST START THINKING ABOUT OUR FUTURE & CHILDRENS FUTURE.

I WOULD LIKE TO SUGGEST AN EXTENSION ON THE DEIS A MORE

J.15 TIME FOR LOCAL HEARINGS & WORDS FROM THE FOLKS WHO LIVE IN AND AROUND FT. BRAGG & EUREKA AREA

PLEASE DO MORE HONEST RESEARCH ON THIS BEFORE YOU ACT WITH OUT THROUGHT & KNOWLEDGE OF THE IMPLICANTIONS OF SUCH DRASTIC STEPS THAT INVOLVE EVERYONE WHO LIVES ON THIS PLANET & DEPENDS ON THE OCEANS FOOD CHAIN FOR SUBSISTENCE.

THANK YOU SO MUCH.

SINCERELY,

[signature]

R. [illegible]
404 SF BLVD. #12
SAN ANSELMO CA 94960

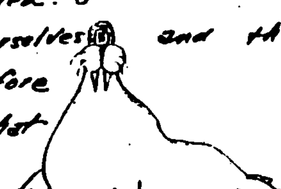
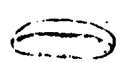
#414

March 24, 1983

Dear Captain Wagner –

We attended the Public Input Hearing on February 24th, 1983 in Sacramento, California regarding your proposed ocean disposal of 120 Nuclear Submarines off the coast of Mendocino, California.

We are concerned citizens who wish to advise you to abandon, not only the dumping of these 120 submarines, but
H.12 also to have you refrain from the construction of any more Nuclear Powered submarines until you find a disposal system to effectivly eliminate the toxic wastes.
L.20, J.76 In the ocean you have no way to monitor the leakage of radiation (which could last thousands of years).
J.6 If this plan is as safe as you claim (which we don't believe) why did you abandon the area to be used near San Diego because of the larger population there? Obviously someone is being deluded and/or manipulated.

Please look at yourselves  and this issue more honestly before you make a decision that will effect the lives 

- 2 -

of not only ourselves, our children, but also the earth that we need for life and evolution.

We are all connected in this world (ocean - earth - plant - air - animal - and man) in a beautifully balanced system that cannot have one part injured and polluted without hurting another part and eventually ourselves.

You must find another solution to this problem you have created, and become more responsible in regards to further construction of these submarines. H.12

Peace,

Tom Strong
Sandra Strong
Randy Pielinski
[illegible]
Ralph Strong
Linda Strong

Strong
24000 Sherwood Rd.
Willits, California 95490

#415

27 March, 1983

Emmett CARSON
301 Lark Drive
Lafayette, Louisiana 70508

Capt. Edward F. WAGNER
Ofc. CNO (OPNAV-22)
Dept of the Navy
Washington, D.C. 20350

Dear Captain WAGNER,

Only in the last few days was I made aware of the DEIS released by the Navy in December of 1982 concerning the disposition of defueled Naval submarine reactor plants.

I am unable to obtain a copy of this Statement from Baton Rouge to study in time to meet the 31 March 1983 deadline for public comments and therefore respectfully request that this be considered the first of a two-part letter; the second part to follow in a few days.

My background for these comments locates me as neither a strong critic nor advocate of nuclear power and only slightly more knowledgeable about the physics of nuclear emissions than the average layman.

In assuming that the DEIS proposes disposal of the reactor plants in an ocean trench, or deep, I do have comments and reservations about such action.

L.20 The first problem which comes to mind is that of encasement and isolation of the radioactive structure to prevent erosion and dispersion. Since some of the isotopes involved have a half-life measured in centuries the encasement would be required to remain intact at least that long in order to prevent said dispersion of particles which make up the reactor heat exchanger, exchanger fluid medium, containment walls, etc.

While I realize the initially dangerous Gamma radiation produced by isotopes with approximately three week half-life would be reduced drastically in much less time than the centuries just mentioned it will <u>always</u> be present; just as the frog who hops halfway to the pond on each leap never reaching the water. Along with the soft, long term Alpha and Beta radiation which can be stopped by a piece of paper or human skin we have what appear relatively benign villans in our discussion.

We have been told that there is no current in the depths of the World's oceans.

We have also been told that for all practical purposes there is no significant life in the 20,000 plus foot depths at which these spent reactors are to be deposited.

I have my doubts about the validity of both these points. Studies of currents at depth have been random and short term and did not take into account possible suboceanic plate shifts (earthquakes) which could cause pressure pulses that would damage an encasement and disperse its contents. J.28 F.22

Asfor marine life at these depths, the indisputable fact is that it <u>does</u> exist, albeit very sparse, and it is part of the food chain which might bring microscopic particles from a ruptured encasement to your dinner table. U.1

Herin lies the problem of which you are probably more aware than I, Captain Wagner - the cumulative effect: how to keep material radiating weakened Gamma rays and soft Alpha and Beta particles, normally harmless outside the body, from entering the food chain and accumulating forever in the organs and bone marrow of people for generations to come.

#415 (Cont)

G.2 I dislike offering criticism without a practical solution in mind but do feel that no matter where the spent reactor plants are disposed of top priority should be given to encasement and acc-

H.16 essibility for retrieval at a later date when the cost of space travel becomes feasible enough to launch the waste into the Sun.

Fusion power offers much promise as a future power source and could eliminate the disposal problem and inherent danger of fission reactors. If there is no immediate solution available to this problem of permanent disposition of radioactive material it is incumbent upon us to expend, absolutely, whatever possible effort and financial resources are available to at least contain our

G.2 own generation's wastes in a stable form to be retrieved and disposed of properly by future generations.

Respectfully submitted

Emmett Carson

Emmett CARSON

#416

March 23, 1983

Captain Edward F. Wagner -

As an environmentalist, I am deeply concerned for the preservation of nature and the well-being of all life on this planet.

I strongly oppose the U.S. Navy plans to dispose of as many as 100 of its nuclear submarine reactors in the ocean waters.

The "ocean option" means that the disposal of each submarine will equal half of the total radioactivity known to have been dumped in American waters since the end of World War II.

L.1 Insufficient information is presently available to permit realistic evaluation of the health or environmental consequences.

I OPPOSE THE "OCEAN OPTION"!

Sincerely -

Don Schrader

Box 171

Dakota

Ill.

#417

Hummock Pond Rd.
Nantucket, MA.
02554
March 23, 1983

Capt. Edward F. Wagner
Office of the Chief of
Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C.
20350

Dear Sir,

I think your proposal to dump decommisioned sub. reactors in the Sea is unintelligent. Please Find a better way.

I live on Nantucket Island. We are 30 miles at sea.

Sincerely yours,

Carl K. Borchert

#418

March 21, 1983

Capt Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Dept of the Navy
Washington, D.C., 20350

315

Dear Sir:

I'm writing to you as a result of proposed plan to dispose of Decommissioned Defueled Naval Sub Nuclear Plants.

I implore you not to stuff them into the sea. Don't you have any conscience about the welfare of others (?) who would be jeopardized by the tremendous amount of radioactivity released by these decommissioned subs? L.20 Please study the information I'm enclosing about this matter.

We have not been responsibly represented by you to protect our well-being because this situation has been allowed to develop this far. Someone has to have some backbone. This has gone too far enough!

You are not just messing with your own welfare but those of millions & billions. You don't have the L.1 knowledge to decide this dumping is your [illegible]. On behalf of the billions now living & those of the future who want to live healthy, fulfilled lives no more dumping on us!!!

Sincerely,

Ronald Yoerger

Mr. Ronald Yoerger
4R Paloma Ave. Apt.#3
Venice, CA. 90291

#419

CHARTERED 1693
COLLEGE OF WILLIAM AND MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE

Gloucester Point, Virginia 23062 Phone (804) 642-2111

29 March 1983

Captain E. F. Wagner
U. S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Washington, D. C. 20350

Dear Captain Wagner:

Enclosed are my comments on the Navy's E.I.S. concerning disposal of decommissioned submarines. As you will note our research group has been working on the ecology of the NW Atlantic continental rise for the last ten years. I have restricted my comments primarily to the biology of the Atlantic Study Areas. In general the Atlantic Lower Rise Area is a poor

J.9 one for your purposes. However, I believe that the Hatteras Abyssal Area may hold promise for reactor plant disposal. Detailed studies of the bottom currents (particularly "extreme events"), and studies of the mobile benthopelagic nekton should be conducted there to properly evaluate the probability of nuclide dispersal to shallow water ecosystems. I hope these comments and supporting citations are of some value to you. Please keep me informed of further developments including future Impact Statements or Requests for Proposals related to the submarine disposal problem.

Sincerely yours,

J. A. Musick
Senior Marine Scientist

JAM/gbr

Enclosure

Comments to the United States Department of the Navy on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

by

J. A. Musick
Senior Marine Scientist

Virginia Institute of Marine Science
School of Marine Science
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March 1983

Marine Resource Report #83-2

#419 (Cont)

My comments will deal primarily with biological phenomenon or with pertinent physical or geological information published in the literature but omitted or ignored in the E.I.S. I am not qualified to evaluate the engineering aspects of this E.I.S. and have assumed that the models presented for corrosion, sinking and impact, etc. approximate real conditions. In addition most of my comments will concern the Atlantic disposal sites which are located in a deep-sea area with which I am reasonably familiar (Musick, 1976, 1979a; Musick, et al, 1975 Musick and Sulak, 1979; Markle and Musick, 1974; Sedberry and Musick, 1978; Wenner and Musick, 1977).

Two Atlantic disposal areas have been proposed: The Lower Continental Rise Area off Virginia and North Carolina (72° 22.5'W-70° 30'W, 34° 45'N-37° 0.7.5'N), and the Hatteras Abyssal Plain Area southeast of Cape Hatteras North Carolina (71°W-75°W, 31°N-36°N). Both of these areas appear to satisfy the generic requirements for selection as radioactive waste dumpsites outlined on page 3-6 of the E.I.S. However, there are several potential problems that have not been addressed or convincingly resolved particularly with regard to the Lower Continental Rise Area. I shall deal with these in order below: J.4

1. The E.I.S. draws heavily on a theoretical model for physical-biological transfer proposed by Robinson and Mullin at a workshop supported by Sandia in 1981 (Mullin and Gomez, 1981). Based on this model the E.I.S. states (page H-3 and elsewhere): "the transport of radionuclides from the ocean bottom to the surface reveals that biological transport is one-thousandth of the physical transport". The E.I.S. fails to note that this model was severaly criticized by other working groups at the same workshop. For instance, the Radioecology group wrote: "... it appears to us that too much emphasis is being placed on large-scale physical oceanography models and not enough on simple submodels of the biological and radioecological aspects of the radionuclides themselves." The Robinson-Mullin model is predicated on nuclides entering the water above a disposal site with the subsequent transport of the nuclides in the water away from the site. The E.I.S. uses the same sort of model (Appendix H) even though it states: "It is anticipated that a large fraction, perhaps as high as 95 percent of the corrosion product particles carrying radionuclides would settle to the ocean floor either through direct deposition or by removal by the detritus particles" (pp H-2, H-3). If this assertion be true, nuclide ocean dispersal models based on simple eddy diffusivity seem to be inappropriate. Rather, bioaccumulation within the benthos and subsequent concentration within benthopelagic predators may provide a more important pathway for dispersal of nuclides like Ni-59 away from abyssal dump sites. U.5

2. The Lower Continental Rise Area is located in a region heavily influenced by the Western Boundary Undercurrent (WBUC); a point mentioned but not stressed in the E.I.S. The WBUC is characterized by a dense layer of suspended particulate matter called a nepheloid layer (Eittreim et al, 1976) which is maintained and transported by the current to the southwest. Gardiner and Sullivan (1981) recently discovered that such nepheloid layers in the deep sea may be subject to frequent and sudden increases in density caused by benthic storms. These density increases may be caused by resuspension of sediments during the passage of severe atmospheric storms. Radionuclides adhering to sediment particles could be resuspended, by benthic storms and carried by the nepheloid layer toward the continental slope to the southwest off North Carolina. The E.I.S. states that the WBUC is deeper than 1800 m. J.4, J.5

#419 (Cont)

J.5, J.4

This is incorrect. The WBUC sweeps to within the 1100 m isobath off North Carolina (Rowe and Menzies, 1968). Physical transport of radionuclides adhering to sediment particles transported by benthic storms might be orders of magnitude higher than that calculated on the basis of eddy diffusion models in the E.I.S. Models including inputs for transport mitigated by benthic storms directly to the 1000 m isobath off North Carolina should be included in the final E.I.S.

U.5

3. Radionuclides introduced into the nepheloid layer could enter benthopelagic food webs. Such webs are probably very important in the deep sea (Marshall and Merrett, 1977; Sedberry and Musick, 1978) and the biomass of benthopelagic organisms may equal or exceed that of benthic organisms in some deep sea regions. Transport of radionuclides by components of food webs may be important in two ways:

a. The dominant benthopelagic predator/scavenger on the lower continental rise off Virginia and North Carolina is a large rattail fish, _Coryphaenoides armatus_ (Musick and Sedberry, 1979). Although we have studied the fishes in the vicinity of the Lower Continental Rise Area for ten years and have found _C. armatus_ to comprise as much as 90% of the biomass of fishes deeper than 2800 m, we have never captured any individuals with fully ripe gonads, nor have we captured more than a few small individuals (Middleton, 1979). We have suggested that _C. armatus_ may migrate to boreal latitudes to spawn, as one of its congeners is known to do (Musick and Sulak, 1979). Most macrourids including _C. armatus_ lay large numbers of pelagic eggs that probably develop in the upper part of the thermocline. These eggs may provide a means by which radionuclides could be transported from the abyss into epipelagic ecosystems. Also, it is significant that _C. armatus_ has been shown to concentrate Ni (at least in its liver) (Greig et al, 1976) because Ni-59 is the isotope of critical interest in the current E.I.S.

In summary, _C. armatus_ could concentrate Ni-59 while near the dump-site, then subsequently migrate to boreal latitudes where its nuclide-contaminated eggs could be introduced into epipelagic food webs. The significance of such a transport route is not clear because of lack of information about residence time of individual fishes and nuclide uptake rates. We currently have sufficient data to estimate standing stocks of _C. armatus_ near the Lower Continental Rise Area but not to estimate production or flux through the area. U.5

An effort should be made to collect information on such parameters, and then appropriate models can be tested.

b. Radionuclides in the nepheloid layer that are carried to near the 1000 m isobath could be incorporated into mesopelagic, benthopelagic, or benthic food webs there. All three food webs can lead to transport upslope and ultimately into resources consumed by man. Most fishes (and many zooplankters) in the mesopelagic zone (100 m - 1000 m) make vertical migrations toward the surface at night, where they are subject to predation by tunas, billfishes and other predators (Marshall, 1979). Some of the dominant benthopelagic fishes such as _Nezumia bairdii_ and _Coryphaenoides rupestris_ make seasonal upslope U.5

#419 (Cont)

migrations from below 1000 m to shallower depths (500-1000 m) (Middleton, 1979). While upslope these species are subject to predation by several large epipelagic predators such as blue sharks (Prionace glauca), and more importantly, sword fish (Xiphias gladius). The latter species is subject to a long-line fishery along the continental slope off North Carolina during the cooler months of the year. Among the benthic fauna, the red crab, Ceryon quinquedens, is a dominant from 400 m to ca 1200 m. The juveniles live >1000 m and make an ontogenetic migration upslope as they grow (Haefner and Musick, 1974; Wigley et al, 1975). The species is the object of a developing fishery and is one of the most important underdeveloped resources off the East Coast. Crustaceans tend to concentrate Ni, but in general, Ni is highest in the chitonous exoskeleton and lowest in edible flesh (Eisler, 1981).

U.5

4. The information given in the E.I.S. and supporting documents (Talbert, 1982; and Appendices) about the biology of the Atlantic sites is woefully inadequate. Even much of the pertinent biological literature has not been cited.

5. The development of an exposure pathway model in Appendix I (I-2) is based on an equilibrium situation for isotope release. This might be justified if isotopes went into solution and were dispersed according to the eddy diffusion models criticized earlier. However, if (as the E.I.S. asserts) the major isotope released is Ni-59 as corrosion particles which settle in the sediments close to the submarines, will the build up of Ni-59 in the sediments be at a slower rate than the turnover rates of nickle in these sediments, or will Ni-59 become concentrated there? What are the turnover rates of nickle in the sediments at each of the Atlantic sites?

U.5

6. In Appendix J (J22-24), in the calculation of the "worst case dose commitment", a different method was used to compute the hypothetical concentration of isotopes in fish. Whereas in other models based on exposure of fish 250 km away from the dumpsite (after considerable dilution of isotopes) a recognized concentration factor of 5×10^2 was incorporated to reflect the tendency of fishes to concentrate Ni from the environment (Table: I-3). In the calculation of "worst case dose commitment" where fish are theoretically exposed to relatively higher concentrations of isotopes in the sediments, no concentration factor was used. Instead concentrations of isotopes in fish were calculated on the basis of average Ni concentration found in fish tissues (from the literature). Such measurements are usually given in ug/kg (Young, 1979). To the contrary, Creig et al (1976) showed that C. armatus, (the dominant large fish at the Lower Slope Area) concentrates Ni (.82 mg/kg) at a level an order of magnitude or more higher than that apparently used in the E.I.S.

T.14

In general, the Lower Continental Rise Area is a very poor choice for a nuclear waste site. The area is subject to strong periodic currents that sweep toward the 1000 m isobath off North Carolina. In addition, large migratory fishes are fairly common there. Conversely, the Hatteras Abyssal Plain Area is relatively tranquil (though subject to rare periodic turbity currents). The physical oceanography of this area (so far as known) would tend to minimize transport of isotopes away from a dump site there.

J.4

In addition, contrary to that implied (out of ignorance) in the E.I.S., the fauna at the Lower Continental Rise Area and at the Hatteras Abyssal Plain Area are not essentially the same. Several workers have shown that the benthic macro-invertebrate fauna changes considerably between 4000 and 5000 m

J.26

(Menzies et al, 1973; Rex, 1981) with lower biomass and diversity in the deeper area. We have no data on fishes from directly within the Hatteras
J.26 Abyssal Plain Area, but we have trawled at similar depths in the same water mass to the south and east. The fish fauna there is much lower in biomass than on the continental rise, and more importantly, the large migratory predator-scavengers like C. armatus are rare or absent.

My recommendations are to reject the Continental Rise Site, and to explore further the Hatteras Abyssal Plain Site. Of particular importance
J.4 is further work on bottom currents there, particularly in the south-east corner (which seems geologically most acceptable), and a survey of the benthic and benthopelagic nekton. The latter objective can most efficiently be achieved by using deep otter trawls, although fish traps would be more appropriate for monitoring fishes immediately adjacent to sunken submarines after disposal. The concept of disposing of nuclear submarines as proposed by the U. S. Navy in the E.I.S. should not be rejected out of hand (as some environmental lay groups have suggested). The deep ocean, particularly the abyssal areas, may provide relatively remote sites where noxious wastes may be disposed of safely. Indeed, some long-lived xenobiotics such as DDT and PCB's ultimately reside in such deep-sea ecosystems after being transported there by natural, meteorological, oceanographic, and/or biological processes (Musick, 1979b). Faunal impact in abyssal areas would probably be insignificant from a demographic point of view. Even if the fauna were disturbed or destroyed over a 100 mi^2 area, a relatively small number of organisms would be involved because energy availability and density of organisms there is among the lowest of all habitable regions on the earth. In addition, the species that occur there have wide distributions over entire ocean basins, or even circumglobal.
J.4 (Because of such low population densities such species could never support commercial fisheries.) Use of abyssal waste disposal areas such as the Hatteras Abyssal Plain, should be pursued only after adequate studies are made at specific sites in question. Much remains to be done at the Hatteras Site proposed in this E.I.S.

#419 (Cont)

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#420

SIERRA CLUB South Carolina Chapter

To explore, enjoy and preserve the nation's forests, waters, wildlife and wilderness

March 29, 1983

Capt. Edward F. Wagner, U. S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
Washington, DC 20350

Dear Capt. Wagner:

As Nuclear Coordinator of the South Carolina Chapter of the Sierra Club, I am writing on behalf of some 1600 concerned members throughout South Carolina.

First I would like to commend the Department for organizing a DEIS that is concise, well-written, and oriented toward the general public, quite in contrast to the usual DEIS written by DOE.

With respect to the disposal of decommissioned sub reactor plants, I have several concerns; these are addressed below according to the category for disposal.

SEA DISPOSAL OPTION

L.24 1. What is the actual thickness of the metal in the bulkheads and reactor pressure vessel, etc.? This does not seem to be stated in any of the sections. Using data presented in F-1--F-9, the bulkhead metal (low alloy steels), if ½" thick, could corrode through in 100 yrs at the long-term rate of 5 mils/yr. With a suggested pitting factor of 46, an inch-thick reactor vessel could perforate in 58-59 yrs (5.9mils/16 yrs x 46). These times and assumed thicknesses would change the stated value of X_w (J-32, 33), resulting in a D_1 value significantly greater than 5.2×10^{-12} mrem.

S.26 2. Moreover, the use of Table H-4 in these calculations for X_w is misleading in that this table is based on "pathway entry points" for fish. I believe a more credible value for X_w should be calculated from Table H-2 where the Ci/m^3 in sea water is that for the disposal site, i. e., Ni-63 = 1.1×10^{-9} Ci/m^3 rather than 4.2×10^{-19} Ci/m^3 as stated in Table H-4.

U.9 This is particularly relevant based on research done by William Schell at Hudson Canyon, June 1978. His data indicate a food chain, 2½ miles down, culminating in edible rattail fish. This is a site very much like those under consideration for disposal, and contradicts the statement on J-22 that no bio-pathways are known for deep ocean organisms linked to man.

Q.13 3. Data reported on F-23,24 do not adequately treat changes in corrosion rates in sediments as compared to sea water, especially

anaerobic sediments. The DEIS admits the evidence is limited and that the brief ocean experiments conducted to date would include any biofouling. However, the time span involved is less than four years, far too low to be indicative. Further, this time span does not account for possible sediment changes as a result of colonization or the "artificial reef effect". L.55

4. At a depth of 14,000 ft and a falling weight of 1000 tons, how far into sediments could the compartment sink? This could be important if the sediments have a different corrosion rate factor. Q.13

5. For someone standing 6 ft from the shipping compartment (B-23), radiation exposure will not exceed 10 mrem/hr. If one assumes a shipping time of 60 days, exposure would be 60 x 24 hrs x 10 mrem = 1440 mrem. Similarly, after land burial, the exposure at the site of a buried compartment is 0.1 mrem/hr., or for a year, 876 mrem (0.1 x 24 x 365). Both of these values are within acceptable ranges according to federal regulations. However, radiation/health experts such as J. W. Gofman, M.D. feel that such amounts added to the national average exposure value of 160 mrem per person will increase cancer rates. Contrary to earlier evidence, more recent data indicate there is no safe threshold below which radiation-associated cancers do not occur. The above figures may seem trivial, but they may not be when added to all the other "trivial" sources to which people are exposed. K.13

6. The suggested monitoring plans are inadequate in view of questions concerning rates of corrosion. Long-term monitoring is needed and would be nearly impossible with the sea disposal option. J.76

7. How will "brittlization" of the metal from radiation affect the reported corrosion rates? Q.13

8. In Appendix G several estimates of Ci/yr release over time are given. These graphs and tables are somewhat misleading in that some are based on 100 sub compartments while others are based on one sub compartment. In addition, there are no tables and graphs for "expected containment with maximum corrosion rates". Why? R.2
Also, on G-2 it states that the "corrosion rates are the highest average rates taken from Table F-1". But are these "average" values the long-term or one-year values? R.22

9. Finally, even without the above concerns, there is a general mistrust of sea dumping in view of the dismal history of past disposal errors and misjudgements. These are well summarized in National Wildlife, Vol. 21:20, April-May, 1983.

LAND DISPOSAL OPTION

I would agree with suggestions made at public hearings that perhaps the best alternative (but not the cheapest) is to continue the present protective storage at least until more data are collected on corrosion rates and dispersal under actual ocean conditions. But if one must choose between land disposal at either Hanford or the Savannah River Plant (SRP), then several factors should be considered. G.2

#420 (Cont)

Sierra
p. 3

1.9 1. Hanford has a water table depth of 100-150 ft, SRP, 45 ft. Rainfall at Hanford averages 6.25 "/yr, SRP, 47"/yr. Given that the compartment is 33 ft in diameter and that it must have 10 ft of undisturbed soil beneath it and 4 ft above it after burial, SRP would hardly appear to be a good choice since a total of 47 ft exceeds 45 ft!

2. The monitoring of radionuclides at SRP is done by DOE, not an outside agency. I have asked EPA personnel (Region IV, Atlanta) about possible EPA monitoring at SRP, but they tell me that they have been denied permission to do any monitoring on SRP grounds. I think this situation compromises any relevant data.

1.9 3. Barge transport on the Savannah River, contrary to the DEIS, is uncommon in the Augusta area. Further, the need to ship compartments during low river levels has enough potential problems to make the Hanford site far more suitable.

4. The extensive dredging needed for such barge traffic on the Savannah River would require an EIS.

Considering the costs of spent fuel rod and sub compartment disposal, I can't help wondering if a nuclear navy is really cost effective.

In closing I would like to add that the 90 day period for public comment allows too little time for input on a complicated, but obviously important proposal.

Thank you for this opportunity to express our concerns.

Sincerely,

Judith E. Gordon

Judith E. Gordon, PhD, Savannah River Group, Sierra Club
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#421

Written comments on the December 1982 U.S. Department of the Navy's
Draft Environmental Impact Statement on the Disposal of Decommissioned,
Defueled Naval Submarine Reactor Plants
by Bruce Campbell March 28, 1983

The DEIS admits that the Pacific Study Area (west-south-west of Cape
Mendocino) is on the "outer fringe of the general fishing area." It is
obvious that Reagan's extension to 200 miles off our coasts for the sole
exploitation of the U.S. will force Japanese, Russian, and other fisher-
people to an area just west of the proposed radioactive submarine dump-
sites. Increase in awareness (particularly in the North Coast of Calif.)
about the dangers of dioxin will tend to move some domestic fisherpeople
further west so as to elude dioxin contaminants entering the Pacific
Ocean coastal areas from streams and rivers; these dioxin contaminants
are an inescapable component of phenoxy herbicides sprayed widely as a
part of "forestry practice" in this and other areas of the northwest.
There will soon be massive increases in the quantities of heavy metals
entering the Pacific in Oregon and Northern California, due to plans to
strip mine the "laterite belt" of Oregon, and especially that portion of
the belt in Del Norte and Mendocino Counties in California. So, this
J.12 allegad "fringe area" will likely be the center of the rich fishing area
within a few years.

Besides dioxin and heavy metals in streams and rivers emptying into the
Pacific Ocean, it cannot be assumed that the radioactivity from these
water sources are natural. For example, this DEIS uses an aged study, the
I.4 National Research Council study of 1976 to prove that past (and allegedly
current) practices at Hanford (and Savannah) have caused "no measurable
harm to human health." Since 1976, it has been discovered that massive
amounts of high-level nuclear waste has leaked into the Columbia River and
entered the Pacific, forming a plume of radioactivity reaching, coinci-
dentally, to the waters off the Mendocino coast of California. Would the
DEIS assume that radioactivity from the Columbia and Savannah Rivers are
L.6 "natural background." The past radioactive dumping off the Mendocino
coast must be accounted for as well. Could a falling sub land on a
previously-dumped 55 gallon drum of radioactive waste?

After admitting that "The biology of the deep waters and the sea floor"
"is little known at present," it is odd and presumptuous to conclude that
photographs indicate that "population density is low, relative to near-
shore areas, with none of the sea life used by man or part of the food
chain leading to man." I have personally witnessed abundant sea life in
tidepools by Mendocino Headlands State Park, so it is possible further
offshore could have relatively less life, but still be quite abundant.
L.36 It is arrogant, naive, and unscientific to conclude that none of the sea
life used by humans, or which could conceivably be even indirectly
consumed by humans could live in or pass through this area. Note your
L.55 own admission that small animals are attracted to the hulls of vessels.

The DEIS admits consistently southerly currents, usually to the south-
southeast, but sometimes to the south-southwest. Obviously, incredibly
dense populations of humans exist to thesouth of this area, including
the San Francisco Bay Area and the Los Angeles - Orange - San Diego -
Tijuana areas. I am surprised that the San Diego dumpsite is not the main
one under consideration, thus mostly bypassing the brunt of the radio-
active effect on the California coast. Yet I find this San Diego area
proposed dumpsite abhorrent and racist. If this area was chosen, it in
effect would continue Third World pesticide dumping, testing, and warfare
practices of poisoning people of other colors and their land. (Pacific
Gas and Electric, for example, secretly dumped PCBs off the Baja
California coast).

Back to the Mendocino study area, there are reports of upwelling J.31
currents capable of bringing radioactivity to the surface and then
down the coastline to populated areas. Despite the IAEA requirements
calling for avoidance of dumping in areas of "intense mesoscale eddy
activities," such activity was admitted in the DEIS. J.27

Please remind Secretary Watt that it is not commercially feasible to
explore for and extract petroleum in the Mendocino area. If the "laterite
belt" being eyed for strip mining in Oregon and NW California extends to
the ocean, it could be mined (even if not commercially feasible) due to
lame-duck Congress-passed price supports for nickel and other strategic
minerals and metals.

Any area contains natural phenomena, particularly less altered by
humans, such as the sea. The Mendocino Fracture Zone is nearby with its
associated heavy seismic and volcanic activity. The San Andreas Fault's
northernmost point is near the coast from the Pacific Study Area. The
DEIS admits that the Mendocino Fracture Zone forms the boundary between
the Gorda-Juan de Fuca and Pacific lithospheric plates. I would like to F.22
see proof that there are not quake faults or splayn related to the
Mendocino Fracture Zone below this layer of silty clay; also please prove
that a seismic focusing effect aimed at a lodged sub or that a massive
plate (thus ocean floor) shift would not damage these subs. Basically,
the Pacific Study Area is south of one of the two largest oceanic seismic
fracture zones meeting California, and west of the northern tip of the
largest fault in the U.S. Please show ocean floor seismic evidence
relating to the alleged separation of the Mendocino Fracture Zone from
the Pacific Study Area, and the PSA's ability to withstand seismic focusing J.19
effects aimed at sub lodging areas.

Rather than just being the "final consideration," the cost of disposal
appears to be the primary consideration. It seems to me that $3 million
per sub (and increased health benefits for shipworkers and their families)
is a small price to pay for assurance of more time to seek out the least N.3
hazardous land disposal option. I disagree that tying up dock space is
an evil; the evil is unnatural fission products and preparation for nuclear
war.

Besides the ocean locations and lies and naivete about containment, what
I find most disturbing about this document is its flimsy and inadequate L.20
monitoring provisions, especially in regards to time of disposal and after
disposal. Even if a sub landed gently and safely on fairly level clay and J.76
silt (with the reactor compartment and primary system intact), this is no
reason to reduce the frequency of monitoring. Who is to prove and check
out such emplacement, will it be done by machine, divers? (please elaborate
and do not reduce frequency of monitoring under any condition). I also
object strongly to (K-2 IV) "post-disposal surveys would be needed very
infrequently." When you are dealing with the most important resource on
Earth, the Pacific Ocean, and discussing some radioactive elements with
half-lives of up to 80,000 years, monitoring should be continuous for past L.6
and future dumpsites. The energy expended on this DEIS should have gone
into research of effects of past radioactive ocean dumping. EPA officials J.76
who decided not to continue monitoring past dumpsites should scuttle
themselves not more radioactivity in our oceans.

#421 (Cont)

For even an intermediate student of containment, figures given in
the DEIS as release rates are preposterously low. Equally ridiculous
are statements such as "all the radioactive nuclear fuel has been
removed" and "this defusling removes all of the uranium and all of the
A.12 fission products." What it obviously ignored here is the crud or coating
of fission products on the reactor vessels and coolant pipes. The coolant
pipes go within and outside these vessels: we need detail on about how
much radioactivity of what varieties are present in this crud or coating,
and how much is within or beyond the reactor vessel. Promises of "metal
L.20 casing" variations sound like the promises that nothing could damage 55
gallon steel drums for 40 years, while these are actually lucky to last
25 years and often were damaged during emplacement.

F.2 Even before the amendments to the Ocean Dumping Act passed by Congress
last December 24th and signed by Reagan, I disagree with the conclusions
that sea disposal of subs is "permissible under current laws" and
"consistent with existing international treaties." A judge in 1970 called
for clear EPA regulations before radioactive ocean dumping could resume.
Such regulations have not surfaced and likely have recently been delayed
from surfacing by other EPA controversies. Since there are such large
quantities of radioactive curies in each sub (50,00 to 60,000), this is
F.10 not "low-level" dumping, thus would not be permitted under the London
Dumping Convention. Obviously, subs with reactor vessels included, are
of the volume and radioactive curie content such that even one could not
be regarded as a "small quantity" or "research dumping." Thus, such
disposal is specifically prohibited by recent amendments, is not allowed
under the London Dumping Convention, and no EPA guidelines have surfaced
to allow such dumping (even if the new amendments had not pre-empted the
sub disposal possibility).

One ocean and solidarity with the poisoned Atlantic as well.

Submitted by Special Delivery mail well before March 31st
by Bruce R. Campbell
614 Gretna Green Way
Los Angeles, CA 90049

#422

March 23, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval Operations
OPNAV 22, Department of the Navy
Washington 20350

Dear Captain Wagner,

This is my first letter voicing an opinion on a public issue. This is one time I cannot in clear conscience be negligent in not speaking out against the proposed dumping of decommissioned nuclear submarines off the coast of NC or any coast.

L.53 My husband and I have 3 healthy children aged 11, 5, and 3, we moved to the coast 3 years ago. Like thousands of people we either swim, fish, go shell fishing or boating almost everyday during the summer and many days throughout the rest of the year.

N.3 There is absolutely no price tag that can be put on

L.36 the value of swimming in clean, safe water, catching and eating fresh seafood you personally catch or go out to eat. The attraction of the ocean, sounds and marshes is that it's unspoiled, rich in marine life, birds and wildlife. The beauty and complexity of these systems are a marvel, to say the least.

Now picture looking at a sunrise on the beach, wondering if it's safe to swim there, walk the beaches, sunbathe, or eat the seafood caught there. That possibility is very real, impossible to clean up, with consequences too tragic to even calculate. This unnecessary threat to people's health and livelihoods, dredges up ramifications so broad it staggers the imagination. W.1

Thank you for reading what you've no doubt have heard many times. This is such a serious proposal, a proposal that frankly I find it difficult to believe any sane, sound individual or group could support with any conscience.

Times Springs and Love Canal are just the tip of the iceberg with our hazardous waste problems. Tax payers are held responsible, not to mention the hardship and suffering of those involved.

I feel strongly about many issues but like most people, believe responsible people are watching out for the public's welfare, so writing letters isn't necessary. This is one time though that I would find the time and resources to oppose, if indeed it looks imminent, nuclear wastes will be dumped in the ocean.

I pray, Capt. Wagner, you are one person who has influence for alternative methods of disposal that will not jeopardize human life or our fantastic natural resources.

Most sincerely,
Mrs. Brenda S. Johnson
Box 8535
Wrightsville Beach, N.C
28480

P.S. I hope you personally read my letter.

654

#423

March 21, 1983

Dear Sir,

I hope you and the Navy will reconsider your position on nuclear dumping and will look for a feasible and ~~viable~~ viable solution to this difficult problem.

Save the Sea,
Tom Hartung

Tom Hartung
3421 Bay to Bay #C
Tampa, Fla 33609

#424

March 27, 1983

Capt E.F. Wagner
Offc of Chief of
Naval Operations
Dept of The Navy
Washington DC 20350

Please do not add to the pollution of the marine environment by using the ocean as a nuclear waste disposal site.

Although the ocean appears vast, it will never be vast enough to use as a permanent dump for radiation

Please don't take the easy way out. Protect our future!

Sincerely
Valerie J Weiss

JACK WEISS
1083 VEREDA DEL CIERVO
GOLETA, CA 93117

1053 Vereda Del Ciervo
Goleta, Ca 93117

#425

March 28, 1983

Beth Troy
201 K Village Ln
Greensboro, NC
27409

Dear Sir -

I am writing a quick letter to oppose the dumping of de-activated nuclear subs off the coast of N.C. I can't express how deeply this bothers me.

I've seen the summaries of the environmental impact studies. I've been studying toxic waste disposal for several years now and environmental impact studies have ~~[illegible]~~ always fallen short of the truth.

Please give us time to find another alternative. North Carolina depends on our tourist trade. No one wants to swim in radioactive waters or find out that the ocean they thought was safe has caused themselves or their children to contract cancer. | L.53

Please don't let ~~[illegible]~~ North Carolina be abused in this manner. I am begging you - please reconsider. Our future depends on you! Look to the past validity of environmental impact studies and understand my fear.

Our future is in your hands,
Beth Troy

#426

LOUISE M. HENRY
48 MORRIS AVENUE
MT. TABOR, NEW JERSEY 07878

3/26/83

Capt. Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I am writing you in regard to the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

I understand that one proposal is to dispose of these Reactor Plants in the ocean. Please, Sir, let me strongly urge you not to do this. The ocean is large, but it is not infinite. We do not yet have accurate knowledge of what the longterm environmental impact of radioactive dumping will be, but it seems reasonable to believe that just as we have killed thousands of lakes & streams with toxic wastes, so can we eventually kill the ocean.

L.1

I don't need to tell you, Sir, that our life depends on the ocean in very many ways. It's demise may not come in our time, but it will come unless we stop dumping radioactive wastes into it now.

To think that we are horribly tampering with our planet is frightening in the extreme.

Again, let me urge you, in the strongest terms I can, to use your influence to prevent dumping the Reactor Plants & other radioactive wastes into the ocean. It is a matter of planetary survival.

Sincerely,

Louise M. Henry

#427

28 March 1983

Captain Edward F. Wagner, U.S.N.
Office of the Chief Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Capt. Wagner,

I am strongly against dumping 100 nuclear submarines 2½ miles off Cape Mendocino.

We have acit rain and now you want to polute our ocean.

We don't have to worry about a war with Russia, because they can sit back and wait for us to die from our own polution.

Most ~~s~~incerely,

Beulah B. Young

Beulah B. Young
2132 Del Norte
Los Osos, Calif. 93402

#428

March 26, 1983

Captain Wagner:

In this day and age pollution building from the cutting of forests (CO_2 buildup) bad agricultural practices polluting rivers, factories polluting air, chemical waste problems, __nuclear waste__ problems, of all of these, most end up in the ocean anyway, sometimes they make it thru the food chain first, or else later by means of fish consumption, or drinking water, etc. | L.36

In the wake of this crime of the industrial age I urge you to oppose the disposal of the submarines proposed to be dumped in the ocean. I still can't understand why people can not live more simply without wasting nor a centralized government.

Sincerely yours,
Brian Hoeve

#429

Captain Edward F Wagner, USN, 3-19-83

I am writing both Senators & House of Representative members of the 98th Congress as well as State Senators & Representatives for their support toward an extended moratorium

L.1 on the dumping or burial of radioactive wastes or nuclear subs at sea. Until proper environmental studies can be done.

Edward L Smith

#430

This Slaughter Must Stop!

Please do everything in your power to prevent any dumping of nuclear submarines nuclear waste, parts, etc. into the oceans. Our wild-life & future must not be destroyed by man's abuses, carelessness, etc. Act now!

Thank you.

CAROL STRNAD
1 S 445 SCHOOL
LOMBARD IL 60148

IFAW Photo By B. Dinner

Capt. Edward F. Wagner
Office of the Chief of Naval Operations (OP-[illegible])
Dept of the Navy
Washington, DC 20350

#431

3/27/83

Dear Capt. Wagner

Regarding your planned disposal of defueled submarine reactor plants, I believe the navy has the recources to develope a safer and more secure plan involving containment of radiation until a final totaly safe solution is found. I thank you for considering this letter and future generations will thank you for taking on this mamoth problem and doing your best to solve it.

G.2

Sincerely

Charles Stova

Charles Stova
P.O. Box 16
Shingletown, Ca. 96088

#432

Capt. Edward F Wagner,

I am opposed to the idea that the U.S. Navy is going to use the oceans as a disposal for nuclear submarine reactors. The Dept. of the Navy has the resourses to study alternative ways to dispose of this waste.

Sincerely,

Mr. Howard N. Friedman

Mr. Howard N. Friedman
3021 Gay Ave.
San Jose, Ca 95127

660

#433

Briarcliff High School

444 PLEASANTVILLE ROAD
BRIARCLIFF MANOR, NEW YORK 10510

March 29, 1983

Dear Captain Edward Wagner,

An incredibly heavy responsibility seems to have fallen on your shoulders. I feel for you with every fiber in my being as the decision of what to do with this nuclear garbage is awesome.

In my mind it is a crime of the highest order to use the ocean as a dump. Especially of highly radioactive waste such as spent submarines. Although land buriel doesn't yet offer a much safer option to sea buriel the slight safety margin is important. The sea must not be allowed to reach the point of no return. In the enviornmental sense the oceans are the base line from which all life begins. Radiation is anti life and therefore to use the ocean as a dump for spent nuclear sub reactors is the height of stupidity as well as safety for the human race.

Dale Saltzman
Industrial Arts Teacher

#434

Mar 25, 1983

Dear Capt Wagner

We wish to inform you that we are vehemently opposed to dumping of decommissioned submarines in the ocean. Surely it would be safer in the long term to store these submarines on land until more effective methods of storage have been designed. A place, by the way, on land that would also be safe.

G.2

Our present administration is opposed to environmental protection. We are not and a majority of the people also support environmental protection.

Thank you

Sincerely,

Edwin & Carol Carlson
PO Box 1727
Central Valley Ca 96019

#435

3/27/83
L.S. RUSSELL
432 ORCAS ST.
MORRO BAY CA 93442

CAPT. E.F. WAGNER
OFFICE OF CNO. OPNAV 22
DEPT OF NAVY

DEAR CAPT. WAGNER

WITH REFERENCE TO RADIATION CONTIMINATED SUBMARINES TO BE SUNK OFF CAPE MENDOCINO IN A 2.5 MILE DEEP.

I SUBMIT THE NAVY HAS COME WITH A "FAIL SURE TIME BOMB" THAT WILL PLAGUE ALL HUMAN KIND AS LONG AS THEY ARE ON EARTH.

W.1 SHOULD THERE BE A BREAK-THROUGH AND THOSE SUBS COULD BE DECONTIMINATED. HOW DOES THE NAVY RE-CALL ITS TIME BOMB?

G.2 I SUGGEST THE NAVY LOOK IN TO THE FEASIBILITY OF REDUCING THOSE BOATS TO THEIR SMALLEST CONTIMINATED COMPONET SECTION AND SEALING THEM IN A REMOTE STORAGE SOME WHAT LIKE A GRAVING DOCK UNTIL THEY CAN BE TAKEN CARE OF PROPERLY

RESPECTFULLY
L.S. Russell

#436

March 24, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Capt. Wagner:

I am writing in regards to the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine reactor plants. Apparently the are two options; either disposal at sea or land burial of radioactive propulsion reactors. Some options! Well, if a decision has to be made on the lesser of these two evils, I encourage you to make a decision against disposal at sea. I am sure a man in your position is well aware of the ramifications of radioactive waste on the marine environment. I can only hope that you are a man of conviction and good conscience. We cannot continue to use our seas as a dumping ground and the concept that the solution to pollution is dilution is not only a fallacy, but a hazard as well.

As a concerned mother, I feel that contaminated oceans are a horrible legacy to leave our children. Life started in the oceans, and unless we start to make attempts to preserve them our very existence is threatened.

Sincerely,

Mary Ritter

Mary Ritter
P.O. Box 1037
Traverse City, Mich. 49684

#437

30 Midvale Ave
Millington, N.J. 07746
March 28, 1953

Capt. Edward J. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

I read about the Navy's Draft Environmental Impact Statement on the Disposal of Decomissioned, Defueled Naval Submarine Reactor Plants in the Calypso Log. As a member of the Cousteau Society I oppose ocean disposal of radioactive substances because there is insufficient
L.1 information presently available to permit realistic evaluation of the health and environmental consequences. As we continue to add to the amount of nuclear material in our planetary ecosystem we approach its breaking point. We have no idea what that breaking point is, but we do know that we have only one Earth.

Yours truly,
Carol H Jones

#438

P.O. Box 464
Willits, CA 95490
March 27, 1983

Captain Edward Wagner
U.S. Navy
Office of the Chief of Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I realize that the Navy has a problem on its hands with these nuclear submarines, but it's nothing like the problem we'll have on our hands if we decide to dump these submarines at sea in an effort to bury the problem of radio-active wastes. I'm not sure that burying submarines on land is going to be a whole lot better than at sea, but perhaps land burial will give us more time...more time for people to become aware of the insidious effects on our health of radioactive wastes.

The problem should not be yours alone to solve; nor the Navy's; the decision affects the total population of the world. There's no quick solution to this one. Please share this problem with a larger forum, and listen to what the people are saying.

Yours in the hope of a healthy future,

Karen Gridley
Karen Gridley
Health Educator

#439

March 15, 1983
J B Morninglight
1180 East Hill Rd
Willits, CA 95490

Dear Captain Edward F. Wagner,

It is not ok with me that any nuclear wastes, by-products or other related materials be disposed of in the ocean.

I live in Mendocino County. I am aware of the proposed dumping here. But it would not be an acceptable plan in any ocean (no matter how or where it is done)

J.76 I am concerned about the lack of accessibility to monitoring when wastes are disposed of in such a "schlocky" way.

It is rude, unprofessional and irresponsible to dispose of dangerous, threatening material in a life sustaining body of water.

We must keep our water and air safe. Basic survival demands air and water. Our first concern (before "national defense") must be to insure the safety of our basic survival needs (air & water). If we don't, what else is there to defend?

The ocean is the lifeblood of the earth and of life as we know it here. When people put dangerous substances in their body that's their business. But, when they want to put dangerous things into the circulartory system of the earth, which sustains my body,

2.

it is a flagrant violation of my rights as a citizen and a human being.

Being in the Navy you have knowledge of the ocean. You know the power and influence of the oceans. And, whether you accept it consciously or not, you know that the earth is a living entity and that her survival and health are intimately intertwined with ours.

I believe that it is the responsibility of each of us to respect and insure the safety of our mother earth, who gives and sustains our life (individually and collectively)

We are the stewards of this planet that sustains and defines our survival. The care and health we allow the earth to maintain will be directly reflected in the condition of our own bodies and the quality of our life.

I trust that you will show wisdom and strength in this matter. Listen to your heart and to the voices of the earth

In our oneness as brothers and sisters through our mother the earth, may we honor the spirit father with the birth of a new awareness and respect for the life that has been gifted to us.

As spring approaches may we all perform with renewed vigor, dedication and respect.

In Hope & Vitality,

JBfff
J B Morninglight

864

#440

DIANE T. LEWIS
P.O. Box 94
Honeydew, CA 95545

March 28, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C., 20350

Dear Captain Wagner:

I am writing this letter to voice my opposition to the U.S. Navy's proposed ocean disposal of 120 nuclear submarines.

Captain Wagner, do you, as an individual, (not as a representative of the U.S. Navy), truly believe that the dumping of out-moded NUCLEAR submarines into the ocean will not detrimentally affect our environment? We have had many examples in the past of our shortsightedness in regards to disposal of dangerous and toxic substances; radioactive wastes with half-lives of thousands of years stored in barrels with lives of fifty; toxic chemicals disposed of at dump sites which are now threatening the lives of whole communities; islands in the South Pacific covered with billions of dollars of concrete, still unsafe for human habitation.

Putting aside any personal support or opposition for nuclear weapons, don't you think that our top priority must be to find a method of decontamination/neutralization and disposal that will perservere into our future and the future of our country and the children of tomorrow?

We must not continue to use short-term measures in an attempt to remedy horrendous long term problems. We cannot continue with these policies if there is to be a future for mankind.

Sincerely,

Diane T. Lewis

Diane T. Lewis

#441

Admiral J. D. Watkins
U. S. Navy, Washington, D.C.
Dear Admiral Watkins

The residents of California should be afforded the opportunity to comment directly on naval intentions to dispose of radioactive material at sea. Despite a IF.2
two year moratorium on the ocean dumping of low level radioactive wastes,
the Navy still plans to evaluate future means of disposing 100 nuclear submar-
ines. With the Pacific Ocean area off Cape Mendocino designated for generic
scientific studies, the citizens of Mendocino, Humboldt and Sonoma counties
in California should have direct access to the Environmental Impact Statement
process. We therefore respectfully request that full public hearings be held in IJ.15
Fort Bragg and Eureka on the Navy's draft EIS for nuclear submarine dumping.
As the lead agency for preparation of the Environmental Impact Statement
the Navy must exercise full environmental impact review in the vicinity of
possible disposal sites. The specter of disposed radioactive material demands
maximum local participation. The conclusions reached by the Navy in its re-
cent draft Environmental Impact Statement have not in any way alleviated the
concerns of many thousands of North Coast residents.
Unfortunately, as announced in the December 11, 1982 Federal Register
the residents of Mendocino, Humboldt and Sonoma counties are being effectively
excluded from the field hearing stage of EIS review – despite generic studies
180 miles southwest of Cape Mendocino. Although the February 24 hearing
in Sacramento is appropriate, both the timing and the location would preclude
participation by the vast majority of North Coast residents.
As you know, the north coast of California is a richly diverse area represent-
ing some of the most scenic and resource-rich areas in the nation. The unique IL.53
and delicate nature of the area's natural resources is the lifeblood of its three
major industries – timber, tourism and fishing. Thus, North Coast residents
have more than a passing interest in insuring that all environmental and econom-
ic considerations be weighed against the Navy's intent to dispose of decom-
missioned nuclear submarines.
Potential dangers associated with any release or dispersal of radioactivity
in the ocean demand comprehensive assessment of all possible factors. The
residents of the North Coast must be an integral part of this assessment.
Thank you for your careful consideration.

Rabbi Hanon Sells Box 334 albion, Ca. 95410
Ella Russell Box 24 Elk, Ca 95432
Carol [illegible] Box 531 Elk, Ca. 95410
[illegible] Box 372 Navarro, CA 95463
Eleanor Lewellen Box 372 Navarro Ca 95463
Sandra Benyon P.O. BOX 391 Albion Ca. 95410
Marita Hurst P.O. Box 1214 Fort BRAGG
Kate Berrigan P.O. BOX 391 Albion cal, 95410
Jennifer Stafford P.O. BOX 63 Albion, CA. 95410
Tortuga Vine P.O Box 63 Albion, Ca 95410
Helen Sawl[illegible] PO Box 244 Albion Ca 95410
Linda Wereman PO Box 63 Albion Ca 95410

Donna Ferrer PO box 415 Albion Ca 95410
Susan Enteen BOX 565 albion, Ca. 95410

Hanon Sells
Rel-Oilem[illegible]
PO Box 334
albion Ca 95410

#442

Dena Mossar
Loma Prieta Chapter
Sierra Club
2253 Park Boulevard
Palo Alto, CA 94306
March 21, 1983

Captain Edward F. Wagner
U. S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

COMMENTS OF DRAFT ENVIRONMENTAL IMPACT STATEMENT on the DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

A primary argument used in the DEIS to support the recommendation
for use of oceanic disposal sites is that it is the solution of
N.3, O.12 least cost. We are concerned that monetary measures are
inadequate, and that greater emphasis must be placed on the
potential hazards to determine the true "cost" picture of this
endeavor.

L.1, J.28, We find that sufficient data is lacking on critical factors such
as ocean bottom currents, the nature and character of abyssal
J.9, L.37 communities, and amount and pattern of radioactive uptake and
accumulation in deepwater species.

L.22, R.1 Analyses included in the DEIS on levels of radioactivity are based
on models of even dispersion. Yet, current research shows that
radiation is absorbed into sediment in concentrated levels. This
higher concentration could well have significant effects on the
bottom dwelling communities. Until further data is collected it
L.39, L.36 is impossible to say that these effects will not be transferred up
the food chain - eventually affecting human populations.

Data available from the dump sites surrounding the USS Thresher,
J.41 and USS Scorpion now show abnormally high levels of Cobalt-60.
This information conflicts with claims that radiation levels will
be miniscule.

The DEIS does not address the cumulative impact of radiation
L.7 doses. We must consider all sources of radiation - both natural
and man made - to determine total hazard to the human race.

L.36 The oceans are the primary source of food for the world's
populations. The United States has served as an international
model in the area of hazardous waste dumping in the oceans. A
decision based on the limited data available today to dump nuclear
F.8 submarines in the ocean is not in keeping with our international
role. It would be an irresponsible act affecting peoples the
world over. More research is required to insure the safety of
humans and other biological entities involved in this complex web L.14
of life.

Sincerely,

Dena Mossar

Dena Mossar

cc: Senator Alan Cranston
Senator Pete Wilson

666

#443

THE PENNSYLVANIA STATE UNIVERSITY

104 DAVEY LABORATORY
UNIVERSITY PARK, PENNSYLVANIA 16802

College of Science
Department of Physics

Area Code 814

24 March 1983

Capt. E.F. Wagner
U.S. Navy
Office of the Chief of
Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C.
20350

Dear Capt. E.F. Wagner:

Enclosed are my comments on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defuled Naval Submarine Reactor Plants. Please note that the material presented herein is my own , and does not necessarily reflect the position of the Pennsylvania State University.

I am particularly pleased to see that the Navy has included consideration of C-14, Ni-59,Nb-94 and Tc-99 in this evaluation.

I hope that this information is useful in your considerations of this issue, and in developing a Final Environmental Statement.

Would you please send me a copy of the Final EIS when it is available.

Sincerely,

William A. Lochstet

Wm. A. Lochstet

Environmental Impact of Disposal of Submarine Reactors

by

William A.Lochstet

The Pennsylvania State University*

March 1983

The Department of the Navy has attempted to evaluate the environmental and health impacts of the "Disposal of Decommissioned, Defuled Naval Submarine Reactor Plants" in its draft environmental statement. There are several items of inaccuracy in this report.

It is stated (see P. G-2) that 0.1% of the total radioactivity in the submarine is due to corrosion products, crud, inside the reactor vessel and piping. This value seems to be quite low, and is difficult to reconcile with commercial plant operations. It would be useful to see experimental justification for this choice of 0.1%. In addition, since the source of this crud is different than the vessel and piping bulk radioactivity, analyses should be performed to ascertain the chemical and isotopic composition of this crud. It is further unclear if the system has or has not been chemically cleaned to obtain this amount of crud. A.12

In the description of the land disposal method on pages4-1 and 4-2, it is suggested that the buried compartment would remain intact for at least 200 years. This is based on a corrosion rate of 0.0025 inch per year. This is somewhat less than the corrosion rate experienced by automobile owners in the Northeast.

* Affiliation for identification purposes only. Material presented here does not necessarily represent the opinion of the Pennsylvania State University.

#443 (Cont)

Submarines
March 1983 2

Further, after the compartment is breached, which would allow water into the reactor compartment, it is suggested that the reactor vessel would provide a barries for the internals and crud until the pressure vessel had been penetrated (P4-2). In fact water will be able to flow thru the reactor vessel as soon as the first connecting pipes are penetrated. The reactor pressure vessel has a mush thicker wall than any of its connecting pipes. Thus the pipes will have their walls penetrated by corrosion before the pressure vessel. At this point water can flow thru the perforation in the wall of one pipe, thru that pipe, into the reactor pressure vessel. This water can then flow out of the
P.2 reactor vessel,thru another pipe to a site of a perforation in it, then thru the perforation to the compartment interior. At this point the crud will x be available for transport as well as new corrosion of the internals. Thus there will also be a large sudden release of radioactivity when pipe walls are perforated. Similarly, the steam generator has different wall thicknesses, and would corrode at a different time scale. The heat-exchanger tubes would present an alternative pathway for corrosion.

It is anticipated that at Hanford, burial would mean a minimum of eight feet of earth, while at Savannah River, four feet minimum would be used (P. 2-5). The compartment is expected to remain intact for 200 years. At some point after that, the compartment walls will develop rather large holes. This will allow earth to be washed into the compartment. With only four to eight feet of earth covering a twenty foot diameter compartment, is expected that the entire earth cover could dissappear into the compartment. It would seem prudent to fill
E.33 the compartment with concrete after placement in the burial pit. The effects of erosion would also seem to dictate more than four to eight feet of covering. Long term erosion should be evaluated.

Submarines
March 1983 3

Thruout the analysis of health effects, for the land disposal option it is assumed that Ni-59 is the dominant radiation (App. C). This is contrary to the current understanding that Nb-94 will dominate after several decades (see for example "Science", Vol 215, K.3
p. 377, 22 January 1982).

Further, the analysis presents the maximum dose per year for the person with the highest dose, and the population dose for the highest year. The requirement of NEPA is to evaluate the B.1
total health consequences, over all time. Thus, the total person-rems should be calculated for each year and added for the total time. Since the half life of Tc-99 is hundreds of thousands of years, the time period necessary should be at least a million years.

Specific criteria for seabed disposal are described on pages 3-9 to 3-10. These are based on bottom current shear stress and mesoscale eddy activity. At best, these criteria can be applied to conditions at present, but their future conditiond are not clearly known. It is suggested that predicting conditions L.39
at these sites 2000 to 10,000 years from now is not possible. The full implications of colonization by life forms, as has been observed at the Scorpion site (P. 4-22) must be measured in great detail. This detail may not be presently possible. L.55
Considering the present state of knowlege of deep sea ecology, it is totally inappropriate to use this site.

It should be pointed out that there are some sites that would be appropriate for submarine disposal. Sites such as the Waste Isolation Pilot Plant site in New Mexico, or the deep Geological site at Hanford would seem to be possibly adequate. H.2
These sites are certainly much more likely to contain the wastes than the sites chosen in the draft.

#444

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Fisheries Center
Beaufort Laboratory
Beaufort, North Carolina 28516-9722

April 5, 1983

Edward F. Wagner
Captain, U.S. Navy
Office of the Chief of
Naval Operations
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

In reference to your recent correspondence concerning comments on the Navy's DEIS for submarine disposal, we have submitted our comments as part of a joint response from the NMFS Southeast Fisheries Center and Southeast Regional Office. We understand these comments will be integrated with other comments to provide a single response to you from NOAA.

Sincerely yours,

Ford A. Cross

Ford A. Cross
Chief, Division of Estuarine
and Coastal Ecology

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Fisheries Center
Beaufort Laboratory
Beaufort, North Carolina 28516-9722

April 5, 1983

Edward F. Wagner
Captain, U.S. Navy
Office of the Chief of
Naval Operations
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

In reference to your recent correspondence concerning comments on the Navy's DEIS for submarine disposal, we have submitted our comments as part of a joint response from the NMFS Southeast Fisheries Center and Southeast Regional Office. We understand these comments will be integrated with other comments to provide a single response to you from NOAA.

Sincerely yours,

T. R. Rice

T. R. Rice
Laboratory Director

#444 (Cont)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington D.C. 20235
OFFICE OF THE ADMINISTRATOR

March 28, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy (OPNAV-22)
Washington, D.C. 20350

Dear Captain Wagner:

This is in reference to your draft environmental impact statement entitled "Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants." Enclosed are comments from the National Oceanic and Atmospheric Administration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving six copies of the final environmental impact statement.

Sincerely,

Joyce Wood
Joyce Wood
Chief, Ecology and Conservation Division

Enclosures: Letter from Richard J. Hoogland, National Marine Fisheries Service (3 pages)
Memo from Gunter Seckel, National Marine Fisheries Service (2 pages)
Memo from Dr. William Conner, National Marine Pollution Program Office (1 page)
Comments from the National Ocean Service (7 pages)

10TH ANNIVERSARY 1970-1980
National Oceanic and Atmospheric Administration
A young agency with a historic tradition of service to the Nation

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

March 21, 1983

F/SER11/RPC
(919)728-5090

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy (OPNAV-22)
Washington, DC 20350

Dear Captain Wagner:

The Draft Environmental Impact Statement (DEIS) for "Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants" has been received by the National Marine Fisheries Service (NMFS) for review and comment.

The statement has been reviewed by members of our Southeast Fisheries Center and Regional Environmental Assessment Branch and the following comments are offered for your consideration.

General Comments:

The organisms which reside in the vicinity of the proposed disposal area consist primarily of crustaceans, starfish, sponges, coelenterates and deepsea fishes - none of which is presently of economical importance. These animals are not very abundant and they feed principally upon the "rain" of dead organisms falling from the surface waters. Available scientific information indicates economically important fishes do not descend to these great depths to feed, nor do fishes which reside on the abyssal plain migrate into surface waters. There is evidence that the eggs and young of these deepsea fish do ascend to shallower depths (about 1000-2000 meters). These eggs and larvae could be fed upon by animals which reside at these intermediate depths which in turn can be fed upon by fish from the surface water. The probability that this process could transport significant quantities of radionuclides to food chains in surface waters is extremely low due to the relatively small populations of fishes that exist in the deep sea and the small contribution of these eggs and larvae to the total abundance of food organisms at these intermediate depths. Thus, we do not believe that biological transport processes could deliver significant amounts of radionuclides from the submarines into surface waters inhabited by commercially valuable species.

Specific Comments:

CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

II. SEA DISPOSAL OPTION

A. Adverse Environmental Effects Which Cannot be Avoided Should the Land Disposal Option be Implemented

3. Radiological Effects

#444 (Cont)

(a) Radiation effects on bottom-dwelling sea-life

Page 4-9 and 4-10. The scenarios which are outlined in this section are consistent with the current understanding of the radiation sensitivities of marine organisms. Actually, the comments on relative radiation doses and dose rates are very conservative. We agree that even in the worse-case estimates that it would be impossible to detect any biological effects on the resident organisms due to our overall lack of knowledge of their physiology and population dynamics.

L.11 Under the section "Radiological Effect" there should be a section entitled "Endangered and Threatened Marine Species". Due to the laws concerning endangered species (i.e., the Endangered Species Act, 1973), it is necessary for the DEIS to address the projected dose commitments to these organisms (i.e., marine mammals and turtles).

4. Non-radiological Effects

(b) Secondary or Indirect Effects

(3) Effect on the Economy of Coastal Areas

O.34 Page 4-23, paragraph 2. The psychological effect of sea-disposal methods on the economics of fishery resources received minimal attention and should be addressed further. For example, discussion is needed on the kinds of monitoring and public relations efforts that will be taken to assure fishery resource consumers that no harmful effects will be or are occurring from contamination by radioactive wastes.

ANNEX TO APPENDIX D - RADIOLOGICAL ENVIRONMENTAL MONITORING AT SITES OF NUCLEAR-POWERED SUBMARINE THRESHER AND SCORPION SINKINGS

II. SITE DESCRIPTION

A. Thresher Site

J.39 Page D-A2, paragraph 2. The statement is made, based on a 1971 reference, that the Western Boundary Underrurrent does not mix to any appreciable extent with shelf water along the entire North American coast. We believe more current information exists which suggests that considerable mixing may be occurring. We suggest you contact Dr. H. T. Rossby of Yale University or Dr. D. R. Watts of the University of Rhode Island for more recent information about mixing. Since mixing of deep and shelf waters may have implications for transport of radionuclides from disposal sites into waters which support fisheries, this point should be clarified.

APPENDIX H - DESCRIPTION OF OCEAN DISPERSION MODEL

IV. TRANSPORT MODEL DESCRIPTION

U.2 Page H-3, paragraph 2. The assumption or conclusion that there is no known link between abyssal sediments and upper water food chains leading to living marine resources is not completely correct. There is circumstantial evidence to suggest that deepsea fishes may have reproductive strategies that involve the mesopelagic zone and thus could enter the food chain. For example, Coryphaenoides armatus, the dominant large fish below 2,000 meters, may spawn in latitudes north of the potential disposal sites ("Rise" and "Hatteras"). Following spawning, the eggs and larvae are found mid-water where they possibly are fed on by components of a food web or chain involving commercial fishery resources. Suggested references include:

1. Wenner, Charles. 1978. Making a living on the continental slopes and in the deep-sea: life histories of some dominant fishes of the Norfolk Canyon Area. Ph.D. Dissertation, College of William and Mary, Williamsburg, VA. 1978. 294 pp.

2. Sedberry, C.R. and J.A. Musick. 1978. Feeding strategies of some demersal fishes of the continental slope and rise off the Mid-Atlantic coast of the USA. Mar. Biol. 44:357-375.

3. Stein, David L. Biological transport and pathways to man: preliminary results for the Eastern North Pacific. In Talbert, D.M. 1982. Oceanographic Studies to Support the Assessment of Submarine Disposal at Sea. SANDIA Report 82-1005.

More detail is needed regarding future potential resources (e.g., red crab, Geryon quinquedens) inhabiting regions upslope from the "Rise" area because of the possibility of nuclide transport via the Western Boundary Undercurrent (Ref: Bulfinch, D.L., M.T. Ledbetter, B.B. Ellwood, and W.C. Balsam. 1982. The high-velocity core of the Western Boundary Undercurrent at the base of the U.S. Continental Rise. Science 215:970-973). J.9, J.39

APPENDIX J - DOSE COMMITMENT ESTIMATES, SEA DISPOSAL

The DEIS sections dealing with dose commitments to the human population appear to be complete and include components which would result from fishery products. These components obviously are fish, mollusks, and crustaceans.

Sincerely yours,

Richard J. Hoogland, Chief
Environmental Assessment Branch

#444 (Cont)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Pacific Environmental Group
P.O. Box 831
Monterey, California 93942

Date: February 25, 1983

To: Jim Slawson, FSP13

From: Gunter R. Seckel, F/SWC4

Subj: Environmental Impact Statement - Disposal of decommissioned submarine

I have looked over the following sections of the subject report:

Chapter 3 II C		Affected environment, Pacific study area
Appendix E IV C		Pacific Ocean study location
Appendix	G	Estimated radioactive release following disposal at sea
Appendix	H	Description of the ocean dispersal model
Appendix	I	Dose committment calculation methods
Appendix	J	Dose committment estimates

It appears to me that the studies were done in a careful way, leaning towards worst case scenarios. Detailed calculations based on reasonable models were presented. However, an easy to follow description of the paths of radioactive products and their eventual fate has not been made.

Although the proposed disposal area is only about 200 miles from the northern California coast, it has a depth of more than 4000 m. At this depth the water in the disposal area is of antarctic origin, which, of course, the temperature and salinity soundings confirm (Fig. E-15 and E-16). There is no exchange of the bottom water with the surface water at this location. Measured currents in the disposal area are about 1 cm/sec and vertical currents are estimated to be 3m/year. A parcel of water at these speeds would be carried 365 km southward while rising only 3 m in a year. In this location, without horizontal currents, the parcel of contaminated water would take 1000 years to rise to within 1000 m of the surface. Clearly then, without complicated calculations, there would be no direct contamination of waters in the vicinity of the disposal area that contain fishery resources or that affect human activity.

I did not examine the radioactive isotopes involved in detail but the maximum annual release is from Ni-63. This isotope has a half life of 95 years which is not long in relation to the corrosion time and length of time before this isotope has any chance to come within reach of human activity.

Another factor that probably reduces contamination is the sedimentation rate. From the sediment cores shown in Fig. E-18 and E-19 it appears that 60 m of sediment was laid down in the last 10000 years. Assuming a sedimentation rate of 0.5 cm/year, in the 100 years before radiation leakage will begin, the submarine will be covered by about 50 cm of sediment.

Finally, it should be borne in mind that only submarines from which reactor fuels and their radioactive products have been removed are to be sunk. This is quite different from disposing of spent radioactive fuels.

Despite my belief that there will be no adverse consequences from the disposal of the submarines, I feel that an environmental impact statement for disposal at sea should contain some discussion of the path of potential contaminants away from the disposal site. Although Fig. H-2 shows a very large "model area" no path was indicated. In fact, I doubt that enough is known about the deep ocean circulation to indicate such a path. Nevertheless, one should speculate on how long a contaminated parcel of water might take to reach the Antarctic because it is there that active exchange of the deep Pacific ocean water with the surface water takes place. Assuming that the deep current measured at the disposal site continues to flow at the same speed all the way to the Antarctic, then a contaminated parcel would take about 30 to 40 years to get there. This is not a very long time but in the case under consideration the contaminants would be so diffuse that they probably could not be detected. T.34 However, the proposed disposal site will not be the only one. Other countries also will dispose radioactive materials in the deep ocean. Ocean disposals will therefore have a cumulative effect. L.7 We do not know what the capacity of the deep ocean for contaminants is. Initially, contaminants will not be uniformly mixed into all the abyssal waters but will follow current paths which are very poorly known or not known at all. In short, disposal of contaminants at sea should be undertaken with caution because the ultimate destination of contaminants and their dispersal in the water mass at the disposal site may not be predictable on the basis of our limited knowledge about abyssal ocean circulation. L.39

#444 (Cont)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Rockville Md 20852
NATIONAL MARINE POLLUTION PROGRAM OFFICE

March 21, 1983

TO: PP2 - Joyce Wood

FROM: N/MPP - Dr. William B. Conner

SUBJECT: DEIS 8212.13 - Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Thank you for the opportunity to review and comment on the subject
draft environmental impact statement. The most significant addition
to the FEIS that I would suggest is a discussion of the recent amendment
F.2 to the Marine Protection, Research, and Sanctuaries Act (see Congressional
Record, December 21, 1982, H10801-H10802). My comments should not be
construed as criticism of the DEIS because the MPRSA was not amended until
after the release of the document. The amendment places a 2-year moratorium
on ocean dumping of low-level radioactive waste, except for research pur-
poses under certain circumstances. After the moratorium, the amendment
W.1 also requires (among other things) a permit applicant to develop a plan
for the removal or containment of the disposed nuclear material if the
container leaks or decomposes, to develop and implement a comprehensive
J.76 monitoring program to determine the full effect of the disposal, and to
provide a determination by each affected state whether the proposed
F.11 action is consistent with its approved Coastal Zone Management Program.

These issues are not adequately addressed in the DEIS and should
be discussed in the final document. For example, the DEIS states that
retrieval of ocean-disposed submarines is not feasible with existing
technology. Also, the monitoring program is described only in vague
terms in the DEIS. The description of the monitoring program should be
J.76 enhanced and the estimated cost of monitoring ($100,000 per submarine)
should be reevaluated in consideration of the new requirement for mon-
itoring by the applicant. Finally, the DEIS makes no mention of consis-
tency with state Coastal Zone Management Programs.

COMMENTS OF THE NATIONAL OCEAN SERVICE ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT
ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED
NAVAL SUBMARINE REACTOR PLANTS

The draft environmental impact statement (DEIS) adequately describes the problem of the disposal of decommissioned, defueled naval submarine reactor plants in terms of the number of submarines involved, their nuclide contents, the physical state and location of nuclides, and disposal alternatives. Although the DEIS considers land-disposal, sea-disposal, and the "no action" or permanent maintenance options, we restrict our comments to the sea-disposal option. The sea-disposal option should remain under consideration, but we recommend that the final environmental impact statement (FEIS) should provide a clearer analysis of this option. Our comments and suggestions focus on the appendices, since with few exceptions, they provide more detail and rationale for the conclusions presented in the earlier sections of the DEIS.

Appendices D, E, G, H, I, J and K describe the sea-disposal option.
Appendix F on corrosion rates is also important, but the necessary
conclusions from it, with which we agree, are repeated in Appendix G.
Appendices I and J deal with dose commitments and apply the Inter-
national Atomic Energy Agency (IAEA) critical pathway model used to set
limits on ocean-disposal of radioactive waste under the London Ocean
Dumping Convention (LDC). These IAEA model calculations appear to be
sound, but we question some of the nuclide concentrations calculated in
Appendices G and H from which the dose commitments were subsequently S.27
calculated. These nuclide concentrations are strongly dependent on the
assumptions made in Appendices G and H. The sensitivity of the results
to those assumptions is inadequately analyzed. These points are expanded
in the following comments on the individual appendices:

Appendix D, Description of Sea-disposal Method.

The engineering of this method has been well considered. However, monitoring of actual sinking operations as proposed in Appendix K would be appropriate to test whether, in fact, the submarines would follow the predicted paths and survive the shock of impact.

J.42 J.47 The annex to this appendix provides a generally good documentation of the status of two accidental sinkings, but the analyses of bottom water (pp. D-A6 to D-A7) are not useful. Analyses were performed on a sample of one liter, which is too small a volume to detect Cs-137 or Co-60 at realistic concentrations. Furthermore, the results given for K-40 are inconsistent, casting further doubt on the analyses. Since K-40 is conservative in seawater and both submarine locations are in the open ocean, the two samples should produce the same result for K-40.

J.50 On page D-A11 measured concentrations of Co-60 in sediment are equated to total amounts of Co-60 lost from the submarines. One cannot conclude, based on the 0.3 millicuries found in the sediments, that the other 9.7 millicuries must be in the submarine. If, as suggested on page D-A12, the source of Co-60 was the reactor coolant, significant dilution and dispersion in the water surrounding the submarine, probably to very low levels, would have been expected.

Appendix E, Description of Ocean Study Areas.

S.24 The descriptions are admittedly rather cursory and we do not recommend detailed studies at this stage. However, in a subsequent appendix the depth of the benthic boundary layer at the Pacific site is used. Nowhere in this appendix is that depth documented. It is repeatedly mentioned in this appendix and elsewhere that these sites are tentative. The described sites all fit the IAEA criteria under the London Dumping Convention, and two are also within the 200-mile U.S. fishery conservation zone (FCZ). J.2 If only sites within the FCZ are to be considered, the choice of areas must be limited. Are additional sites available in the FCZ, as deep as 4000m and otherwise within the IAEA criteria?

Appendix G, Estimated Radioactive Releases Following Disposal at Sea.

This appendix commendably strives for a realistic assessment of release rates. A few criticisms should be helpful. First, it should be clear that even if all nuclides were immediately available for migration once a submarine reached the seafloor, the proposed disposal would still be acceptable under the LDC. F.31 Second, in the attempt to calculate actual release rates some complicated processes are described which are later ignored. Delving through calculations that lead nowhere is only confusing. Finally, the rationale for some assumed values of parameters used in equations is not clear.

Maximum acceptable annual release rates for ocean dumped nuclides in the LDC have been determined by the IAFA in a manner similar to Appendices H, I, and J in the DEIS. Those limits are compared below to the radioactivity that would be introduced with three submarines.

Nuclide	Maximum Allowable Annual Release at a Single Site	Amount Introduced in One Year by Three Subs (Page 1-3 of DEIS)
Co-60	8.4×10^5 curies	6.6×10^4 curies
Ni-63	6.2×10^6	5.4×10^4
Fe-55	3.8×10^7	5.1×10^4
Co-58	8.2×10^{10}	9.6×10^3
Cr-51	9.1×10^{18}	3.0×10^3
Mn-54	1.9×10^7	2.0×10^3
Ni-59	3.7×10^6	3.6×10^2
Fe-59	1.5×10^{13}	1.5×10^2
C -14	6.1×10^5	3.0

Except for Co-60, where three submarines could contribute about 10% of the maximum allowed under the LDC, three submarines per year could yield only less than 1% of the maximum even if the nuclides were released F.31

#444 (Cont)

immediately and completely. This point should be made in the FEIS so that the reader could evaluate the estimates of actual release in the context of existing regulations and policy.

Equations G.5 through G.8 (p. G-27) are general expressions to describe rates of change of nuclide concentrations within compartments in models of expected releases. They include an unnecessary distinction between transportable and non-transportable forms of a nuclide. The
R.19 footnote on page G-27 explains that all calculations will use f=0 for the non-transportable fraction. Since this reasonable and simplifying assumption is used, the unnecessarily complicated equations should not be written in the first place.

The unnumbered equation at the bottom of page G-38 is important since it describes the rate of release of nuclides by bulk flow through extensively corroded containment walls. This would be the major pulse in release since up to this point release is only via molecular diffusion through pit holes. The time assumed for this bulk release is one year (first sentence, p. G-40). The expectation of a uniform release for a
R.18 fully exposed compartment over a one-year period is not reasonable. Figures G-2 (p. G-7) and G-3 (p. G-11) could include other assumed release rates, both uniform and non-uniform.

Appendix H, Description of Ocean Dispersion Model.

The objective of this appendix is to relate release rates to concentrations of nuclides in the water column which can then be related (in Appendices I and J) to dose commitments. The appendix, especially
S.15 its "best estimate," gives a false sense of how precisely this can be done. The IAEA limits in the LDC are not based on a physical model that purports to predict precise concentrations at so specific a location as the "entry point of radionuclides to the pathways to man" (p. H-10),
S.16 defined in this appendix as 250 km to the east of the dumpsite and 385 m above the seafloor. No clear rationale for this assumed entry point exists, and the "best estimate" model is highly misleading.

The IAEA limits for a single site (those listed above) are based on a very simple model. A volume flow of water over the site is assumed to present $10^6 m^3$ of water per second into which released nuclides are continuously and fully mixed. No account is taken of nuclide decay. This plume model assumed a deep-sea fishing ground to be 1500 km from the site and the current to flow uniformly toward the site at 1 cm/sec. S.19
Using site-specific flow rates and horizontal distances to deep-sea fisheries, a similar site-specific calculation could be made in this appendix.

At large scales (greater than 100 km) and long times (about a month) horizontal diffusivities of $10^7 cm^2/sec$ (Table H-1) may apply. Small-scale mixing, however, is not so rapid and the calculations in the appendix are therefore inappropriate for the concentration fields immediately S.18
around the submarines. However, it is the large scale which matters. The fundamental basis for IAEA site selection criteria is that the site itself is remote from man and is sacrificed. The initial hypotheses were that (1) no direct pathway to man from the site itself exists and (2) biological responses at the site are of no consequence to maintenance of populations. Due to containment and slow release, nuclide concentrations at the site may be very low and may appear not to be an indirect hazard to man or direct hazard to organisms. These hypotheses warrant continued testing through appropriate monitoring designs at the site.

At large scales, the IAEA models for basin-wide allowable release S.17
limits assume that nuclide concentrations are horizontally homogeneous. The basin-wide limits are based on nuclide concentrations which, because vertical mixing is slow, are always greater or equal (for long-lived nuclides) in bottom water than anywhere else in the water column. The rationale is based on the assumption that if bottom water concentrations are acceptably low, then waters closer to man or his seafood cannot contain higher concentrations. In this sense the "conservative estimate" in Appendix H is a more rigorous estimate of hazard since it uses bottom S.15
water values and avoids the artificiality inherent in the "best estimate" where concentrations 385 m above the seafloor are used.

#444 (Cont)

This appendix introduces a refinement of the Shepard model which
in its one-dimensional form (horizontal homogeneity, vertically varying
S.17 concentrations) is the basis for IAEA basin-wide release limits (equal
to single-site limits for long-lived nuclides, larger for short-lived
nuclides). As in the previous appendix, the reader can be led to
believe incorrectly that the choice of the sea-disposal option depends
on the validity of the refined model and the parameters plugged into it.

S.19 We recommend that Appendix H first use release rates from Appendix
G and apply them to the single-site plume model and the basin-wide
S.17 Shepard model as used by the IAEA. The more realistic model with its
accounting for benthic boundary layers and vertically variable mixing
coefficients can then be used. When it is used, the "conservative
S.21 estimate" approach should be applied, estimating coefficients for removal,
settling rates, and distance off the seafloor all to be zero. Also,
tabulated results of nuclide concentrations on the basin-wide scale
should include the time scale. Time scales are important and are not
S.20 indicated now. For example, on a basin-wide mixing scale over about
1000 years, Ni-59 with its 80,000 year half-life should be at the same
concentration everywhere using the "conservative estimate."

<u>Appendix J, Dose Commitment Estimates, Sea-disposal</u>.

Appendices I and J are essentially applications of the IAEA critical
pathway approach using nuclide concentrations derived from the release
rates of Appendix G and dispersion rates of Appendix H. Inconsistencies
appear in these sections on the assumptions pertaining to uniform mixing
of nuclides into the sediment column. On page J-22 uniform mixing is
U.22 indicated to occur to 1 or 10 cm depending on whether nuclides are
released more or less than 100 years after disposal. On page 4-9 mixing
depth is 15 cm. These sediment distributions could be more realistic if
they were calculated on the basis of deep ocean bioturbation coefficients.
Maximum concentrations in sediment would then be higher since surficial
concentrations would not be diluted (as they mathematically are diluted)
by mixing with less contaminated sediment from below.

<u>Appendix K, Monitoring Program</u>.

We agree that if submarines are disposed at sea, the first order test should be their predicted stability on the seafloor. If nuclides are contained, an intensive, frequent measuring program would be of little value.

#445

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAR 3 1 1983

Captain Edward F. Wagner,
U.S. Navy
Office of the Chief of Naval
Operations (OPNAV-22)
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

We have reviewed the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, dated December 1982. Enclosed are comments provided by the staff reviewer. I trust that these will be helpful in preparing the FES.

Sincerely,

William V. Johnston

William V. Johnston, Assistant Director
Materials, Chemical and Environmental
Technology
Division of Engineering

Enclosure:
Comments on DEIS

Comments on Draft Environmental Impact
Statement on the Disposal of Decommissioned
Defueled Naval Submarine Reactor Plants

Page	Paragraph	Comment	
C-4	C	Justify (by reference to appropriate data in this report) the contention that the effects of other pathways would be small in comparison with those for which calculations were made. Even if the exposure to an individual for the direct intrusion pathway is negligible compared to other land-disposal exposure scenarios, it may be of comparable magnitude to exposure from sea disposal.	P.17
C-4	IV.3 thru IV.5	Justify the use of 10% as the fraction of consumption for average individuals. Was consideration given to the values listed in Table E-4 of Regulatory Guide 1.109 (Reference C.2)?	P.18
C-16	B, C	Explain the use of 370 l/y in paragraph B versus 730 l/y in paragraph C for ingestion of drinking water. If switching from an evaluation of average individual exposure to maximum individual exposure, explain why.	P.19
C-17	X.A	Here and elsewhere in this study, frequent use is made of references (e.g., reference to a study involving 0.1 percent airborne release), without justification. This makes it difficult to assess the validity of the results and conclusions of this report.	P.20
C-19	B	The final paragraph on this page states that "the sequence of events required.... is extremely unlikely." In order to make this statement, it is presumed that some quantitative estimate of likelihood must be available. Justify this assertion by referring to such a quantitative estimate.	P.21

#445 (Cont)

-2-

T.28	I-11 J-6	last last	The assertion that the maximum usages are mutually exclusive is not entirely true. The maximally exposed individual may consume the maximum amount of fish, and drink the maximum amount of desalinated sea water, and spent the maximum amount of time exposed to shore sediments, etc.
L.59	J-14	C	(last paragraph): If a submarine sinks in transit at a location much closer to shore than 25 km, doses may be higher than those for the accident scenario postulated here, if the submarine can not be recovered in a reasonable period of time.

#445a

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 27 1983

Captain Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

Comments were provided to you on your Draft Environmental Impact Statement (DEIS) on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants by letter dated March 31, 1983. In response to your recently extended time period for receipt of comments, we are hereby transmitting additional comments prepared by our Division of Waste Management.

In addition to the enclosed comments, we are providing for your consideration a copy of a draft technical position paper on waste form which NRC staff uses in their licensing actions. While NRC does not have licensing authority over DOE low-level waste disposal activities, DOE has in the past expressed interest in complying with the requirements of 10 CFR Part 61 to the extent possible. Furthermore, since Part 61 is now issued in final form, references to the document should reflect this fact in your final EIS.

Additional information on the enclosed review topics can be provided if desired.

Sincerely,

William V. Johnston

William V. Johnston, Assistant Director
Materials, Chemical & Environmental
Technology
Division of Engineering

Enclosures:
As stated

#445a (Cont)

ATTACHMENT 1

I. General Comments

Based on past experience at low-level waste disposal sites, the final Part 61 regulation places considerable emphasis on long-term disposal site stability. Criteria for waste and disposal site structural stability are included in several sections of the regulation -- principally Sections 61.7, 61.44, 61.52 and 61.56. Additional guidance is available in the form of a technical position paper on waste form (see attachment). The final EIS should consider these criteria and guidance, and determine whether the proposed land disposal option is compatible with them. Based on a cursory review of the data provided in the DEIS and soil corrosion data for ferrous materials, it appears the land disposal option described would provide stability for the 300 year period stated in 10 CFR 61. E.33

The DEIS indicates that the reactor compartments would be in the category of Class B waste (10 CFR 61.55) based upon radionuclide concentrations obtained by dividing the inventory by the volume of the reactor compartment. However, 99.9 percent of the total radioactivity would be contained within the reactor pressure vessel. It would be more consistent with the pathway evaluations performed to determine the waste classification system limits, if the concentrations in such a heterogeneous waste form were based on the volume of the pressure vessel rather than on the total volume of the reactor compartment. Depending on the pressure vessel volume, the waste could be defined, according to 10 CFR Part 61, as Class C waste. Class C waste would require special measures to protect against inadvertent intrusion, such as disposal at greater depths or the provision of an engineered intruder barrier. E.32

ATTACHMENT 1

II. Detailed Comments

Chapter 1: Purpose and Need for Action.

No comments.

Chapter 2: Alternatives.

1. In Section 1.A Method of Disposal, it is stated in the second paragraph on page 2-5, that the reactor compartments would be placed in trenches and covered with "a minimum of four feet of earth at Savannah River and eight feet of earth at Hanford." Additional cover may be required if the waste is determined to be Class C waste. E.32

2. On page 2-8, in Section 1.D. Measures to Mitigate Adverse Effects, it is proposed that the reactor compartments would be covered with "at least four feet of earth." The final EIS should discuss the adequacy of the criteria and show that subsequent surface activities will not disturb the waste. E.32

3. The Navy has referenced proposed 10 CFR Part 61 in Section 1.H. Comparison with NRC Proposed Waste Concentration Limits for Land Burial, on page 2-9. This section should be revised in the final EIS to reflect the final 10 CFR Part 61 regulations which were published in the December 27, 1982 Federal Register. Table 2-1 on page 2-10 should also be revised to reflect the final 10 CFR Part 61 regulations. X.1

It is stated, in Section 1.H, that the activity concentrations were calculated on the basis of the reactor compartment volume, and that the "disposal package" would be in the category of Class B stable waste. The determination is questionable since 99.9 percent of the E.32

#445a (Cont)

total radioactivity would be contained within the reactor pressure vessel. It would be more consistent with the pathway evaluations performed to determine the waste classification system limits, if the concentrations in such a heterogeneous waste form were based on the volume of the pressure vessel rather than on the total volume of the reactor compartment. Thus, it is possible that the waste could be classified as Class C waste (10 CFR 61.55). The waste classification analysis conducted by the Navy should be reevaluated in the final EIS to determine if additional disposal measures would be required at the disposal facility.

Chapter 3: Affected Environment.

1. A potential burial site for reactor compartments is described in Section 1.A. Hanford Site, on page 3-3 (also page B-3) of the DEIS. The burial site, located along the west boundary of the 200-W Separations Area of the Hanford Reservation, lies within an 18 mi^2
I.4 area which the DOE has selected as a candidate site for a HLW repository. Any projected effects of a land disposal facility on the proposed Hanford repository operation should be addressed in the final EIS.

2. A potential burial site for reactor compartments is also described in Section 1.B. Savannah River Plant (pages 3-3 to 3-5, and B-3 to B-4). A more detailed description of the burial site is presented in the DOE Final Environmental Impact Statement on Waste Management Operations (DOE/EIS-0082). The DOE EIS-0082 suggests that the same
I.10 burial ground would be used for the disposal of 87 x 10^3 m^3 of saltcake, a LLW by-product precipitated when liquid HLW is processed into a form for ultimate disposal. Any operational or monitoring conflicts resulting from the disposal of reactor compartments and saltcake in the same burial area should be addressed in the final EIS.

Chapter 4: Environmental Consequences.

1. The construction of a barge landing slip on the Savannah River is discussed in Section 1.A.3.(e) on page 4-5 (Secondary or Indirect Effects). Implementation of the land disposal option would require excavation of the slip and dredging of the river bottom, and would necessitate the disposal of large volumes of earth and dredge spoil. K.10
The physical and chemical characteristics of the dredge spoil, including nutrient, metals, and salt content, and radionuclide concentrations, should be considered in the final EIS.

2. If the submarine hull and bulkheads are to be considered as a high integrity container, an evaluation should be performed to ensure it will remain structurally stable for a 300 year period (10 CFR 61.7(b)(2)) using soil corrosion data specifically applicable to the proposed disposal sites. E.33

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ATTACHMENT 2

March 3, 1983

Technical Position on
Waste Form

A. Introduction

The regulation, "Licensing Requirements for Land Disposal of Radioactive Waste," 10 CFR Part 61, establishes a waste classification system based on the radionuclide concentrations in the wastes. Class B and C waste are required to be stabilized. Class A waste have lower concentrations, and may be segregated without stabilization. Class A wastes may also be stabilized and disposed of with the Class B wastes. All Class A liquid wastes, however, require solidification or absorption to meet the free liquid requirements. Structural stability is intended to ensure that the waste does not degrade and promote slumping, collapse, or other failure of the cap or cover over the disposal trench and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder since it provides greater assurance that the waste form will be recognizable and nondispersable during its hazardous lifetime. Structural stability of a waste form can be provided by the waste form itself (as with large activated stainless steel components), by processing the waste to a stable form (e.g., solidification), or by emplacing the waste in a container or structure that provides stability (e.g., high integrity container).

This technical position on waste form has been developed to provide guidance to both fuel-cycle and non-fuel-cycle waste generators on waste form test methods and results acceptable to the NRC staff for implementing the 10 CFR Part 61 waste form requirements. It can be used as an acceptable approach for demonstrating compliance with the 10 CFR Part 61 waste stability criteria. This position includes guidance on the processing of wastes into an acceptable, stable waste form, the design of acceptable high integrity containers, the packaging of filter cartridges, and minimizing the radiation effects on organic ion-exchange resins.

It is the intent of the NRC staff to add other guidance on waste form in additional technical positions as is necessary to address other pertinent waste form issues.

B. Background

Historically, waste form and container properties were considered of secondary importance to good site selection; the combination of a properly operated site having good geologic and hydrologic characteristics were considered the only barriers necessary to isolate low-level radioactive wastes from the environment. Experience in operating low-level waste disposal sites indicated that the waste form should play a major role in the overall plan for managing these wastes.

The regulation for near-surface disposal of radioactive wastes, 10 CFR Part 61, includes requirements which must be met by a waste form to be acceptable for near-surface disposal. The regulation includes a waste classification system which divides waste into three general classes: A, B, and C.

The classification system is based on the overall disposal hazards of the wastes. Certain minimum requirements must be met by all wastes. These minimum requirements are presented in Section 61.56(a) and involve basic packaging criteria, prohibitions against the disposal of pyrophoric, explosive, toxic and infectious materials, and requirements to solidify or absorb liquids.

In addition to the minimum requirements, Class B and C wastes are required to have stability. As defined in Section 61.56(b) of the rule, stability requires that the waste form maintain its structural integrity under the expected disposal conditions. Structural stability is necessary to inhibit slumping, collapse, or other failure of the disposal trench resulting from degraded wastes which could lead to water infiltration, radionuclide migration, and costly remedial care programs. Stability is also considered in the intruder pathways where it is assumed that after the active control period wastes are recognizable and, therefore, continued inadvertent intrusion is unlikely. To the extent practical Class B and C waste forms should maintain gross physical properties and identity over a 300 year period.

In order to ensure that Class B and C waste or its container will maintain its stability, the following conditions need to be met:

a. The waste should be a solid form or in a container or structure that provides stability after disposal.

b. The waste should not contain free standing and corrosive liquids. That is, the wastes should contain only trace amounts of drainable liquid, and in no case may the volume of free

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liquid exceed one percent of the waste volume when wastes are disposed of in containers designed to provide stability, or 0.5 percent of the waste volume for solidified wastes.

c. The waste or container should be resistant to degradation caused by radiation effects.

d. The waste or container should be resistant to biodegradation.

e. The waste or container should remain stable under the compressive loads inherent in the disposal environment.

f. The waste or container should remain stable if exposed to moisture or water after disposal.

g. The as-generated waste should be compatible with the solidification media or container.

A large portion of the waste produced in the nuclear industry is in a form which is either liquid or in a wet solid form (e.g., resins, filter sludge, etc.) and requires processing to achieve an acceptable solid, monolithic form for burial. The liquid wastes, irregardless of its classification, are required to be either absorbed or solidified. In order to assure that the solidification process will consistently produce a product which is acceptable for disposal and will meet disposal site license conditions a process control program should be used. General requirements for process control programs are provided in the NRC Standard Review Plan 11.4, "Solid Waste Management Systems," (NUREG-0800) and its accompanying Branch Technical Position ETSB 11-3, "Design Guidance for Solid Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants," (revised in July 1981). These documents may also be used as the basis for individual solidification process control programs by other fuel-cycle and by non-fuel-cycle waste generators who would solidify wastes. The guidance in this technical position should be the basis for qualifying process control programs for Class B and C wastes. The use of applicable generic test data (e.g., topical reports) may be used for process control program qualification. Process control programs for solidified Class A waste products, which are segregated from Class B and C wastes, need only demonstrate that the product is a free standing monolith with no more than 0.5 percent of the waste volume as free liquid.

An alternative to processing some Class B and C waste streams, particularly ion exchange resins and filter sludges, is the use of a high integrity container. The high integrity container would be used to provide the long-term stability required to meet the stability requirements in 10 CFR Part 61. The design of the high integrity container should be based on its specific intended use in order to ensure that the waste contents, as well as interim storage and ultimate disposal environments, will not compromise its integrity over the long-term. As with waste solidification, a process control program for dewatering wet solids should be developed and utilized to ensure that the free liquid requirements in 10 CFR Part 61 are being met.

C. <u>Regulatory Position</u>

1. Solidified Class A Waste Products

a. Solidified Class A waste products which are segregated from Class B and C wastes should be free standing monoliths and have no more than 0.5 percent of the waste volume as free liquids as measured using the method described in ANS 55.1.[2]

b. Solidified Class A waste products which are not segregated from Class B and C wastes should meet the stability guidance for Class B and C wastes provided below.

2. Stability Guidance for Processed (i.e., Solidified) Class B and C Wastes

a. The stability guidance in this technical position for processed wastes should be implemented through the qualification of the individual licensee's process control program. Through the use of a well designed and implemented process control program, frequent requalification to demonstrate stability is expected to be unnecessary. However, process control programs should include provisions to periodically demonstrate that the solidification system is functioning properly and waste products continue to meet the 10 CFR Part 61 stability requirements. Waste specimens should be prepared based on the proposed waste streams to be solidified and based on the range of waste stream chemistries expected. The tests identified may be performed on radioactive or non-radioactive samples.

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b. Solidified waste specimens should have compressive strengths of at least 50 psi when tested in accordance with ASTM C39[3]. Compressive strength tests for bituminous products should be performed in accordance with ASTM D1074[4].

Many solidification agents will be easily capable of meeting the 50 psi limit for properly solidified wastes. For these cases, process control parameters should be developed to achieve the maximum practical compressive strengths, not simply to achieve the minimum acceptable compressive strength.

c. The specimens for each proposed waste stream formulation should remain stable after being exposed in a radiation field equivalent to the maximum level of exposure expected from the proposed wastes to be solidified. Specimens for each proposed waste stream formulation should be exposed to a minimum of 10^8 Rads in a gamma irradiator or equivalent. If the maximum level of exposure is expected to exceed 10^8 Rads, testing should be performed at the expected maximum accumulated dose. The irradiated specimens should have a minimum compressive strength of 50 psi following irradiation as tested in accordance with ASTM C39 or ASTM D1074.

d. Specimens for each proposed waste stream formulation should be tested for resistance to biodegradation in accordance with both ASTM G21[5] and ASTM G22[6]. No indication of culture growth should be visible. Specimens should be suitable for compression testing in accordance with ASTM C39 or ASTM D1074. Following the biodegradation testing, specimens should have compressive strengths greater than 50 psi as tested using ASTM C39 or ASTM D1074.

For polymeric or bitumen products, some visible culture growth from contamination, additives or biodegradable components on the specimen surface which do not relate to overall substrate integrity may be present. For these cases, additional testing should be performed. If culture growth is observed upon completion of the biodegradation test for polymeric or bitumen products, remove the test specimens from the culture, wash them free of all culture and growth with water and only light scrubbing. An organic solvent compatible with the substrate may be used to extract surface contaminants. Air dry the

specimen at room temperature and repeat the test. Specimens should have observed culture growths rated no greater than 1 in the repeated ASTM G21 test, and compressive strengths greater than 50 psi. The specimens should have no observed growth in the repeated ASTM G22 test, and a compressive strength greater than 50 psi. Compression testing should be performed in accordance with ASTM C39 or ASTM D1074

If growth is observed following the extraction procedure, longer term testing of at least six months should be performed to determine biodegradation rates. The Bartha-Pramer Method[7] is acceptable for this testing. Soils used should be representative of those at burial grounds. Biodegradation extrapolated for full-size waste forms to 300 years should produce less than a 10 percent loss of the total carbon in the waste form.

e. Leach testing should be performed for a minimum of 90 days in accordance with the procedure in ANS 16.1[8]. Specimen sizes should be consistent with the samples prepared for the ASTM C39 or ASTM D1074 compressive strength tests. In addition to the demineralized water test specified in ANS 16.1, additional testing using other leachants specified in ANS 16.1 should also be performed to confirm the solidification agents leach resistance in other leachant media. It is preferred that the synthesized sea water leachant also be tested. In addition, it is preferable that radioactive tracers be utilized in performing the leach tests. The leachability index, as calculated in accordance with ANS 16.1, should be greater than 6.

f. Waste specimens should maintain a minimum compressive strength of 50 psi as tested using ASTM C39 or ASTM D1074, following immersion for a minimum period of 90 days. Immersion testing may be performed in conjunction with the leach testing.

g. Waste specimens should be resistant to thermal degradation. The heating and cooling chambers used for the thermal degradation testing should conform to the description given in ASTM B553, Section 3. Samples suitable for performing compressive strength tests in accordance with ASTM C39 or ASTM D1074 should be used. Samples should be placed in the test chamber and a series of 30 thermal cycles carried out in

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accordance with Section 5.4.1 through 5.4.4 of ASTM B553. The high temperature limit should be 60C and the low temperature limit -40C. Following testing the waste specimens should have compressive strengths greater than 50 psi as tested using ASTM C39 or ASTM D1074.

h. Waste specimens should have less than 0.5 percent by volume of the waste specimen as free liquids as measured using the method described in ANS 55.1. Free liquids should have a pH between 4 and 11.

i. If small, simulated laboratory size specimens are used for the above testing, test data from sections or cores of the anticipated full-scale products should be obtained to correlate the characteristics of actual size products with those of simulated laboratory size specimens. This testing may be performed on non-radioactive specimens. The full-scale specimens should be fabricated using actual solidification equipment.

j. Waste samples from full-scale specimens should be destructively analyzed to ensure that the product produced is homogeneous to the extent that all regions in the product can expect to have compressive strengths of at least 50 psi. Full-scale specimens may be fabricated using simulated non-radioactive products, but should be fabricated using actual solidification equipment.

3. Radiation Stability of Organic Ion-Exchange Resins

In order to ensure that organic ion exchange resins will not produce adverse radiation degradation effects, resins should not be generated that have loadings which will produce greater than 10^8 Rads total accumulated dose. For Cs-137 and Sr-90 a total accumulated dose of 10^8 Rads is approximately equivalent to an 10 Ci/ft^3 concentration. This position is applicable to resins in the unsolidified, as-generated form. In the event that the waste generator considers it necessary to load resins higher than 10^8 Rads, it should be demonstrated that the specific resin will not undergo radiation degradation at the proposed higher loading. The test method should adequately simulate the chemical and radiologic conditions expected. A gamma irradiator or equivalent should be utilized for these tests. There should be no adverse swelling, acid

formation or gas generation which will be detrimental to the proposed final waste product.

4. High Integrity Containers

a. The maximum allowable free liquid in a high integrity container should be less than one percent of the waste volume as measured using the method described in ANS 55.1. A process control program should be developed and qualified to ensure that the free liquid requirements in 10 CFR Part 61 will be met upon delivery of the wet solid material to the disposal facility. This process control program qualification should consider the effects of transportation on the amount of drainable liquid which might be present.

b. High integrity containers should have as a design goal a minimum lifetime of 300 years. The high integrity container should be designed to maintain its structural integrity over this period.

c. The high integrity container design should consider the corrosive and chemical effects of both the waste contents and the disposal trench environment. Corrosion and chemical tests should be performed to confirm the suitability of the proposed container materials to meet the design lifetime goal.

d. The high integrity container should be designed to have sufficient mechanical strength to withstand horizontal and vertical loads on the container equivalent to the depth of proposed burial assuming a cover material density of 120 lbs/ft^3. The high integrity container should also be designed to withstand the routine loads and effects from the waste contents, waste preparation, transportation, handling and disposal site operations, such as trench compaction procedures. This mechanical design strength should be justified by conservative design analyses.

e. For polymeric material, design mechanical strengths should be conservatively extrapolated from creep test data.

f. The design should consider the thermal loads from processing, storage, transportation and burial. Proposed container materials should be tested in accordance with ASTM B553 in the

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manner described in Section C2(g) of this technical position. No significant changes in material design properties should result from this thermal cycling.

g. The high integrity container design should consider the radiation stability of the proposed container materials as well as the radiation degradation effects of the wastes.

Radiation degradation testing should be performed on proposed container materials using a gamma irradiator or equivalent. No significant changes in material design properties should result following exposure to a total accumulated dose of 10^8 Rads. If it is proposed to design the high integrity container to greater accumulated doses, testing should be performed to confirm the adequacy of the proposed materials. Test specimens should be prepared using the proposed fabrication techniques.

Polymeric high integrity container designs should also consider the effects of ultra-violet radiation. Testing should be performed on proposed materials to show that no significant changes in material design properties occur following expected ultra-violet radiation exposure.

h. The high integrity container design should consider the biodegradation properties of the proposed materials and any biodegradation of wastes and disposal media. Biodegradation testing should be performed on proposed container materials in accordance with ASTM G21 and ASTM G22. No indication of culture growth should be visible. The extraction procedure described in Section C2(d) of this technical position may be performed where indications of visible culture growth can be attributable to contamination, additives, or biodegradable components on the specimen surface that do not affect the overall integrity of the substrate. It is also acceptable to determine biodegradation rates using the Bathta-Pramer Method described in Section C2 (d). The rate of biodegradation should produce less than a 10 percent loss of the total carbon in the container material after 300 years. Test specimens should be prepared using the proposed material fabrication techniques.

i. The high integrity container should be capable of meeting the requirements for a Type A package as specified in 49 CFR

173.398(b). The free drop test may be performed in accordance with 10 CFR 71, Appendix A, Section 6.

j. The high integrity container and the associated lifting devices should be designed to withstand the forces applied during lifting operations. As a minimum the container should be designed to withstand a 3g vertical lifting load.

k. The high integrity container should be designed to avoid the collection or retention of water on its top surfaces in order to minimize accumulation of trench liquids which could result in corrosive or degrading chemical effects.

l. High integrity container closures should be designed to provide a positive seal for the design lifetime of the container. The closure should also be designed to allow inspections of the contents to be conducted without damaging the integrity of the container. Passive vent designs may be utilized if needed to relieve internal pressure. Passive vent systems should be designed to minimize the entry of moisture and the passage of waste materials from the container.

m. Prototype testing should be performed on high integrity container designs to demonstrate the container's ability to withstand the proposed conditions of waste preparation, handling, transportation and disposal.

n. High integrity containers should be fabricated, tested, inspected, prepared for use, filled, stored, handled, transported and disposed of in accordance with a quality assurance program. The quality assurance program should also address how wastes which are detrimental to high integrity container materials will be precluded from being placed into the container. Special emphasis should be placed on fabrication process control for those high integrity containers which utilize fabrication techniques such as polymer molding processes.

5. Filter Cartridge Wastes

For Class B and C wastes in the form of filter cartridges, the waste generator should demonstrate that the selected approach for providing stability will meet the requirements in 10 CFR Part 61. Encapsulation of

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the filter cartridge in a solidification binder or the use of a high integrity container are acceptable options for providing stability. When high integrity containers are used, waste generators should demonstrate that protective means are provided to preclude container damage during packaging handling and transportation.

D. Implementation

This technical position reflects the current NRC staff position on acceptable means for meeting the 10 CFR Part 61 waste stability requirements. Therefore, except in those cases in which the waste generator proposes an acceptable alternative method for complying with the stability requirements of 10 CFR Part 61, the guidance described herein will be used in the evaluation of the acceptability of waste forms for disposal at near-surface disposal facilities.

References:

1. NUREG-0800, Standard Review Plan

2. ANS 55.1, "American National Standard for Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants," American Nuclear Society, 1979

3. ASTM C39, "Compressive Strength of Cylindrical Concrete Specimens," American Society for Testing and Materials, 1979

4. ASTM D1074, "Compression Strength of Bituminous Mixtures," American Society for Testing and Materials, 1980

5. ASTM G21, "Determining Resistance of Synthetic Polymeric Materials to Fungi," American Society for Testing and Materials, 1970

6. ASTM G22, "Determining Resistance of Plastics to Bacteria," American Society for Testing and Materials, 1976

7. R. Bartha, D. Pramer, "Features of a Flask and Method for Measuring the Persistance and Biological Effects of Pesticides in Soils," Soil Science 100 (1), pp-68-70, 1965

8. ANS 16.1, "Measurement of the Leachability of Solidified Low-Level Radioactive Wastes," American Nuclear Society Draft Standard, April 1981

9. ASTM B553, "Thermal Cycling of Electroplated Plastics," American Society for Testing and Materials, 1979

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March 29, 1983

Captain Edward F. Wagner
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Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Re: Comments on Draft Environmental Impact Statement, Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

This letter provides the comments of the Attorney General of the State of California and of the staff of the California Coastal Commission on the Draft Environmental Impact Statement (DEIS) noted above. The comments focus on the alternative of ocean disposal off the California coast, since that is the only currently proposed alternative which would directly affect California and which would come under the State's regulatory jurisdiction.

This comment letter will explain the basis for the Coastal Commission's regulatory jurisdiction over the Navy's proposed project, discuss the concerns over ocean disposal of the nuclear submarines, and finally discuss the inadequacies in the DEIS.

1. The Jurisdiction of the California Coastal Commission Over the Navy's Proposed Project

The California Coastal Commission is responsible for implementing the California Coastal Act of 1976 (California Public Resources Code, §§ 30000 et seq.). That statute is the main component of the California Coastal Management Program (CCMP), which has been approved by the federal government under

the federal Coastal Zone Management Act (16 U.S.C. §§ 1451 et seq.), and it therefore implements both national and state coastal zone policies in California.

Under the federal Act, no agency of the federal government may conduct any activity which directly affects California's coastal zone, unless the federal agency first determines that the activity would be consistent with the CCMP to the maximum extent practicable, and unless the Coastal Commission first concurs in that determination. If the Commission does not so concur, the proposed activity may not be carried out, unless the federal agency is prohibited by some other law from complying with the CCMP. F.11

The DEIS states that the possible disposal of the Navy's decommissioned and defueled nuclear submarines at the study area off the Mendocino County portion of the California coast "would not directly or indirectly affect land or water use in the coastal zone of any state . . . [n]or would activities conducted in or on the water in the coastal zone and in or on the shorelands within the zone, be affected." DEIS, 2-11. The DEIS also declares that "the economy of coastal areas" would not be adversely impacted. We disagree for numerous reasons, and believe that the Navy is required to prepare a consistency determination and to submit it to the California Coastal Commission for review and action, in the event that the Mendocino disposal site is chosen.

The California Coastal Act requires the maintenance, enhancement and restoration of marine resources. Section 30230 of the Act requires that "uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes." The Act also specifies that one of the purposes of the Act is to protect marine fisheries and other ocean resources. Section 30001. The effects of the Navy's possible scuttling of nuclear submarines must therefore be measured against these and any other applicable Coastal Act provisions.

We believe, that under these statutory provisions, the Navy's possible program for dumping at the Mendocino site has the strong potential of directly affecting the California coastal zone in at least the following ways:

1. Bio-accumulation of radionuclides through the marine food chain; L.37

2. Adverse synergistic effects caused by the combination of radionuclides and biological and chemical constituents of ocean water; L.10

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T.18 3. Radiation effects on the fecundity of various fish species, especially those which are currently over-exploited; and

4. Serious financial impact on California's coastal fisheries industry. These impacts may result, in part, from either actual or publicly perceived radiation hazards or contamination to various marine resources. If the California or national consumer either knows or feels that L.53, O.34 fish and shellfish are coming from offshore California coastal waters where radioactive wastes have been dumped, the purchaser is likely to avoid the product. Consumer avoidance or rejection of California's fisheries products could economically devastate California's coastal fisheries industry.

The potential direct effect on the California coastal zone is magnified by the possible cumulative effects of radioactive waste disposal off the Pacific coast. Nuclear wastes have been dumped at several locations off the California coast and at numerous L.6 other locations in the Pacific Ocean. In most cases, accurate records of the amounts and locations of such dumping were not kept: no federal agency, for example has been able to accurately document either the dumping of nuclear wastes near the Farallon Islands outside San Francisco Bay, or its effect. Even current monitoring efforts at such dump sites have been cursory and inconclusive. Little definitive information is available concerning the long-term fate and effects of the various types of radionuclides in the ocean environment. L.7 Yet, the DEIS for the Navy's possible scuttling of the obsolete nuclear submarines does not even touch on the cumulative impact of the possible additional disposal at the Mendocino site.

The potential impact on the California coastal zone is again greatly increased by the conceded fact that any scuttling of nuclear submarines at the Mendocino site is irreversible: the W.1 Navy concedes that "[r]etrievability would not be feasible with current technology." DEIS, 2-13. The scuttling must therefore be considered a final, irreversible action, impossible to correct even if serious long-term radiological problems are later discovered.

We therefore believe that the DEIS is incorrect in its assertion that the Navy's proposed use of the Mendocino site will not directly affect California's coastal zone. The federal Coastal Zone Management Act requires preparation of a consistency

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determination by the Navy if the Mendocino site is chosen, and concurrence in that determination is required from the Coastal Commission prior to any dumping.

2. The Inadequacies In the Draft Environmental Impact Statement

Our concerns lie in part with the issues noted above. They are greatly increased by the inadequacy of the DEIS in numerous areas; it is impossible to adequately evaluate the potential impacts of the Navy's possible scuttling because of those inadequacies. Our concerns are in the following specific areas:

1. The most serious inadequacy of the DEIS is its failure to address in any manner whatsoever the cumulative impact question, necessary under both federal and state law. There is no discussion whatsoever of past nuclear waste dumping, the results of any monitoring of that dumping, the L.7 impact of other man-made sources of radiation, or the potential cumulative impact of the additional radionuclides which would be placed in the marine environment by the Navy's plans. The Navy's plans cannot properly be considered in isolation from other past federal actions: the cases under the National Environmental Policy Act make that point clear beyond question.

Any cumulative impact discussion must, moreover, consider not only past actions, but possible future actions. The DEIS (at page 3-9) recognizes federal and international policy to strictly limit the number of radioactive dumping sites. Once a site is selected, it therefore becomes one of a limited number available for possible future dumping. Given this policy, L.9 can we realistically expect that only the current 120 nuclear submarines discussed in the DEIS will eventually rest forever off the California coastline? What of the Navy's current production of the Trident submarine class? What of the Navy's larger class ships currently operated under nuclear power? N.12, A.1 Can California expect future Navy proposals for the scuttling of decommissioned and defueled Trident submarines and aircraft carriers?

As early as February, 1982, State Senator Barry Keene wrote the Navy that an annotated outline of the DEIS failed to consider these cumulative impacts as required by Council on Environmental Quality regulations implementing the National

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Environmental Policy Act (NEPA). You personally responded, and assured the Senator that the report would "include a consideration of cumulative impacts of action" in compliance with federal law. Yet, the DEIS was issued without such discussion. The DEIS does not demonstrate that the cumulative impact of federal actions, past and potential, is safe: there is not even any effort to make such a demonstration.

2. As you know, section 104 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. § 1431(b)), now prohibits any ocean dumping of low-level radioactive waste, except under certain circumstances not present here, until F.2 January, 1985. After that date, such dumping is permissible only after approval by the Environmental Protection Agency and after affirmative approval of both the Senate and House of Representatives; even with such approvals, the dumping is permissible only with "a comprehensive monitoring plan to be carried out by the applicant . . . ." Section 104 details some of the requirements of any such monitoring plan.

The DEIS is inadequate in its discussion of any such required monitoring plan. First, the DEIS does not reflect the requirements of section 104; there is no discussion whatsoever of the explicit specifications of that section. Second, there is no commitment by the Navy to carry out any such required monitoring plan--or even any monitoring plan at all. The DEIS, J.76 for example, states that "a monitoring program could be performed using existing proven technology." DEIS, K-1 (emphasis added). The DEIS likewise states that both pre- and post-disposal monitoring "could" include various activities, without more specificity. DEIS, K-3. Moreover, there is no explicit commitment by the Navy at any place to fund and continue such a program. There is likewise no indication as to who would or could carry out such a program; there is no indication of the number of years that such a program would or should be continued. A nuclear waste pile now lies off the Farallon Islands, close to some of Northern California's richest fishing grounds. The L.6 federal government has not adequately monitored that site; indeed, many of the waste disposal containers cannot now even be located. The inadequacy of the DEIS in its discussion of monitoring at the Mendocino site raises the spectre of another similar experience.

The lack of information on a monitoring plan or commitment to it is critical for two additional reasons. First, the DEIS itself concedes that monitoring is necessary to ensure that no

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adverse impact occurs. DEIS, 4-23. The lack of a specific monitoring plan which both complies with federal statutes and guarantees the long-term monitoring necessary makes it impossible for the Navy to reach its conclusion that no significant adverse L.39 harm will result from its proposed dumping. It also makes it impossible for the Navy to accurately conclude that dumping at the Mendocino site would have no long-term direct effect on the California coastal zone. Secondly, the DEIS favors ocean disposal over land disposal of the nuclear submarines, almost entirely because of its conclusion that ocean disposal is less costly. That conclusion, however, is impossible to analyze or J.76 verify given the lack of information about the necessary monitoring plan and its cost. These deficiencies are clearly inconsistent with the requirements of NEPA.

3. The DEIS is also inadequate in its discussion of the fishery resources at the site of the proposed ocean disposal. The DEIS recognizes that an ocean site should not be chosen for disposal of low-level radioactive materials if it has "potential sea-bed resources which may be exploited . . . by the harvest of marine products, or . . . as feeding grounds for marine organisms important to man." DEIS, 306. The DEIS also declares, however, that "[t]he biology of the deep waters and the sea floor . . . is little known at present." DEIS, 3-11. It is impossible to determine from the DEIS whether the Mendocino site satisfies the necessary criteria, and the DEIS therefore cannot properly serve, under federal law, as an appropriate document for a decision by the Navy.

The DEIS further declares that the fish productivity of the site is low. DEIS, 3-11, and E-30. The data on which that statement relies, however, show only that the site is of a lesser relative productivity than other extraordinarily rich sites in waters closer to the shoreline; the figures demonstrate that the site considered by itself is still a highly productive one for albacore J.12 fishing. The data also fail to reflect the fact that albacore, like all tuna, migrate over long distances: the significant question is J.9 whether they feed at or near the site prior to being caught elsewhere. The emphasis of the DEIS only on catches at the site is therefore misleading and inaccurate.

In addition, the figures on which the DEIS relies are based on inadequate and out-of-date information from the 1961-1970 fishing seasons. DEIS, E-30. In the public hearing on the DEIS in Sacramento, representatives of Humboldt and Mendocino Counties pointed out that the current data show the site to be a more

Captain Edward F. Wagner
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significant fishery resource, and that new fish technology makes the site one of even more commercial significance.

J.12 Dr. Herz from the Oceanic Society also testified that current data available from the Scripps Institute of Oceanography indicates that the albacore catch at the site is currently one of the highest in the Mendocino area. We believe that this current information, if properly included in and analyzed by the DEIS, would demonstrate that the site cannot satisfy the criteria which the Navy recognizes as appropriate for site selection.

O.34 Finally, the DEIS is inadequate in its failure to even mention the possibility of consumer avoidance or rejection of fish caught off the Mendocino coast after the scuttling of nuclear submarines. Such avoidance may occur from either actual or publicly perceived radiation hazards, and could have a significant adverse effect on the Northern California fishing industry; this avoidance may well be increased by the low credibility of the nuclear industry in many sections of the society. For example, the sales of products using aerosol propellants dropped sharply after studies demonstrated that aerosols could deplete the ozone layer. As a more analogous example, we have been advised that Japanese purchases of sablefish from California fisheries dropped by almost 50% after press accounts of the Farallon Islands dumpsite, and that public fear of contamination may have been the cause of the decline. The DEIS, however, fails to even consider the economic costs of such consumer avoidance in its cost-benefit analysis. The clear inadequacies of the DEIS on the many other points discussed in this letter can themselves only contribute to public concern about the Navy's possible actions.

4. A fourth ground on which we find the DEIS inadequate is in its failure to disclose in any manner whatsoever the source of the data on radionuclides likely to be found in the submarines which will be dumped. Under these circumstances, it is impossible to adequately address the conclusions which the Navy draws from the data.

A.6 For example, is the data an average of actual radiological tests of the existing defueled and decommissioned submarines, or is it an average of a group of hypothetical or computer-modeled submarines? The oldest nuclear submarines, those likely to be first scuttled, seem likely to be much more radioactive than the newest models. If so, it is unclear whether this factor was considered in the DEIS. We understand that the Navy maintains detailed safety and radiological records of all nuclear submarines. If so, the data for those records could be significant in validating or disputing the conclusions of the DEIS.

Captain Edward F. Wagner
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The failure of the DEIS to disclose the source of the basic radiological data is made even more significant in light of the international limits on ocean disposal of radioactive waste which have been developed by the International Atomic Energy Agency for the London Convention. The DEIS recognizes that those limits applicable here are 100 curies per metric ton for beta/gamma emitters with half-lives of at least 0.5 years. DEIS, 2-13. The DEIS concludes that the proposed disposal would be within those limits, since the activity concentration of each submarine reactor compartment is approximately 58 curies per metric ton. DEIS, 2-14.

However, because the DEIS does not disclose the source of the data on which the radionuclide data is based, it is impossible to analyze or verify this conclusion. If the data are incorrect by only a small factor, it appears that the proposed ocean disposal would violate the IAEA standards. The failure of the DEIS to disclose the source of the data is therefore of critical importance, and the failure of the DEIS to disclose it, in our view, renders the DEIS inadequate under federal law.

5. There is yet another critical area in which we find the DEIS inadequate. The DEIS indicates that the reactor compartment of each submarine would be sealed and filled with water prior to scuttling, and that a check valve or one-way valve in the reactor compartment bulkhead would ensure that the reactor compartment pressure would be equal to the pressure in adjacent compartments during the sinking. DEIS, 2-11. Because of this precaution, the DEIS states that there will be no possibility of ocean pressures crushing the reactor compartment and no possibility of water escaping from the compartment. The DEIS therefore concludes that radioactivity release would occur to the ocean waters "only after many years due to the slow process of corrosion . . ." DEIS, 2-12.

It seems clear to us, however, even assuming the validity of the remainder of the DEIS, that the conclusion will depend substantially upon the operation of the one-way valve. Yet, the DEIS contains no discussion whatsoever of the construction or operation of such a valve, or whether such valves have themselves withstood ocean corrosion for extensive periods. If the valve allows escape of water caused solely by corrosion, the conclusions of the DEIS are completely incorrect, and the release of radionuclides into the marine environment may occur much sooner than the DEIS concludes. F.21
Much of the DEIS is based on the conclusion that certain radionuclides will have decayed to a stable and harmless form

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prior to their release from the submarines that no danger will be posed. DEIS, 2-12. That conclusion is incorrect, however, if the one-way valve poses the possibility of earlier release of water and material from the reactor compartment.

Without a complete analysis of the one-way valve system proposed by the DEIS, and a demonstrated history of its containment avilities over a lengthy period in the marine environment, we again believe that the DEIS is inadequate under federal law.

6. The DEIS recognizes that a marine disposal site should not be selected if it is in a known area of natural phenomena. DEIS, 3-6. The document indicates that disposal in an area containing active geologic phenomena will increase the likelihood of unpredicted disturbances which might shorten biological pathways to man's use. DEIS, E-6. The DEIS concludes that the Mendocino study site is an "[i]solated, tranquil and predictable" area, compatible with the site identification guidelines. DEIS, E-30.

That conclusion may be incorrect, and we urge further study before the Navy reaches a definitive conclusion on the question. The DEIS recognizes that an active fault line lies only 40 to 80 miles away, but concludes that "[i]ts associated seismicity does not extend into the study area." DEIS, E-30. There is no indication whatsoever on what studies such a conclusion is based, and we do not believe that the limited coring samples taken at the site are sufficient bases for the conclusion. At a minimum, additional work is necessary to verify the conclusion, in light of California's long history of geological instability and in light of increasing knowledge of newly discovered fault lines. The recent discovery of the Hosgri fault, only when construction was nearly complete on the Diablo Canyon nuclear power plant, should serve as a highly visible and pertinent caution in this area. F.22

Finally, we note that one core sample taken at the site showed "fresh glass volcanic ash layer at 8.5 meters." DEIS, E-27. The source of such material is not otherwise discussed or analyzed, but itself may indicate geologically recent active phenomena at the site. We thus urge further studies by the Navy in this area; the information contained and discussed in the DEIS is insufficient to satisfy the criteria for ocean disposal, and insufficient to satisfy the requirements of the National Environmental Policy Act.

7. There is another inadequacy in the DEIS. An environmental impact statement, of course, is expected to disclose the environmental aspects of a possible course of action, so that the decision maker can make an informed decision, weighing the adverse environmental impact of the project against any possible benefits. The final decision which is reached based on an environmental impact statement, however, is not immunized from the requirements of any other applicable laws; simply because a federal agency has analyzed the impact of a proposed activity does not free it from compliance with other statutory requirements.

The DEIS here admits that a reactor compartment, once sunk to the depths proposed by the Navy, cannot be feasibly retrieved with current technology. DEIS, 2-13. Current federal law, however, requires retrievability before any such dumping may legally occur. The Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. § 1431(b)(i)(1)(A)) explicitly requires a permit from the Environmental Protection Agency for any such dumping, and, after January 1985, no such permit may be issued unless the disposal includes "a plan for the removal or containment of the disposed nuclear material if the container leaks or decomposes . . ." Since the DEIS concedes that no such retrievability is possibile, marine disposal is squarely precluded by federal law. F.2 W.1

8. An additional deficiency in the DEIS lies in its failure to present sufficient information regarding oceanographic and biological data. An EIS is intended both to provide sufficient information on which to make an informed decision and to allow comment and analysis by interested parties. Yet, the DEIS here concedes that "counting and identification are now in progress." DEIS, E-29. Since the identification of the various specimens of fish and invertebrates from the sea floor and various depths are not included in the DEIS, how can it be possible for interested parties to adequately comment on the conclusions? The necessary biological work should have been completed and distributed as part of the DEIS, so that adequate analysis of it could have been made. Since it was not, we believe that the DEIS is inadequate. L.1

Another inadequacy in the presentation of the oceanographic data is in the discussion of current patterns. Only a brief summary of the Oregon State University study is provided in the DEIS, and it is virtually impossible from that summary to determine the type of current analysis which was done. It appears that current measurements were made at 40 meters, 450 meters and 1250 meters from the ocean floor, but little other information is available. DEIS, E-20. J.28

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The DEIS should have thoroughly described the bottom water circulation and the exchange rate of the bottom waters with mid and surface waters. Most oceanographers believe that one of the sources of upwelling waters in the California current is the poleward counter current, but the DEIS does not analyze the movement of the counter current at the Mendocino study area. Studies should have been done on this horizontal and vertical movement of the current. Currents may provide a pathway for the movement of radioactive materials from the floor into the mid and upper portions of the water column. The lack of discussion of the currents is especially disturbing in light of the assertion of the DEIS that "the rate of which physical processes could transport radioactivity from the bottom waters of the deep ocean to the surface is much more important than that for biological processes." DEIS, 3-17.

L.36 Moreover, the DEIS also lacks discussion of any possibility of concentrated absorption of radionuclides by benthic organisms and transport of those concentrations through the marine food chain to species harvested by man. Various biological pathways by which individuals might be subjected to radiation explosure are discussed in exceedingly general and unilluminating terms, but that discussion appears to focus only on "direct ingestion paths" (DEIS, 4-17) without explicit discussion of either the concentration of radionuclides through the marine food chain or any adverse synergistic effects caused by the combination of radionuclides and biological and chemical constituents of ocean water. These possibilities must also be addressed and appropriately analyzed in the DEIS to comply with federal EIS requirements. L.37, L.10

9. The DEIS purports to adequately analyze the alternatives of ocean and land disposal, and concludes that the radiation hazards from either course of action are miniscule. It then concludes that the preferable course of action is ocean disposal, and the principal reason given for the conclusion is the lesser cost. DEIS, 2-10, 2-14; A-1. At no place, however, does the DEIS provide a detailed analysis of how the respective costs were calculated. Table A-4 (DEIS, A-13), for example, presents certain "estimated total costs," but there is no supporting data whatsoever to show the basis for such estimations. The associated text describes the cost constituents only in the most general terms, but the information is far from sufficiently specific to allow for adequate cost analysis. O.2

For example, the studies required to qualify a sea disposal site are estimated at six million dollars, with an additional nine million for ongoing monitoring. DEIS, A-14. As we previously noted, however, the figure for ongoing monitoring is impossible to verify, and there is no indication in the DEIS as to the extent of any such program or commitment to it. In addition, the monitoring discussion does not reflect the applicable requirements of federal law. Moreover, the DEIS does not describe in any way whatsoever what studies are necessary to qualify a sea disposal site. It is therefore impossible to know whether the cost conclusions are valid. These deficiencies, along with the general failure of the DEIS to specify the basis for determining the costs involved in the other components of an ocean disposal plan, demonstrate the inadequacy of the Navy's cost conclusions. J.76

The inadequacy of the data on which to analyze the Navy's cost conclusions is especially disturbing given another point of the DEIS. The DEIS concedes that sea disposal of the submarines would result in three times as much radiation exposure to the population as would land disposal. Table 4-11 (DEIS, 4-27). The sea disposal option would result in forty-five times more radiation exposure, if the disposal plan is somehow inadequate and results in only minimum containment. Given the magnitude of these differences, the deficiency in the cost analysis is quite properly of the highest concern. L.47

10. Our final concern lies in the lack of adequate public hearings on the DEIS. Notwithstanding the fact that the Mendocino site is included within the DEIS for analysis, only one public hearing was held in California. No hearing was held in the physical areas which would be most heavily affected by the dumping, Mendocino and Humboldt Counties. Numerous requests for such a hearing were made prior to the Sacramento hearing and at that hearing itself, including requests from numerous California legislators and members of the California Congressional delegation, but no such hearing was held. The lack of a local hearing may have prevented testimony from local fisherman and others knowledgable about the resources of the offshore area from offering their own historical observations of the fishery and natural resources at the possible dumping site. Especially given the conceded lack of firm biological data in the DEIS, such testimony from those most directly affected would have been unusually valuable. J.15

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Captain Edward P. Wagner
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Conclusion

As the DEIS concedes, scuttling of nuclear submarines at the Mendocino site would be a final, irreversible action. If serious problems are discovered after such disposal of nuclear wastes, it will be impossible to take corrective action. Calculations and decisions based on incomplete or faulty data and analyses may well be of little concern when a risk to public health is non-existent. Those same calculations and decisions, however, are impermissible when miscalculation may be catastrophic. The land disposal site analyzed in the DEIS would permit on-going
W.1,J.76 monitoring and retrieval. Ocean disposal will not, and will instead leave any possible error irreversibly to the continuing and long-term detriment of our successors.

Based on the information and analysis of the DEIS, we do not believe it either legally permissible or in the public interest to select the ocean disposal option at the Mendocino site. We urge the Navy to choose the option of land disposal as the option which poses the least threat to the continuing health and economy of California and her citizens.

Yours very truly,

JOHN K. VAN DE KAMP
Attorney General

RICHARD C. JACOBS
Special Counsel to the Attorney General

MICHAEL L. FISCHER
Executive Director
California Coastal Commission

RCJ:ccb

#447

RONALD V. DELLUMS

COMMITTEE ON THE DISTRICT OF COLUMBIA

ARMED SERVICES COMMITTEE

Congress of the United States
House of Representatives

March 30, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

There is a tendency, which is often justified, to minimize long term consequences in solving immediate problems, but this is not the case with the problem of radioactive waste disposal.

Radioactive waste by nature is a long term substance. The sixteen different radioactive nuclides in the 62,000 curies that the submarine reactors contain range in half-lives from 5.3 years for Cobalt-60 to 80,000 years
L.20, Q.13 | for Nickel-59. There is no vessel yet known or partially tested which will contain radioactive waste, in salt water and under pressure, even for the 20 to 50 years which is necessary to allow for the anticipated early rapid decay of the short-lived radioactive isotopes. The steel containment
L.6 | of the waste drums which were sunk off the Farallon Islands lasted 20 to 40 years. It is hard for any person to foresee or even imagine what the world will be like in 80,000 years, much less in 100. But if the scuttling proposal is chosen, it would be insane to pretend that we would not be contributing to a much more radiated ocean environment with significantly wider ramifications.

I am convinced that it is in no one's best interests to contribute to the degradation of our oceans. Scuttling one submarine reactor alone, with a minimum of 62,000 curies, equals approximately one-half of the entire amount of radioactivity already estimated to have been dumped by the U.S.
L.7, F.12 | between 1946 and 1970. The Draft Environmental Impact Statement insufficiently examines the cummulative effects of past and the proposed radioactive dumping, ignoring scientific studies done by the United States
L.37, L.22 | Environmental Protection Agency, which reveal radionuclide bioaccumulation in the food chain. Since dumped waste does not diffuse through the ocean, as originally believed, the ocean bottom near the dumpsite becomes intensely contaminated. As bottom dwelling animals feed off the sediment and as
L.36 | sponges attach to the decaying containment vessels, the radioactivity is concentrated from there up the food chain. To act on a report which does not adequately investigate this basic health concern, and which fails to

Captain Edward F. Wagner
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address the question of biological transport pathways of radionuclides and oceanic currents of the potential sites, is to act in a completely irresponsible and totally reprehensible manner. | L.35, J.28 The DEIS either deliberately tries to misrepresent or demontstrates a gross lack of scientific professionalism by presenting the size of catches of the albacore fishing industry near the proposed Mendocino site based on the size of catches from 13-23 years ago. | J.12 Available current data suggests a much more significant fishery in that area. Considering that this potential site is one of California's richest commercial fishing grounds further necessitates a far more thorough examination.

Besides the lack of scientific data on the effects of ocean dumping, there are other serious flaws in the DEIS, which warrants its rejection. The sea disposal alternative presented in the DEIS indicates that the submarines would be irretrievable. This contradicts the Anderson | W.1
Amendment which requires that radioactive waste disposed in the ocean be retrievable. In addition, according to information made available to me, | F.2
a number of scientists challenge the DEIS' estimates of initial radioactivity present in the reactors, and ignore the radioactivity in the | A.12
subs shells, which have absorbed radioactive particles over the years of service.

Of the two recommendations contained in the DEIS, ocean dumping should not be considered. I believe the plan has three major flaws: the half-lives of the radionuclides far exceed the life expectancy of the con- | L.20
tainment vessel, resulting in inevitable leakage; the decomposition of the submarines can not be monitored for environmentally damaging leakage; | J.76
further, in the event of any leakage the submarines are irretrievable. | W.1
Thus were any health hazards revealed, no other disposal option would exist to limit the effects.

The second recommendation for protective storage and monitoring deserves more consideration. Land-based storage fulfills the minimal requirements of nuclear radioactive waste disposal. It allows the materials to be isolated from the surrounding environment, to be frequently and easily monitored for leakage, and for the containment vessels to be repainted to ensure less decomposition. | G.2 Most importantly, the plan allows for the retrieval of the vessels when and if a safe disposal method is developed.

To act in haste is unconscionable. The priority of protecting the ecosystem transcends all short term political concerns. The decision on how to deal with radioactive waste is simply a matter of foresight and prudence. The cost difference between a land-based and ocean disposal is a matter which can be solved in the short run. Whereas the problem of environmental damage and bioaccumulation of radioactivity in the food chain | N.3
is of a permanant nature. Even if the scuttling and ocean floor deposits give rise to a minimal adverse environmental impact (which is not adequately determined in the report), this continues and fosters a dangerous policy attitude: that ocean dumping is an acceptable solution. It is not. Underlying this argument is a deceptive, yet psychologically appealing concept, that what we can't see won't hurt us.

I respectfully ask you that we consider the question seriously: what really

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Captain Edward F. Wagner
March 30, 1983
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is the hurry? You have the opportunity to state the Navy's commitment to human health, and to the sanctity of our environment by rejecting this report and redrafting a new Environmental Impact Statement giving proper attention to the alternatives to ocean disposal.

Sincerely,

Ronald V. Dellums
Member of Congress

RVD:cr

#448

WALBRIDGE J. POWELL
ENGINEER & GEOLOGIST
4314 ISLAND CREST WAY
MERCER ISLAND, WA. 98040

March 30, 1983

Capt. Edward F. Wagner
U. S. Navy, Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington D. C. 20350

Gentlemen: SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED SUBMARINE REACTOR PLANTS

I wish to preface my remarks on the subject specifications for disposal of deadly, mutation-causing radioactive waste with one or two facts about the operations of the U. S. Navy.

During 1982 I repeatedly requested information about the location and quantity of radioactive waste being held by the Navy.

I submit Exhibits A and B as evidence that the Navy could not in an emergency such as a fire or explosion at a base or radioactive storage facility, be able to supply proper information to their own personnel or to civil authorities so that they might assess what action to take to avert a disastrous spread of nuclear matter throughout the surrounding area and into the atmosphere.

Exhibit A states "the requests made in paragraphs VIII and IX (see Exhibit B) are very broad and involve information held by six naval shipyards and a number of other shore facilities.Thus, the search required to locate potentially responsive documents would be extensive. "

I ask you to contemplate the chaos that would result if a fuel or ammunition dump explosion occurred or circulation was lost in a storage tank used for spent fuel or reactor casings. Would this "extensive search" be for days or weeks while aerosoled radioactive waste is spread about the countryside.

If the Navy has not immediately available records of storage of radioactive wastes at a central location would this not imply that they have no control of the quantities in inventory and a subsequent suggestion that the quantities stored in proximity to each other are also not recorded at bases with regard to interreaction. One then proceeds to the question of how much of the waste is actually there and how much is not.

I also submit Exhibit C as evidence that the Navy will go to any length to deny information to an individual. In paragraph 3 Exhibit C Dennis F. McCoy states " It is considered that Mr. Powell's request has not been denied inasmuch as he has not perfected his Freedom of Information request."

Apparently the legal aid employed by the Navy cannot discern when a clear concise request for scientific information has been made. He prefers to cover his lack of knowledge of scientific matters with coprolitic utterance peculiar to the legal profession.

L.20

The untrue implications expressed in Page 8-4 of the DEIS are appalling: "Thus they (reactor and pressure vessel) act as a container for radioactive atoms and delay the time any of the radioactive atoms inside would be released to the environment..etc.This is important because radioactivity "decays" away with time -- which means that as time goes on, radioactive atoms change into nonradioactive atoms. Since radioactivity decays away with time , the effect of a delay is that fewer radioactive atoms would be released to the environment." Such a statement is the equivalent to

" A dose of clap is no worse than a bad cold " This seems very valid until the affected organ rots and falls off.

A.3

The degree and quantity of radioactivity found in a spent reactor casing will not, under any circumstances, " decay away". It will, for thousands of years, be able to induce terminal burns, genetic disruption, and long term tumor formations in all species, including humans.

L.36, L.14

To dump these casks into the ocean depths off our shores is to assure that our ocean as well as estuarial food fish supplies will become unuseable. In addition, all of the vertebrates, invertebrates at all depths will be tainted. J.31 There is no way that radioactive substances resting on the bottom of the ocean can be separated from the upwelling of currents, and other inexorable forces that have been forming the earth's crust since time uncountable and will continue to do so. L.1 Our sketchy knowledge of the oceans will not suffice to make any assumptions.

I think that the above fully illustrates the general tenor of this whole DEIS.

The Navy has taken a very difficult scientific problem, the disposal of highly and permanently radioactive waste, submitted it to contractors paid to study the problem and turned it into a farce of a public relations campaign. I can assure you that if any of the paid contractors who studied this problem came up with a negative report, they would be purged not only from the Navy bid lists but also from all government bid lists. Solution: If the problem is too difficult, just paint an optomistic and totally false picture of it and it will solve itself.

Since 1945 our government bureaucrats as well as the Army and Navy have tried to assure us that radioactivity is harmless. There is no truth in any of their statements. These statements only serve to cover up the paucity of knowledge in the various departments relative to nuclear affairs.

I recommend that this DEIS be dismantled and the useable portions salvaged and assembled in conjunction with data found in government and commercial archives relative to the handling of radioactive waste. When this assembly has been made, a new DEIS should be issued and distributed for comment. Until a logical document is produced we ca not attempt to solve a problem that in no way can we avoid.

I request that these comments be included in the records of this DRAFT ENVIRONMENTAL IMPACT STATEMENT or an ensuing EIS.

I further request that a copy of any future Draft Environmental Impact Statements , Environmental Impact Statements, or related documents be forwarded to me when they become available. If the cost of such is over $5.00 I should be informed before shipment is made. I assume that DEIS's and EIS's are forwarded without charge.

I further request that I be informed of all future action on this subject.

Yours very truly,
Walbridge J. Powell
Walbridge J. Powell

EXHIBITS: A. LTR DTD OCT. 25, 198 U. S. Navy, Naval Sea Systems, Command T. T. Marchitelli to W. J. Powell
B. LTR DTD AUGUST 31, 1982 Walbridge J. Powell to Dept. of Navy of The Judge ADvocate General
C. LTR DTD NOV. 26, 1982 Dept. of The Navy, Office of The Judge Advocate General, Capt. Dennis F. McCoy to The Honorable Henry M. Jackson, U. S. Senator

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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362

SEA 00D
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5720/01

Mr. Walbridge J. Powell
4314 Island Crest Way
Mercer Island, Washington 98040

OCT 25 1982

Dear Mr. Powell:

This is in final response to your letter of August 31, 1982 which requested information under the Freedom of Information Act. Your letter was received in this office on October 4, 1982, and an interim response was provided by letter dated October 18, 1982.

Your letter requested information pertaining to the Navy's evaluation of methods for disposal of decommissioned, defueled nuclear powered submarines, including the Environmental Impact Statement (EIS) which the Navy is preparing on this subject. Your letter also stated that if the expenses associated with responding to your request exceeded five dollars, then you should be advised of the charges and your agreement obtained prior to further processing of your request.

Your request has been carefully reviewed under the provisions of the Freedom of Information Act (5 USC 552) and the implementing Navy regulations. Items which you have requested in paragraphs I through V of your letter are all covered in the Navy's Draft Environmental Impact Statement (DEIS) on this subject. The DEIS is scheduled to be issued before the end of this year, and a copy of the document will be sent to you free of charge.

The requests made in paragraphs VI, VII and X of your letter do not adequately specify the records which you are seeking. Specifically, you ask for "Related documents" without identifying the nature of the documents, or precisely in what they should be related. Further, you ask for "actions" of the Department of the Navy and other government agencies pertaining to disposal of nuclear powered submarines, without defining what is meant.

The requests made in paragraphs VIII and IX are very broad, and involve information held by all naval shipyards and a number of other shore facilities. Thus, the search required to locate potentially responsive documents would be extensive. This search would have to be performed by professional personnel who are familiar with the subject matter. Thus, although a specific estimate of the costs associated with responding to your request can not be provided, they are likely to be substantial, and certainly considerably in excess of the five dollar limit which you have specified.

Further, in order to properly respond to your requests in paragraphs VIII and IX, you must specify additional information, such as the time period for the shipments identified in IX, and the more specific nature of the components (reactor plant or all components) in VIII.

Thus, for those documents which are adequately described, Navy regulations require that you state a willingness to pay necessary fees to permit processing of your request to proceed.

If you have any questions on this matter, or wish to advise us as to how you want to proceed, you may contact Ms. Judy Wise at 202-692-3779 who will be pleased to assist you.

Sincerely,

[illegible signature]
T. T. [illegible]
Director of Congressional
and Public Affairs

WALBRIDGE J. POWELL , GEOLOGIST & ENGINEER
4314 ISLAND CREST WAY
MERCER ISLAND, WA. 98040

August 31, 1982

Department of The Navy
Office of The Judge Advocate General
200 Stovall Street
Alexandria, 22331

Sirs: A.OCEAN SCUTTLING OF NUCLEAR SUBMARINES
B. LAND DISPOSAL OF NUCLEAR SUBMARINES

Pursuant to the Freedom of Information Act. 5 U. S. C. 522

I hereby request access to (or a copy of):

I. Proposal for ocean scuttling of nuclear submarines

II. Draft Environmental Impact Statement for ocean scuttling of nuclear submarines . [or Final Environmental Impact Statement.

III. Proposal for land disposal of nuclear submarines .

IV. Draft or Final Environmental Impact Statement for disposal of nuclear sumarines

V. Alternative methods of disposal for nuclear submarines.

VI. Actions by the Department of Navy relative to Items I-V since January 1, 1982.

VII. Actions proposed by the Navy or any other government agency From August 31, 1982 through January 1, 1985.

VIII. Tonnage of radioactive material being held at Naval yards and other depositories pending a decision on where to dispose of it. This includes hulls, reactor encasements, shielding, and all other components of a nuclear submarine and its power plant. Please be specific about location and amount for each holding location.

IX. Disposal locations to which high and low level radioactive waste is presently being routed and average tonnage per month.

X. Related documents.

If any expenses in excess of $5.00 are incurred in connection with this request, please inform me of all such charges prior to their being incurred for my approval. If you do not grant my request within ten working days I will deem my request denied.
Thank you for prompt attention to this matter.

Yours very truly,

Walbridge J. Powell

ATTACHMENTS: A. LTR W J POWELL TO MR. D. CARR.
B. LTR DEPT. OF NAVY P. M. CORMLEY TO W J POWELL

#448 (Cont)

WALBRIDGE J. POWELL
ENGINEER & GEOLOGIST
4314 Island Crest Way
Mercer Island, Wa. 98040
(206) 232-5295

October 8, 1982

Department of The Navy
Office of The Judge Advocate General
200 Stovall Street
Alexandra, VA 22331

APPEAL LETTER

Sirs:

SUBJECT: FREEDOM OF INFORMATION REQUEST DTD August 30, 1982 WALBRIDGE J. POWELL TO PATRICIA M GORMLEY ACTING DEPUTY ASST. JUDGE ADVOCATE GENERAL

REFERENCE: A. OCEAN SCUTTLING OF NUCLEAR SUBMARINES

B. LAND DISPOSAL OF NUCLEAR SUBMARINES

By letter dated August 31, 1982 I requested access to (or a copy of)

I. Proposal for ocean scuttling of nuclear submarines.
II. Draft Environmental Impact Statement for ocean scuttling of nuclear submarines [or Final Environmental Impact Statement]
III. Proposal for land disposal of nuclear submarines.
IV. Draft or Final Environmental Impact Statement for disposal of nuclear submarines.
V. Alternative methods for disposal of nuclear submarines.
VI. Actions by the Navy Department relative to Items I-V since January 1, 1982
VII. Actions proposed by the Department of Navy or any other government agency from August 31, 1982 through January 1, 1985.
VIII. Tonnage of radioactive material being held at navy yards and other depositories pending a decision on where to dispose of it. This includes hulls reactor encasements , shielding and all other components of a nuclear submarine and its power plant. Please be specific about location and amount for each holding location.
IX. Disposal locations to which high & low level radioactive waste is presently being routed and average tonnage per month.

X. Related documents.

I HAVE RECEIVED NO REPLY AS OF THIS DATE.

I am enclosing a copy of my request letter (including a signed Certified mail receipt for Article P 20250612 dated Sept. 9, 1982 showing receipt Hoffman Building ZIP 22332 signed D. Huffman)

If you do not act upon my request within 20 (twenty) working days I will deem my request denied.

Very truly yours,
[signature]
Walbridge J. Powell

wjp/bo

DEPARTMENT OF THE NAVY
OFFICE OF THE JUDGE ADVOCATE GENERAL
200 STOVALL STREET
ALEXANDRIA, VA 22332

IN REPLY REFER TO
JAG:144:RRW:njc
Ser: 14/15726

NOV 26 1982

The Honorable Henry M. Jackson
United States Senator
802 United States Courthouse
Seattle, Washington 98180

Re: Walbridge J. Powell

Dear Senator Jackson:

This is in reply to your letter of November 9, 1982, to Rear Admiral Bruce Newell, Chief of Legislative Affairs, on behalf of your constituent, Walbridge J. Powell, regarding his Freedom of Information Act request/appeal for information concerning disposal of nuclear submarines.

Mr. Powell's initial request dated August 31, 1982, was re-addressed and forwarded on September 13, 1982, to Naval Sea Systems Command as a matter within their cognizance. A response by the Deputy Assistant Judge Advocate General (Litigation) to Mr. Powell's October 8, 1982, letter was made on October 20, 1982, wherein he was informed that his initial request had been forwarded to Commander, Naval Sea Systems Command as the command having cognizance over the requested information. Mr. Powell was also informed that since the information requested might be provided, thereby mooting his appeal, no action would be taken on his letter of October 8, 1982, at that time. He was, however, informed of his right to resubmit his appeal should there be a denial of any or all of the information by Naval Sea Systems Command.

Mr. Powell was apprised on October 25, 1982, by the Naval Sea Systems Command that he needed to offer a statement of his willingness to pay for those items that he had adequately described. For some of the other items sought, Mr. Powell's request lacked the required specificity to identify the documents, and he was requested to provide additional information relating to those items. (A copy of the Naval Sea Systems Command letter is enclosed for your information.) It is considered that Mr. Powell's request has not been denied inasmuch as he has not yet perfected his Freedom of Information Act request.

I hope this answers any questions you have regarding this matter.

Sincerely,

[illegible]
[illegible] U. S. Navy
[illegible]
[illegible] (Litigation)

Enclosure

898

#449

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

APR 1 1983

ER 83/24

Captain Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

We have reviewed the draft environmental impact statement for the disposal of decommmissioned, defueled naval submarine reactor plants and have the following comments.

Disposal sites under consideration in the at-sea alternative in the DEIS are located either seaward of the 200-mile limit or seaward of the lower end of the continental slope and on the abyssal plain. These sites are not considered to be resource areas for solid minerals or hydrocarbons at this time, and as such, we have no objection to designation of these sites as disposal areas. However, since use of the sea bottom in or near the disposal sites would be prohibited, the Minerals Management Service requests that it be informed of any disposal site so that the information will be factored into the minerals leasing program.

We hope these comments will be helpful to you.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

#450

3-27-83

Dear sir

I understand that you are accepting comments on the disposal of decommissioned, defueled Naval Submarine Reactor Plants. I also understand that 1 of the options is to dispose of them in the sea.

There have been recent news reports of all the trouble they are having in China with rats. Cats were considered "decadent" and disposed of in the 1950's. Now the country is being overrun with rats. In the recently published National Geographic book on China, they point out a similar problem in the cities. Birds preformed no "function," therefore they were killed off. The insects are eating everything in sight and they are having problems with duststorms, not to mention crop losses. "How stupid," we think, "everyone knows this would happen." But, obviously, they didn't know

2

when they did this, or didn't listen to those who did.

I am afraid that if we dispose of the radioactive portions of the submarines in the sea, 30 years from now there will be news reports and people will think "How stupid, everyone knew this would happen." We just do not know enough about the sea and about the effects radioactive things would have, or do have, on life in the sea, and subsequently, on us. L.1

I hope you can see your way clear to insisting on more study before disposing of more radio-active substances in the sea.

Sincerely yours,

K. Hackett
7004 Ted Morse
Austin TX
78723

700

#451

March 27, 1983
Genoa Ohio.

Sir:

Concerning U.S. Navy plans to dispose of nuclear submarine's reactors – I am opposed to scuttling at sea. We do not KNOW if it

L:1 is dangerous. Common sense tells me it is not a good idea. At the very least we should know more about its effects, before we put more radioactive materials in the ocean.

We all share the same fate.

Sincerely

Gary Schnider

917 MAIN
GENOA Ohio 43430

#452

PO Box 640
Laytonville CA 95454
April 1, 1983

Dear Captain Wagner—

My family, my neighbors + I are totally opposed to the Navy's proposal to dump nuclear submarines off the Pacific Coast. With all due respect to you — since I never have met you — I find the proposal insane, inhuman + (in my opinion) immoral. I'm enclosing a letter I read in the local paper that expresses this opinion well. I hope you'll read it.

Sincerely,

Bernard Kamoroff
Sharon Kamoroff
Crystal Rose Kamoroff

Dear Captain Wagner,

In view of the proposed dumping of used nuclear submarines off the Northern California coastline, I wish to comment.

I am aware of the great importance of how these radioactive submarines should be discarded. Their radioactivity will be around for centuries to come.

I am sure that you have the coast residents' safety in mind, but I wish for you to imagine for a moment the condition of our beautiful coast in future years: inevitable poisoning of all plant and animal life in the waters as well as along the beaches, entire coast areas restricted from human habitation, cross-contamination of airborne life (birds, insects) inland, into the more populated areas of the north coast counties. It is evident that many thousands of people will become sick in years to come as a result of the proposed navy action. L.14 L.36

You might wonder what I suggest as an alternative to the plan. I suggest that there is finally no safe place on this earth in which to dispose of nuclear waste, no place which is not a part of our earth's ecosystem.

My answer is extravagant, but no more so than the use of nuclear submarines: send all radioactive waste into space, into a faraway and eternal orbit. The sooner the better! H.16

Very sincerely
Ruth A. Vest

702

#453

3-30-83

Dear Capt. Wagner,

I have just learned of the Navy's proposal to dispose of nuclear submarines at sea. It is too late to review the DEIS since the deadline for submitting comments is March 31. I wish I had learned of this sooner, but I would like to comment anyway.

I am opposed to the disposal of nuclear materials
L.1 | in the sea. There are too many unknowns (which
seem to me would invalidate a DEIS in the first place),
such as; what is the oceans tolerance level for nuclear
L.6 | waste & how much waste is presently in the sea;
U.7 | how fast does radioactive bottom water (surrounding
dump sites) reach the surface; what will be the
L.14 | effect on marine life and on land life when
L.36 | radiation is transferred through the food chain. I think
L.39 | you'll agree it is beyond our present capacity to determine
answers to these questions that are even near exact.

Recent research has shown that the abyssal depths are not biological deserts as was once thought,
J.28, J.31 | & that bottom waters circulate with surface waters much
faster than was previously believed. Also, bottom dwelling
L.36 | creatures stir the sediment, mixing radioactive material
into the water & mud. The bottom dwellers can become radioactive | L.36
& transfer it through the food chain to pelagic animals and
ultimately to man. Radioactive fish have already been
discovered off the coast of San Francisco.

I am opposed to the pollution of any part of our planet by radioactive & toxic wastes, but if such things must be disposed of, wouldn't it be better to dispose of them on the land where they could & hopefully would be constantly monitored.
If sea disposal must be used perhaps it would
be best to use the deepest of deep sea trenches | J.17
(like the Marianas) where, hopefully, mixing of
deep sea water with upper waters would be slowest.
One thing is certain, more research needs to be done to find safer methods & containment for disposal.

Sincerely,
Nic Jaman

#454

HELLO -

I DON'T WANT NUCLEAR
WASTE IN NUCLEAR SUBMARINES
L.36 OFF MY COAST - I EAT SEA
FISH.

PLEASE USE COMMON
SENSE WITH DANGEROUS
THINGS SUCH AS THIS.
I.76 THEY NEED TO BE KEPT
UNDER CONTROLLED WATCH.
UNTIL WHAT TO DO WITH THEM
SENSIBLY.

SINCERELY YOURS
IN THIS MATTER

S K Eanes

Rt 1 Box 528
DOBSON, N.C. 27017

#455

March 31, 1983

Dear Captain Wagner,

Please do not
allow dumping of nuclear
subs off our coast at
Cape Hatteras. This has
been illustrated in common
knowledge to be foolish
management of wastes.
Steel and other metals L.20
corrode, nuclear waste is
emitted into the atmos-
phere, various living L.36, L.14
things contract cancer.
No!

Very Sincerely,
Gail E. Ashburn

Gail E Ashburn
Kelly Eanes
Rt. 1, Box 528
Dobson, N.C.
27017

704

#456

March 23, 1983

Captain Edward F Wagner
OPNAV-22
Department of the Navy.
Washington, DC 20350

Dear Captain Wagner,
We are gravely concerned about the Navys proposed ocean disposal of 120 nuclear submarines. Instead of actually being disposed, the dangerous wastes will remain forever a threat to life in the ocean and to all life on earth.

John + Susan Weber
14780 Mariposa Creek Rd
Willits, Ca. 95490

#457

ap. 24.83

Have just discovered that there is some discussion of allowing the Navy to dispose of approx. 100 of its nuclear sub. reactors ~~by~~ scuttling them at sea.

The problem of disposal of radioactive waste is overwhelming and there is no satisfactory solution at the moment - but surely dumping of ANY sort in the ocean is COMPLETELY unacceptable - retrieval to correct errors is impossible and there is no really clear info. to allow realistic evaluation of environmental or health consequences. The oceans are the basis for all of life on earth, we MUST STOP using them for our dumping grounds - the theory that what you can't see won't hurt you is clearly invalid. Do NOT allow this further outrage. My husband joins me in this opinion

G.2

W.1

L.1

Thankyou

Eleanor Culberson (Mrs Jim)
P.O. Box 390
Sealy. Tx 77474

#458

Chuck Dietzel
2785 Fickle Hill Road
Arcata, CA 95521

Captain Edward F. Wagner, USN
Office of the Chief of Naval Operations
(OPNAV-22)
Washington, D.C. 20350

March 25, 1983

Captain Wagner,

The U.S. Navy's plan to dispose of 120 decommisioned nuclear submarines by sinking them off the Northern California is totally unacceptable, unthinkable, illogical, and outrageous. No ships hull is forever and one hundred percent impervious to the ravages of salt water. Within our lifetimes, possibly, these sunken caskets of radioactive death will begin to leak. Tides and currents will carry the wastes for hundreds of miles to be consumed by a huge variety of marine life and passed right up the food chain to sea animals that humans use for food. HOT TUNA!

L.20

L.36

But whether or not *these* ships begin to leak in our lifetime or not is irrelevant. This is a radioactive legacy that we have no right to foist off on future generations.

G.2

The Navy must keep these ships in its own back yard until a better solution, a <u>permanent</u> one, can be found. They are <u>your</u> garbage. Don't dump it (them) in my backyard.

Chuck Dietzel

#459

Timothy Zachmann
Lea Lackey-Zachmann
515 Keating Drive
Winston-Salem, NC

Captain Edward F. Wagner
Department of the Navy
Washington, D.C.

Dear Captain Wagner,

I am aware of the Draft Environmental Impact Statement and the conclusion that sea disposal of radioactive waste would be less costly than land disposal and that sea and land disposal is considered basically equal to, or not more dangerous than, land disposal.

I am also aware that Greenpeace and other [illegible] scientists disagree with the DEIS in the opinion that more studies, such as [illegible] marine life cycles, [illegible] and bottom currents [illegible] of disposal should be considered. L.1, L.55, L.13, J.28

I am against any radioactive dumping in our oceans. If we must have radioactive waste and dumping sites we should [illegible] these sites [illegible] the earth and its inhabitants. The oceans allow for no such [illegible]. The land disposal sites could be a [illegible] expense but the [illegible] would be [illegible] and not [illegible]. J.76

I hope the moratorium on ocean dumping of radioactive waste continues indefinitely.

Sincerely,

Lea Lackey Zachmann
Timothy Zachmann

#460

208 Southwood Drive
Buffalo, N.Y. 14223
March 27, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I am writing concerning the Navy's December 1982 DEIS as it pertains to the disposal of nuclear submarine reactors.

Specifically, I want to express opposition to the use of ocean
L.1 waters as a disposal option. I believe that until there is more adequate and conclusive information regarding such factors, as, for example,
the amounts of existing radiation currently present in the seas, as well
L.28, L.36, L.14 as revised estimates for human, plant, wild and aquatic life tolerance limits for this radiation, the ocean cannot be chosen as a just and viable alternative for resolution of this problem.

Thank you for your consideration.

Cordially,

Alicia Heim

#461

PACIFIC FISHERY MANAGEMENT COUNCIL

526 S. W. Mill Street
Portland, Oregon 97201
Phone: Commercial (503) 221-6352
FTS 8-423-6352

CHAIRMAN
John R. Donaldson

EXECUTIVE DIRECTOR
Joseph C. Greenley

March 29, 1983

Captain Edward F. Wagner
Office of Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20357

Dear Captain Wagner:

At its March 16-17, 1983 meeting in Portland, the Pacific Fishery Management Council (Council) unanimously recommended to oppose ocean dumping of radioactive wastes. This action was taken in light of the U.S. Navy proposal to dump out-dated nuclear submarines in waters about 150 N. miles off the coast of northern California.

The Council is concerned with maintaining and managing productive marine resources withing the U.S. Fisheries Conservation zone under aegis of P.L. 94-265 as amended. It strongly believes that the threat, either actual or implied, of possible food fish contamination or environmental damage from ocean dumping of such nuclear wastes will have devastating and potentially long-term impacts on the West Coast fishing industry - both commercial and recreational. This industry provides food, jobs, and economic and social well-being to the region and the Nation as a whole. The consequences of radioactive wastes in the marine environment are at best poorly understood and would be irreversible in contamination from these submarines is greater than the Navy estimates. L.53, O.34 L.1 W.1

Irrespective of Navy contentions that the option to dispose of these vessels at sea is the least expensive, the potential total cost to the fisheries and the public if the environment is contaminated far outweighs other disposal options, such as on land. O.12

The Council urges that scuttling of submarines containing nuclear wastes in the Pacific Ocean waters over which the United States has control be prohibited until and unless future valid and reliable scientific studies prove it safe.

Sincerely,

John Donaldson
Chairman

HOW:lw

cc: Council members
Zeke Grader
John Hernandez, EPA

#462

March 20, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief Naval Operations
OPNAV 22 Dept. of the Navy
Washington, D. C. 20350

Dear Sir:

I wish to express my opposition to the dumping of the nuclear subs into the ocean off the San Francisco coast (or any coast for that matter). The oceans are full of
L.14 | pollution, but nuclear waste is the most dangerous. I'm very concerned about the affect on the marine life, and
L.36 | especially the fish that might be eaten by humans. I do hope the Navy will decide against dumping them into the ocean.

L.6 | Thirty years ago radioactive cartridges were dumped off the Farallon Islands, and appear to be leaking. Some of the fish caught in the area have shown slight traces of radiation.

Your consideration of this request will be appreciated.

Sincerely,

Bettye Myers
1228 Nancy Court
Upland, CA 91786

#463

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON DC 20350

To Recipients of Draft Environmental Impact Statement

On December 22, 1982, the Department of the Navy announced that a draft environmental impact statement (EIS) had been prepared to assess the environmental implications of alternatives that could be used to permanently dispose of decommissioned, defueled naval submarine reactor plants. The announcement stated that written comments on the draft EIS should be submitted on or before March 31, 1983, in order to be incorporated into the final EIS.

The Navy has concluded that the comment period should be extended another 90 days. This provides a further comment period to June 30, 1983. It is requested, however, that comments be submitted as soon as possible to facilitate their prompt evaluation by the Navy.

Written comments on the draft EIS may be submitted to me, Captain Edward F. Wagner, U.S. Navy, Office of the Chief of Naval Operations (OPNAV-22), Department of the Navy, Washington, D.C. 20350.

Sincerely,

Edward F. Wagner
Captain, U.S. Navy

Dear Captain Wagner:

The officials of the Navy know more about the problem presented in your letter than I do and having confidence in them, I leave the matter entirely with them and when they exercise their judgment, it will meet with my approval.

Sincerely,

SB:kr

The House of Representatives
STATE OF SOUTH CAROLINA
SOLOMON BLATT
Barnwell, S.C. 29812

#464

MARCH 23, 1983

DEAR SIRS,

I WISH TO OBJECT TO YOUR DUMPING ANY NUCLEAR WASTE IN THE OCEAN .. OFF MENDOCINO OR ANYWHERE.

TOO MUCH POISON AND HAZARDOUS WASTE HAS ALREADY BEEN PUT INTO OUR GROUND AND WATER.

I CANT IMAGINE HOW ANYONE WOULD THINK THAT DUMPING

L.36 POISON INTO OUR FOOD CHAIN WILL NOT HAVE SERIOUS AFFECTS.. ON US AND FUTURE GENERATIONS.

I URGE YOU IN THE NAME OF ANYTHING YOU CONSIDER SACRED.. OR HOLY.. TO PLEASE RE-CONSIDER YOUR ACTIONS -

THE [redacted] SOLUTION YOU CONTEMPLATE IS NOT A SOLUTION.

THANK YOU SINCERELY

WM. T. [illegible]

P.S. TO SUPPORT MY VIEW OTHER THAN COMMON SENSE I RECOMEND FOR YOUR READING

RAD WASTE BY FRED SCHAPIRO

ENTROPY BY JEREMY RIFKIN

THE FATE OF THE EARTH BY JONATHON SCHELL

#465

April 3, 1983

Captain Edward F. Wagner
OPNAV Chief of Naval Operations
Department of the Navy
Washington, D. C.

Dear Sir:

I strongly object to the dumping of nuclear submarines in our oceans for several very important reasons:

L.6 (1) I believe radiation has or is about to enter the food chain! (See Mother Jones magazine July 1981 issue "You are what they eat"). This article illustrated how radiation is leaking from the shifting, rusting barrels of nuclear waste (dumped by the Navy and others from 1946 to 1970) near the Farallon Islands about 25 miles from San Francisco and also off the eastern coast of New Jersey) and how it appears to be entering the food chain. I have suddenly lost my appetite for sea food!

(2) Since this administration has extensive plans to drill for oil in the oceans and some drilling is now being done, I'm beginning to wonder if we will soon have radioactive oil and gasoline!

L.3 (3) Ocean mining--I am enclosing an article from Pacific Gas & Electric Company's "PG&E Progress" entitled "The Ocean Rich in Resources". Raising lobsters in captivity, raising kelp to produce methane, mining trillions of tons of manganese, cobalt, copper, nickel from the ocean floor, mining lead, vanadium, copper, cadmium and zinc. The dumping of nucleer wastes on the ocean floor would nullify this possibility.

W.1 (4) It certainly doesn't appear to be "cost effective" to contaminate the fish, oil and minerals for just a "quick fix" solution--out of sight, out of mind, but also out of control! If at a later date ocean dumping proves to be a mistake, how will these ships be retrieved and put in a safer place?

(5) I have read that warmer ocean currents may have contributed to the recent disastrous weather changes. I wonder if the dumping of nuclear wastes by us and other countries have contributed to the heating up? I believe this possibility should be investigated by our scientists.

Sincerely,

Maxine King

cc: Senator Barry Keene
Representative Barbara Boxer
Senator Alan Cranston
Senator Pete Wilson
Senator Warner, Chairman Subcommittee Energy & Mineral Resources
Senator Packwood, Chairman National Ocean Policy Study
Senator Pressler, Chairman Subcommittee Arms Control, Oceans, International Operations & Environment
Senator Michaelson, Chairman Subcommittee Environmental Pollution

Maxine King
27 Villa Ct.
Montfield, Ca. 94904

California 2002

The oceans: rich in resources

Some of California's most productive ranches may be operating under water 20 years from now.

The "livestock"— shrimp, prawns, salmon, lobster, abalone, shark will not only end up on dining room tables but also may be the source of chemicals and industrial products. The fish may even be rounded up by porpoises.

Fish ranches in tanks or estuary cages are just one example of the potential of the Pacific Ocean and the world's other great bodies of water— all 3 million cubic miles of it. Even today experiments in raising Maine lobsters in captivity are under way in Bodega Bay

As for the potential for food from the oceans, consider:

Right now the world harvests more than 66 million tons of food a year from the sea. Yet each year the oceans produce about 100 *billion* tons of living matter, scientists estimate. That's about 2,000 pounds produced for every pound harvested.

Much of the living matter isn't edible. Much of it is food for the fish and shellfish we eat. But with a 2,000-to-1 ratio, there's still lots of room for increasing marine food harvests, says writer Howard Pennington.

Kelp may be planted near California's coast, then floated far offshore on pontoons. After it is grown, the kelp could be fed into a digester to produce methane, which is the main component of natural gas and a complete fuel in itself.

Underwater mining is another exciting prospect.

The entire Pacific contains an estimated 1.5 trillion tons of manganese, cobalt, copper and nickel The metals mingle in small potato-shaped nodules on the ocean's floor. By 2002, these valuable clumps may be harvested by scoops attached to flexible pipelines as much as three miles long that suck the metal particles to a ship on the surface, says William Stephenson, professor of Oceanography at Diablo Valley College in Pleasant Hill.

Undersea metals come in other shapes, too.

Volcanic action has created about 40,000 miles of cracks along the floors of the world's oceans. Towering above these cracks are "chimneys" containing lead, vanadium, copper, cadmium and zinc.

The U. S. will step up efforts to tap the ocean's potential, experts predict.

Says *California Business Magazine*, "The 1980s are likely to be a decade of research and development during which the seeds will be sown for a harvest we may reap during the 1990s."

PG & E Progress 2
Editor Ted W. Fuller

8/1/82

Rebuttal on nuclear sea dumps

By Sheila Caudle
Gannett News Service

"No serious consideration should be given to the use of the oceans as a disposal medium for radioactive wastes."
—Center for Law and Social Policy study

WASHINGTON — A coalition of 15 national environmental organizations disputes a federal government claim that dumping nuclear waste in ocean sites, including one off the Marin coast, poses no hazards to humans or the marine environment.

In a special report issued Tuesday, the coalition urged that further dumping stop until more research is done.

In a sharply-worded rebuttal of a General Accounting Office report released last October, the coalition released a 38-page study by the Washington based Center for Law and Social Policy. It concludes that until more research is done on the old dump sites, "no serious consideration should be given to the use of the oceans as a disposal medium for radioactive wastes."

The new report won instant praise from the executive director of the Marin Conservation League, Karin Urquhart of San Anselmo. "How on earth anyone can consider nuclear dumping anywhere can be 'safe' is absurd?"

She backed the report's plea that dumping be discontinued "until there are assurances — although I frankly don't think there can be any."

Sen. Barry Keene, D-Elk, a leader in a move by the state Legislature to stop Navy plans to dump decommissioned nuclear submarines in the ocean, also [illegible] the new report.

Branding the GAO report as "shoddy" [illegible] "unworthy of the GAO," Keene said the critique of the GAO report correctly pointed out that the GAO based its conclusions on "a lack of solid scientific knowledge."

Sea dumping has been banned by the United States since 1970, but the Environmental Protection Agency, relying on the GAO's findings, is considering resuming use of the oceans for low level radioactive wastes.

The Navy also is looking at ocean sites, including areas off the North-

See Dumping, page A6

Dumping

From page A1

ern California coast, to dump decommissioned nuclear submarines. In addition, the department of Energy has a proposal to get rid of radioactive materials.

Speaking for the environmental groups, an attorney for the center, [illegible] Curtis, said that such plans [illegible] because the GAO [illegible] "is permeated with [illegible] documentation, [illegible] of evidence [illegible] of [illegible], other pertinent evidence. As a result, its principal [illegible] are defective."

A spokesman for the GAO said [illegible] while the agency has not reviewed the coalition's document, it [illegible] its report.

The GAO report centered solely on low-level radioactive waste [illegible]. It did not predict what [illegible] in the future.

[illegible]

the "overwhelming body of scientific research and opinion" shows that concerns over the consequences for man and the environment from past dumping "are unwarranted and overemphasized ... Past ocean dumping poses neither an environmental nor a public health hazard."

That, claimed Clifton, represents "an unsound and risky leap of faith" which "is anchored in the belief that past dumping has been harmless."

During the 1940s, 1950s and 1960s about 90,000 containers of radioactive wastes were jettisoned into waters off the East and West coasts. Records are incomplete because when the dumping occurred, recordkeeping was not required. The coalition's study did not address each specific dump site.

But a report to Congress a year ago said that an estimated 47,500 containers were dumped off the Farallon Islands outside the Golden Gate. Another 3,144 went in the [illegible] Basin and 4,41[illegible] were [illegible] miles off San Diego. [illegible]

[illegible] received fewer than 40 containers.

In the Atlantic, 28,[illegible] containers were dumped more than 100 miles off Sandy Hook, N.J. Massachusetts Bay got 4,0[illegible], and a site off Cape Henry, Va., received 104. In the Gulf of Mexico, 78 containers were dumped 100 miles south of Apalachicola, Fla.

Clifton said that a quarter of the 275 to 300 old waste containers examined by the EPA in a monitoring project had been damaged in some way, leading to speculation that a significant amount of the total 90,000 pose a radioactive risk.

His study cited United States and international studies and research findings to question the GAO's conclusions. As an example, he noted that a report done for the EPA contains strong evidence linking significant levels of radioactivity in fish to the waste dumpsites off the California coast.

"First, great white sharks now, great black sharks"

#466

Captain Edward F. Wagner
U.S. Navy, Office of the Cheif of Naval Operations (OPNAV-22)
Department of the Navy,
Washington, D.C. 20350

Dear Captain Wagner,

In reference to your DEIS on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants, please accept this input from me:

Your plans seem extremely shortsighted. It seems that it is imperative that the long view of disposal must be taken given the long time that the reactors will remain radioactive.

L.20 There appears to be no way to guarantee that there will be no contamination of the ocean sooner or later from the sinking of the decommissioned submarines. At best scientific data can be extrapolated only a (relatively) short time into the future (in relationship to the life of the radio-ac tivity) and that this data cannot incorporate changes in [redacted] conditions and events which might effect these atomic wastes.

L.20 In light of the absence of a foolproof system to prevent contamination of our oceans, it seems foolhardy to dump in them. A basic law of nature is that one does not foul one's nest - there is not a single exception to this rule I have heard of - and surely "Mother" ocean provides us with such a wealth of resources that the slightest possibility of fouling her must be decried.

N.3 Despite other answers being more temporary and more expensive, to me, there is no doubt that dumping radioactive decommissioned submarines into the ocean is a dangerous and suicidal activity for our culture. I pray you choose an alternative....

Respectfully,

Jed Handler
660 York Street
San Francisco,
California 94110.

April 4, 1983

#467

Dear Sir:

I do not supoit the idea of dumping DeFueled Navel submarine Reactor plants into The ocean.

I understand that just two sush subs equal the total know amount of radiation dumped in American waters since World War II.

Sincerly,

#468*

THE CONSERVATION COUNCIL OF NORTH CAROLINA

307 Granville Road, Chapel Hill, N.C. 27514
(919) 942-7935 or 942-1080 (24 hours)

March 31, 1983

Captain Edward F. Warner
Office of the Chief of Naval Operations (OP-NAV 22)
Department of the Navy
Washington, D.C. 20350

Re. DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Dear Captain Warner:

Both Jane Sharp, President of the Conservation Council of North Carolina, and I testified at the public hearings in Raleigh, North Carolina, on the disposal of the nuclear submarines. The Conservation Council would at this time like to re-emphasize our opposition to the dumping of the submarine reactor plants off
*L.9, F.8 the coast of North Carolina. It sets an extremely bad precedent in the dumping of all types of radioactive and hazardous waste into the ocean.

The DEIS is incomplete and as such makes analysis of the specifics of the Navy's proposal very difficult. Our objection to the DEIS is as follows:

1). Repeatedly throughout the DEIS the Navy assures us it will rely on the criteria established under the Law of the Sea Treaty for dumping radioactive material in the ocean. As the United States did not sign the final Law of the Sea Treaty, will the Navy still follow the international procedures for dumping even
F.9 if they do not have to? What criteria for dumping radioactive materials will the Navy follow?

2). Our technical committee finds it extremely difficult to assess the environmental impact of radiation leakage on the benthic and other organisms as the DEIS presents "study areas" rather than the actual sites to be used. Discussion with oceanographers at the University of North Carolina at Chapel Hill indicates that Navy has made extensive studies of bottom conditions off the
J.1 coast, presumably in this area also. The Final EIS, or better yet, a revised DEIS, should contain all studies already made by the Navy.

3). Studies need to be made on the effects of high pressure and low temperature (such as found on the ocean floor at that depth) on the rate of corrosion on the sealed-off container units. Are such studies currently available? Q.13

4). Studies need to be made on the effects of biological action (corals, borers, etc.) on the rate of corrosion of the container units. Are such studies currently available?

5). A monitoring plan needs to be implemented to detect radiation J.76
leakage over the life-time of the proposed project. The container W.1
units need to be made retrievable in case of leakage that is premature or in excess of the Navy's proposed scenario.

6). As to the disposal of the submarine reactor plants at the Savannah River site in South Carolina, the cummulative effects of the various sources of radiation there need to be compiled E.17
to determine any synergistic effects. This includes determining background radiation levels, radiation from the proposed "L-reactor," low-level radioactive waste being disposed at Barnwell, and the potential addition of radioactive wastes from decommissioning all existing commercial nuclear power plants.

7). The figure quoted of 100 submarines being involved in the project assumes that no new submarines of this type or other nuclear-powered submarines will be built. Over the life of the A.1
project how many additional submarines does the Navy expect to have built? N.12

8). What is the life of this project?

9). North Carolina's coast has as its two prime industries fishing and tourism. What are the effects of the project on the allowable L.53
take of fish off-shore? Will fish take be monitored for radio-activity? What effect will the project have on tourism? The Navy
recognizes some of the psychological effects of the project; what will be the overall stress caused by the project on tourism? O.34

The Conservation Council, based on the inadequate analysis supplied by the DEIS, urges the Navy not to decommission its submarines off the coast of North Carolina. Of the alternatives, above-ground dry storage or mothballing, would make it the easiest to determine and monitor the leakage of radiation and would make the reactor units retrievable for alterations. G.2, H.3

Thank you for your consideration.

Sincerely,

John Runkle
Executive Coordinator

*Other issues discussed by Mr. Runkle are side barred in Exhibit 18.

#469

CAPT WAGNER,

AFTER READING MOST OF THE DEC 82 ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OF NUCLEAR SUBMARINES IT SEEMS THAT ALTHOUGH BURYING THEM AT SEA SEEMS THE MOST EFFICIANT WAY OF ~~OF~~ DISPOSAL IT LEAVES THE FUTURE GENERATIONS OPEN TO CONTAMINATION.

MY VOTE IS TO BURY THEM AT THE HANFORD SITE & SCRAPPING THE REMAINS.

I'M IMPRESSED AT THE SIZE OF THE REPORT.

Nik

NIK COLLYER.
P.O. BX 2151
GRASS VALLEY, CA
95945

#470

April 8, 1983

Dear Capt. Wagner,

Please do all you can to stop the Navy from dumping nuclear subs and material off of our coasts!

No place is a good dumping place, but the oceans and heavily populated land are the worst.

The idea is ill-conceived, irresponsible, and illegal. Remind the U.S. Navy they're on our side aren't they?

We civilians feel so helpless and unheeded. Please help.

Sincerely,

Rosamond Close

Rosamond Close
632 Kearney #7
El Cerrito 94530

714

#471

and another thing Captain,
who is going to be around
1-2 hundred years from now?
Not you or me, mister,
and thats a fact!

Sincerely,
Timothy Clanton

#472

Sharon E. Strasser
Box 270
Gualala
Ca. 95445

Captain E.F. Wagner
Office of Chief Naval Operations
OPNAV - 22
Dept. of Navy,
Washington DC 20350

Captain Wagner,

I am concerned & very much opposed to the proposed nuclear sub dumping off of our coast. It seems absurd to willfully contaminate one of our best fishing resources, plus contaminating the ocean & very possibly ourselves & families. L.53

I am definitely against this proposal!

Sharon E. Strasser

#473

6th April, 1983

Dear Capt. Wagner:

We strongly object to the Navy's announced disposal of decommissioned nuclear submarines off the Calif. coast. We find no proof in the Draft Environmental Impact Statement that this is *safe*! It will adversely affect the whole environment & be poisonous to humans also.

Sincerely,

Dr. Rudolf E. Holzinger

Dr. Rudolf E. Holzinger
P. O. Box 1456
Ukiah, CA 95482

#474

April 4, 1983

Captain Wagner,

My family and myself enjoy the fish that come from our waters in Fort Bragg and Eureka. We live in [redacted], Ukiah Ca, and fish are very hard to beat as a all around good food the entire family likes. I don't want to worry about the amount of radiation in the fish I am feeding my family. | L.53

Why can't we ship the waste to another planet. A planet that is dead and unenhabital to humans. | H.16

Put equipment up there to dig holes and to cover them up.

(over)

#474 (Cont)

Instead of leaving stuff on the moon we pay for and use only once. Put, all things to good use not waste.

thank you, for reading this

Deborah Filbeck

Deborah Filbeck
2100 S. State St #46
Ukiah Calif. 95482

P.S.

I know we can do it
we are a very inteligent race
and with Gods help
we will overcome

#475

SPACESHIP EARTH
We are all crew members aboard Spaceship Earth. Together we whirl thru a vast universe. This NASA photo reveals our full round[ness] and interdependence as an oasis among the stars. Bounda[r]ies disappear among swirling life-giving oceans of water, air, and sunlight. North America shines up from the center.

Captain Wagner,
I love this earth It's my home and we have got to stop pollution like dumping with the navel submarine reactor plants. Who really knows what impact it will have. It's not worth the chance of getting nuclear waste into our food chain. Please stop it!
Sincerely
Sally Hencken P.O. Box 1213 Willits Ca. 95490

Captain E. F. Wagner
U.S. Navy Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C.
20350

L.36

#476

MARCH 29, 1983

DEAR CAPTAIN WAGNER -

I AM WRITING TO PROTEST THE NAVY'S PLAN TO SCUTTLE NUCLEAR SUBMARINES OFF THE MENDOCINO COAST. NO ONE CAN OVERLOOK THE OVERWHELMING EVIDENCE THAT THIS PLAN POSES A SERIOUS THREAT TO THE HEALTH AND SAFETY OF ALL LIVING THINGS. IT IS NOT AT ALL REASSURING TO LOOK AT PAST OCEAN DUMPING PRACTICES. THEY HAVE NOT BEEN ADEQUATELY MONITORED. AN EXAMPLE

L.6 IS THE FARALLON DUMPSITE. THE TESTS THAT HAVE BEEN DONE THERE SHOW VERY DANGEROUS LEVELS OF CONTAMINATION. OBVIOUSLY, PROPER TESTING AND MONITORING IS EXPENSIVE. BUT TO DELIBERATELY TRY TO CUT COSTS IN THIS IMPORTANT AREA IS AN ARROGANT INSULT TO PEOPLE. WITH THE PUBLIC BECOMING MORE AWARE OF THE DANGERS OF RADIATION CONTAMINATION OF THE ENVIRONMENT AT LARGE, IT PUTS THE NAVY IN A BAD LIGHT. IT IS NO ONES PRIVELEGE TO KNOWINGLY HARM THE EARTH AND ITS PEOPLE. ON THIS SCORE, HISTORY SHOWS US THE U.S.A. HAS A POOR RECORD. IN PACIFIC NUCLEAR TESTS AT THE MARSHALL ISLANDS AND BIKINI, THE NATIVES WERE NOT GIVEN THE TRUE FACTS. THEY WERE TOLD THAT THEY WERE HELPING PRESERVE PEACE FOR ALL PEOPLE. WHAT THEY GOT WAS A LEGACY OF RADIOACTIVE CONTAMINATION AND HEALTH PROBLEMS. BY THE SAME TOKEN, THE MENDOCINO DUMPSITE IS BEING CONSIDERED OVER SAN DIEGO, LOS ANGELES OR OTHER MORE POPULATED AREAS. THE NAVY CLAIMS WE HAVE LESS OF A FISHING RESOURCE. BUT I SUSPECT THAT WE ARE GOING TO BE NUCLEAR GUINEA PIGS, AND THERE ARE FEWER OF US TO COMPLAIN. L.53

AGAIN, I BELIEVE IT IS THE NAVYS RESPONSIBILITY TO ACT IN A MORE RESPECTFUL MANNER. CERTAINLY CREDIBILITY AND PUBLIC OPINION IS IMPORTANT TO THE NAVY. FOR ITS OWN SAKE, AND THE PROTECTION OF THE EARTH THAT WE **ALL** LIVE ON, PLEASE ACT IN A MORE SENSIBLE AND SAFE WAY.

RESPECTFULLY YOURS -

NELSON LINDLEY
32000 N. HWY ONE
FORT BRAGG, CA. 95437

818

#477

Melvin L. Holland
345 Thomas Ave.
Vallejo, Calif. 94590
April 8, 1983

Captain Edward F. Warner;

Permanently dispose of decommesseoned, defueled Naval Submarine reactor plants.

Sence the comment period has been extended until June 30, 19 3. I havn't changed my mind.

I'm not in favor of dumping, Nuclear Subarines, in any water East or, West coast. Some of the purest water, on Earth, is were the Department of the navy wants to Dump the old Submarines.

There should have been, Dosposal sight already for these Submarines, and other Nuclear Powered ships before the were built.

The Department of the Navy, went ahead and built Uuclear ships with no thought, were and when they were to be Disposed of.

N.12 What are your plans to Disposeal of the Air Craft Carrier? With (8) Eight Reactors Aboard.

Has there been any study of Recycleing the Nuclear Waste, on refueling these Ships?

Yours Truly,

Melvin L. Holland

Melvin L. Holland

MLH

#478

1302 MID MT
95469

Edward Wagner
CAPTAIN, U.S. NAVY
Office of the Chief of NAVAL OPERATIONS (OPNAV-22)
Dept of the NAVY
WASHINGTON, D.C. 20350
: Comments on the draft EIS: dead Nuke sub dumps

History has shown that few can predict what the future will be. Many look to the past, so that those mistakes will not be repeated.

Nuclear radiation continues to damage lives in doses that were once considered safe. In a cancer study between 1970 and 1975, cancer mortality rate rose 58% in the town of Waterford, where the giant Millstone Nuclear Power ~~Plant~~ Station is located. Five miles away in New London the rate was 44%.

Forty miles away in New Haven, the rate of mortality with cancer was 27%, while for Connecticut as a whole, the rate 12%.

The most feasible, safe way to dispose of these nuked subs, may be

#478 (Cont)

G.2 | TO STORE THE VESSELS FOR 20 YEARS IN SALT MINES.

SPACE TRAVEL HAS GREAT POTENTIAL. IT IS UNKNOWN PRECISELY WHEN OUR CIVILIZATION WILL MAKE THE

H.16 | TECHNOLOGICAL BREAKTHROUGH, SO THAT THE MATTER AND ENERGY REQUIRED TO SHIP THE SUBS TO THE SUN, CAN OCCUR WITHOUT DEPLETING THE EARTH'S RESOURCES OR OVERLY STRESSING THE ENVIRONMENT.

PERHAPS EVEN NOW COOPERATION WITH HIGHER INTELLIGENCE i.e.: so-called UFO's as one example, could help detoxify the disposal solutions.

Dumping the subs in the ocean, to speak crudely, will eventually contaminate the sea, which is great for destroying

L.36 | gene pools, and therefor humanity in the food chain.

Existing nuclear power stations, chemical farming, and polluted air + water are already destroying human culture, untied from its grassroots. More IONIZING, genetic, gene-damaging influence is not

G.2 | needed. Put the nuke sub disposal on storage/hold, protect the sea, and encourage mental [illegible] to stop soil erosion. ERIK SUNSWHEAT

#479

129 Gloria Avenue
Winston-Salem, North Carolina 27107
April 8, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
OPNAV-22
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I oppose the proposed dumping of nuclear submarines off the coast of North Carolina.

There are many problems with the draft Environmental Impact Statement recently released by the Navy. The cumulative incremental impacts of increases in radio-activity entering the marine environment aren't considered in the statement. The proposed monitoring is inadequate for either the land or sea disposal option. Monitoring is difficult and retrieval has been found to be financially prohibitive and in some cases physically impossible. The effects of accidental sinking of the submarines while being towed to the Hatteras site are not adequately considered. A primary fault with the Navy assessment stems from the irretrievability of submarines placed on the deep ocean floor. An Oceanic Society Scientific Committee recently concluded that retrievability is a primary concern which must be assured before nuclear wastes can be safely disposed of in the sea and that insufficient scientific information exists to permit sea disposal. | L.7 | I.76 | W.1 | L.63 | W.1 | L.1

In 1970, after two decades of dumping, the U.S. government imposed a moratorium on all radioactive dumping in the ocean. They were moved to do this on the advice of scientists who said that studies were needed to determine the effects of radioactive waste on the ocean; no studies have conclusively determined that this type of disposal is now safe.

National and international policy on ocean dumping would be greatly affected by the single decision to use the California or North Carolina coast for radio-active dumping. TMI is still waiting to dispose of thousands of gallons of radioactive waste which resulted from that accident. And the military which generates the largest amounts of both high level and low level wastes, will be requesting more permits to dump. Those nations who are currently dumping would see no reason to stop their practice and nations considering ocean dumping would no doubt be encouraged by U.S. reassurances that the ocean option is safe. | F.8 | L.9, F.8

Because of the above factors and because so little is known about the effects on the food chain, I stand opposed to this proposal. | L.36

Sincerely,

Sharon Winters
Kendall Baird

#480

April 11, 1983

Dear Capt. Wagner

I WISH TO INFORM YOU THAT I AM VERY MUCH OPPOSED TO THE GOVT. PLAN TO ENDANGER THE FUTURE RESIDENTS OF MENDOCINO COUNTY AND THE ENTIRE WESTERN U.S. BY DUMPING MORE NUCLEAR WASTE IN OUR PRECIOUS OCEAN WATERS.

WE ARE PEOPLE, WE HAVE A RIGHT TO PURSUE OUR HAPPINESS IN A CLEAN ENVIRONMENT. HOW CAN YOU CONSIDER CONDEMNING OUR CHILDREN AND (IF THE CONTAINERS LAST THAT LONG) GRANDCHILDREN TO THIS HAZARD.

WHAT HAS HAPPENED TO THE AMERICAN SPIRIT OF FAMILY? WHY ARE ALL OF YOU (GOVT. & BIG BUSINESS) SO EAGER TO STEAL FROM YOUR CHILDREN BY GRABBING & DESTROYING IT ALL NOW SO THAT THEY WILL HAVE TO GROW UP IN AN AMERICA FULL OF DISEASE, RADIATION, AND DESTRUCTION. ARE YOU ALL MADMEN?

A TAXPAYER &
CITIZEN OF
MENDOCINO COUNTY,
CALIFORNIA

Patricia Toridio
Box 162
Redwood Valley
Ca 95470

#481

4/8/83

Box 51
Phillipsville
Calif. 95559

Dear Capt Edward Wagner,

I am pleading with you to help arrange a 90 day extension of the Draft Environmental Impact Statement. This would allow time for public hearings to be held closer to the affected coastal communities. I'm sure such meetings would show strong opposition to ocean burial of any radioactive or toxic wastes. | J.15

I am totally opposed

#481 (Cont)

to any ocean dumping of decommissioned nuclear subs and hope you will consider this urgent matter that threatens ~~our~~ our health and the health + safety of generations to come.

Thank you.

Sincerely,

Judith Horvath
Bx 51
Phillipsville
Calif. 93559

#482

April 10, 1983

Katherine Kelly
990A Union St.
Arcata, CA 95521

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I am writing you concerning the Navy's draft EIS on the nuclear submarine decommissioning and dumping. I have looked over the document and thought seriously on the issue; I've come to the conclusion that nuclear sub-dumping into the ocean is extremely dangerous and outright absurd.

As a resident of the Pacific Northcoast I would be scared to death of the implications of such an act. As any scientist can tell you, the radioactive particles will escape their vessels and be dispersed in every direction. It would only be a matter of time before these lethal substances worked their way up the food chain to the fish we eat. Furthermore, we must not destroy such a fragile environment as our vast and beautiful oceans with this deadly nuclear poisons. | L.20 | L.36

I recommend a ground burial with a highly sensitive monitoring system away from all water sources used by animals and humans. This may be a more costly option, but the price for the destruction of our ecosystem and the human populace is much much higher.

Sincerely,

Katherine Kelly

#483

4-9-83
712 8th Ave.
Trinidad, Ca. 95570

Edward F. Wagner,
Captain, U.S. Navy
Office of the Chief of Naval
operations (OPNAV-22),
Department of NAVY
Washington, D.C. 20350

Dir Sir:

Your address alone is a barrier to public participation, I'm Sorry to Say!

Thank for extending the comment period on the SUD Dumping EIS!

However, Dumping there is

(2) a poor idea and the Navy should have held a hearing closer to the dumping sites. J.15

Sacramento was not convenient for me, And I know it wasn't for others in close proximity to Cape Mendocino.

Radioactive wastes are a bad idea in the First place and the oceans are a bad place to put them.

Sincerely,
Tim McKay

#484

GILBERT FRIEDMAN
ATTORNEY AT LAW
408 LITTLE LAKE STREET
P.O. BOX 1295
MENDOCINO, CA 95460
(707) 937-0866

4-11-83

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Wash. D.C. 20350

Dear Captain Wagner

I urge you to decide against any ocean dumping of nuclear wastes.

If I may I'd like to argue by analogy. You are driving home late at night. You are very low on gas. You come to a gas station. You can make two mistakes. One is that you stop for gas & that is a mistake because you could've made it home without stopping & you wasted several minutes getting gas. The other mistake is that you think you can get home, don't stop for gas, and in the middle of nowhere run out of gas. Which mistake would you rather make?

As to nuclear dumping, you can not dump in the ocean & this turns out to have been a mistake because it would've been 'safe'. The other mistake is that you do dump & then the chain of reactions start which kill fish, effect the whole chain of food, polute the ocean, upset the ecology of the ocean,

0.12 which spreads throughout all oceans & so forth. Well, which type of mistake would you rather make?

It seems to me we cannot afford to make the latter mistake & have to refrain from dumping nuclear wastes in the ocean.

I hope you will give this letter some consideration. I realize you have a very tough job and hope and wish you the best of luck throughout the long process.

Sincerely yours,

Gil Friedman

724

#485

JUSTIN M. ELLIOTT, M.D.
Mobile Services Medical Clinic
A Professional Corporation
P.O. Box 199, Garberville, CA 95440
(707) 923-3614

April 11, 1983

Edward F. Wagner
Department of the Navy
Washington, D.C., 20350

Dear Captain Wagner:

As a Radiologist and Physician, as well as a concerned citizen; I
G.2 strongly feel that land depot storage of radio-active waste is best.
L.20 The likelihood of leakage and contamination of the general environment
with this type of waste with land storage would be much less than on the
ocean floor. Monitoring could be accomplished much easier with pre-installed monitoring devices.

Despite the compiled data in your manual; it is my feeling that the
L.36 risk of food chain contamination would be much greater in an ocean depository than in a land depository.

I realize that this is a complex problem with Geo-political and economic factors; however, we must protect future generations as best we can
N.3 regardless of economic factors or political difficulties.

Thank you very much.

Sincerely,

Justin M. Elliott, M.D.

JME/bd

#486

Department of Land Conservation and Development

1175 COURT STREET N.E., SALEM, OREGON 97310 PHONE (503) 378-4926

April 12, 1983

Captain Edward F. Wagner
United States Navy
Office of the Chief of Naval Operations
(OPNAN-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

The Oregon Department of Land Conservation and Development has reviewed the Draft Environmental Impact Statement on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants. Please consider the following as formal comments submitted pursuant to both the National Environmental Policy Act and Section 307 of the Coastal Zone Management Act.

1. The DEIS does not fully substantiate the assertion that the decommissioned reactor plants can be considered low level radioactive waste. Thus, seabed disposal may not be provided for by the International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter or the Marine Protection Research and Sanctuaries Act. F.10

2. The DEIS was prepared under the assumption that any seabed disposals would occur at the edge of a United States' 200-mile economic zone pursuant to the United Nations Law of the Sea Treaty. The Department of the Navy is now aware that the United States is not a signatory nation to this treaty, and legislation implementing the March 10, 1982 unilateral declaration of a 200-mile economic zone has only recently been introduced. The Navy should await passage of this legislation, and then prepare the Final EIS under the new national authority. J.18

3. The Department of Land Conservation and Development, Oregon's designated coastal zone management agency, disagrees with the assertion on page 2-11 that any disposal within a 200-mile economic zone would not "directly or indirectly affect land or water use in the coastal zone of any state." If the study site approximately 200 miles west of Cape Mendocino were selected as a disposal site, 100 square miles of submarine lands and subadjacent waters would be closed to competing uses. These uses might include scientific research, fishing or the mining of polymetallic sulfides. A similar disagreement exists for the declaration of no impact on the economy of any coastal areas found on page 4-23. Oregon's coastal economy is heavily dependent upon fisheries and tourism. The Pacific Fishery Management Council has considered the potential impacts of ocean disposal on fisheries off California, Oregon and Washington and unanimously adopted a position against ocean disposal during its March 1982 meeting. F.11 L.53

#486 (Cont)

Captain Edward F. Wagner -2- April 12, 1983

F.22 J.35 L.35, U.5 F.2

4. Areas off the Pacific coast are tectonically active. Areas such as the Juan de Fuca and Gordon Spreading Ridges have mineral development potential and contain waters much warmer than 1° to 2°C used to calculate corrosion rates in the DEIS. Earthquakes, thermal waters, benthic circulation patterns and radiation entering the food chain through benthic pathways should be given fuller treatment during the two year moratorium placed upon this project by the Congress. The establishment of a recoverable disposal method is also required by the Congress.

F.11

5. The degree of analysis conducted for the west coast vs. the east coast (e.g., use of the Glomar Explorer in cost calculations) implies a preference for a west coast disposal option. The DLCD considers any ocean disposal option between Point Conception and the Canadian border and the Hanford land disposal option as federal activities directly affecting Oregon's coastal zone. The Final EIS must contain a determination by the Department of the Navy of whether the preferred disposal options are consistent to the maximum extent practicable with the enforceable policies of Oregon's federally approved coastal zone management program, pursuant to Section 307 of the Coastal Zone Management Act. The Department of Land Conservation and Development will review the consistency determination as expeditiously as possible, and will either agree or disagree with the determination based upon the analysis presented in the Final EIS.

I thank you for the opportunity to provide these comments.

Sincerely,

James F. Ross
Director

JFR:AB:af
3371B/2B

Attachment

cc: Pat Amedeo, Governor's Office
Kay Wilcox, IRD
Jim Hurley, OCRM/CPD

#487

April 10, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I have read the Environmental Impact Statement that has been prepared to assess the environmental implications of the disposal of the nuclear submarines. And I believe that it is very important to study this problem a great deal more. No matter what it says in the book, the fact remains that the sea disposal method will add large, irretrievable amounts of radioactivity to the ocean. According to the studies of John Gofman, the effects of low level radiation could be disastorous in the long term. It is too soon to report on the effects of the radioactivity released from fallout and the Thresher and Scorpion accidents. I want to see an independent agency, other than the Navy, test for contamination in the ocean food chain and other areas of waste disposal. Many of the radioactive elements are deadly for thousands of years. The book tries to show these elements decaying in a very few years, and disappearing without any harmful effect. I feel very sad for the workers who are elected to take care of this dismantling problem. They may become victims of cancer caused by the radiation. W.1 J.42 L.6

If we have to dispose of the nuclear submarines, it seems to me that land disposal would be preferable to ocean dumping. At least on land, the monitoring of the radioactivity can continue over many years. The smartest thing to do would be to stop creating all of these radioactive headaches, and you won't be so perplexed by what to do with the leftovers.

Sincerely,
Arlene Reeves
Box 43, Boonville, CA. 95415

#488

Dear Captain Wagner:

April 11, 1983

I am writing to voice my displeasure about the U.S. Navy's plan to dispose of nuclear submarines in our coastal waters. This plan is insane - horrendous - ridiculous! The ocean is the beginning of the food chain, part of the water cycle - a vast and to a large extent unknown and untapped resource. The Navy plans to dispose of their nuclear waste in our oceans - the oceans of generations to come ?! This compares to throwing contaminated feces into food and water sources - although much more complex and horrible. Until safe methods are found (if they can be found) to dispose of nuclear waste it is foolhardy to build and employ its energy. The Great Depression (and its ramifications today) were caused by the borrowing and live for the moment attitudes of the Roaring 20s. Don't we ever learn? What kind of legacy are we leaving future generations if we live for today - using energy that we'll pay for tomorrow - with such horrible costs? Please reconsider and do not dump these subs in our oceans.

Sincerely,

James David Rogoff

Jim Rogoff
Box #253
Leggett, Ca. 95455

#489

4.15.83

This is to let you know that I'm another citizen of this country who pays your salary and who is strongly opposed to the cockamamie plan to "dispose" nuclear subs in the ocean. Really now, can't you folks be better stewards of your trust than that!?

Nelson Evans
Box 5431
San Mateo, CA
94402

#490

April 15, 1983

Captain Wagner,
my family and I are very distress-
ed over your proposal to dump
nuclear subs off the coast of
Northern California. my husband,
L.53 daughter and I are scuba divers
my husband was attached to U.D.T.
as a reconnaissance marine, he has
been an avid diver for years
and is sickened by the thought
that the navy would move to
destroy these waters they
taught him to love. Would
L.36 want to eat radioactive fish
do you? Carol Bath

#491

12 April '83

Captain Edward F. Wagner
U.S. Navy
Office of the Chief Naval Operations
OPNAV-22
Dept. of Navy
Washington, D.C. 20350

re: Dumping of 100 used nuclear submarines

Please use your influence to do something constructive - instead of something destructive with those 100 used nuclear submarines. Right now, the Navy is planning to dump these decomposing machines 2½ miles deep in the Pacific Ocean, off of Cape Mendocino. If this plan is followed through with, these submarines may do the United States more damage than they ever did to Russia.

Please see to it that these submarines are based somewhere where they can be closely watched and monitored, until technology catches up with the problem. G.2

Thank you for your time and consideration.

[illegible signature]
SP/4 Carolyn L. Sears, Ret.
570-70-6609
P.O. Box 6024
Los Osos, CA 93402

#492

11 April 1983

Captain Edward Wagner
US Navy office of the Chief of Operations
OP-NAV Dept of the Navy
Washington D.C. 20350

Dear Captain Wagner,

I am writing you because of my concern over the nuclear submarine dumping proposal for off the coast of California.

That is no place to put them. It seems a very hasty proposal and one I am convinced we will all regret if it ever actually occurs. Everything I have studied indicates my opinion is correct. If you have information to convince me otherwise I will be happy to review it. However until then I strongly urge the proposal be withdrawn and other, more palatable alternatives pursued.

Sincerely,

Wm H Evans
Box 261
Lagunitas California 94938

#493

Carteret County Crossroads

P O Box 155 Beaufort, N C 28516

April 1?, 198?

Captain Edward W. Wagner
Office of Chief of Naval Operations (OPNAV-??)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I have reviewed the Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants and would like to make known my objection to the sea disposal of these units. I speak for myself as an oceanographer of ?5 years' experience (15 years with the U.S. Navy) and for Carteret County Crossroads.

Crossroads is an eastern North Carolina organization which was formed to educate our citizens about the problems and opportunities for growth along the entire North Carolina coast.

We object to the sea disposal of the units for the following reasons:

(1) Once the defueled reactor plants are placed on the ocean floor they would become irretrievable and, in the event monitoring efforts proved the units to be radiological hazards, little or nothing could be done to recover the units and free the ocean of their danger. 1 W.1

(2) The sea disposal of these units could be the incentive for the ocean dumping of additional nuclear wastes. Regardless of their size, our oceans cannot continue to be the cesspool for our wastes. 1 L.9, F.8

These objections are made with the full recognition of the higher land disposal costs. However, our ability to properly monitor these units on land, and later take corrective action makes this alternative method of disposal much more desirable than sea disposal.

Thank you for your consideration of these comments.

Sincerely,

Alfred W. Anderson

#494

F.16 Note: old LSD[illegible] might transport subs (powerless) to dump site(s).
(appeared: other No. Calif. pubs)

13 April, '83 WILLITS, CA THE DAILY DIGEST

HANK'S CORNER

By Henry M. Plymire

This is an 'open letter' to:
CHIEF, NAVAL OPERATIONS
Navy Department
Washington, D.C. 20350

Dear Admiral *7 April, 1983*

we truly do LOVE the United States Navy. However, we sincerely believe the Navy service is pursuing a somewhat stupid/lost cause . . . . trying to dump old nuclear submarines off Mendocino coast of northern California.

Many legislators have raised voices in a distinct —NO! Numerous 'editrs' have most emphatically stated the negative to this idea. Editorials in many, many media have logically/clearly stated - D-O-N-'-T! Recent Sacramento (Navy) hearings gave clear indications that no dumping was wanted!

The Navy, often times in need of 'friends', should 'GET THE MESSAGE' . . by now. Alternate disposal means, such as consulting Admiral Hyman Rickover (Ret.), acknowledged 'father of nuke navy' and, obviously a brilliant person who just might come up with a 'pregnant', disposal idea.

J.17 *One other suggestion: As WWII sailor aboard an LSD (landing ship dock) in Pacific . . . we swam in such areas as Philippine/Marianis "DEEPS". These depths reach some 36,000 feet (deep) . . approximately seven miles. They are distant from land/civilization. Navy . . . . Use GOD—GIVEN BRAINS!*

Wi

Henry M. Plymire
41 Ridgewood Park [illegible] 101
Willits, California 94590
707-459-9777

C[illegible]t in---[illegible] [illegible] there [illegible]...in [illegible] of [illegible]

[illegible]

[illegible]lc/EngDL, [illegible] (Ret.)

#495

1570 E, Ave. Q-13
Palmdale, CA935 0
April 20, 1983

Dear Captain Wagner,

The effects of the disposal of nuclear submarines in the sea make it an ill-conceived idea. Twenty five drums containing radioactive material were dumped by the Navy off San Francisco were found to be crushed and broken open. Past Navy methods of disposing of radioactive material are unacceptable. The sea is the foundation upon which all life rests. What enters the sea is eventually returned to us in our food and drink. L.6 L.36

In the 1920s, the beginning of the Uranium Age, a tonic water containing minute quantities of radium was sold at fantastic prices as a miracle cure-all. Years later even the AEC reported that "people died lingeringly and painfully from drinking that water." There is no such thing as a safe level of radiation.

Concerning disposal in the ocean of radioactive wastes, Jacques Cousteau has said, --"no risk at all should be taken when survival of the human species is at stake or the quality of life of future generations may be threatened.--Any irreparable damage done to the system is an unatonable crime, any human enterprise that might bring about such permanent scars must be witheld until it is proven harmless--as far as non-degradable pollutants are concerned they just pile up in the sea and are biologically concentrated in the flesh and entrails of marine creatures--nuclear waste should be isolated forever from the water system."

In the Navy's Feb., 1982 fact sheet it was stated, " with the sea disposal option, the entire submarine is sunk at an EPA approved site which would be at least 100 miles from land." The name EPA lends small assurance as to the environmentally safe disposal method for the remaining radioactivity in the defueled submarine.

Forty years into the atomic age of nuclear power and there is still no plan for safe radioactive disposal. The volume is so heavy that a government agency has estimated that by the year 2000 it could be large enough to fill a four lane highway coast to coast to a depth of one foot.

Sincerely,
Mr. Marvin [illegible]

#496

KRQR 97FM

Editorial

Subject: The Navy Should Hear Your Nuclear Views
Broadcast: 4/21/83 7:55 AM, 9:20 AM

KRQR is happy to hear that the Navy has extended the deadline for public comment on its plan to dump old nuclear submarines off our coast. We hope you'll let them know your views.

The Rocker's view is that there shouldn't be any ocean dumping
L.1 of nuclear waste. There are too many scientific unknowns. That's why the United States stopped dumping radioactive garbage in the sea 13 years ago. The Federal Commission on Environmental Quality said it was a serious and growing threat to the environment.

We don't know much about the effects of dumping nuclear waste in
L.6 the ocean, but we do know that 25% of the 50,000 barrels the feds dumped near the Farallon Islands have broken open. And that "hot" fish have been found near the islands. Not radioactive enough,
L.36 we're assured, to be harmful, but who needs this stuff in the food chain?

The Oceanic Society, Greenpeace, the Boards of Supervisors of Marin, Mendocino, Humboldt and Santa Cruz counties have all come out against the Navy's plan to dump 130 old nuclear subs off Cape Mendocino. The public has until June 30th to respond. Write to the Navy Department in Washington.

George L. Sosson, Vice President, CBS Radio Division, General Manager KRQR 97 FM

KRQR 97 FM
ONE EMBARCADERO CENTER
SAN FRANCISCO, CALIFORNIA 94111
(415) 765 4097

#497

4-16-83

Dear Sir:

I feel most compelled to write
and let you know how strongly I
oppose dumping radioactive subs (or other
materials) in the Ocean. Mendocino County L.53
relies heavily on tourism, fishing and
lumbering for it's economy. As more
and more agricultural land is developed
for housing it becomes imperative that
we do not harm a vital food source — L.36
the Ocean. The Ocean is teeming with
life, much of it edible. There
is a great possibility of the fish
becoming contaminated and therefore
affecting the food chain.

I urge the Navy to seek
responsible solutions to radioactive W.1
materials. Dumping in the Ocean may
be easy but the effects are irreversible.

Sincerely, E. Hodges
P.O. box 237
Westport, Ca. 95488

#498

214 Carl Street
San Francisco, CA 94117
April 19, 1984

Captain Edward L. [illegible]
Office of the Chief of Naval
Operations
(OP-NAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain [illegible]:

I would like to express my concerns regarding the Navy's current proposal to dispose of decommissioned nuclear submarines off the Pacific Coast.

G.3 First, I would question the necessity of retiring some 100 submarines over the next 30 years, when the cost of doing so, by whatever means, will amount to a huge expenditure of tax dollars. I am assuming that this is a "phase-out" operation, aimed at updating the current Polaris fleet with Trident submarines, rather than a plan designed to replace malfunctioning vessels.

Secondly, assuming that the disposal operation __is__ necessary, I am alarmed by the lack of foresight reflected in the proposed plan. At whatever depth, any disposed nuclear wastes present
L.36 a severe and cumulative contamination hazard to our entire food chain. I was disturbed to read that the Navy's plan apparent-
F.12, U.9 ly overlooked some important research findings regarding the pathways by which radioactivity from the disposed subs could find its way into sediments, marine organisms and other marine
J.76 life. Adding to this the obvious difficulty of monitoring
W.1 radioactivity levels or of retrieving the vessels in case leakages occur, I see nothing but hazards in the proposed plan.

J.15 Finally, if the Navy is considering local California sites for such disposal operations, __local__ hearings should be held to determine the projected environmental impact, monitoring and retrieval plans, and other available alternatives to dumping such environmental time bombs at sea.

I would appreciate hearing your response on this matter. Thank you.

Sincerely,

Deborah L. Clifford

Deborah L. Clifford

#499

Dear Sir
Don't dump the old nuclear submarines in the ocean off the coast of California. Don't dump them in the ocean.

Patty Freeman

NO ADDRESS

732

#500

Dear Captain Wagner,

I seriously oppose the dumping of Nuclear Submarines off the coast of North California, or in any ocean.!

Our enviroment is a precious part of our world - Dumping into the ocean is no solution!

Sage Mountainfire
Box 13
Willits CA
95490

#501

Kathleen Nangle
P. O. Box 268
Sea Ranch, California 95497

April 16, 1993

Dear Captain Edward E Wagner

We as registered voters and property owners, would like to oppose the dumping of decommissioned nuclear submarines off the Northern California coast

Sincerely,

Kathleen E Nangle

[illegible]

Craig R Williams

#502

Dolly Gudder
2035 W. 17th Ave
Eugene OR 97402

Capt. Edward F. Wagner
Office of the Chief of Naval Operations (OPNAV 22)
Dept of the Navy
Wash D.C. 20350

April 22, 1983

Dear Captain Wagner

I am writing to express my concern over the possibility of the United States resuming radioactive waste dumping in the ocean. As I understand it, the Navy is currently reviewing its plans to sink 100 obsolete nuclear submarine reactors.

I want you to know that I strongly disapprove of dumping any nuclear or radio active waste of any kind in the ocean!! I am deeply upset over the waste that was dumped between 1946 and 1970. Our oceans are a valuable and beautiful natural resource and we must protect them for future generations.

I would appreciate it if you would let me know more about the Navy's decision on this issue.

Thank you.

Dolly Gudder

#503

April 18, 1983

Captain Edward F. Wagner,

Thank you for extending the public comment period until June 30 on the very important issue of Radioactive Ocean dumping. I strongly urge you to have a public hearing in Fort Bragg, California, on this issue, as it is the community most affected. J.15

My first concern on this issue is how radiation enters the food chain. L.36
I am not sure that this has been determined yet scientifically. But I do understand that there is a cummulative effect L.13
on each organism that ingests radioactive materials.

Secondly, this will affect the fishing industry adversely. L.53
Unemployment in Mendocino County is 19.5% right now. I would not like to see the fishing industry jeopardized in this way.

Thirdly, I understand that there has been no monitoring of the 47,500 barrells of radioactive L.6
wastes previously dumped off the Farallon Islands. Why is this so, and why was the dumping kept secret
from the public for so long? Please be specific in your answer. D.6

#503 (Cont)

L.9, F.8

Lastly, at this time, is the U.S. not a member of the 1983 London Dumping Convention which calls for an international ban on ocean dumping of low level radioactive wastes? How did we vote and are we not bound by such a convention?

I fear the precedent that this action will set for the ocean. Immeasurable amounts of toxins are released daily into the oceans at this time. I should hope that in all good sense, we would try and curb this nasty habit through our own example and not set precedent to include even more deadly substances.

Thank you for your time,
I look forward to your response.

Sincerely,

Kelly Townsend

Kelly Townsend
Star Rt 2 Box 277
Ukiah Cal 95482

#504

4/22/83

CARL LINCOLN
4491 SPRING
EUGENE OR. 97405

SIR:

A NOTE TO EXPRESS MY CONCERN OVER PROPOSED OCEAN DUMPING OF OLD NUCLEAR SUB REACTORS. WHAT WITH THE CURRENTS, THE BASE OF OUR FOOD CHAIN WOULD BE ENDANGERED. RATHER, LETS PAY A NORTH AFRICAN NATION TO BURY THEM IN THEIR SAND, TAKING OUT AN OPEN ENDED LEASE.... L.36

-CARL

#505

Janet Wolfe-Hunnicutt
Box 125
Westport, Ca 95488
April 18, 1983

Captain Edward Wagner
US Navy Office of Chief of Operations
Dept of Navy
Washington, D.C. 20350

Dear Captain Wagner,

I live on the coast in Northern California with my three sons. I grew up on the coast and it is important to me to raise my children near the ocean so they too can benefit from the invigorating yet calming aspects of this area. I feel very threatened for the safety of us all - and future generations - by the prospect of the Navy dumping used nuclear submarines in our coastal waters. Please do not allow this to happen. I'm sure we both love the ocean and our children - please work to preserve these gifts.

Sincerely,
Janet Wolfe-Hunnicutt

#506

Captain EF Wagner
US Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Subject: EIS - Submarine Reactor Plants.

Sir,

My comments are as follows:

1. The report should include the disposal of the fuel prior to decommissioning. | A.17

2. There would appear a need to include an additional section on the uses of these sturdy hulls.

#506 (Cont)

H.11 I would suggest that storage of other materials inside these vessels would be a more cost effective approach, than disposing of the Submarines & then disposing of other items in fabricated Containers. There must be other uses.

Thank you for the Document

[signature]

3579 Maurine
Santa Clara
95051

#507

Santa Barbara County

RESOURCE MANAGEMENT DEPARTMENT

DIANNE GUZMAN, AICP
Director

Deputy Directors
Comprehensive Planning — Kirk Shinnerland, AICP
Environmental Review — Jeffrey T Harris
Current Planning — Albert J McCurdy

April 20, 1983

Captain Edward F. Wagner, USN
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

Our department has had the opportunity to review the Oceanic Society's Scientific Committee Report concerning the disposal of decommissioned nuclear submarines. As a County department charged with managing resources, we are sincerely concerned about certain deficiencies of the Draft Environmental Impact Statement.

The following areas of concern are provided for your consideration in amending the DEIS to include:

1. the need for additional study of potential pathways for radioactivity to migrate through the marine environment; L.1

2. the need for additional study of the probability and potential impact of accidental sinking of a submarine while being towed to a disposal site; L.57

3. the absence of consideration of cumulative impacts of incremental increases in radioactivity released to the marine environment; L.7

4. the inadequacy of the Navy's proposed monitoring program; J.76

5. and a lack of attention to an alternative land disposal option which may minimize release of radioactivity to the environment. H.3

The discussion of these items is clearly in the best interests of public health and safety and sound environmental planning.

Sincerely,

[signature]

Jeffrey T. Harris, Deputy Director
Division of Environmental Review

JTH:kf

123 East Anapamu Street, Santa Barbara, CA 93101 (805) 963-7135

#508

April, 1983

Dear Sir;

I am writing to express my complete disagreement with the idea and intention of dumping nuclear submarines in the Pacific Ocean -

I request an extension in consideration of this problem and I think it is vitally important to
J.15 hold local hearing on this matter, especially in Fort Bragg

Thank you for this opportunity to express my dissatisfaction. Radioactive waste doesn't belong in the ocean -

Ban Ocean Nuclear Dumping

Sincerely

Nancy McHone

Excerpted from: NUCLEAR CALIFORNIA
published by GREENPEACE and
the CENTER for INVESTIGATIVE REPORTING

BURIAL AT SEA

DOUGLAS FOSTER

A blue fishing boat called the *Marilyn J* sliced through ocean swells the color of dishwater while the sun dropped through a pink flush behind the Golden Gate Bridge. Men hoisted their catches — black cod, butterfish — above their heads, gripping the fish in oily plastic bags and waving them toward San Francisco civic leaders and state officials waiting on the dock. This was no ordinary fishing trip. It was a periodic check, at taxpayers' expense, to determine whether a prime fishing area which supplies the city's Fisherman's Wharf with butterfish, squid and crab had been contaminated by radioactive trash.

It is not generally known that during the past 35 years the oceans have been used internationally as junkyards for more than 76,000 tons of nuclear garbage. In the United States alone, 50 dumps were sprinkled along both coasts. Nearly all of them are located close to densely-populated cities, in prime fishing grounds within a few hours' boat ride from New York, Newark, Boston, Los Angeles and San Francisco.

San Francisco's dump, a 600-square-mile expanse of sea surrounding the Farallon Islands, is the most famous of the radioactive junkyards established by the federal government in 1946, and then used until 1970. The site is the largest known dump off American shores and has achieved fame partly because public concern in Northern California has risen from benign neglect to forceful tides of fear and outrage.

Spokesmen for federal agencies overseeing the dumps — retired brass from the Atomic Energy Commission (AEC), and present staff at the Environmental Protection Agency (EPA) — have steadfastly insisted that there is "no evidence of any harm to either man or the marine environment" from jettisoning radioactive trash into the ocean near San Francisco or elsewhere. But while over $20 million has already been spent to find ways of stashing high-level nuclear waste *beneath* the ocean floor, a mere $250,000 has been spent to assess the damage from the *existing* dumps. Scientists who have reviewed the monitoring program believe the federal government's efforts have been flawed from the outset, revealing little about the existing environmental dangers from the dumps. Several critics of the federal monitoring — including Representative Glenn Anderson (D Long Beach), Representative

738

#508 (Cont)

John Burton (D-San Francisco) and Governor Jerry Brown — doubt that federal officials have any convincing data to support their reassurances of safety.

There is evidence to show that federal officials have little idea how much radioactive garbage lies off each coast, where the radioactive canisters which hold it are and even whether large numbers of fish have already been contaminated.

At congressional hearings and press conferences, the EPA trots out a set of figures which constitutes the government's best guess of the inventory of nuclear garbage dumped into the ocean. Government officials believe that 47,500 barrels filled with radioactive trash were dumped at the Farallons, containing 14,500 curies of radioactivity. (A curie is a measurement of radioactivity equivalent to that emitted by a gram of radium.)

Although five other dump sites were officially established off the California coast, EPA oceanographer Bob Dyer — who has been in charge of all dump monitoring — said that more than 90 percent of the refuse dropped into California's coastal waters was sunk off San Francisco. "As far as trusting the records, they are the only records available, and I have no reason to suspect that I shouldn't trust the records because the sea disposal that was occurring at the time was done with public acceptance. They were reporting it as it was, that's my opinion," Dyer said.

Despite Dyer's trust in the old AEC records he inherited, even a cursory perusal of the data reveals that either federal officials are making fanciful guesses or that a boggling form of New Math is employed. Watch carefully now as the statistics get jumbled.

In a 1957 report, AEC researcher Arnold Joseph wrote that through 1956, 12,500 barrels had been dumped in the Pacific Ocean off San Francisco, garbage with a radioactive count of 10,000 curies. In 1960, the AEC told Congress that 21,000 barrels had been dumped, with 14,000 curies radioactivity. In 1980, EPA comes up with its seminal estimate: 47,500 barrels with a 14,500-curie content. From 1956 to 1970, when the dumping stopped, the number of radioactive canisters went up 400 percent, but the radioactive inventory increased only 26 percent, if government data is to be believed. Joseph himself was more careful, noting that the radioactive inventory contained in his report could be off by as much as "a factor of 10."

Leave aside, for a moment, that particular numerical jungle. There are other pieces of the puzzle, enough to riddle the official estimate with doubts:

- A man who packaged waste for Lawrence Livermore Laboratory in 1954 remembers averaging 40 barrels *a week*. At that rate, Livermore alone could have generated more than 30,000 barrels, and there were two other laboratories in the San Francisco Bay Area generating wastes at the time and five licensed disposal firms in California.

- Military dumpers jettisoned radioactive cargo wherever it was convenient, ignoring AEC regulations and apparently keeping no records of how much nuclear waste was dumped. Retired officers have told Congressman John Burton of San Francisco that the military routinely air-dropped nuclear waste into the Pacific Ocean. "Once a week, from 1952 to 1967, the U.S. Air Force stationed at Hamilton Air Force Base dropped nuclear waste approximately one-half mile from the Farallon Islands," Burton claimed.
- No land disposal dump sites were established until the early 1960s. With the military producing more than 90 percent of all nuclear waste, it is legitimate to ask where they *did* place nuclear garbage if not in the ocean.

Perhaps even more bothersome than the questions about the quantity of radioactive trash dropped into the sea are the recurrent indications of very hot material being dumped. Federal officials insist that only low-level waste was accepted for ocean disposal, mostly "paper towels, rags, broken glassware, clothing and other laboratory paraphernalia contaminated with trace amounts of radioactive materials."

But Congressman Glenn Anderson has been haunting federal officials for more than a year about the admission of a former university researcher who acknowledged that "high-level liquid waste" had been dumped in the ocean. Navy documents only recently released show that, despite Department of Defense denials, the military dropped nuclear waste off Los Angeles on a regular basis. Those documents contain vague references to reactor fuel elements and samples, references which have yet to be explained by Navy officers.

Long-buried Atomic Energy Commission records demonstrate that the government was aware that firms licensed to dump radioactive waste took shortcuts, accepted high-level material illegally and kept scanty records. In one case, Coastwise Disposal Company of Long Beach was accused of hauling waste away from an Atomics International plant near Ventura, where a nuclear meltdown took place in late 1959, without asking what the barrels contained. The firm's license was yanked after an explosion at its dock in late 1960, but not before it dumped 650 tons of radioactive garbage off the coast of Long Beach.

On May 13, 1958, California state officials and representatives of the firms licensed to drop radioactive waste off the California coast met in Berkeley to hammer out an agreement about where, and at what depths, nuclear trash could be dumped. They agreed on the Farallon Islands site, Port Hueneme, Los Angeles, San Diego and the Santa Cruz basin. But the provisions for dumping insisted on "a safe means of disposal which will adequately protect human and marine life." The representatives agreed all wastes would be jettisoned in "at least 2000 fathoms" (12,000 feet) in "containers of such integrity that they will remain intact at the depths prescribed."

#508 (Cont)

Nearly two decades later a group of deep-sea divers led by Dr. Harold Ross of Project Tek-Tite, a private organization of marine enthusiasts, was searching for a piece of lost equipment just 18 miles from San Francisco. Diving in less than 160 feet of water between the Farallon Islands and the Golden Gate Bridge, one of the divers saw something that brought him up in a hurry.

"The guy came up all flushed and he said, 'Doc, there's barrels down there' . . . When you've got a young crew and you talk about barrels, the first thing they think about is treasure. So we all went in the water," Ross remembers.

The Tek-Tite divers were disappointed, and frightened, when they discovered there was no treasure at the bottom. Several dozen barrels had been corroded away, and the contents were spilling out. Large pieces of laboratory equipment were visible, material was scattered along the ocean floor and there were fish feeding nearby.

The AEC had required only a depth of 6000 feet for the disposal of radioactive garbage, and the licensed companies had simply ignored their agreement with California officials. But even the AEC restriction turned out to be a paper protection. None of the dump sites was surveyed to ensure that waste would land in areas of sufficient depth, and barge operators were given large latitude in determining where to drop their nuclear cargo.

The dangers of radioactive leaks beneath the sea would likely have remained a buried issue in the 1980s if not for the persistence of environmental groups and the considerable energy of a soft-spoken, unassuming scientist from the University of California. Jackson Davis, a marine biologist at UC's Santa Cruz campus, was launched onto center stage of the ocean dumping debate when he teamed up with San Francisco Supervisor Quentin Kopp and Dan Hirsch, a spokesman for the Los Angeles–based Committee to Bridge the Gap, to demand the release of government information about the dumps.

In July 1980, Hirsch had uncovered evidence of 50 nuclear waste dumps spread down both coasts like a bad case of poison oak. At the time, federal officials were acknowledging only four dumps. Both Hirsch and Davis were also concerned about the EPA's secretive approach. Surveys of the existing dumps which had been conducted in 1974 and 1977 had been kept under tight wraps, while summaries prepared by Dyer assured there was "no evidence of any harm to either man or the marine environment."

Once the EPA survey data had been dislodged, Davis charged the information "furnished compelling evidence that radioactive contamination from the dump sites has entered edible fish and now presents a measurable health hazard." At the Farallon Islands dump, radioactive levels in bottom sediments were 2000 times what scientists expected from "background" — a level combining natural radioactivity and the plutonium added to the environment by years of atmospheric testing of atomic weapons. Off New Jersey,

the readings were even higher: up to 260,000 times higher than the level expected from fallout.

Perhaps most important, Davis found that a colossal error had been made in government plans. From the inception of ocean dumping in 1946, AEC officials pursued two different strategies for dealing with nuclear waste: one, release the toxic elements into the air or water and dilute them to safe levels; or two, contain and store the most dangerous waste until the radioactive readings fall to harmless levels. Davis could see that the government strategy had been the worst possible merger of the two methods

AEC officials had expected their garbage to remain intact until it hit the ocean floor, there to leach bit by bit into sea water and disperse. But by thoroughly reviewing government documents, Davis found that nearly a third of the radioactive canisters crumpled on their way to sea bottom. Instead of diluting, radioactive isotopes imbedded themselves in ocean mud, sticking there in concentrated form. Perhaps most disturbing, the radioactive canisters created an artificial environment attractive to marine life — a kind of condominium project for soft fish wanting to get out of the currents. Sponges attached themselves to the barrels, small worms ate the leaching waste material and spread it into the bottom sludge. Fish could eat the worms, of course, concentrating the radioactivity in their systems many thousands of times.

"You couldn't actually design a better way to put that radioactivity in our food," Davis said.

Although state researchers have not found fish with astronomical radioactivity readings near the Farallons, only a small sample has been taken so far and the findings have been "luck, not planning," according to one top EPA official.

The story of radioactive ocean dumps is a catalog of ill-conceived, uncontrolled and secretive government operations. At every step in the history of ocean dumping, government scientists were profoundly ignorant of the consequences of their acts. When the dumping began, AEC analysts were certain that food fish never ventured more than 400 fathoms (2400 feet) below the surface. In 1962, the National Academy of Sciences found commercial fish at 1200 fathoms, *1200 feet deeper than the legal restriction for nuclear waste.*

In 1962, the Academy also recommended that radioactive ocean dumps be "exhaustively surveyed and sampled for organisms living on or near the ocean bottom" and urged routine monitoring of the dump sites. Instead, U.S. officials waited four years after the dumping had stopped — then took a few photographs and samples on a shoestring budget of $250,000 before pronouncing the dumps safe. These pronouncements harken back to the repeated assurances of the AEC in late 1961. "Report Shows No Radioactiv-

#508 (Cont)

ity Attributable to Waste in Two Pacific Sites," one press missive was headlined, above an ironclad finding that all waste was "safely contained" 6000 feet below the surface at ocean bottom. The early reports were met by a trusting public. The more recent EPA reports have encountered skepticism.

Repeated entreaties to conduct systematic studies of the dump sites have been rebuffed, and legislation has been introduced to force the government's hand and require extensive monitoring. Even Dr. William Schell, a radiological specialist who compiled much of the EPA's sketchy data on fish, has been appalled by the government's strenuous efforts to remain ignorant about the dumps. While more than $20 million is spent to design ways to jettison high-level nuclear waste onto the ocean floor, nothing is budgeted for an assessment of health hazards from material already dropped into the sea. "What we don't understand is the transfer vehicle, how the radioactivity gets through the food chain to man. . . . It's surprising to me that nobody will fund such a study," Schell said.

What do the government officials, who repeatedly assure us that ocean dumping poses no hazard, really know? Not how much radioactive garbage lies off each coast. Not where it is, at what depth, in what condition. Not whether large numbers of fish have been contaminated already. Government officials cannot even be sure when radioactive canisters can be expected to release their toxic contents.

"If you assume that an undamaged barrel will rot in 40 years and a damaged barrel would rot in 20 — which is my best assessment — I would imagine that you would see a steady buildup of activity . . ." Davis said recently. "I'd say peak release would occur in the 1980s and 1990s.

"Of course, the full impact of the health hazard depends upon the exact composition of the waste, something we may never know. But if it is plutonium, then the toxicity duration is the equivalent of 20 half-lives, which is 500,000 years. So that's the period of time we're talking about, 10,000 human generations — which is not our grandkids, not their grandkids, but whole new civilizations somewhere downstream."

#509

4-18-83

To Captain Edward E Wagner,

We oppose the sub-dumping on the coast of California or anywhere for that matter. I am very surprised that the Navy would want to dump anything in the oceans. This is Mother Earth we all have ~~can~~ got to clean her up and keep this planet clean and safe for coming generations. Peace.

Janece Cedar
Glen Dell
Forestville, CA.
95154

#510

Captain Wagner.

I urge you once again to not dump any nuclear submarines in our ocean. We are a family living on the coast of Mendocino. We have two young children who play in the ocean & on the shore. We are aware that these submarines may & will pollute the ocean for generations & generations to come. We believe the pollution will contaminate the fish and enter the food chain. You will evetualy eat radioactive fish L.36

The fishing industry on our coast would be ruined forever. It is our main livelyhood on this coast. L.53

I believe you are aware of radioactive pollution of our beloved ocean. Please understand we definetly Do not want any submarines dumped in our oceans.

Marlene Ruiz

#511

4/22/83

Dear Captain Wagner:

Thank you for your concern about the dumping of nuclear waste in the ocean. As one who enjoys and appreciates the ocean, and land, I am most interested in preserveing their health and cleanliness for ~~futwxxe~~ future generations of children and adults. I know you also like the waters of the world and realize that dumping of toxic waste is not really a very good idea, even though it may seem expedient in the short run.

Please know that I support the navy and am glad people like you are working to keep the waters free from chemical polution.

Sincerely,

S. Brooks.

S Brooks

#512

928 Chapala Street
Santa Barbara, Ca. 93101

April 12, 1983

Captain Edward F. Wagner
Department of the Navy
Office of the Chief of Naval Operations
Washington, D. C. 20350

Dear Captain Wagner:

Thank you for the copy of the draft environmental impact statement on the disposal of decommissioned, defeuled naval submarine reactor plants.

I wish to make the following comments with regard to the above DEIS.

Although it would appear that release of radioactivity from the nuclear plants would proceed slowly and that plants would be sunk off the continental shelf in an area remote from human habitation, the DEIS does not adequately discuss the possibility that unforseen seismic or volcanic disturbances on the ocean floor could cuase the plants to break up or melt with an associated rapid increase in radiation. F.22 L.20

Although the amounts of radiation that would enter the food chain and to which human beings would be exposed appear minute, it should be remembered that the total radiation burden to which we are exposed continues to increase. Government efforts should be directed toward decreasing total radiation exposure rather than increasing it.

I also wish to note that deep ocean sciences are still in their infancy. No definitive statements can be made in any aspect of biological or physical phenomena at great ocean depths. L.1

Finally, I fear that the approval of ocean disposal of these plants will open the door for similar disposal of the reactors themselves and all sorts of equipment that the Navy wants to get rid of. I feel that land disposal at the Hannaford, Washington site is the only feasible method of disposing of these defeuled nuclear submarine reactor plants. L.9

Very truly yours,

Bruce Meacham

Bruce Meacham

cc to: files
Hon. Jack O'Connell, Calif. State Assembly
Hon. Gary Hart, Calif. State Senate
Hon. George Dukemejian, Governor, State of California
Hon. Robert Lagomarsino, House of Representatives

#513

Dear Captain Wagner,
I am very much opposed to the
nuclear dumping on our coasts.
I was informed that the navy
wasn't aware of any concerns by
the citizens that live up here. The
L.20 thought of having a possible nuclear
leakage in our oceans has global
catastrophic potentials. The ocean
houses a whole different form of
life that I feel deserves to live
as well as human beings regardless
of the fact that it could seriously
L.20 effect the quality of human life
if leaks were to occur. The life of
radioactive wastes will last longer
than those submarines will. We
may not be around but can your
~~conscious~~ feel good about killing
living things even 5,000 years from
now? Please don't dump them in
our oceans.

Sincerely
Emily Hall
Box 4871
Redway CA
95560

#514

4/24/83

Captain Wagner or to whom it may concern,

I am writing because of my concern over your proposal to dump toxic waste off of the Mendocino coast.

I have read much literature on the subject the pros and cons and am deeply disturbed that this would even be considered by our knowledgeable leaders. The dangers of polluting our food chain is inevitable if such action is taken. L.36

Sincerely
Thomas Buccard Jr.
586 Valley St.
San Francisco, Calif 94114

744

#515

11010 Des Moines Avenue
Northridge, California 91326
April 25, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Captain Edward F. Wagner:

As an American citizen, I am writing to you to inform you of my opposition to the Navy's plan to ocean dump over 100 decommissioned nuclear subs off the coast of California and North Carolina. There are much safer places to dispose of radioactive wastes, and the ocean is not that place. Please make a review of your Draft Environmental Impact Statement and allow for safer options. Thank you.

Sincerely,

David Reames

#516

48 Palomas
San Francisco, Ca 94127

Captain Edward F. Wagner -
US Navy
Office of the Chief of Naval Operations (OPNAV-22)
Dept of the Navy
Washington, D.C. 20350

Dear Captain Wagner.

I am very much opposed to the ocean disposal of scrapped nuclear submarines. By the Navy's own estimates, this would be 6 million curies of radioactivity, 6 times the levels dumped in the ocean by the U.S. between 1946-1970. This increased, out of control, pollution is unsupportable.

The ocean dumping solution to junking submarines is unacceptable for a number of reasons, the most serious

L.1 of these being that not enough is known by anyone, including the Navy, about deep ocean ecology. Another reason your proposal is unacceptable is that we need more research on just what such dumping will do to the marine environment.

The Navy's cavalier attitude about monitoring the

- 2 -

proposed dumping reflects an overall lack of concern about any long-term negative effects. L.39

The problem of disposal is real; an alternative must be found. Why has the Navy not paid more attention to securing land disposal?

Sincerely yours,

Carole Roberts

(Carole Roberts)

746

#517

Nancy Sheehan
241 Church St. #2
San Francisco CA 94114
April 17 1983

Captain Edward F. Wagner US Navy
Office of Chief Naval Operations
Dept of Navy
Washington DC 20350

First, thank you for extending the public comment period on the Navy's plan to dump used nuclear submarines into the Oceans. I've been researching the issue of radioactive disposal methods available under today's technology. It is my conclusion that the Draft Environmental Impact Statement on the Disposal of Nuclear Submarines has serious flaws.

L.20

1) Ocean disposal is not the "least cost" alternative, because cost considerations reviewed in the DEIS minimized release of radioactivity into the environment.

2) Radioactivity escaping into the environment some 100 or 80,000 years from now is a real possibility. And at that time, you or I maybe our children will be eating fish at some health club & contracting cancer soon thereafter.

I do feel that the land disposal option is more viable one. On land if something happened we could correct the problem.

Captain Wagner I hope you have considered my plea & are able to change the Navy's plans for ocean disposal to one of land disposal.

Thank you for listening

Yours Truly

Nancy Sheehan

#518

YALE CANDEE MAXON
820 EUCLID AVENUE
BERKELEY, CALIFORNIA 94708

29 April 1983

Captain Edward F. Wagner
OPNAV 22
Dept of the Navy
Washington D.C. 20350

Dear Captain Wagner

I want to protest that the DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants is inadequate and should not be used in deciding how to dispose of these still radioactive materials.

In particular the listing of a site 160 miles off the Mendocino Coast as a prime disposal area is a serious mistake.

That area is within the waters of
L.53 Northern California's fishing industry, and
L.36 by the operation of the "food chain" it is likely that the ultimate effect of such dumping will be to render fish caught along the Northern Coast inedible because of radioactivity. If that happens a rich current source of naturally occurring protein will have been sacrificed. (As you know, for a time swordfish were rendered inedible as a result of their position near the top of the food chain.)

In sum, ocean dumping is not a safe possibility, and should not be considered despite the illusion that it is "cheap" — for the "cheapness" depends on closing our eyes to the most likely future consequences.

Sincerely,

Concur!
Helen H. Maxon

Yale Maxon
Cdr. USN, Retired

748

#519

4/26/83

Dear Sir,

You must realize at this point how extremely dangerous dumping radioactive material into the ocean, to say nothing of the northern Calif. coastal area, would be. There has got to be a better way of rectifying all the destructive energy that has gone into the perpetuating of nuclear defense systems. Knowing what a devastating affront to all that is good, healthy, beautiful and loving in this world, I urge you from the bottom of my soul and from perspective of my three beautiful daughters' futures to please find an alternative.

1.15 It is time for more talks with the public - Eureka & in Mendocino County cities.

Wishing you all the best in this gargantuan reality which includes us all

Sincerely,

Yanow Righter

ALWAYS USE ZIP CODE

#520

4/29/83

Captain Edward F Wagner
U S Navy, Office of the Chief of Naval Operations OPNAV 22
Department of the Navy.
Washington, DC 20350

Dear Captain Wagner,

In your on going proceedings regarding the Navy plan to dispose of radioactive submarines, I urge you to recognize the Oceanic Society Scientific Committee study of your disposal plans.

Specifically, it seems clear there has not been sufficient study of alternative land disposal options which would minimize the release of radioactivity in the environment. The Society asserts there is a significant lack of understanding of the deep ocean environment and the impact of sea disposal of these nuclear subs.

I am most concerned about these issues and hope to hear the Navy will pursue researching alternatives as suggested by the Oceanic Society

Thank you.

Nika Brady
136 Mullen Ave
San Francisco Ca
94110

#521

Captain Edward F Wagner
U S Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C.20350

Dear Captain Wagner:

In spite of the feeling that I have, gained from the hearings in Sacramento, where I attended, and spoke, that further protest is futile, I feel that I must, again, say that I feel that the proposal to bury the A-Subs at sea is unfortunate, and is the wrong thing to do.

I do not feel that elaboration on this point will influence you, so I will only state that I vote against the proposal.

Sincerely,

Syd M Hall

Syd M Hall
13983 Gracie Road
Nevada City CA 95959

#522

Box 885
Sitka, AK. 99835
April 28, 1983

Dear Captain Wagner:

Thank you for sending me the Draft Environmental Impact Statement on disposal of nuclear submarines. I have given it to our college library to obtain the most exposure possible.

I am still of the opinion that it would be too hazardous to marine life to dispose these reactor plants in the ocean. Once sunk they could never be retrieved if it was found they were causing problems. | L.14 | W.1

Yours truly,

Virginia Gibson

Virginia Gibson

750

#523

Capt. Edward [illegible]. Wagner   April 30, 1983

Office of the Chief of Naval operations (OPNAV-22)

Dept. of the Navy

Washington D.C. 20350

Dear Captain Wagner:

I urge you to consider any option for disposal of the U.S. Navy's decommisioned submarines other than ocean dumping. As our knowledge of the oceans and the effects of radioactivity on life increases we may be able to decide that this is a perfectly
L.1 viable course of action. However, the lack of scientific knowledge in these areas dictates that we not do anything now which cannot be undone later.
G.2 A temporary solution to the disposal of submarines is most advisable until all the facts are in. Someone should look into the matter of radioactive ocean dumping and find out if it is safe or not.

These are my thoughts regarding this subject.

Thank you for your time.

Gregory E. Parker

Gregory E. Parker
2321 Allied Drive
Madison, Wisconsin 54711

Gregory E. Parker
2321 Allied Drive
Madison, WI 53711

#524

April 25 /
Ukiah

Dear Captain Edward F. Wagner, U.S. Navy,

I am one of thousands of citizens in Mendocino County concerned about the prospect of nuclear sub dumping off of our coast or any coast for that matter. I believe that by now, you must see the hazards in doing so. so I don't understand how you, in clear conscience can advocate such a dangerous mode of waste disposal.

Of course, the basic problem is that nuclear
energy is made at all, but since it is, and
we now have to deal with, the least we can
do for ourselves, our children, and future genera-
N.3 tions, is to dispose of it as responsibly as is
possible.

W.1 There is the problem of irretrievability of the
poisonous matter in case of an accident, the
L.20, L.6 past history of container leakage (The Farallons),
increase of toxicity in the food chain, etc.
The list goes on and on. There is no such thing as a negligible dose of radiation. For one thing, the effects are cummulative; for another, there have been plenty enough studies done linking radiation to cancer and birth defects.

How can you face your own children, or any children, knowing you are playing a part in a process that not only poisons their environment, but threatens their very existance? (proliferation of nuclear subs weapon systems). What gives you the right to take part in denying a safe and healthy future to generations to come who already won't escape the exposure to a contaminated planet, and possibly won't even have the opportunity to be born. Negotiations and conciliation is needed not more poisons and increasing threats to health and life.

Please reconsider your recommendations
and give more study to other options. I
am seriously requesting a 40 day extension
to this extension, and local hearings in J.15
Fort Bragg and Eureka. I find it appalling and unethical that hearings are done so far away from those who will be most effected by these decisions.

I pray that you have read and honestly and deeply considered what I have written.

Thank you -

Laura Maguire
Elementary Teacher

Laurie Maguire
P.O. Box 387
Ukiah, Ca 94952

752

#525

Dear Sir:

As residents of Humboldt County California, living fifteen miles from Cape Mendocino, we want to go on record as whole-heartedly opposing the proposal to dump "spent" nuclear subs off the Cape.

G.2 Mothballing the old subs in restricted areas seems the only present alternative.

Sincerely,

Gary Bertnick Gary Bertnick

Carol Bertnick CAROL BERTNICK

P.O 165
PETROLIA, CAL. 95558

#526

(April 26, '83)

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
WA., D.C. 20350

Dear Captain Wagner,

There is some misunderstanding among our twin student groups concerning the disposal of nuclear reactors from naval submarines. It is rumored that they will be deposited in an ocean area off the coast of WA state (rather than Mendocino, CA)

The SEIS states that approval will be necessary from the EPA. However, the EPA has stated that that power or priviledge has been taken from them by the federal courts. Who really has the final authority?

Since the radioactive constituents already exist it seems a more useful pursuit to study the benefits and disadvantages to our country from nuclear powered submarines, rather than the whereabouts of their disposal.

I believe in the necessity of protecting our country. To what extent and in what ways would you say that this has been furthered

-2-

by the 100 vessels now in operation?

I would feel safer if the reactor cores were buried at sea than at Hanford. I take my food and water from the land rather than from the sea and that is the main reason.

I hope that the radiation levels really are as low surrounding the submerged reactors as estimated in the SEIS

Thank-you for sending this document to me for reading.

Sincere wishes from,
Megan Raymond

Megan Raymond
4214 - 139th Av SE
Bellevue, WA 98006

753

754

#527

Pacific Seabird Group

DEDICATED TO THE STUDY AND CONSERVATION OF PACIFIC SEABIRDS AND THEIR ENVIRONMENT

1 May 1983

Captain Edward F. Wagner,
U.S. Navy, Office of the Chief of Naval Operations
Department of the Navy
Washington, DC 20350

Dear Captain Wagner,

These remarks are comments on the DEIS for the disposal of decommissioned, defueled naval submarine reactor plants. We understand that the comment period has been extended to June 30, 1983.

U.8 We have two concerns regarding this proposed action. First, we do not believe that sufficient attention is paid to the possibility of biological creatures transporting radionuclides to surface waters. My recent research with the diets of Laysan and black-footed albatrosses indicate that they eat many mysids (Gnathophausia gigas and G. ingens), isopods (Anuropus branchiatus), leptostracans (Nebaliopsis typica), shrimps (Notostomus japonicus), and amphipods (Eurythenes gryllus) that are known to inhabit very deep waters. Albatrosses feed only at the surface of the ocean, and consequently creatures from very deep water migrate to the surface. The amphipod Eurythenes gryllus was recently found in baited traps at 4700 meters at the Nuclear Energy Agency dumpsite in the North Atlantic. We are very concerned that seabirds and other organisms might come into contact with marine organisms that picked up radionuclides from deep water and returned them to surface waters.

Second, we firmly believe that the comparison of disposal costs (S-16 and elsewhere) is seriously biased. The costs of disposal of a nuclear submarine must be viewed in the context of its entire cost and operation. We believe that the costs in Table 3 should

be revised to reflect the costs of building, operating, and maintaining a submarine for its entire useful life, using constant dollars. For example, if the 20-year life of a submarine cost $1,000 million, the second line on Table 3 (S-16) might read:

$1013.3 million $1007.2 million $1005.2 million.

Disposal is simply the last phase of the life of a submarine. To view disposal apart from the huge cost of building and maintaining a submarine in the first place distorts the costs of the various disposal options. It does not serve the public interest to assert with selective data that the costs of land burial are much greater than sea burial. The fact of the matter is that the costs of either are trivial compared to the costs of the submarine. 10.4

Sincerely,

Craig S. Harrison

Craig S. Harrison, Chairman
45-024 Puulena St #614
Kaneohe, HI 96744

#528

Captain Wagner, April 20, 1983

Some people don't take care of their teeth. Some people abuse the ones they "love." And some people contemplate dumping nuclear subs off the California coast. Simply, this is the issue here: it is one thing to neglect good, natural fortune, it is another thing to abuse it, and then there is extreme abuse.

Think of the water and the fish and the unknown possibilities wrecked, think of your grandchildren and your wife and your own good name. You are like a god in this matter, or you are like a deamon.

Sincerely,

BRANSCOMB APR 28 AM 1983

#529

MRS. J. C. YOUNGBERG
POST OFFICE BOX 1078
ROSS, CALIFORNIA 94957

Ross Ca.
May 1, 1983

Capt. Edward F. Wagner USN
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C.

Dear Sir:

It has been called to my attention that the U.S. Navy Draft Environmental Impact Statement is totally inadequate in the dumping of nuclear waste. Just because it is the 'least costly method', i.e. dumping in the ocean, doesn't mean that we all could not suffer from such a decision. N.3

We will never get rid of nuclear waste until we stop producing it!

Yours sincerely,

[signature]

#530

120 Sheridan Rd.
Oakland, Ca. 94618
April 30, 1983

Captain Edward F. Wagner
U.S. Navy
Office of Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Based of the U.S Navy DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants proposal, I feel this plan is inadequate. Ocean dumping should not be accomplished based on this document.

Sincerely,

Nancy Albers

#531

29 April 83

Captain Edward F Wagner
U.S. Navy, Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, DC. 20350

Dear Captain

The U.S. Navy DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants is inadequate. Ocean dumping cannot be considered based on this document.

Sincerely,

Phoebe Grigg
1560 8th Ave #7
San Francisco, CA 99122

#532

4716 LARKIN ROAD
MENDOCINO, CA 95460
1 MAY 1983

CAPTAIN EDWARD WAGNER
OFFICE OF THE CHIEF OF
NAVAL OPERATIONS (OPNAV-22)
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20350

DEAR SIR: re. DUMPING OF RADIOACTIVE SUBMARINES

I OBJECT TO THE DUMPING OF OBSOLETE NUCLEAR SUBMARINES OFF THE CALIFORNIA COAST!

I THINK IT INSANITY TO DESPOIL AND POLLUTE OUR, AND FUTURE GENERATIONS', OCEAN, NATION AND PLANET!

I QUESTION THE VERACITY OF THE MILITARY AND THE PRESENT ADMINISTRATION IN ACCURATELY ASSAYING THE DANGER FROM THE RADIOACTIVITY EMANATING FROM THESE VESSELS NOW AND IN THE FUTURE!

SINCERELY,
Julius A. Altvater
JULIUS A ALTVATER

#533

4/30/83

Dear Sir,

As a Californian,

I'm writing to object to your plan to dump decommissioned Reactor Plants into the ocean. It is horrible to imagine leaking radiation and its potential effects on the food chain. | L.20, L.36

Also I wonder why in the DEIS report only 2 biologists were included in a team of 15? I also wonder why hearings on the matter aren't held on the coast, with the communities effected being able to voice their opinions, especially when they have continuously asked for this. I read that the data used in the study on albacore fishing was 23 years old. Is this a modern up-to-date report? | N.11 | J.15 | J.12

I feel Hanford, Washington solid radioactive waste site is the best option for disposal. If better ways are found of dealing with the problem of radioactive waste, at least the subs are retrievable there. We can not use our oceans as a place to dump and forget about these serious problems.

Thank You for your time

Sincerely
Sara Schatz
California Resident

S. Schatz
2800 Sparks way
Hayward, CA.
94541

758

#534

SANTA ROSA, CA 954 PM 2 MAY 1983

ALWAYS USE ZIP CODE

Mrs. M.M. Rowland
1652 S. Main
Willits, Ca 95490

Capt. Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Oper. (OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Captain Wagner,

It is my objective to let you know exactly how I and my family feel about nuclear ocean dumping. We are against it whole heartedly for numerous reasons.

L.20 The environmental and economic dangers and implications are truly astounding. For instance...if leakage were to occur from the waste of Niobium-94 which has a half life of 20,000 years, just where do estimate that will leave all of us? Including yourself, Sir? There is also no negligible dose or a safe dose of radiation, and I amoung thousands of other concerned citizens do not wish to become experiements for the government or the military or big business while you all decide just how much of this radioactive garbage the human race can ingest, live with before we all die.

L.36 Contamination of the food chain is evident and the fact
L.6 that the Navy refuses to monitor past dumpsites, such as the ones at the Farallon Islands, does not breed confidence in your actions and or reports to the public.

WE HAVE THE RIGHT TO KNOW. WE HAVE THE RIGHT TO OPEN HEARINGS. WE WILL NOT GO ALONG LIKE SO MANY BLIND SHEEP TO THE SLAUGHTER.

What we do today will affect all of us tomorrow and being that we care what happens to our world and the world we want to leave our children, I think it is high time that the public speaks up mow....before it's too late.

J.15 WE WANT A 90 DAY EXTENSION ON DEIS COMMENT PERIOD AND OPEN HEARINGS IN THE FORT BRAGG AND EUREKA AREAS....

Sincerely,

Mrs. M.M. Rowland

M.M. Rowland

#535

SANTA ROSA, CA PM 2 MAY 1983

ALWAYS USE ZIP CODE

Ms Theresa L. Greenlaw
P.O. Bx 1158
Willits, CA 95490

Capt. Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22) Dept. of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I wish to let you know my views on nuclear dumping as well as make a request that the DEIS comment period be extended for ninety, (90), days. I also want to have local hearings held, particuarly in the Fort Bragg and Eureka areas, concerning the ocean dumping of nuclear waste. J.15

My views on nuclear ocean dumping are quite negative...I am against it. As a citizen of this country, a country I have always looked up to, admired and loved with devotion and pride, I feel it is not only my right, but my obligation to speak out on these issues. Captain Wagner, I can not begin to impart to you how very concerned I am over these matters. I have two little children that mean everything to me and to teach them to honor and respect thier government and military is so shatering when I know that both are, in fact, setting in motion the extinction of our human life through unconcerned actions.

OBJECTION AS FOLLOWS:

1. Ocean dumping is a non-solution. L.9, F.8
2. Sets a poor precedent-ocean opened to become huge radiation dump.
3. Not enough research is being put into finding a safe, permanent solution for radioactive waste disposal. L.1
4. Creating more weapons creates morewaste.
5. DEIS shows a lack of adequate & conclusive data. J.20
6. Manufacturers of nuclear waste should take responsibility for safe disposal.
7. WE CAN'T AFFORD FAILURES OR MISTAKES.
8. Comprehensive monitoring of existing dumpsites should occur before any new dumping programs are considered. L.6
9. NO DIALOGUE WITH THE NAVY DURING THIS ENTIRE PROCESS...WHY?

We live on the coast, Captain Wagner, and our main food source happens to be fish caught off the West Coast in the Mendocino Area. I do not want to feed my children contaminated food. Would you feed, willingly, contaminated food to your family? I think not. L.36

Again Sir, extend the DEIS comment period and hold public hearings in our area...Fort Bragg & Eureaka.

We Are our Brothers Keeper....

Sincerely (& concerned)

Theresa L. Greenlaw

#536

May 2, 1983

Doug Hansen
4234 Mt. Henry Ave.
San Diego, CA 92117

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

I am writing in order to comment on the Draft Environmental
Impact Statement concerning the Navy's plan to dump over 100
decommissioned submarines into the ocean off of North Carolina
and California. I oppose this plan, because once the subs
W.1, J.76 are sunk they will be too deep to monitor or retrieve should
L.20 they start leaking radioactivity. Any such leaks could be
disastrous, since just 2 subs contain more curies of radiation
than the U.S. dumped into coastal waters in the entire period
J.15 between 1946 and 1970. The Navy should hold more public hearings
on this plan, and locate the hearings in coastal cities near
the proposed dumping areas, since the people in these cities
would be the ones most affected if leaks should occur.
Previous hearings were held only in inland cities.

Sincerely yours,

Doug Hansen

Doug Hansen

#537

1116 58th Avenue
Oakland, CA 94621

May 3, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

We are writing you in reference to the U.S. Navy Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. It appears to us that this statement is grossly inadequate.

How can the Navy consider undertaking ocean dumping of radioactive wastes based on this document?

The study included input from only two biologists, and does not adequately deal N.11, F.12
with all research findings to date. To think that nuclear waste from decom-
missioned nuclear subs could be dumped into the ocean and be forgotten is
completely non-rational. Simply because this may be the "least costly method" N.3
does not warrant its use.

The ocean is an extremely complex ecosystem. How long do we think we can tinker
with this system and degrade it and pollute it with substances that do not break
down in the nutrient cycle? How long before human beings accumulate con-
centrations of radioactive waste in their own bodies that are carcinogenic? It
is already happening! All life interacts with the ocean. It is considered the
mother of all life. The RISK involved in radioactive contamination of the ocean L.14, L.39
is beyond our calculation! And what about non-human life forms? Do they not
matter as much as we?

Please, Captain Wagner, consider the extreme seriousness of what the Navy is proposing. It seems clear that at this point, the Hanford site is the only possibility for nuclear dumping. And remember, as long as we continue to produce nuclear waste, it will always be with us! And, in the long run, it will be in us! For can we escape our ties with the earth and the ocean? If we can, can our grandchildren?

On behalf of all creatures, those born and not-yet-born, we are,

Sincerely,

Nancy Tuttle
Will Tuttle

Will Tuttle
Nancy Tuttle

#538

May 4th

Dear Captain Wagner,

I apologize for this letter being just
past the time line for public comment. However
I have a couple of things to say. I feel
that the longterm, hazardous effects of
radiation in the Ocean by Nuclear Sub
Dumping are extremely threatening. I am concerned
for my & future generations. I don't
L.53 want to see one of the best fishing grounds
in the world threatened. I hope that land
disposal will be considered as I think it is safer &
wiser. I would like to request local
J.15 hearings in Ft. Brag Ca. & Eureka Ca

Thankyou,

Lorie Leaf
Box 223
Calpella Ca 95418

#539

Karen Ankersmit
907 Shattuck Ave
Berkeley, CA 94707
May 4, 1983

Captain Edward F. Wagner
U.S. Navy, Office of the Chief of Naval Operations
(OP-NAV 22) Dept. of the Navy
Washington D.C. 20350

Dear Captain Wagner,

I am writing you regarding the U.S. Naval Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. The document lacks information on the effects L.14 of low level radiation on the ocean ecology, including plant organisms, commercial fishing and, eventually, on L.53 humans. The favored site off the Mendocino Coast is particularly alarming as it is within the boundries of Northern California's coastal fishing industry.

I believe that our inability, with current technology, to retrieve the Submarine Reactor Plants should problems arise should be the deciding factor against their ocean disposal. W.1

I believe the U.S. Navy DEIS on this subject should be reconsidered, and possibly redrafted in the light of caution and longterm safety, not fiscal costs. N.3

Thank you,

Karen Ankersmit

#540

May 4, 1983

Captain Edward F. Wagner
United States Navy

Dear Captain Wagner,

I am writing to you to officially oppose the Navy's plan to dispose of obsolete nuclear submarines off the Carolina Coast.

My grounds for such opposition are that:

1) insufficient study has been given to disposal of the subs on land, where checks + controls could be monitored + more efficiently,

W.1

2) that the subs will not be recoverable in case of unforseen problems.

Further, I wonder why when these subs were built this problem was not resolved + why the Navy (Army, etc.) almost always want to dump things on the Carolinas? We are already doing our share for the nation on the nuclear problem.

Sincerely,
Beverly Heisner
(over for address)

Beverly Heisner
1011 Coil[illegible] Dr.
Columbia, S. C. 29205

#541

"The Wood N' Carr"
2667 E. 28th St., Suite 515, Signal Hill, CA 90806
(213) 427-7388

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- Antique Auto Wood Restoration
- Bars, Cabinets, Wall Units, Etc
- Commercial, Private Inquiries Invited

5-5-83

Dear Captain Wagner:

On behalf of Greenpeace, my husband and I are writing to you concerning a matter, that we feel is of great importance. We would like it to be known that we are strongly opposed to the dumping of wastes of any type and especially radioactive, into the sea. By killing the ocean, we are killing ourselves, and every other living thing! The persistent and archaic attitude of "out-of-sight, out-of-mind", must stop. Besides ourselves, we all have a responsibility to future generations. We do not feel that ocean-dumping is the answer to our waste disposal problems. We must come up with a better solution.
Thanks for allowing us to air our views and for your consideration in these matters.

Sincerely,

Doug & Suzanne Carr
Doug and Suzanne Carr

#542

March 14, 1983

U.S. Naval Dept:
I am writing in response to the dump-
ing of nuclear waste by means of sub-
merging these products in sealed sub-
marines. I feel the risk is too great
in endangering our oceans and its in-
habitants, and therefore effecting the
L.36 food chain of our earth. Should there
L.20 be leakage from these submarines,
radiation and other harmful substances,
W.1 there seems to be no provisions for correct-
ing or eliminating the hazardous situations
that may arise during the next 200 years.
I urge you to consider the irrevocable
damage and consequences this can have
on all of us now and the future.

Sincerely,
Mamie Lee Kiyohara

KIYOHARA
1547 9TH AVE. #7
SAN FRANCISCO, CA 94122

#543

May 5, 1983

Dear Capt. Wagner,
No more ocean disposal for radioactive wastes! The navy's plan to dump 100 decommissioned nuclear subs off the coast of Calif. and N. Carolina is outrageous! As a human being (as well as a fine naval officer) I hope you have the courage to add your protest to those of alarmed citizens. Sincerely.
Mrs Jeanne King
Los Altos, Ca.

#544

5/3/83

Dear Captain Wagner,
We are gravely concerned that the Navy's DEIS on Disposal of Submarine Reactor Plants is inadequate. Ocean dumping is a serious and dangerous practice & this document is no means by which to gauge its safety.

Barbara Shulgold
Dr R.E. Albert &

#545

JOHN FLYNN

BOARD OF SUPERVISORS
COUNTY OF VENTURA

GOVERNMENT CENTER HALL OF ADMINISTRATION
800 SOUTH VICTORIA AVENUE VENTURA, CALIFORNIA 93009

April 19, 1984

The Honorable John Lehman
Secretary of the Navy
The Pentagon
Washington, DC 20350

Subject: Comments on Proposed Sea Disposal of Obsolete Nuclear Submarines

Dear Secretary Lehman:

The Ventura County Board of Supervisors has reviewed the Draft Environmental Impact Statement (DEIS) on the subject [illegible]. [illegible] of the disposal options considered, the sea disposal option poses the greatest threat to human health and the environment.

PROBLEMS WITH SEA DISPOSAL

It appears that [illegible] will remain in the submarine [illegible] structures. [illegible] materials are contained in the pressure vessel walls and in the corrosive build up in the [illegible]. There are concerns that the long-lived radioisotopes, such as [illegible] and nickel-59, with half lives of 20,300 and 80,000 years respectively, may be released to the environment through corrosion of the hull and reactor bulkheads. L.20

Evidence does exist that radioisotopes undergo bioaccumulation in aquatic ecosystems. For example, [illegible] were reported to have concentrated [illegible] and phosphorus-32 [illegible] 100,000 in the Columbia River. However, the actual fate and effects of radionuclides [illegible] at this [illegible] subject and [illegible] additional information. L.37 J.12

It is recognized [illegible] (14,000-15,000 [illegible]) and approximately 160 miles offshore. However, there exist significant uncertainties concerning the physical and biological environment of the deep ocean and the behavior of radioactive elements in such environments. Consequently, the ocean disposal alternative poses an "unknown risk" to human health and marine life.

LAND DISPOSAL

Land disposal is not without risks. However, based on the existing information, it is preferable to sea disposal for the following reasons:

- Land disposal is far easier to control and monitor.
- Land disposal would minimize corrosion, the principle mechanism producing available radioactivity.
- Land disposal is not irretrievable and may be improved with advances in technology.

This Board considers the risks associated with sea disposal unacceptable, as well as the precedent setting nature of the use of the oceans as a dumpsite for radioactive wastes. Therefore, we urge the Department of the Navy not to adopt the ocean scuttling proposal and instead, adopt the land disposal alternative. L.9, F.8

We appreciate the opportunity to comment on this proposal. Should you have any questions regarding our concerns, please feel free to contact Victor Husbands, Director, Resource Management Agency, at (805) 654-2661.

Sincerely,

JOHN K. FLYNN, Chairman
Board of Supervisors

JKF:lra

cc: U. S. Senator Alan Cranston
U. S. Senator Pete Wilson
Congressman Robert Lagomarsino
Congresswoman Bobbi Fiedler
Senator Gary Hart
Assemblyman Thomas McClintock
Assemblyman Thomas O'Connell
Assemblywoman Cathie Wright
Michael Fischer, California Coastal Commission
Richard Charter, Coordinator for Local Government
City of Oxnard
City of Port Hueneme
City of Ventura

#546

Mary Langley Hague 26711 Ironwood Avenue Sunnymead, California 92388

May 9, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

I am writing in regard to the Draft Environmental Statement. I believe, that it is extremely ill-advised to consider dumping decommissioned nuclear submarines in our coastal waters.

The ocean environment is just as important to the welfare of all human beings as is that on land. Evidence indicates that eventually radioactive material, however well it might

L.36 be sealed and however distant from land, will make its way into the life cycle. Surely we have ample data on the detrimental effects of radiation to provide a rationale for permanent containment of all forms of radio activity.

I strongly urge that any consideration of burying these submarines at sea be permanently halted.

Sincerely,

Mary L Hague

Mary L. Hague

#547

May 6, 1983

Captain Wagner,

I would like to voice my strong disapproval of the proposed dumping of radioactive wastes off the California coastline. I realize, sir, that nuclear weapons must be used at this point in time as a deterrent against attack against our homeland, but at the same time, there is no point in strengthening our defense if, in the process, we destroy everything we are defending. I urge you to stop the radioactive dumping, not only for our nation's sake, but for the sake of the planet itself.

Appreciatively,

Joseph J. Grima

Joseph J. Grima

Joseph J. Grima
2160 Alameda
Redwood, CA 94061

#548

TOTAL ABOLITION

CALIFORNIA ANIMAL DEFENSE AND ANTI-VIVISECTION LEAGUE INCORPORATED

The Pioneer Society of the Pacific Coast
1551 W Redondo Beach Blvd., 1010
P.O. Box 3047
Gardena, Calif 90247 1247

Bay Area Representative
Mary Evelyn J. Davis
1615 Geary #302
San Francisco Calif 94121

Captain Edward T. Wagner
U.S. Navy
Office of Chief of Naval Operations
Department of the Navy
Washington, D.C.

Dear Captain Wagner:

We send a message: loud and clear! "No more ocean disposal for radio-active waste"! please.

We protest the Navy's plan to ocean dump over 100 decommissioned nuclear submarines off our California coast and the coast of North Carolina!

The U.S. Navy doesn't own the oceans, so kindly stop trying to destroy the peoples oceans!

Sincerely
Mrs. Mary Evelyn J. Davis

CALIF. ANIMAL DEFENSE
1615 GEARY, #302
SAN FRANCISCO, CA. 94121

5-8-83

#549

May 2, 1983

Dear Captain E. T. Wagner:

I am writing to express my concern about the ocean dumping proposal. I feel that it is unthinkable, we as a superior nation, would introduce pollutants to an already overtaxed & precarious ecological system. Maybe someone should explain to the public who appointed us "God" and think ahead to the problems of radioactive waste disposal when building them.

Sincerely,
Patricia Simonson

Patricia Simonson
626 W. Naomi Ave
Arcadia CA 91006

#550

5-6-'83

Dear Captain Wagner,

I am writing to protest the ocean dumping of decommissioned submarines. L.53 The potential economic hazards are enormous and the benefits are doubtful. Please reconsider your dumping plans.

Robert Gansowski
131 A Crescent Ave.
San Francisco CA 94110

#551

5-7-1983

Dear Capt. Wagner -

I am writing to express my concern about the dumping of nuclear powered submarines reactors in the ocean. Scientists have no conclusive proof of a margin of safety + tell us it may be hazardous for future environment. L.39

Sincerely, Marge Harburg

34 Hill Street
San Francisco, CA 94110

#552

P. O. Box 7297
Boulder, CO 80305

Captain Edward F. Wagner
U. S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

This letter is in response to the Draft Environmental Impact Statement for the ocean dumping of 100 decommissioned nuclear submarines off the California and North Carolina coasts.

I am totally against nuclear waste dumping in the ocean and believe this is one of the worst possible methods available for nuclear waste disposal. The following analogy should explain why.

When a business has valuables to guard, it is normally the practice to put these valuables in a safe, but highly visible place. For instance, supermarkets normally keep their safes in the front of the store where it is visible to everyone. The reason for this is that is that if a burglar were to break open the safe and steal the valuables, the burglar would be highly visible and everyone would know that the act was committed and who committed it. If the safe were kept in a place where only a few people knew of, it would also be the case that it would be much less likely for a burglary to be noticed.

Nuclear waste storage is very similar. Nuclear waste is a valuable, in the sense that if it is lost, i.e. it is leaked, it will be much more dangerous. Storing nuclear waste in the ocean is like keeping valuables in the back room where few if anyone will notice when the are gone until it is too late and the ocean has been contaminated. A more reasonable solution, it would then seem is to keep nuclear waste in a guarded and visible location where any leak would be immediately detected and cleaned up.

L.20

W.1

Sincerely,

Thomas H. Slone

#553

22727 Anza Avenue
Torrance, California 90505
May 12, 1983

Captain Edward Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I strongly oppose ocean disposal of radioactive wastes. The Navy's plan to ocean dump over 100 decommissioned nuclear submarines off the coast of California and North Carolina is very irresponsible and should be abandoned. Thank you for considering my views. I would like a response detailing your views, position, and intended action on this issue.

Sincerely,

Colleen Yawn

Colleen Yawn

#554

May 12, 1983

this letter is to voice my dissent of the plan to dump Nuclear submarines off the coast of Northern California!

Joann Joeckel

Joann Joeckel

Box 387

Ukiah CA

95482

#555

Dear Captain,

This letter concerns the Navy's irresponsible ocean disposal for radioactive wastes. The lives of us all are at stake if the Navy continues these acts.

L.14 The entire population of sea life is in danger with these toxic substances being dumped on them. Now that there is progress being made in saving these endangered animals of the sea, a new threat is being struck upon them. To kill off all of these beautiful creatures because of another form of man's egotistical ways is completely thoughtless and uncaring.

If you still don't give a damn about the suffering animals, think, then, about people. Man harvests the
L.36 ocean like he harvests land. Huge nets are used to get a food source for man. The fish that have to live with your toxic chemicals in their water ingest these wastes. People are then eating their own waste! The consequences of these wastes are birth defects and disease.

It is up to the Navy to have a conscience to think about the crimes being perpetrated against humanity by dumping toxic wastes in the ocean!

Sincerely,

FRANK MORELLO
2825 KNODE ST.
TORRANCE, CALIFORNIA
90501

#556

July-11-1983

Dear Sir,

I would like to take a few minutes of your time if possible. I am writing in regards to ocean disposal of radioactive wastes. This issue concerns me very much as I am sure it does you. The disposal of waste products today is very much an issue in all of our lives and a very troublesome one at that.

I realize the Navy is faced with a huge problem on disposing of the radioactive waste but ocean disposal is not now the solution. Please Sir, do not allow this to take place. Ocean disposal will eventually come back to haunt later generations of Americans if not our own. It is time we handled problems like these properly and not put them off creating larger burdens for future Americans. I would appreciate it very much if you said no to the Navy's plan to ocean dump over 100 decommissioned nuclear submarines off the coast of California and North Carolina. I can not at this time offer an alternative but I know this is not the answer. Thank you for your time

Sincerely

Homer F. Yates
2929 Albatross Way
Sacto. Ca 95815

770

#557

5-11-83

Dear Sirs:

NO More ocean disposal of radioactive wastes!

Who in the hell do ya think you guys are. You don't want the stuff in your front yard, well neither do I or my children. Take your nuclear problems + stick em.

Sincerely Philip m Lloyd + Family

#558

James W. Dearing

4456 Dee Court
Sacramento, CA 95841
(916) 487 5360

May 12, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Having grown up a military person, I know that responsibility has to begin somewhere.

The disposal of radioactive wastes is certainly a touchy matter, requiring well thought out decisions. The U.S. Navy has an opportunity to show itself as a responsible national leader by banning ocean dumping of radioactive wastes. Such a move would garner the Navy better public relations and stifle critics.

The prestige of the Navy and the integrity of our oceans can both be enhanced by halting the dumping of radioactive wastes. Why not seize the opportunity?

Thank you for your time,

Cordially,

Jim Dearing

Jim Dearing

#559

MAY 10, 83

DEAR SIRS

I DONE 30 YEARS IN UNCLE SAMS YACHT CLUB, AND I DONT KNOW WHAT HAS COME OVER THE OLD OUTFIT. THOSE OLD SUBS STILL HAVE A LOT OF SERVICE IN THEM, WHY DUMP THEM SO THE DUMB MAKE BELIVE SENETORS HAUSER + KEENE CAN SHOW OFF, HELL THEY WOULD SELL THERE OWN MOTHER FOR A VOTE. IN WORLD WAR 2 I MADE QUITE A FEW ISLANDS, NOBODY ON THEM, WHAT WOULD BE WRONG WITH SINKING A FEW AROUND THEM TAKE THEM DOWN 60 LEVEL OFF 55 PERISCOPE DEPTH. RUSSIAN SATTELITE'S COMING OVER WOULD WONDER WHAT THE HELL THE US NAVY SUB FORCE WAS DOING NOW, ACTIVE SUBS COULD SAIL BY AND WOLDEN SHOW UP SO YOU CAN SEE THOES OLD GALS ARE GOOD FOR ANOTHER 30 YERS. THE ONLY THING WOULD BE TO HAVE AS FEW PEOPLE AS POSSABLE IN ON THE DEAL, LIKE TOWING THEM OUT AND PLANTING THEM, THEN FORGET THEM. LET THE RUSSIAN DO THE WORRING G.3

I REMAIN

James S. Lanham

A.C.C. USN RETIRED

J. S. Lanham
1455 Peterson Lane
Santa Rosa, CA 95401

#560

2632 Diamond St.
S F , CA 94131

May 10, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNVA-22)
Dept. of the Navy
Washington D.C. 20350

Dear Captain Wagner:

I am very upset about the intentions of the Navy to dump obsolete nuclear subs in the ocean waters of Mendocino County. I am a biology graduate with a deep-sealed dread of radioactivity after intense study of its effects, but it seems the people in charge of its dispensation have the mental levels of 10 year olds playing with their fathers' 38's.

Radiation WILL EFFECT humans in the long run as it finds its way into the food chain. It is and has always been a Pandora's box since its inception, and the way radioactive materials are dealt with is irresponsible, lethally dangerous to the existence of life as we know it on the planet, and immature of grown men and women. L.36

Mendocino is a lucrative fishing and tourist area. It's waters harbor abundant and varied creatures that will most certainly have a very diminished chance of surviving this radioactivity in their habitats. Such creatures that do survive and find their way into the digestive processes of food animals and human beings will increase the carcinoma rates significantly. L.53

I urge you to go back to the drawing boards on how to get rid of the Navy's radioactive scrapped subs.

Sincerely,

Beverly H. Forbus

Beverly H. Forbus

772

#561

Dear Captain Wagner,

Oceans are increasingly becoming sinks into which are poured and dumped the posions and refuse of land, air, and ships. Every deadly material, however apparently minor, brings the oceans inexorably closer to an irreversible inability to sustain the life which a great multitude of this planet's populace depend on for their lives and their livlyhoods. Those who would contribute to this death, a far more awesome one then that which emptyed California's Cannery Row, will have forever consigned their memorie of themselves to the outer darkness of history.

It is a poor reflection of the brillance that created the modern U.S. Navy, that a safer more life-instinct oriented means has not been devised to dispose of 100 decommissioned nuclear submarines, then dumping them in the ocean.

Sincerely

J.C. Krieg

J.C. Krieg
812 ParkCenter Dr.
Santa Ana, California. 92705

May 9, 1983

Captain Edward J Wagner, U S Navy
Office of the Chief of Naval Operations

Dear Captain Wagner,

Although I did not send in to
your office for a DEIS on Ocean
dumping of radioactive wastes, I
understand that the comment period
has been extended to June 30. And so
I wish to comment.

The oceans are the nurseries of
nature. Dr. Paul Erlich of Stanford
University has said that when the
oceans of the world go, "that's it." Since
it is virtually impossible to safely
L.20 contain radio-active material, therefore,
it is in no way wise to take a
chance on putting old nuclear sub-
marines into the oceans off California
and North Carolina. When they start
L.14 to leak, it will adversely affect
the fish, the biological life on the L.14
ocean bottom, the resultant food chain, L.36
and the water quality – which will
eventually reach inland territories T.17
in the form of rain.

I understand that if the subs
are simply put into dry dock the
nuclear power in them will dissipate H.3
within fifty or sixty years.

In view of the above, I would
recommend that the ditching of subs
at sea be abandoned.

Sincerely yours,

Frances Dollar
6000 Coldwater Canyon #1
North Hollywood, Calif. 91606

#562

#563

Dear Capt Wagner,

Put your atomic submarines in the big desert where they will do no harm. Do not dump them in the ocean to pollute.

Thank you,
Hazel M. [illegible]
PO Box 3678
Clearlake, Ca
95422

#564

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
Department of the Navy
(OPNAV-[illegible])
Washington, D.C.

Jill S. Gregory
2? Truman Drive
Novato, California 94947
[illegible]

Dear Sir:

I am writing to inform you of my anger that the Navy is seeking to dump over one hundred decommissioned nuclear submarines off the coasts of California and North Caroline. This is a completely irresponsible and reprehensible plan of disposal! How dare the United States Navy endanger our own citizens by throwing more radiation into the oceans off from our own shores! If some other country dump radiation off our coast, we would consider it a threat. It appalls me that this method of "disposal" can even be seriously considered. Please seek another way!

[illegible]

#565

CARL STUEBNER
3134 Occidental Dr, Apt. 67
Sacramento, Ca 95826
(916) 381-5130

May 11, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations (PONAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner.

I recently offered a suggestion to Govenor Deukmejian in the controversy surrounding the disposal of the obsolete nuclear subs. The Deputy Director of the Environmental Health Division, of the State of California, Harvey F. Collins, Ph.d., recommended I send my suggestion to you.

L.52 Of course, my knowledge of submarines is very limited. I assumed, and Dr. Collins, confirmed, the residual radioactivity is in the support structure, and the reactor pressure vessel. I suggested these would be coated with a thin lead coating. Then the space between the inner and outer hulls, around this compartment, be filled with concrese. Then the whole compartment would also be filled with concrete. This concrete would be impregnated with such substances as graphite, and barium-or whatever.

I'm fairly certain the amount of radiation escaping would be negligible. Furthermore, even if the whole hull were to corrode,-which, I'm sure, is highly unlikely-the concrete section,certainly, would not.

To carry my suggestion one step farther, I think all nuclear wastes-whether dumped in the ground, or the ocean, should be put in~~[illegible]~~ ~~[illegible]~~ reinforced plastic containers. These would then be coated with lead and, in turn, placed in containers fabricated from concrete, (the kind suggested above.)

I hope my suggestions will prove of some help.

Sincerely,

Carl Stuebner

776

#566

To: Capt Edward F. Wagner
Office of Naval Operations

10 May 83

Dear Sir,

I am very concerned with the Navy's choice of disposing with Atomic Submarines in our coastal waters.

Being a Honorably Discharged U.S. Marine serial number 2065813, from 1963-1969, and a proud American, I am not anti-military, but I'm very concerned.

I feel that I must go on record and let you know how I feel.

I don't believe that one small group of people have the right to endanger the people of the U.S., or their future generation, by sinking Atomic Submarines in our coastal waters.

There must be a better way to dispose of these history making ships, possibly even a profitable means of disposal.

Please consider the long term effects, ~~of~~ your disposal plans for this countries Atomic war ships.

There has to be a better way, I hope.

Thank you for your time.

Sincerely Yours

Gary J Jones
357 Devonshire Blvd
San Carlos Ca
94070

Gary & Elke Jones
357 Devonshire Blvd.
San Carlos, CA 94070

#567

7 May 1983

Captain Edward F. Wagner
U.S. Navy
OPNAV-22
Department of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

It seems to me that the mission of the U.S. Navy is to protect the citizens of the United States. For the most part, it is hard to find instances where the Navy has not lived up to this fundamental commitment.

So why is the Navy proposing to scrap dozens of NAUTILUS class submarines in the ocean? I think that this is a subversion of your mission. As far as the ecological soup is concerned, there are no free lunches -- I believe this cliche. Surely there is a better way to solve this disposal problem.

Sincerely yours,

Lynn M. Peterson

Fred E. Peterson

Fred E. Peterson
953 The Alameda
Berkeley, CA 94707

#568

Dear Sir: May 7, 1983.

Ocean dumping of radioactive waste is irresponsible - the threat to marine wildlife and the possible contamination of all strata of life calls for a stop to such action. L.14 L.36

(Mrs.) Violet Soo-Hoo
Mr. Carroll Soo-Hoo
(Mrs.) Viola Howard.

#569

208 Eden Terrace
Winston-Salem, NC 27103

8 May 1983

Captain Edward F. Wagner
Office of the Chief of Naval operations
OPNAV - 22
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I am concerned about many aspects of the Department of the Navy's
Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled
Naval Submarine Reactor Plants. First of all, I feel that the oceans
should not be fooled around with. We just do not know enough about
L.1 the complex ecological interactions which occur there

Secondly, as I understand it, federal law prohibits dumping of irretrievable
W.1 nuclear waste in the ocean. Since the DEIS essentially states that
the submarines will be irretrievable. I don't see how the Navy
can even consider dumping them in the oceans. The statement in
the DEIS declaring that if problems result from the first submarine
dumping the second will not be dumped is not very encouraging
Considering the quality of the proposed monitoring plan it
L.21 is doubtful that significant damage to the oceans would not
be discovered until after the third, fourth or fifth submarines
had been dumped.

Finally, there are international implications to dumping submarines
in the ocean. As I understand the situation, many countries
are watching for a renewal of U.S. nuclear waste ocean
F.8 dumping to begin their own ocean nuclear waste dumping
programs. Considering the information presented in the DEIS, I
feel the land disposal option would be a much safer
course to follow than the ocean disposal plan.

Sincerely, Mike Landen

#570

Soroptimist International Mendocino-Sonoma Coast

Box 654
Pt Arena, CA 95468

May 4,1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C.
20350

Dear Captain Wagner,

Soroptimist International of the Americas, Inc. is one of four federations composing the largest women's classified service organization in the world. We consist of over 70,000 women strong in 2,200 clubs situated in over 72 countries.

Soroptimist International of Mendocino-Sonoma Coast, Inc. opposes the disposal of nuclear submarine reactor plants off the Mendocino coast as proposed in the Navy Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants published December 1982. Our main reasons are:

1) Extensive possibilities of pollution J.76
2) Insufficient on site monitoring proposals W.1
3) Nonretrievability of reactor plants L.36
4) Impact on food chain
5) Buildup of artificial reef L.55

We urge you to reevaluate this Environmental Impact statement and pursue other alternatives, such as land sites which would contain the waste with minor deterioration that can be easily renovated and diminish the threat of extensive pollution to food and water supplies.

We believe this issue to be of the highest priority in regards to our daily environment.

Very Truly Yours,

Molly Randall

Molly Randall, President

mam/MR

#571

Walter Dodds
Department of Biology
University of Oregon
Eugene Oregon
97403

Dear Captain Wagner,

Regarding the Navy's Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. In the draft, D-5, it is stated that a successful sinking procedure had been developed using an obsolete diesel submarine. I do not feel that one submarine which broke in half represents accurate enough data on the safty of the procedure. If anything, the data presented makes me believe that the assumption (Dose Commitment Estimates, J-3) that only one submarine in 100 which are sunk at the disposal site will have its containment penetrated is optomistic, not conservative. I would suggest more testing of sinking procedures, and that your estimate of containment penetration upon sinking should be raised. F.19, L.57

I also feel that the section which dealt with selection of disposal sites should include a survey for hydrothermal activity since such activity could hasten the penetration of the reaction vessel by corrosionspeeded by the elevated temperature. Furthermore such areas have higher biological productivity than you have assumed in your dose commitment estimates, and entry to the food web at this point could represent a greater translation of radioisotopes to human populations. J.24

Thank you for your time.

Sincerely,
Walter Dodds
Walter Dodds

#572

2120 Royall Drive
Winston-Salem, North Carolina 27106
10 May 1983

Captain Edward P. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

We are writing to oppose the Navy plan to dispose of radioactive submarines by burying them in the ocean off of the North Carolina coast. We think that the plan is a serious disservice to the people of North Carolina and America and hope that you will reconsider. L.20,

We are not scientists, but we know enough to realize that putting a corroding, radioactive hunk of metal in the ocean, where radiation will surely become a part of the food chain, is rash foolishness. The Navy doesn't seem to have any plan for monitoring the submarines once buried, nor does it have any way to retrieve them if there are problems. We think that your primary consideration is not safety, but disposal, even in an untested, unsafe manner. L.36 J.76 W.1 N.3

We are paying for these submarines to protect us. Now you are telling us that, to save money, they have to be buried in our ocean. It is ironic that we may all be poisoned by our friends, the Navy, long before we are killed by invading Russians.

Sincerely,

Edgar D. Christman
Edgar D. Christman

Jean S. Christman
Jean S. Christman

780

#573

8th May 83.

To Captain Edward F. Wegner!
Dear Sir, I am writing this important letter about
the plan of the navy, to dump 100 decommissioned
nuclear submarines off the coast of California and North-
L.20 Carolina. Once this subs start leaking, nobody can't
W.1 stop it, like in the case of the Farralon - Island
dumps of the 50'ties. It is utterly irresponsible
to deliberately putting more radiation in our Ocean.
The armed Forces are a Government responsibility
and the Government is the one that has to despose
of the waste in a safe manner and that is put it in
H.2 the ground deep, incased in Cement in the moun-
tains, not in the ocean. Sure it cost more, but
N.3 that preventing is an cancer and other related deceases
like they have in Japan from Ocean dumping,
like this.

What "short-sighted mentality" could treat
the oceans of the world as open sewers.
No more dumping of toxins in our precious Oceans.

Sincerely
Louise Ewens

LOUISE EWENS
57 MEADOW AVENUE
SAN RAFAEL, CAL.
94901

#574

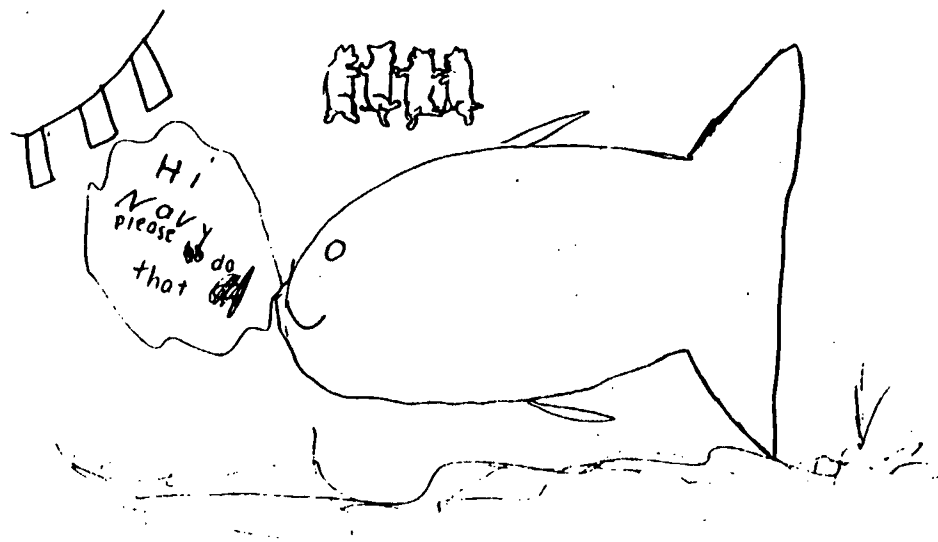
Dear Captain Wagner:

The sea is the worst concievable place to dump nuclear waste! Science
has shown that the depths of the ocean are
not biological and non circulating benthic deserts,
but quite the contrary have storms and circulate S.35
vast amounts of sediment. Your plan to dump
subs in the sea is an environmental and ecological
disaster. Stop this insanity - protect the future. Show
concern for the future ~~of~~ our children - please!! Ron Good

#575

May 9, 1983
Dear Captin Wagner
I talket to a fish a few deys ago it Said that all the fish hade a meeting as Soon as they found out what you wanted to do to their beatiful Ocean
they decided to tell Some One to write a letter to the Navy and say you Should not put old atomic reactors into the ocean you Should dig a big big houle in the ground and Keep everybody 3000 miles a way from it Love Shona and the fish

Shona Friedman
P.O. Box 1245
Mendocino, Ca
95460



#576

May 14, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

OCEAN DISPOSAL OF RADIOACTIVE WASTES MUST BE STOPPED!

I was appalled to hear of the plan to ocean dump over 100 decommissioned nuclear submarines off the coast of California and North Carolina.

The oceans are in enough trouble already. How can the Navy be so irresponsible in wanting to contribute to the environmental devolution? YOU CREATED THESE NUCLEAR SUBMARINES; TAKE RESPONSIBILITY FOR THEM AND DON'T CONTRIBUTE TO THE DEATH OF OUR EARTH!

STOP RADIOACTIVE OCEAN DUMPING!

Sincerely,

Patricia E. Sills

Patricia E. Sills

P. Sills
14760 Runnymede St.
Van Nuys, CA 91405

#577

5/13

Captain E. Wagner
US Navy
Wash DC

Please - use your influence to stop the disposal of Radioactive wastes that are a menace to our environment.

For the sake of our future, find an alternative! Now!

Jane Heagney
Calif.

JANE HEAGNEY
745 MOUNTAIN VIEW
MONROVIA CA 91016

#578

May 16, 1983

Dear Captain Wagner,

I am using this opportunity to plead with you to closely examine your own point of view about disposal of nuclear materials. Can all of us "internationally" go on endlessly contributing large quantities of nuclear wastes to our backyards and oceans?

I think being heavily immersed in the military life - it is comprehensible to get to the place in your job that you are doing the best that you can -- and realistically if you quit there are endless others who would be willing to take your place. Such is the way of the world for most heinous jobs.

I have many friends and acquaintances who work for Mare Island Naval Shipyard in Vallejo, California. Several, to most of them are not "pro-nuke" but just getting a good paycheck. "It's a job," says most.

Yet, the point of my letter is to please stop any plans of ocean dumping of decommissioned submarines off the coasts of California and North Carolina.

Must this nuclear madness go on and on? I feel we need submarine (power), but I definitely question the increase of larger numbers of nuclear subs. Again, do not pollute our oceans with radioactive submarines! Life is too valuable!

Sincerely,

Hermine Spitz
2194 Shurtleff Ave.
Napa, Calif. 94558
(schoolteacher)

#579

5/17/83
243 Caselli Ave.
San Francisco, Ca 94114

Dear Capt. Wagner,

I am writing to express my opposition to the US Navy's current plan to dispose over one hundred decommissioned nuclear submarines by dumping them into the oceans.

I fully support the feelings of Greenpeace that it is entirely irresponsible to use our oceans as toilet bowls for our wastes.

Please give this your greatest consideration.

Sincerely,
James M Miller

#580

5-14-83

DEAR CAPTAIN WAGNER

I RECENTLY HEARD ABOUT THE NAVY'S PLAN TO DISPOSE OF DECOMMISSIONED NUCLEAR SUBS BY SINKING THEM AT SEA. THIS IS A VERY POOR PLAN. LEAKAGE OF RADIOACTIVE WASTES FROM THESE SUNKEN VESSELS WILL INEVITABLY OCCUR WITH TIME. L.20

WHILE DISPOSAL AT SEA MAY REPRESENT THE MOST EXPEDITIOUS MEANS, I, FOR ONE, AM NOT WILLING TO SEE OUR OCEANIC FOOD CHAINS POISONED IN FUTURE YEARS. L.36

PLEASE KEEP ME INFORMED ON THE STATUS OF THIS DISPOSAL PLAN.

JOHN BLACK

MOTOROLA INC.
John Black
Manager
Microsystems Systems & Technology
MOS Integrated Circuits Group
2900 South Diablo Way Tempe Arizona 85282
P O Box 2953 Phoenix Arizona 85062
(602) 829 3009 MD DW196 DiTel 238 3009

JOHN BLACK
3407 E HUBBELL
PHOENIX ARIZ
85008

#581

Dear Captain Wagner -

I wish to express my alarm and concern regarding ocean dumping of radio active waste.

I strongly urge you to help stop this dumping now.

Sincerely,

Susan S Moschetti

Scottsdale, Az

#582

Captain Edward F. Wagner
U.S. Navy
Office of the chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

May 17, 1983

Dear Sir:

I am writing to protest the Navy's plan to ocean dump over 100 decommissioned nuclear submarines off the coast of California and North Carolina!! This is unthinkable!! What are you trying to do? I am appalled at the idea of the seas becoming a garbage dump for radioactive and toxic wastes! All life ultimately comes from the sea, and our food, air, and water cycles are all linked irrevocably with the sea's "health".

Ocean dumping is not a viable alternative to land disposal of wastes!! It will not "simply go away"!! There is no justification for such an irresponsible plan for deliberately putting more radiation in our oceans! Waste disposal is a problem that should have been dealt with + solved before the wastes were generated!!! I think the whole thing has been handled and tossed about in a very careless manner, and I am totally disgusted. NO MORE OCEAN DISPOSAL FOR RADIOACTIVE WASTES!!

Bobbie / Sam Daniels
Rt. 1, Box 562
Blowing Rock, N.C.
28605

#583

Captain Wagner,

I am opposed to the Navy's irresponsible plan for deliberately putting more radiation in our oceans. No more ocean disposal for radioactive wastes.!

Sincerely,

Jessica Hawks

#584

May 14, 1983
3660 Holly Oak Way
Santa Rosa, Calif
95404

Captain Edward Wagner:

I am writing this letter to protest the Navy's plans to dump at sea, their decommissioned nuclear subs. This is insane! Any normal person with common sense will tell you this. Please, consider the future and our environment. Once this irresponsible act is done it cannot be undone at any price at any time by anyone. W.1

Thankyou.

Sincerely,

Gary E. James

#585

75 Old Pasture Road
Cohasset, MA 02025

May 16, 1983

Mr. Christopher Roosevelt, President
The Oceanic Society
Magee Avenue
Stamford, CT 06902

Dear Mr. Roosevelt:

Thank you for sending a copy of your draft report on disposal of decommissioned nuclear submarines.

Considering the natural sources of radioactivity in sea water, and the extremely slow process of leaching radioactive materials from submarine parts, the Society's concern seems misplaced.

I abhor the anti-nuclear bias of the Council on Economic Quality, of the Council on Economic Priorities, and of others of that ilk. Science should not be perverted to serve the socio/political views of their leaders.

Yours truly,

R. M. Campbell

R. M. Campbell

Copy to Oceanic Society Committee member.

#586

78 San Carlos St.
S.F. CA 94110
May 17, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operation
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Please stop preparing to dump submarines at sea. Listen to the 1970 report on dumping by the Council on Environmental Quality. Heed the Anderson Amendment to the gas tax bill, banning ocean nuclear waste dumping for two years. Give ear to the resolution at the London Dumping Convention calling for suspension of nuclear waste dumping until the many questions of environmental safety are answered. | F.12 | F.2

We don't want nuclear waste in the ocean, air, or land. Dumping is a risk we don't want around. This is the only earth we've got.

Timothy Wilson

#587

Captain Edward Wagner
U S Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept of the Navy
Washington, D C. 20350

May 17, 1983

Dear Captain Wagner,

L.53, L.36 I am asking you to halt the dumping of radioactive submarines in the ocean. This is a very irresponsible plan and endangers us all. Peoples livelihoods, food sources and our most valuable resource is being severely threatened.

Please make a plan we can all live with. This is also your ocean and your children need it too.

Sincerely
Peter C Blackford LVN
6014 Bloomfield Rd
Petaluma, Ca 94952

PS Protect me, please. Protect the ocean.

P. Blackford
6014 Bloomfield Rd
Petaluma, Ca 94952

#588

May 17, 1983

Subsidies for ocean incineration and the disposal of toxic and/or radiation materials as well as obsolete nuclear equipment should be applied to programs that reduce, reuse or recycle hazardous wastes rather than the irresponsible disposal methods of ocean dumping or incineration on the seas. Help keep our air, land and oceans pure for this and for future generations!

Boys Town
NEBRASKA 1983

[illegible signature]
[illegible address]
[illegible] Calif 90247

#589

5/18/83

Captain F. Wagner
U.S. Navy

STOP

RADIOACTIVE
WASTE
DUMPING
NOW
Please!!

DONNA HOUPT
Los Angeles, CA

So your kids can live and enjoy our beautiful oceans + environment

#590

654 Carolina
San Francisco, CA 94107
17 May 83

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV - 22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I have been reading about the Navy's plan to scuttle old nuclear submarines off the North Carolina and California coasts. I feel very strongly that this is a short-sighted and foolish answer to the problem of nuclear waste disposal and that the whole world will pay a price in increasing mutation and cancer rates if we adopt a policy that is sure to poison the oceans and their food chains. | L.36

While alternate disposal methods that are safe and cost effective may not presently be available, they may be developed in the near future as increasing need prompts increased research and development. These submarines and other sources of spent nuclear fuel can sit awhile longer waiting for that day. Please don't allow the seemingly simple expediency of open ocean dumping to prostitute this country's commitment to maintaining the integrity of our planet's seas. | A.16

Sincerely yours,

B.D. Wapen, MD

790

#591

5-18-83

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington D.C. 20350

Captain Edward Wagner,

L.36 | Allow no more ocean disposal of radioactive wastes!! Given the biological food chain and the ocean as a whole system, I don't want the subs dumped in any waters! The "low-level radiation" from the subs in the ocean ecosystem will have a harmful impact, plus the combined effects of all ocean polluting! Do not dispose of these subs in the ocean!!!

Sincerely
Debbie L Roberts
Debbie Roberts
3385 Santa Paula Dr
Concord Ca 94520

Debbie Roberts
1611 Frisbie Ct #6
Concord, Ca 94518

#592

5/16/83

K. Saltwedell
1552 Armacost Ave. Apt. #8
W. Los Angeles, CA 90025

Dear Capt. Edward Wagner,

As a California resident I strongly oppose the Navy's proposal to dump decommissioned nuclear submarines off of our coast. I oppose dumping them in any ocean.

Our oceans are becoming increasingly polluted by industry and the effects of man's farming and industrial practices on the land. We have an invaluable resource in the sea, which has barely yet been understood, and it would be a shame if it was spoiled before we can explore it further.

The problem ultimately, as with all nuclear materials is where can we dispose of it safely. It is unfortunate that through necessity and choice we proceed along without having an answer.

I urge you to find another solution, other than ocean dumping.

Sincerely,

Kathy Saltwedell

#593

Radiation Awareness
Box 81
Folly Beach, S.C. 29439
May 17, 1983

Captain Edward F. Wagner
U. S. Navy
Office of Chief Naval Operations
Washington, D.C. 20350

Dear Captain Wagner:

I would like to comment on the Navy's Draft Environmental Impact Statement on the disposal of decommissioned defueled Naval Submarine reactor plants.

I, and a number of other South Carolinians feel this DEIS is inadequate and fails to address many factors which may significantly effect human health in the near future.

W.1 A major reason for seeing the sea disposal option as unworkable, is the inability of the Navy to ever retrieve these submarines from the ocean floor, should they become a serious source of radioactivity. This one factor alone is more than sufficient cause to abandon the sea disposal plan. In addition to
L.1 this, the present lack of detailed knowledge about many aspects of deep sea ecology demonstrates that more research is needed to fully assess the impact of this ocean disposal plan.

There are a number of other serious flaws and ommissions of critical factors in this DEIS. No assessment is made of the potential pathways through which
L.36 radioactivity could enter the marine environment and ultimately effect human health. Although studies done for the United States Environmental Protection Agency have shown the existance of pathways for radioactivity to migrate from
U.9, L.36 low-level radioactive waste into rattail fish (Schell and Nevissi), the DEIS does not address the probabilities of this migration into the food chain.

L.55 Also the chances of "the artificial reef effect" occuring is not taken into consideration. The fact that this reef effect could speed up the amout of time it took for this radioactivity to effect man's health, is reason enough for further evaluation and study of the "artificial reef effect" in a revised EIS.

L.7 There is also a lack of research into the cumulative impacts of increasing the radioactivity available to the marine environment. There is a need to develop
L.6 a comprehensive register of all past, present and potential sources of radioactivity, and a study of the ocean's ability to assimilate these substances without irreversiable damage.

J.76 Another deficiency in the DEIS is an inadequate monitoring program, which would fail to measure any long-term releasesof radioactivity to the marine environment.

The alternatives to sea disposal are not adequately considered in this DEIS. The land disposal option needs more in-depth examination, and there should be a comparison of the estimated time periods until release of radioactivity to the environment, for these options.

We urge the Navy to abandon the sea disposal plan in light of the above-stated problems and inadequacies. We urge an examination into other alternatives,

such as land burial of the reactor plant in open trenches in an arid environment, and/or burial in a deep-mined repository. H.3, H.2

I would appreciate being notified of the date, time and place of the final EIS public hearing.

Sincerely,

Janet T. Orselli

Janet T. Orselli
Research Consultant

#594

Dear Captian Wagner,

I would like to be counted as one who is opposed to the ocean dumping of radioactive subs, or any other radioactive wastes.

It would seem to me that someone in the Navy would have more respect for the ocean than that.

Thank you,

Francine Morris

Francine Morris
1620 York Drive
Vista, Ca. 92083

#595

ROBERT T. BAYARD, PH. D. JEAN BAYARD, PH. D.
160 SARATOGA AVE., SUITE 50
SANTA CLARA, CA 95050
PHONE 446-2423
CLINICAL PSYCHOLOGY

May 14, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

As a citizen of the United States and a resident of the State of California, I respectfully protest the Navy's proposal to dump nuclear submarines off the California and North Carolina coasts. I believe the Navy's mandate is to care for and protect the ocean rather than to abuse it, and--if we think of the ocean as "belonging" to anyone, is it not to the citizens of our country? I believe the Navy should be concerned to care for and protect those citizens too, not further pollute their environment by dumping radioactive submarines into their waters. Please do what you can to prevent any such dumping until our government figures out some better way of dealing with radioactive wastes!

Very sincerely yours,

J. Bayard

Jean Bayard

#596

MAY 17-83

MR. S.G TROMBA
2120 GAITHER ST
SELMA, CALIF 93662

(1)

MY DEAR CAPTAIN WAGNER,

HOPE YOU ARE WELL. I AM FINE.

CAPTAIN WAGNER, I AM WRITING TO YOU, TO ASK YOU PLEASE IN THE NAME OF HUMANITY STOP THE DUMPING OF RADIO ACTIVE — WASTES IN OUR BEAUTIFUL OCEANS, THEY ARE NOT DUMPS. OCEANS HAVE THOUSANDS OF DIFFERENT LIVINGS KINDS OF FISH. WE ARE DESTROYING OURSELVES ON THIS PLANET WHEN THE OCEANS GET POLLUTED. WHEN THE OCEANS GO THAT WILL BE THE END OF HUMANITY I AM SURE YOU REALIZE THIS. PLEASE DO WITHIN YOUR AUTHORITY TO HELP STOP THIS INSANITY. THIS PLANET IS OUR HOME, (YOURS AND MINE.) WHY POLLUTE IT? WOULD YOU POLLUTE YOUR OWN HOUSE BY DUMPING RADIO ACTIVE WASTES? NO YOU WOULD NOT. WELL THIS PLANET EARTH IS OUR HOUSE WITH WHICH YOUR PRIVATE HOME IS ON. IT IS ALL TIED TOGETHER WITH ONE →

(2)

CAPTAIN WAGNER, WHAT WE ARE DOING IS DAMAGING NATURE BECAUSE WE ARE LITTERING. THE LAW SAYS LITTERING ON STREETS, PARKS, HIGHWAYS SIDEWALKS, ANYWHERE IS WRONG AND IT IS POLLUTING OUR - ENVIRONMENT. SO IT IS WITH THE OCEANS: WE ARE LITTERING IN THE OCEAN WITH POISONS. THINK OF IT PLEASE WHAT WE ARE DOING. HAVE WE ALL GONE ALL MAD AND INSANE? WE NEED THE OCEAN FOR OUR SURVIVAL. THE OCEAN IS VULNERABLE TO OVERLOAD, DETERIORATION AND BREAKDOWN SOON, WITH THE DUMPING OF RADIO ACTIVE WASTES. AS YOU CAN SEE CAPTAIN WAGNER I HAVE ENCLOSED WITH THIS LETTER AN ARTICLE BY THOMAS W. WILSON, JR → CALLED, "THE FOUR FRONTIERS OF GLOBAL SECURITY." READ IT WELL CAPTAIN WAGNER. THANK YOU. I WANT TO SAY I AM A MAN 60 YEARS OF AGE →

794

#596 (Cont)

(3)

I HAVE SEEN MUCH IN MY LIFETIME BUT WE ARE GETTING NATURE TO ITS BREAKING POINT. WE ARE NOT GIVING IT TIME TO CLEANSE ITSELF. WE ARE OVERLOADING HER WITH POISONS EVERYWHERE OUR SOIL AIR AND OCEANS. WE WILL PAY FOR IT WITH OUR LIVES AND HEALTH AND WITH THE BREAKDOWN OF THE PLANET. THANK YOU.

PLEASE LET US STOP ACTING IRRESPONSIBLE. WRITE ME PLEASE.

YOUR FRIEND

FOR A CLEAN HOUSE TO LIVE IN, ON (OUR PLANET EARTH)

S. G. Tromba

The Medical Aspects of Nuclear War

This topic is being discussed by the country's leading experts on nuclear war in a series of national symposia entitled "The Medical Consequences of Nuclear Weapons and Nuclear War," organized by Physicians for Social Responsibility, Inc. The following message summarizes the findings of the symposia. PSR has sent this information to world leaders, including President Reagan and Chairman Brezhnev.

PSR

#596 (Cont)

PAGE 1 PAGE 2

THE FOUR FRONTIERS OF GLOBAL SECURITY

THOMAS W. WILSON, JR.

THE FRONTIER of national security today is fundamentally a conceptual problem. The question is whether we can expand our concept of the national interest to include the integrity of the global systems that sustain human society and life itself. Can we not perceive that there can be no security for any nation if the planet itself is at risk? And that world security has become the precondition for national defense? Surely the point of departure for a modern defense policy is an understanding that national security is conceivable in these latter years of the twentieth century only within the framework of a wider world security.

There are four strategic frontiers of world security that must be defended if we are to retain even a potential capacity to cope with many of the most dangerous world problems of the 1980s and 1990s. Each of these frontiers is threatened increasingly. None is adequately protected as of today. Indeed, national governments do not even seem to be aware of some of the gravest perils to world security on the contemporary scene. These are the four frontiers.

First, the strategic systems of the natural biosphere. These are the basic biological systems that, over the millennia, created conditions favorable to life on earth—and that ever since have nourished the only life we know to exist in the cosmos: the croplands, the pasturelands, the forests and the fisheries. These are the master strategic systems of a living planet; without them, nothing survives.

And there is no doubt that these strategic systems are vulnerable and subject to impairment; no doubt that their integrity is threatened increasingly by the rising impact of human activities; no doubt that, as things stand today, these planetary systems already are deteriorating on a global scale, and there is no doubt that the world at large is neglecting the security of this global frontier.

Governments simply have not yet perceived the connection between their national security and the viability of global strategic systems. Yet the point is supremely simple and straightforward: no nation—no people—can ever be secure within their political borders if the planet as a whole is physically insecure. Nothing very difficult or complex about that.

Second, there is the strategic frontier of critical services in the artificial, man-made environment or, as it is sometimes called, the technosphere. These are the vital technological systems and supporting services and institutions that make it possible for the tribes of mankind to communicate with each other, to travel far and quickly, to navigate safely, to engage in commerce, to keep accounts, to deal with endless minor conflicts, to exchange knowledge, data and technology, to take part in thousands of meetings for as many purposes around the globe, year in and year out—in brief, to cope with the multifarious and complex daily affairs of an interdependent contemporary world with an increasingly differentiated division of labor.

These socially created systems, like the natural systems of the biosphere, are globally integrated and provide a vital metabolism for the international society of nations. And, like biological systems, they are vulnerable to overload, deterioration and breakdown. They also are subject to physical attack and to political sabotage. It is simply impossible to envision world security without an elaborate system of reliable global utilities and services—all requiring international agreement, international cooperation and international organization.

Again, the point is simple. The modern world would grind to a crashing stop without a functioning network of reliable global services. And again, governments seem unaware of these crucial services as an essential frontier of a workable world security system. This seems especially curious in the case of the major powers—for they are much more dependent than others upon the reliability of critical global services, and hence are much more vulnerable in the event of malfunction, paralysis or collapse of the systems.

The third frontier involves the security of the global commons, where it is essential to have agreed-upon rules of conduct if chaos and conflict are to be contained. These commons are the great shared resources of the oceans, the atmosphere, outer space and the polar continent of Antarctica.

As things stand now, we have a treaty reserving Antarctica for cooperative scientific research, but it will expire before long and there have been some threats of a return to conflicting national claims and free-for-all exploitation of marine and other resources; we have a treaty reserving outer space for peaceful uses, but this has not prevented a creeping militarization of that global domain; we have a treaty designating the surface of the moon as the common heritage of mankind, but it may not be ratified by key countries; and we may or may not have a treaty for the rational management of the global ocean systems after more than seven years of complex and tedious negotiations.

In brief, the security outlook for the global commons is anything but encouraging. Yet these dangers are given little or no weight in debates about national security or in the allocation of resources to national defense.

The fourth and final frontier for world security is a basic capacity for political action on priority issues at the world level. This, of course, is the very heart of a workable system of world security—for without the ability to make decisions about matters beyond national jurisdiction, it manifestly would be impossible to do anything at all about the security of the strategic planetary systems or the critical global services or the endangered global commons—which together sustain the biosphere and the technosphere alike, the living systems and the man-made systems that constitute the human environment.

It is perfectly obvious that there can be no world security without the political capacity to cope with an agenda of inherently transnational problems that will not take care of themselves and will not oblige us by going away—no matter how hard we may try to ignore them. To be secure we have to be able to exist in peace, and to exist in peace we have to be able to cope with our most urgent and threatening problems. Without that, disintegrative forces take charge of events and drag the world toward that unmarked but fateful threshold between a state of peace and a state of war.

Today there is evidence on all sides that our political capacity for coping with contemporary problems is seriously strained—to put it very mildly. Almost every national government in the world is in trouble today—regardless of its ideological beliefs, social structure, economic system, stage of development or length of experience. On the international level we are facing something close to a pervasive political paralysis—along the East-West axis and the North-South axis as well.

This paralysis in political systems is deadly dangerous. It is all too likely to lead to political polarization. And when issues become polarized, the next stage is almost certain to be the outbreak of violence. How much evidence do we need of the progression from paralysis to polarization to mindless violence—what with Ireland, Lebanon, Iran, Cambodia, Ethiopia and El Salvador staring us in the face?

World security is threatened, then, on all four frontiers: the biospheric strategic systems that sustain all life, the critical services that sustain international society, the global commons beyond national jurisdiction, and the political systems that underlie any capacity for action on the other frontiers of world security.

IF ONE STILL has to ask what all this has to do with the national security of the United States, it is because the subject of national security has been isolated, fenced off in a special compartment of thought, belief and action. And this artificial and arbitrary separation of perceptions of security from perceptions of political, social and strategic realities in the world today has deceptive and dangerous results.

First, we fail to see that demographic, economic and environmental world trends have combined in recent years to create a qualitatively distinct class of unavoidable world-level problems that are virtually unknown to traditional diplomacy, that are beyond the reach of national governments, that cannot be fitted into perceived traditions of international relations, that cannot be wished away, that are coming increasingly to dominate world affairs, that have powerful implications for national security and that are indifferent to military force.

Second, more specifically, we fail to identify the security significance of direct threats to the strategic natural systems of planet Earth or to the vital man-made systems that sustain the interdependent society of nations.

Third, we fail to see that political paralysis is a threat to security—because paralysis leads to polarization, which leads to violence, which is all too likely to have international dimensions difficult to foresee and even more difficult to control.

Finally, by keeping our perceptions of security isolated from the political, social and strategic conditions of the real world, we limit our concepts of the national interest and of national security to a perilously narrow military base.

This is doubly perilous. On the one hand, nonmilitary threats to national security are on the rise. On the other hand, even a casual inspection of the recent record brings to light some hard questions about relevance of military force to real-world problems and conditions in the 1980s and beyond.

- In the last two wars we have fought, our most powerful military weapons have remained in their arsenals because the United States could not find an acceptable way to use them.
- In Iran, the weapon used to destroy a regime holding all the cards of conventional military and police power was a general strike.
- For the past several years, the economically and technologically most powerful nations in the world have been staring down the barrel of something known as an "oil weapon" wielded by a group of nations of almost insignificant military capability.
- Remote desert sheikdoms, without benefit of a single aircraft carrier among them, have the power today to make major nations sit up and take notice.
- After six years of strenuous effort the United States was unable to produce a military victory in Indochina, the Chinese attempt to "teach a lesson" to Vietnam was costly and inconclusive, and the modern military might of the Soviet Union has yet to pacify the primitive countryside of Afghanistan.

Meanwhile, the search for effective military options for action in world trouble spots turns out to be less and less productive—as the practice of power politics, based on reliance upon military force, looks more and more like a loser's game. Armaments pile up at record rates, but national security policy verges on doctrinal bankruptcy.

The United States and the Soviet Union share a special responsibility for expanding obsolete concepts of national defense to embrace the strategic frontiers of world security. Both nations have the military capacity to destroy each other's society under worst-case assumptions, yet both feel militarily insecure vis-à-vis the other. For this reason alone, they should be the first to perceive that there is something fundamentally wrong with their inherited concepts of national defense.

Beyond that, Soviet and American scientists are well aware that man-made changes in the global climate system could have devastating impacts on the viability of national societies—that depletion of the ozone layer, destruction of tropical forests, deterioration of coastal zones and estuaries, extinction of animal and plant species, loss of genetic resources—all this on top of degradation of cropland, pastureland, fisheries and forests on a worldwide scale, necessarily places the modern security issue squarely in a global context. In sum, East and West now share the knowledge that mankind can put an end to the human experiment not only through nuclear war but through destruction of the natural systems that sustain all life on the planet.

Still and all, it might seem naive, in the present political climate, to hope that the superpowers could break out of the conceptual traps that drive the "mad momentum" of the strategic arms race. Except for one thing. A strictly military concept of national defense has become a central threat to world security—and thus, inescapably, to the national security of both nations. □

Thomas W. Wilson, Jr. was formerly political adviser to the U.S. Mission to NATO. This article is adapted from the author's speeches before the Hubert H. Humphrey Institute for Public Affairs and the U.S. Association for the Club of Rome.

 ← SIERRA CLUB MAGAZINE

OVER →

795

#597

May 15, 1983

Dear Captain Wagner,

I am writing to express my concern at the possible dumping of subs off the Mendocino Coast. Possible leakage of radiation would make such an action very hazardous. Leakage of radiation would definitely upset the ecological balance in the coastal waters, and would be very dangerous to humans inhabiting the area. *L.20 | L.14 | L.36

As a person of conscience, I'm sure you will want to halt any further activities aimed at the irrevocable poisoning of marine and human life. W.1, L.14, L.36

Thank you very much.

Sincerely, Marcy Jackson

Jackson

4201 Muir Mill Rd.

Willits, CA

95490

*Other issues discussed by Ms. Jackson are side barred in Exhibit 174.

#598

Dear Sir,

I have read the material re: disposal of decommissioned nuclear submarines. In the Congressional Fact Sheet it is repeatedly mentioned that nuclear fuel would be removed before any subs are placed on the ocean floor. The sheet never states what will be done with the nuclear fuel. I would like to know this answer. | A.17

Sincerely,

Maria Kay

64 Taylor Dr.

Fairfax Ca 94930

I am against this nuclear madness which is already out of control

#599

Mrs. D. H. Alden
4246 Manuela Ct
Palo Alto, CA 94306

May 18, 1983

Dear Capt. Wagner,

I have been proud to have 2 members of the family serving in the Navy but I am now outraged that the government plans to add to the deadly pollution of our world by dumping nuclear subs in the ocean we should be protecting. Our earth & its living things cannot bear much more poison.

Respectfully yours

(Mrs) Margery B. Alden

#600

Dear Capt Wagner, May 16, 1983

I am writing to voice my opinion against the practice of nuclear sub dumping. Please do all you can to end this practice as well as any others which would further endanger our oceans and environment. Thank you -

Sincerely,

Carol Avery

#601

2246 Mar East
Tiburon, CA
94920

May 20 '83

Dear Captain Wagner,

I wish to protest the Navy's proposed dumping over 100 decommissioned nuclear submarines of the coast of California & North Carolina. This is a deliberate & irresponsible plan to put more radiation in our oceans. There has been only one public hearing on the Draft Environmental Impact Statement (EIS) which outlines the ocean disposal option.

I am glad that because of public pressure the comment period for the Draft ~~EIS~~ has been extended to June 30 '83, and that I can protest the dumping and ask the Navy to find a better & safer way.

Sincerely,

K. Dirkzwager

K. DIRKZWAGER

797

#602

Captain E.F. Wagner   May 15, 1983
U.S. Navy
Office of Naval Operations
Washington, D.C.

Dear Sir:

I wish to register my objection to ocean dumping of nuclear submarines.
We need the ocean to be free of nuclear poison to preserve the
L.14 well being of the fish and mammals that live there
we need them.
I'm sure you can find other ways.

Sincerely
Helen Kovarsky

H. P. KOVARSKY
[illegible] KEARNEY VILLA
SAN DIEGO, CAL.
[illegible]

#603

5/15/83

Captain Edward F. Wagner

I would like to comment on the proposed ocean dumping of decommissioned nuclear submarines.

As a commercial fisherman dependant on the L.53
rich fishery of Northern California, I am dismayed at the proposal to dump radioactive waste in the ocean off of Cape Mendocino.

This area is widely known for its tectonic activity, a result of several oceanic crustal plates merging and subducting under the continental North American Plate. This is evident by studying oceanic geologic maps of the region and by noting the preponderance of earthquakes recorded in this area. F.22

Present radioactive waste disposal technology is not advanced enough to ensure that containers would L.20
not leak, thereby posing a threat to the cold, slow ocean currents in the proposed dump site. The radioactivity would then be uncontrollable, working its way through the food chain up to the abundant albacore tuna and L.36
ultimately human beings.

As an individual whose livelihood is tied to a pollution-free resource, and as a concerned citizen who chooses to live here for the purity of air and water, I urge you to settle ocean dumping of radioactive waste.

Christopher L. Hayes
1726 Buttermilk Ln
Arcata, Ca. 95521

#604

REED AND MUIR
ATTORNEYS AT LAW
SUITE [illegible] PIERCE LACKEY BUILDING
P. O. BOX [illegible]
PADUCAH, KENTUCKY [illegible]

ROBERT B. REED
([illegible] - [illegible])
DONALD S. MUIR

([illegible])
OFF. [illegible]
RES. [illegible]

February 25, 1983

Secretary of the Navy
Department of Defense
Washington, D.C.

Dear Mr. Secretary:

I am writing in protest of the plan to scuttle one hundred nuclear, obsolete submarines off the coast of California. As a former and still concerned Navy man, I am deeply concerned that the delicate balance of our oceans is again to be subjected to abuse. Why can not these vessels be scrapped and their reactors transported to a tunnel deep in a mountain and there entombed until our technology reaches a point where we know how to dissipate the radiation. G.2

I do not like the idea of eating radioactive king crab and tuna fish and I know that my children do not look forward to that prospect. Once a vessel is scuttled, it is very difficult, if not impossible with today's technology to change that decision. L.36 W.1

Please reconsider.

Yours very truly,

Donald S. Muir

DSM/lh

cc: Congressman Carroll Hubbard
Congressman Hal Rogers
Senator Wendell Ford
Senator Walter "Dee" Huddleston

#605

17FEB83

DEAR MR. SECRETARY,

I AM IN THE NAVY AND WILL BE RETIRING 31JULY83. I HAVE A SUGGESTION CONCERNING THE NUCLEAR SUBMARINES THE NAVY IS GOING TO DISPOSE OF, SO THOUGHT I WOULD SEND IT TO YOU. I HAVE ALSO SENT IT TO THE SENATORS FROM FLORIDA, WHERE I WILL BE LIVING. AFTER I RETIRE.

MY SUGGESTION IS; DO NOT JUST SCRAPE THE SUBMARINES, USE THEM AS POWER PLANTS, IN REMOTE AREAS OF THE STATES. THEY COULD ALSO BE USED FOR EMERGENCY POWER IN AREAS THAT HAVE HAD THEIR OWN POWER DISRUPTED, DUE TO FLOODING, HURRICANES, ETC, ETC. THEY SUBS ARE SELF-CONTAINED, LIVING QUARTERS, GALLEY,ETC, AND HAVE PROVEN TO BE SAFE. WE SHOULD MAKE GOOD USE OF THE SUBMARINES INSTEAD OF JUST THROWING THEM AWAY, AS WE DO WITH TOO MANY OF OUR OLDER SHIPS, TRUCKS, PEOPLE, ETC. I AM SURE THE RUSSIANS WOULD MAKE GOOD USE OF THEM INSTEAD OF JUST THROWING THEM AWAY. G.3

YOUR THOUGHTS ON THIS WOULD BE APPRECIATED.

MY NAME AND ADDRESS; J.D. CRASH CONNER CTR1
NSGA BOX 832
APO NEW YORK, N. Y.
09240

SINCERELY,

J.D. CRASH CONNER
CTR1 USN

COPIES TO: SECRETARY OF THE NAVY
SENATOR CHILES
SENATOR HAWKINS

800

#606

BRYANT L. YOUNG
TWENTY-THIRD FLOOR
TWO EMBARCADERO CENTER
SAN FRANCISCO 94111

March 14, 1983

Mr. John F. Lehman
Secretary of the Navy
Pentagon Building
Washington, D.C. 20350

Dear Secretary Lehman:

I strongly urge you not to dump obsolete radioactive submarines off the coast of California. It would be irresponsible to jeopardize our health and safety as well as that of future generations.

Sincerely,

Bryant L. Young

cc: Ronald Regan, President of the United States
Casper Weinberger, Secretary of Defense
Mr. James Baker, Counsellor to the President
Allan Cranston, United States Senator
Pete Wilson, United States Senator

3 UO2 1191

#607

1983 MAR -2 AM 5: 13

OFFICE OF THE SECRETARY OF DEFENSE

City of Santa Cruz
CITY HALL • [illegible] CENTER STREET, ROOM 10
SANTA CRUZ, CALIFORNIA [illegible]
MAYOR AND CITY COUNCIL
TELEPHONE [illegible]

February 15, 1983

Secretary of Defense Weinberger
The Pentagon
Washington, D.C., 20301

Dear Secretary Weinberger:

As you may know, the Navy is presently preparing a "generic" environmental impact report on the dumping of refueled nuclear submarines off the Pacific Coast.

The general proposal would be to dump decommissioned nuclear submarines 160 nautical miles southwest of Mendocino, California over a period of years. A report by the Oceanic Society indicates that the radiation left in just one of these submarines at the time of dumping could equal one-half of the radiation dumped into the ocean during the entire waste dumping program in effect from 1946 to 1970.

Our Council has gone on record in opposition to the proposal, until the following items occur:

1. The U. S. Government has established a single, coordinated comprehensive nuclear waste management program under the responsibility of one agency.

2. The U. S. Environmental Protection Agency activates its promise to conduct a thorough scientific monitoring program of existing nuclear waste ocean disposal sites off California. | L.6

3. The U. S. Government can prove that an ocean disposal option offers less harm to human health and the environment than other practical methods of disposal.

This is in close proximity to the waters off our city, and we believe that there must be better alternatives. We are anxious that you join with us in this opposition, and are anxious to hear of your views in this matter.

Very truly yours,

Bruce Van Allen
Mayor

BVA:slc

30436

#608

1983 MAR -2 PM 3:54

OFFICE OF
THE SECRETARY OF DEFENSE

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF SANTA CRUZ, STATE OF CALIFORNIA

RESOLUTION NO. 58-83

On the motion of Supervisor Moore
duly seconded by Supervisor Levy
the following resolution is adopted:

RESOLUTION OPPOSING THE OCEAN DISPOSAL OF RADIOACTIVE SUBMARINES

WHEREAS, the U.S. Navy has prepared a program for the ocean disposal of at least 100 decommissioned nuclear submarines, as evidenced by the release of a draft environmental impact report on this plan; and

WHEREAS, the draft EIR indicates that such submarines will contain about 50,000 curies of residual radioactivity at the time of disposal; and

WHEREAS, medical science has proven that radioactivity endangers human health both from direct exposure and from ingesting food sources formerly exposed to radiation; and

WHEREAS, the United States Government terminated all ocean disposal of radioactive waste in 1970 as an unwise and unsafe program; and

L.36 | WHEREAS, the disposal of radioactive submarines in the ocean could result in the concentration of radioactive materials in edible fish, as radioactive elements are transmitted up the food chain; and

WHEREAS, the Navy has stated that the priority site for this disposal on the west coast is 160 nautical miles southwest of Cape Mendocino, California; and

WHEREAS, all coastal locations along the California coast have the potential of receiving the effects of this proposed increased radioactive accumulation in the Pacific Ocean if such disposal actually takes place.

NOW, THEREFORE, BE IT RESOLVED that the Board of Supervisors of the County of Santa Cruz opposes the ocean disposal of radioactive submarines and further resolves that the U.S. Navy should postpone any ocean disposal plan for radioactive substances until:

1. The U.S. Government has established a single, coordinated comprehensive nuclear waste management program under the responsibility of one agency, and

L.7 | 2. The U.S. Environmental Protection Agency activates its promise to conduct a thorough scientific monitoring program of existing nuclear waste ocean disposal sites off California, and

3. The U.S. Government can prove that an ocean disposal option offers less harm to human health and the environment than other practical methods of disposal.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the Board of Supervisors of Santa Cruz County urges the United States Government to encourage other governments with nuclear submarines and concerned international agencies to seriously address the issue of nuclear waste disposal in the ocean; and

NOW, THEREFORE, BE IT FURTHER RESOLVED that the Board of Supervisors of Santa Cruz County requests the United States Government to hold public hearings in coastal areas on this matter. | J.15

PASSED AND ADOPTED by the Board of Supervisors of the County of Santa Cruz, State of California, this 15th day of February, 1983 by the following vote:

AYES: SUPERVISORS FORBUS, MOORE, LEVY, CUCCHIARA
NOES: SUPERVISORS NONE
ABSENT: SUPERVISORS PATTON

JOE CUCCHIARA
Chairperson of said Board

ATTEST:

HELEN J. BRIGHTWELL
Clerk of said Board

Approved as to form:

C.A. Carlson
County Counsel

DISTRIBUTION:

President Reagan
Secretary of Defense
Secretary of Navy
Senator Cranston
Senator Wilson
Congressman Panetta
State Senator Mello
Assemblyman Farr
Save Our Shores
Humboldt and Mendocino
  Counties Board of Supervisors
Congressman Zschau

STATE OF CAL[illegible] SS
COUNTY OF [illegible]
I GEORGE [illegible] Officer and ex-officio C[illegible] Board of Supervisors of the [illegible] State of California [illegible] the foregoing is a [illegible] copy of a resolution passed and adopted by and entered in the minutes of the said board. In witness whereof I have hereunto set my hand and affixed the seal of the said Board on February [illegible] 19 83
GEORGE [illegible], County Administrative Officer
By [signature] Deputy

801

802

#609

William F. Wetmore
2510 Eighth Avenue
Oakland, California 94606
(415) 444-6794

February 23, 1983

The Honorable John F. Lehman
Secretary of the Navy
Pentagon Building
Washington, D.C. 20350

Dear Mr. Lehman:

Your plan to use the coastal waters of the Pacific Ocean to dispose of decommissioned nuclear submarines is ill-conceived, irresponsible and illegal. Reconsider your plan so that this waste can be better managed and do not repeat Love Canal or the Farallon Island incidents. Let us not take away our seasidos away from our children and their chilren.

As a former nuclear submariner, I ask that your make a responsible decision not a convenient decision.

Sincerely,

W F Wetmore

William F. Wetmore

cc: The President of the United States
The Honorable Alan Cranston
The Honorable Pete Wilson
United States Senate

#610

REDWOOD COAST MEDICAL SERVICES, INC.

Skaggs Springs Road at Coast Hwy 1
Post Office Box 8
Stewarts Point, CA 95480
Telephone 707 785 2215

MAY 18, 1983

Captain Edward Wagner
Office of Chief of Naval Operations
Washington, D.C.
20350

Dear Captain Wagner;

The membership, Board members and staff of the Redwood Coast Medical Services, Incorporated, wish to express to you their opposition to the dumping of any nuclear materials off the northern California coast.

This Medical Center provides primary health care and emergency response for the people living in the rural areas of northern Sonoma County, including Timber Cove, Fort Ross, The Sea Ranch, Annapolis and the Pomo Indian Rancheria of Kashia. It also serves the southern Mendocino County coast with the communities of Manchester, the fishing port city of Point Arena, Anchor Bay, Gualala, and two Pomo Rancherias.

The waters off these areas are some of the richest suppliers of food for this nation. The Coast itself is the most priceless of national treasures. Any disposal of nuclear materials in these waters constitutes danger to health, welfare and safety. L.53, L.36

Respectfully Yours,

Maxine Rosenthal, Chairman
Board of Directors

#611

118 W. Palm Ln
Phoenix, AZ 85003
May 21, 1985

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Sir,

Please don't dump nuclear submarines in the ocean. I'm absolutely convinced that we will eventually do ourselves in if we do that. Perhaps there is no safe means of disposing of an obsolete nuclear sub. In that case, I strongly question the building of nuclear submarines in the first place. If we can't come up with a more far-sighted disposal method, we shouldn't be producing nuclear energy of any kind.

H.12

Sincerely,

Roberta Charlton

#612

NANTUCKET SHELLFISH AND MARINE DEPARTMENT
38 Washington Street
Nantucket, MA 02554

20 May 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I am writing to comment on the Draft Environmental Impact Statement (DEIS) for the disposal of the Navy's nuclear submarines. At the outset I must state my belief that although land disposal is the more desirable of the two alternatives; at present there does not exist a proven method of safely isolating any type of nuclear waste on land or sea. Therefore I feel the Navy should cease building
H.12 more nuclear subs until a safe method of disposing of existing ones is developed.

The DEIS is based on a number of faulty assumptions which show a basic lack of understanding of biological processes in the ocean and radioactivity in general. The statement that after 400 years when
A.16 the reactor core is finally breached the radionuclides will have
L.20 decayed to "safe" levels ignores the many long-lived nuclides (Tc-99) which are found in nuclear reactors. One long lived element found in reactors which is conspiciously absent from the calculations in
A.11 the DEIS is plutonium, one of the most toxic elements known.

A typical example of an unfounded statement is on p. 4-17 where the DEIS states "Radiation exposure to the public from the release of radiation materials from submarine disposal would probably be zero."
L.22 This ignores the possibility of disperion of elements from the disposal site and the concentration of elements through the marine
L.36 food chain. The reliance for assumptions made in the DEIS on criteri for exposure established by the IAEA is flawed. Scientists have challenged these standards as numerous studies have shown them to be too high; and have concluded that any increase in expsoure to radiation will result in increasing numbers of cancers, deformities and leukemia in humans.

Another concern I have with the DEIS is with the reliance on models to predict the behaviour of radionuclides released from the submarine in the ocean. A number of researchers in the field of marine radioecology, including Dr. Vaughn Bowen of the Woods Hole Oceanographic
T.3 Institution, have shown that models have underestimated the actual concentration of radionuclides in the marine food chain.

The past record of disposal and monitoring of nuclear
L.6 wastes dumped in the ocean by the U.S. speaks strongly against the resumption of this practice. The fact that the Navy has never

NANTUCKET SHELLFISH AND MARINE DEPARTMENT
38 Washington Street
Nantucket, MA 02554

located the nuclear sub SEAWOLF which was disposed off Delaware is J.85
a good example of the haphazard practices employed by the U.S. The J.76
monitoring program proposed in the DEIS is inadequate, and even if it were to detect problems nothing could be done as the subs would W.1
be irretreivable.

I feel that too little is known about the ecology of the deep ocean L.1
and the consequences of dumping nuclear waste there to allow dumping nuclear submarines at sea. Furthermore the disposal of nuclear subs in the ocean would set a dangerous precedent whereby the disposal of L.9
low and high level waste by the U.S. would be more likely. There are too many unknowns and risks involved in ocean dumping of nuclear L.39
submarines. The possibility of poisoning seafood and endangering coastal populations make those risks unacceptable.

As a marine scientist with a deep concern for the well being of the ocean I ask that the Navy refrain from anymore consideration of the sea disposal alternative for their nuclear submarines.

Respectfully submitted,

Ken Kelley

Ken Kelley
Town Biologist

#613

400 Clayton St
Winston Salem NC
27105

Capt. Edward F. Wagner
Office of the Chief of Operations.
Dept of the Navy.
Washington DC 20350

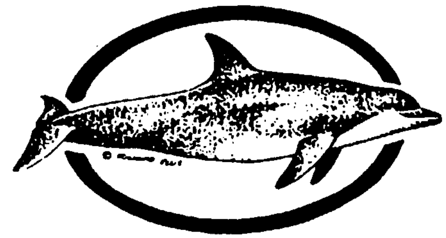
Dear Capt Wagner.

Please, no dumping of obsolete nuclear submarines or other radioactive waste at sea. No where in Any Ocean, not even off the Coast of North Carolina or California. If the Creation of and the disposal of nuclear waste is not stopped we will not have to relie on bombs to destroy us.
L.36 We will do it ourselves through the food chain.

No dumping please!

Sincerely
J P Richardson

#614



Dear Sir,

my vote is against Ocean Dumping.

Thank You
for the Earth
Jim Ray

TIM RAY
P.O Box 1708
SAN BRUNO CA
94066

#615

Please keep your radioactive subs out of our oceans! Keep them in protective
G.2 storage until studies are done to show the best option for their disposal. Do not contaminate the oceans irrevocably*! (+ please don't waste tax money by sending me a form letter saying it's O.K. to do just this* – it's not, + I know it!)

Ann Matteson + family Yosemite, CA

#616

Dear sir:

We are writing in the hopes that our sincere opposition to ocean burial of your decommissioned nuclear submarines will help change your mind. It is a grave responsibility to be in charge of this disposal. Please do not take the easy way out for the ocean is frailer than you think. My reading assures me that the radioactivity from these subs will certainly find their way ~~thru~~
L.36 the food chain into our bodies. Let's find a safer method.

Be aware, also, that nuclear dumping in our oceans is cur-
F.8 rently an international issue. Your decision will help turn the world away from this dangerous path.

Sincerely,

[illegible] [illegible]

#617

Eric C. Rehnke
1067 Jadestone Lane
Corona, CA 91720
May 30, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
Washington, D.C. 20350

Captain Wagner,

I would like to register my opposition to the Navy plan for disposing of over 100 decommissioned nuclear submarines off the coast of California and North Carolina.

The sort of thinking that went into the formulation of this plan is obviously short sighted and blatantly ignorant of the overall function of the earths life support systems.

Dumping waste into the ocean, or burying it for that matter, DOES NOT get rid of the problem. It only postpones the effects slightly. So then our children have to deal with it.

Is this what you want for your children?

Sincerely Yours,

Eric C. Rehnke

#618

Captain Edward F. Wagner

OCEAN DUMPING

No more ocean disposal for radioactive wastes is the simple and direct message I wish to convey, as a voting citizen of the U.S.A.

Michele Navone
Two Ash Lane
Petaluma, CA 94952

#619

Memorial Day '83

Dear Captain Wagner:

It seems fitting that this protest should be written on a day that remembers the American war dead and maybe the potential dead as a result of another American war - the nuclear waste war fought between the American war mongers in our Pentagon and in our government.

I protest the Navy's plan to ocean dump over 100 decommissioned nuclear submarines off the coas of California and North Carolina. I protest the Navy's irresponsible plan to deliberately put more radiation in our oceans,

Sincerely,
[illegible]

#620

27 May 83

Dear Cpt Wagner

No more ocean disposal for radioactive waste! Those are my relatives in the water & it will come back to you 100-fold!

Carolyn Downing

[redacted]

C Downing
715-A Liggett Ave.
Presidio SF, CA 94129

#621

5-23-83

Captain Edward F. Wagner,

I assume you are a person who loves the Oceans of ~~our~~ our land. By placing these nuclear subs in our waters we are only lessening your children + my childrens chances of ever having peace on earth & beautiful waters to love & prosper with. This must stop. Please reevaluate your priorities. I cannot lie to my children about their future on this planet. Love & accepting words & communication is all it takes. This nuclear power gaming must stop, or we will.

Karen McKay

KAREN McKAY
28110 SAND CANYON RD.
CANYON COUNTRY CA
91351

#622

April 26, 83

Dear Wagner,

We are fishermen & we don't want you dumped your radioactive submarines off our coast. it would put us out business

Thank you

33310 Sandy Lane (Molly Swanson
Fort Bragg Calif 95437 Pres. Noyo Women for Fisheries

L.53

#623

5/25/83

CAPT. WAGNER,

I WOULD LIKE TO EKSPRESS TO YOU THAT I TOO BELIEVE THAT THERE SHOULD BE NO MORE OCEAN DISPOSAL FOR RADIOACTIVE WASTES, INCLUDING MOTHBALLED NUCLEAR-POWERED SUBMARINES.

THERE MUST BE ANOTHER ALTERNATIVE TO THIS GROWING PROBLEM.

THANK YOU,

Richard L. Bratset

RICHARD L. BRATSET
(CONCERNED VETERAN)
BOX 1071
COLUMBIA CA. 95310

RICHARD L BRATSET
VETERAN OF THE NAVY
BOX 1071
COLUMBIA CA. 95310

#624

May 9, 1983
750 Clayton Street
San Francisco, Ca. 94117

Capt. Edward F. Wagner
U. S. Navy
(OPN[illegible])
Department of the Navy
Washington D. C. 20350

Dear Sir:

I wish to convey to you the concern I feel about the current U. S. Navy DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. It is definitely an inadequate study of the problem and cannot be considered the final document for assessment of the problem. Ocean dumping cannot be considered based on this document.

I must add moreover that I think it folly for mankind to assume we can say what is "safe" regarding radio-active substances and their interaction with the earth, air, and water of our world, given the relatively short amount of time these large amounts of the substances have been in existence. Since they have such long lives the possibility of extensive damage to the food chain is at most enormous and at the least unknown, a factor not to be taken lightly. L.36

Please take every action to assure me that this important decision will not be made on the basis of monetary and immediate needs only.

Thank you.

Sincerely,

Margery Knyper

810

#625

May 23, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, C.C. 20350

Re: Dumping of Decommissioned Nuclear Submarines

Dear Captain Wagner,

I am writing to you because I fear the "continued deliberate dumping" of radioactive materials into our oceans and would like to see it totally stopped.

Most people now have the knowledge, as I know people directly involved with radioactive materials always have, the devasting impact of these materials on the environment and on human life.

Please do not allow the 100 nuclear submarined that are decommissioned to be dumped into our oceans.

Sincerely,

Rose Marie LaPorta

Rose Marie LaPorta
336 Keystone Ct.
San Rafael, CA 94903

#626

General Delivery
Postal Bx 85632
May 22, 1983

Dear Captain Wagner:

I feel that there need be much more responsible use of our precious resources than to dump nuclear wastes (in the form of decommissioned nuclear submarines or otherwise) into our oceans. Though oceans seem vast and endless, they are the origin of life-giving sustenance to us in the most crucial way. Even sewage dumped out to sea has returned later to our beaches killing fish and making the areas uninhabitable. Oil spills damage speaks for itself in death and destruction. How much more awful to have seeping radioactivity | L.36
finding its way through our food chain.

As a person with hope for the future of our children, I ask you to stop plans for any nuclear disposal in the ocean.

Sincerely,
Janice Palma

#627

May 25, 1983

Captain Edward F. Wagner
U. S. Navy, Office of the Chief of Naval Operations (OP-22)
Department of the Navy,
Washington, D. C. 20350

Dear Sir,

The DEIS on the Disposal of Decommissioned Submarine Reactor Plants is strongly slanted in favor of Ocean Disposal. One of the major considerations cited is the economic advantage. Much of the cost involved in Land Disposal or Protective Storage would provide jobs. Currently the government is commiting money to programs designed to
O.11 create jobs, and land disposal of these submarines could provide many jobs, including skilled jobs. Additionally, non-permanent disposal would preserve 4000 tons of metal
O.12 per submarine which is not <u>currently</u> economical to salvage. Land Disposal or Protective Storage would keep this scrap metal so that a decision could be delayed on whether to use or dispose of it.

The DEIS also suggests that one of the three options must be decided upon. If, for example, the Ocean Disposal option is chosen, and found to be unsatisfactory, will the remaining submarine reactors be disposed of on land?

The Ocean Disposal option has two very major drawbacks
W.1 which are underplayed in the DEIS: irretrievability and
L.36 possible entry of radioactive material into the food chain. Irretrievability admits a complete loss of control over possible unanticipated ill effects, except to monitor those ill effects. The DEIS contradicts itself with regard to the effects of ocean scuttling on fisheries and sea life.

2

On page twelve of the summary, for example, it states that sea life is very sparse in the study areas. However, in Appendix E, there is much evidence of life, including a fish, in the photographs. Perhaps the sea life inhabiting this area is not <u>now</u> economically important, but as pressure on the fisheries resource causes fishermen to diversify their catch, other fish may become more economically important. Also, the statistics with regard to catch in the Cape Mendocino study area are not up-to-date, and curiously only include less than a decade. There is more data available, which I think would change the shading in the study area in figure E-20. J.12

In closing, I was curious about the "worst case" calculation on page S-13, of a person at some time in the future consuming "a very large amount of seafood", or 145 pounds per year. If this is filleted weight, I would agree that it represents a fairly large consumption of seafood. However, one pound of fish, raw weight, contributes an average of less than 200 calories, in most cases less than 150 calories. One hundred forty-five pounds of fish per year would be 2.8 pounds per week. If this is raw weight this is not a very large amount of fish, but approximately 1.7 pounds per week, or two servings, after it has been prepared. T.12

Sincerely,

Carol E. Mone
944 F Street
Arcata, CA 95521

#628

670 West Montrose Street
Clermont, Florida 32711
May 27, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C.

Dear Sir:

Count the undersigned among those who are opposed to the Navy's plan to scuttle nuclear submarines off the coast of Northern California. It is wrong to use the ocean as a dump site for anything. But it is absolutely wrong to use it for such a project without knowing the ecological effects that
L.39 it will have for future generations.

Yours truly,

Jerry Meilan

Marie Meilan

Mr.&Mrs. J. Meilan
670 W. Montrose St.
Clermont, Fla.32711

#629

May 31, 1983

Kathleen J. Walden
1329 Bancroft St.
San Diego
California 92102

Captain Edward F. Wagner
Dept. of the Navy
Office of Chief of Naval Operations
Washington DC 20350

Dear Captain Wagner,

I am writing to comment on the Draft Environmental Impact Statement for the disposal of defueled submarine reactor plants.

I am opposed to any dumping in the ocean especially off the coast of California. L.1
There is insufficeint research completed at this time to conclude that dumping nuclear wastes in the ocean is a safe procedure. L.36
Leaking nuclear wastes dumped in the ocean could easily contaminate the food chain. What will be the effect of this proposed dumping in ten years, 20 years, 50 years, 100 years or longer? What will be the effects on future generations? L.39

In the 1950's we did not know the dangers of nuclear wastes. We did a lot of stupid things. Let us not repeat the 1950's by dumping more nuclear wastes in the ocean. Because it is cheaper to dump in the ocean is no reason to select the ocean as a sump site. Pay less now - pay more later in terms of contamination and illness. N.3

Because of the southern currents off the northern California coast, the radioactivity from these submarines will travel south to San Francisco Bay and Southern California. Such dumping will harm the ocean and the human environment - don't fool yourselves into believing otherwise. J.28

Bury it on land. Neither alternative is very good - but a leakage in the ocean could very easily contaminate the food chain. Stop producing nuclear weapons. Either the weapons will kill us quickly in a war or the nuclear wastes will kill us slowly through illness and disease. Either way we die of our own doing at our own hands.

Sincerely,

Kathleen Walden

Kathleen Walden
Citizen

#630

May 28, 1983

David Oaks
P.O. Box 11284
Eugene, OR 97440

Capt. Edward F. Wagner
Office of the Chief of Naval Operations
OPNAV-22
Dept. of the Navy
Washington, DC 20350

Dear Captain Wagner:

I am writing as a concerned citizen opposed to dumping nuclear waste into the ocean, a practice that a local newsletter states you might implement. It is simple: dumping radiation is hazardous, and should not be done.

Each of those subs has as much radiation as about half of the mistaken dumping which took place since 1946. There is no such thing as a safe dose of radiation: any amount can cause harm, death, genetic damage — it is a gamble.

They say we are at peace. But I wonder: were the human guinea pigs who were marched close to

P. 2

the atomic tests in the 1950's casualties of a war of technological mistakes?

Congress has expressed its intent: the moratorium showed great concern with this proposed dumping.

We humans with our new technology have a huge responsibility. Descended from animals that crept out of the ocean, are we now returning the most dangerous substance known to that ocean? Why?

I wonder what environment you find yourself, Captain Wagner: No doubt there are stacks of details and documents you are faced with in your office, meetings with other military people, following orders and directions from the chain of command, in the atmosphere that a decision has been made to promote a nuclear arsenal. What pressure!

But express that simple truth, Captain, and as a citizen I ask you to pass on my concern: Radioactive dumping in the ocean is hazardous and wrong. Let the actions that result flow from this fact.

Sincerely,

David Oaks

#631

COD

June 1, 1983

Captain Edward F. Wagner,

This letter is written in response to the Navy's proposal to scuttle decommissioned naval submarine reactor plants off our coast. For each letter received you can be guaranteed there are numerous others who disagree with your proposal, but have not written. Enclosed are many names our organization has gathered of people who do not want to see this happen.

Although your organization feels there is no threat to the health of the environment or people, this is something which can not emphatically be guaranteed. People are weary of public officals stating there is no need for concern, only to later learn a hazard is sitting in their own backyard.

Looking at the calculations provided in the EIS for estima-
tion of radiation exposure, the question keeps coming to mind --
L.40 theory vs reality. Too often what is calculated on paper is not
the way it happens in "the real world." Too many times we do
something only to learn later there are serious ramifications
W.1 which were never considered. Your department gives no means of
retrevial so if a reactor plant does begin leaching radioactive
L.20 substances, they are there to leak forever.
Our oceans are an ecosystem we by no means totally understand.
L.1 The oceans have preceded man's existance and will most probably
exceed our existance. The idea is absurd to think that after a
four to five year study one could guarantee the workings of the
ocean in this area, when areas nearby are often hit with earth-
quakes. This body of water is an everchanging ecosystem with
current and temperature fluctuations.
J.12 The EIS states commercial albacore fishing is low in the
targeted area. Let me point out to you, as has been done, alba-
core are a migratory species and there have been substantial catches
J.12, J.9 in this area according to the National Marine Fisheries Resources,
La Jolla, CA.

People are upset with this scuttling proposal and are not willing to let submarines be scuttled in ocean waters. Many countries (Japan and several European countriess) are watching the U.S. and if we begin discarding our waste products in the ocean what wil happen others begin using the ocean as a waste dump? This is not only a local issue, but an international concern as well. F.8

Sincerely,

Rebecca Paterson

Rebecca Patersun

Concerned about Ocean Dumping
P.O. Box 4624 • Arcata, CA 95521

attached to Rebecca Paterson letter –
57 pages of photocopies of signatures.
total signatures = 1037.

#632

Patrice E. Larkins
1808 Painted Pony Road
El Sobrante CA [illegible]
(415) 222-[illegible]

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I was very glad to read that the comment period for the Draft Environmental Impact Statement for Ocean Disposal of Radioactive Wastes has been extended to June 30, 1983.

I would like to ask for a copy of the Draft EIS and also register my concern over the Navy's plans to push through legislation that would allow such dumping into the oceans off the coasts. I am in opposition to such dumping until such time as we have properly studied the consequences and developed fail-proof methods. When this is accomplished, I would support dumping in only retrievable sites. | W.1

The long-term effects that follow a wrong decision by the Navy in this matter, emphasis the need for a long, hard, unbiased look at potential dangers associated with ocean dumping.

Sincerely,

Patrice Larkins

#633*

May 31, 1983

Captain Edward Wagner

I am against all dumping of radioactive wastes into the ocean. I am interested in your environmental impact report and would like you to send it to me. The subs are irretrievable if you dump them in the ocean and no one knows the long term harm that could be done if the ocean is contaminated. | W.1* | L.39

Mrs. R. Albertson
P.O. Box 995
Sequim Washington 98382

*Other issues discussed by Ms. Albertson are side barred in Exhibit 663.

816

#634

5201 McFadden Avenue
Huntington Beach, CA 92149

May 31, 1983

Captain Edward F. Wagner, U. S. NAVY
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I thank you for the opportunity to comment on the Draft Environmental Impact Statement (December, 1982) for "Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants". This is one of the better DEIS documents I have reviewed lately and I would like to complement the Navy and its contractors for a job well done. I particularly appreciate the extended comment period which allows the interested public (myself included) a reasonable chance to make meaningful comments, which often requires a considerable amount of "leisure time".

I have a number of general and specific comments (Enclosure 1) which I hope may be used to further enhance the quality of the DEIS. A document with a minimum of ambiguities is the best way to develop the readers' confidence in understanding the project. All things being equal, I would more likely support a project where the proposer is "upfront" and establishes a line of credibility than one that does not.

I have not read every page of the DEIS, however, based on my review of the documents, I have the following comments. Open ocean disposal of the submarines seems to be the best method available particularly in light of cost factors. It is not likely that the project will result in significant environmental radiation problems if the Navy follows the safeguards proposed and implied by the text of the DEIS.

To further my understanding of the proposed project I would appreciate it if you could send me copies (on loan if necessary) of the following references listed in the DEIS: Ref.4.9, Ref.D.A1, Ref.D.A17, Ref.D.A18, Ref.E.3, and Ref.K.4. Thank you.

Sincerely,

Martin F. Golden

Enclosure

Enclosure 1

Comments on
DEIS (December, 1982) on the Disposal of
Decommissioned, Defueled Naval Submarine Reactors

GENERAL:

A. Four of the more important objectives I believe this document should address are listed below with my comments.

   1. Describe the project (and alternatives). This was well done; a commendable job.

   2. Identify the impacts (and significance). Again, well done especially with respect to radiological effects, however, it is not appropriate to draw unqualified conclusions concerning biological communities that are unknown or only slightly understood. J.20

   3. Discuss how impacts can be mitigated or eliminated. The DEIS did a relatively good job in this area but it is important that all reasonable mitigation techniques be discussed. More detail should be provided in many cases concerning why a certain procedure is not recommended.

   4. Discuss what mitigation will actually be implemented for the project. This is an area of some concern to me. It is often difficult to determine the difference between what can be done and what will be done. This is closely related to a rather general treatment of the subject (i.e., exactly what will be done for the monitoring program). Crutial to document credibility is the "good faith" established by a well documented mitigation plan. E.1

B. My specific comment for pages 4-22, D-A2, D-A4, and review of the list of preparers indicates that biological scientists of the appropriate disciplines may not have been directly involved in the preparation of the DEIS to a desirable level. N.11

C. When an item is discussed in a general manner in one part of the document and more detailed somewhere else, more care should be given to cross referencing.

D. Protective storage is a waste of money and increases the chance of some structural damage to the submarines occurring. As soon as environmental studies and safeguards are completed (3-4 years if actively pursued) disposal should begin.

E. It might be a good idea to have several outside consultants to review DEISs for the Navy.

#634 (Cont)

SPECIFIC:

X.2 °Page S-12, ¶ 2, 2nd sentence: It is not known if the animals do form part of a food chain known to lead to man. Reword the sentence in part, "...are used by man and it is unlikely, but not documented, that any of them form part of a food chain known to lead to man".

°Page S-12, ¶ 4, line 5: "many years" could be reworded using information presented in other sections of the report (i.e., "approximately X years").

°Page 1-1, Introduction: The DEIS should show a general schematic of the entire regulatory process (i.e., DEIS--FEIS--Environmental Assessment of Chosen Site (draft & final)--other reports related to monitoring.

X.2 °Page 4-8, ¶4, last sentence: A conclusion is considered a scientific fact that can and has been proved based on verifiable data. In the last sentence, change "concluded" to "believed" or "thought". Please review the document to insure that other similar "conclusions" are not made.

°Page 4-9, ¶2, lines 6 and 7: The difficulty of observation should not be translated into no damage to deep ocean populations. Again conclusions or implied conclusions should not be made without data.

°Page 4-13, Table 4-4: I hope that tables such as this cannot be used to back calculate classified metallurgical information (if there is any).

°Page 4-20, last ¶: Good; enhances the document's credibility.

X.2 °Page 4-21, ¶1: Items 1 and 2 could be given more detail (one or more sentences each).

°Page 4-21: Should/could there be a discussion of an external coating being applied to reactor compartments (i.e., epoxy or tefalon spray).

N.11 °Page 4-22, last ¶, last sentence: The phrase "grassy-looking, small animals" implies that this observation was not made by a skilled benthic scientist or that the resolution/clarity of the observation

X.2 was poor. At least provide a reference for this information. Rewording is probably appropriate.

E.24 °Page 4-23, section B, ¶ 1, last line: Re: "weather requirements". This phrase is used in several places in the document (see p. D-3). I believe it would be appropriate to indicate somewhere in the DEIS under what conditions tows would and would not be made (i.e., fog, rain, sea state, etc.). Also provide more details on the kinds of "traffic restrictions" and the role and capability of accompanying vessels.

X.2 °Page 4-23, ¶ 2, last sentence: Appendix D does not provide a satisfactory amount of detail to document this statement (see my comments for page D-A2 and D-A4).

(2)

°Page B-13, ¶ 2: The lack of regulations shuld not stop you from proposing safety requirements that would benefit this project. E.25

°Page D-4, section A-1, ¶ 1, last sentence: You should discuss what and how this data will be used (i.e., to increase accuracy of positioning for future submarine disposal operations). X.2

°Pages D-A2 and D-A4: Discussion of the biological resources is very limited and not well documented with references. The implication is that there is no significant biological information available or that a deep water benthic specialist was not involved in putting this section together. J.42

°Page E-6: Criterion 6 may include turbidity currents, however, the significance of turbidity currents is very important and should be established as a separate criterion. J.19

°Page E-19: There is no discussion related to turbidity currents for the Pacific Ocean Study location. J.77

°Page H-1, Summary and Conclusions: The material in this section, for the most part, belongs in the Introduction. The "summary and conclusions" seem to be missing from this section.

°Page K-1: The environmental impacts for the Hanford Site are not adequate. References K.1 and K.3 environmental impacts should be summarized here. There is no discussion concerning endangered or threatened species. If there are none, it should be stated. X.2

°Page K-2, Section IV: There should be more detail for this entire section. Page K-2's introduction should state that monitoring programs will follow procedures in Reference K.4 (if appropriate). In any case, (in summary at least) state what will be done rather than what could, can or may be done. X.2

°Page K-2, Section IV A: The actual target area for disposal of each submarine should be "cleared" by doing a sidescan survey of the site to insure there are no anomolies which could have an adverse effect on a submarine's integrity upon impact with the bottom. J.19

°Page K-2, Section IV: There should be some provision for special monitoring if an accident related to disposal of a submarine occurs. J.84

°Page K-3, item A.e.: Provide more detail or at least references for methods to be used.

°Page K-3, Section B, last ¶: How long will this survey take? X.2

°Page K-3, Section C, last ¶: How many years of survey work is this estimate based on?

(3)

#634 (Cont)

V.1 *Pages L-10 and L-11: The environmental impact analysis lacks detail. The section on endangered species is not adequate. There should be some discussion on organisms listed in reference to L.16 and L.17. Also, positively state which endangered species are in the area. The way this section is written, one could be led to believe there may be threatened or endangered species that were not discussed.

#635

June 4, 1983

Dear Captain Wagner:

I am absolutely against the dumping of old nuclear submarines in the area, or any other radioactive wastes for that matter. W.1

To irretrievably pollute the source of marine life is an irresponsible and dangerous policy. G.2

Let us store these subs for 25 to 50 yrs. at naval bases, till the short-lived radionuclides will have decayed. And meanwhile make studies to find the best options for the subs' disposal.

Yours in concern,

Marjorie Cofer

Marjorie Cofer
991 Terrace 49
Los Angeles, CA 90042

#636

Dear Captain WAGNER

I oppose the Navy's proposal to dump nuclear [illegible] in the OCEAN. This action would be regrettable for our generation & criminal to impose such a legacy for thousands of years to our survivors. The nuclear waste needs to be guarded like the poison it is, not 'thrown away'. We need to investigate much more thoroughly the issue before [illegible] I's supposed [illegible] in [illegible]. Has the NAVY

L.6 checked out what happened off the Farallon Islands outside the Golden Gate?

Thank you Carlos [illegible]

131 KENT AVE #E
KENTFIELD CA 94904

To:
CAPTAIN EDWARD F. WAGNER
U.S Navy Office of Naval Op.
OPNAV-22 Dept of Navy
WASHINGTON D.C.
20350

#637

L. Mastrella
Box 471 - Denali NP AK 99755
June 6, 1983

Capt. Edward F Wagner
Office of the Chief of Naval Operations
Department of the Navy
Washington DC 20350

Dear Captain Wagner,

I am strongly opposed to the Navy's plan to scuttle decommisioned nuclear submarines in the Pacific Ocean. We cannot turn the ocean into a nuclear waste dump! Ocean "disposal"
would make monitoring more difficult and | J.76
retreival impossible in the case of leakage. The | W.1
proposed site off the Mendocino coast is a | L.53
prime albacore fishing area. Land storage -- "disposal" is an inappropriate term -- will allow much more effective monitoring. True, nobody wants the poison in their own back yard - but the stuff is here and needs to be dealt with, and it is a denial of the interrelationships of life on our planet to think you can just dump something in the ocean and forget
about it. Eventually that radiation could end up in | L.36
human food supply. It's a rotten idea. Please use your authority to see that those subs are not scuttled in the ocean.

Sincerely,
Laurie Mastrella

820

#638

Dear Sir;
this has got to stop. Period.
This world is really going downhill. I'm going to be 21 on may 29, and I don't expect to see age 30 {at the maximum}. - Traci Lawsley

Traci Lawsley
4901 Little Oak Ln.
Sac, Ca. 95841

#639

5/83

Dear Capt. Wagner,
Please register in the public record my opinions ré: sub disposal in the oceans — NO.

Our oceans are crucial to human life - an extremely delicate eco-system on which we depend for our lives. Hazards of nuclear waste and sub disposals in it are too unknown + too dangerous and too long-term. Please focus on research to de-activate nuclear waste and subs rather than just dispose. | L.39

The risks of raising ocean temperatures, ir-radiating water marine life, esp. plants + plankton are dangerous to the entire food + water cycles, and human life. | A.19, L.14 | L.36

Thank you. Lillie Kocher

Kocher
3827 Clement, SF

#640

Lorene Terhell
15660 Bittner Road
Occidental, CA 95465

28 May 83

Dear Captain Wagner:

Re: Navy's Plan to Ocean Dump over 100 decommissioned Nuclear Submarines off the Coasts of CA. and North Carolina (Draft Environmental Impact Statement [EIS]) (Ref. Greenpeace EXAMINER Pac SW Regional Edition Spring 1983 - p. 13)

I am absolutely AGAINST your irresponsible plan for deliberately putting MORE radiation in our oceans!

Thank you

Lorene Terhell

#641

Nancy M. Wassmuth
2001 Apache Drive
Silver Springs, Nevada 89429

June 6, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the chief of Naval Operations
Washington, D.C. 20350

Dear Captain Wagner,

Please add my voice to the many who are protesting the Navy's plan to dump over 100 decommissioned nuclear submarines off the coast of California and North Carolina.

It's time to stop using the ocean as a radioactive dump site. It is large but still finite. We would be wiser to err by dumping less than it can safely dissipate rather than crossing over that vague line between safety and hazard. Once dumped, the subs can never be retrieved. | W.1

Please reconsider and find another option.

Sincerely,

Nancy M. Wassmuth

Nancy M. Wassmuth

822

#642

June 2, 1983

Captain E. F. Wagner
US Navy
Office of the Chief of Naval Operations
OPNAV 22
Department of the Navy
Washington, DC 20350

Dear Capt. Wagner:

A very simple message -- no more ocean disposal for radioactive wastes!

Sincerely,

Judy

Judy Kenny Johnson
794 N. Livermore Avenue
Livermore, California
94550

#643

Capt. Edward Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV 22)
Dept. of the Navy
Washington, D.C. 20530

June 3, 1983

Honorable Captain Wagner:

This is a very brief message, urging you not to allow the dumping of obsolete nuclear submarines off the coast of Mendocino in California, or anywhere especially near the habitation of people. The adverse effects of nuclear waste are becoming more and more apparent, and I consider it inhumane to even consider dumping it here off the coast.

Thank you for your consideration.

Sincerely,

Carolyn Rice

Carolyn Rice
1321 High St.
Santa Cruz, CA 95060

#644

Torrey C. Brown, M.D.
[redacted]
SECRETARY

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
TIDEWATER ADMINISTRATION
TAWES STATE OFFICE BUILDING
ANNAPOLIS 21401

(301) 269-2784

LOUIS N. PHIPPS JR
DEPUTY SECRETARY

June 3, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief
of Naval Operations (OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

Thank you for sending us a copy of the DEIS on the Disposal of Decommissioned, Defueled Navy Submarine Reactor Plants. We only recently became aware of the proposal and I would hope that even at this date our comments could be considered.

G.2 The Maryland Department of Natural Resources, Coastal Resources Division supports the "No Action Alternative". We believe that before we can support any type of long term, permanent disposal method the United States must be prepared to dispose of all radioactive wastes under a uniform disposal regime. We are confident that the short term, "No Action Alternative" provides substantial time for a technologically safe and sound method to be developed.

Given the state of the economy and current fiscal deficit this option is more attractive in the short term. And more importantly, this alternative allows for the improvement and mitigation of the potential adverse impacts, especially in the long term, regarding permanent disposal methods.

While we commend the Navy for their detail in the DEIS and sympathize with the apparent low risk associated with permanent disposal methods, the Coastal Resources Division can not support this "statistically low" level of risk. We do, however, support continued research and monitoring of long and short term ocean dynamics and land based disposal alternatives.

I appreciate the opportunity to express our views and would also request that we be included on the distribution list for any ocean disposal activities conducted by the Navy.

Sincerely,

Sarah J. Taylor

Sarah J. Taylor, Ph.D.
Director, Coastal
Resources Division

SJT:ps

cc: Mark Butterworth

824

#645

June 1, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV - 22)
Department of the Navy
Washington, D.C. 20350

RE: Review of the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, December 1982.

Dear Captain Wagner:

Reviewing the Draft Environmental Impact Statement (DEIS) has not lessened my concerns about the Navy's proposal to dispose of decommissioned, defueled nuclear submarines, either by land or by sea burial.

Although my focus is on sea disposal, most of the same issues are raised by the land disposal option. In either case, the conclusion that "there would be no significant environmental impacts from any of the disposal methods..." is questionable.

G.2 | The only tenable alternative is the 'no-action' one. Otherwise, the U.S. Navy will be:

L.1 | #1. making choices based on scientific uncertainties arising from gaps in the existing data regarding biological and ecological processes;

L.9 | #2. setting a precedent that suggests that nuclear waste can be disposed of with little long-term hazard;

J.20, L.1, L.10, L.7 | #3. performing an action, the consequences of which are only partially known. Not only have they been evaluated and predicted on an inadequate body of knowledge, but even the existing information has not been considered from a synergistic or cumulative perspective; and

#4. reducing options, primarily in the areas of health and in the quality of the environment, for future individuals.

The following discussion examines each of the above points:

#1. <u>The need for more biological data</u>

On pages 3-11, in the discussion of the Pacific Study area, the statement that "none of the sea life (is) used by man or (is) part of the food chain leading to man" is not preceded or followed by observations, data, or lists of species and/or food webs that provide the basis for this conclusion. Rather, it is preceded by the sentence, "The biology of the deep waters and the sea floor, which are not exploited commercially, is little known at present." It is contradictory to arrive at a firm, final conclusion based on a little known biology.

#2. <u>Setting a precedent</u>

The generation of nuclear wastes continues while the problem of waste disposal remains unsolved. Nowhere in the DEIS was there any indication that the 100 submarines to be scuttled between now and the year 2000 were the anticipated full extent of the Navy's nuclear submarine fleet. | A.1

Additionally, "the Nation's 73 operating commercial nuclear plants" are continuously producing radioactive waste. "By 1986, twenty-eight could be forced to shut down because of lack of storage space." (<u>Geo, The Earth Diary</u>, Vol. 3, Aug. 1981)

Academic and medical, as well as other military and industrial activities, continue to produce nuclear wastes. If the Department of the Navy has the go-ahead on using the oceans as a dumping site for the radioactive wastes, would it be the Navy's exclusive right? | L.9

Captain Edward F. Wagner
Page 3
June 1, 1983

#3. A non-synergistic perspective

In Chapter 1, Part III ("Materials Other Than Radioactive Materials') the "slow process of corrosion" is referred to as the only consequence of the combination of water and:

- chromium and nickel metal;
- cadmium as plating;
- lead as ballast & radiation shielding;
- asbestos as thermal insulation.

As corrosion occurs, these wastes would no longer be in the solid form "that would minimize their return to the environment as hazardous material."

L.37

It is not indicated in the main text (as it is in Appendix F) that these materials will be in combination with mud, which contains anerobic bacteria, as well as with water. Consideration needs to be given to the metabolic processes of these bacteria. They may methylate or, through some other biochemical pathway, integrate components of the structural steel, such as nickel, into their molecular structure. Thus, these components may readily enter the food webs of the ocean (Simpson & Simpson, Biology: A Human Approach).

The process of biological magnification needs to be considered, too, where even minute amounts of a toxic substance introduced at the base of the food chain may become greatly concentrated in the animals at the higher trophic levels. The effect of agricultural use of DDT in the breeding success of brown pelicans and many raptors is a well-known example.

Yet another consideration is the fact that, although quantities of such materials as listed above are "added to the oceans by intentional dumping of construction and demolition rubble, dredge spoils, and miscellaneous materials by maritime accidents, and by natural run-off of water from the land" (DEIS, 4-22), this is not a logical justification for adding more.

My fear of this kind of reasoning--the justifica-

Captain Edward F. Wagner
Page 4
June 1, 1983

tion of a proposed action on the basis of its similarity to a previous action--was expressed in the above discussion regarding the setting of a precedent (#2).

Perhaps we should, instead: (1) question the process of dumping any wastes into the oceans; (2) understand that maritime accidents do not occur by choice; and (3) recognize that natural run-off has been an ongoing ecological process that created and modified the environment in which life evolved. In other words, probably some kind of biological equilibrium/adaptation has evolved in relation to the substances and the amounts entering the marine ecosystem through run-off. L.29

#4. Reducing future options

Current and future environmental costs are not considered in the analysis decision not to recover the 4000 tons of potentially salvageable material per ship. The justifications given are: O.32

1. "None of the material is in short supply nor are the resources of these materials expected to be exhausted in the near future." (2-12)

2. "...the cost to the government to recover it would be far greater than the scrap value. " (2-12)

The first justification does not consider the needs of the more distant future. Neither point includes the pollution effects of the mining, the transportation, and the manufacture of these materials. Also not included are the cost to the government to subsidize some of these activities (e.g., nickel mining, railroads).

Concerning the pollution effects, we are experiencing those now. Will the members of the next ten or more generations choose to experience them also? Can we offer them a choice?

#645 (Cont)

Captain Edward F. Wagner
Page 5
June 1, 1983

Thank you for this opportunity to review the DEIS. I appreciate your consideration of my comments.

Sincerely,

Ivana Noell
286 E. Mountain Drive
Santa Barbara, California 93108

IN/jds
cc Wm. D. Dawson, Director, Dept. of Health Services, State of California, Sacramento, California
E. Charles Fullerton, Director, Dept. of Fish and Game, State of California, Sacramento, California
Senator Barry Keene, State Senate, Sacramento, California
Senator Alan Cranston, U.S. Senate, Washington, D.C.
Senator Pete Wilson, U.S. Senate, Washington, D.C.
Representative Douglas H. Bosco, House of Representatives, Washington, D.C.
Representative Barbara Boxer, House of Representatives, Washington, D.C.

#646

1238 W. 4th Street
Winston-Salem, N.C. 27101
June 6, 1983

Captain E. F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I have just learned of the Navy's plans to bury radioactive submarines in the ocean, perhaps off Cape Hatteras. I must seriously question the safety of such a disposal system in the ocean.
L.20 | What would happen if leakage should occur?
I.76 | What plans are there to monitor the sunken submarines?
W.1 | How would leaking subs be retrieved?

I urge re-consideration of the disposal plan in order to protect the ocean from widespread contamination. I look forward to hearing from you on this subject.

Sincerely,
Jo Ann Thomas

#647

1590 Lance Dr.
Santa Rosa, Ca. 95401

6-9-83

Dear Captain Edward,

I oppose the dumping of the obsolete nuclear submarines off the Mendocino Coast or any coast. While the Navy argues that it is safe to dump the nuclear-powered submarines in the ocean, you can also maintain that it is safer to dispose of them on land. There is no excuse for not using the safer available method of disposal, which is land disposal.

I am against the dumping of obsolete nuclear submarines into the ocean, off the coast of Cape Mendocino or Cape Hatteras.

Sincerely,
Susan E. Goreline

#648

June 14, 1983

Captain Edward F. Wagner
U. S. Navy

Dear Sir:

I am committed to protecting the fragile and environmentally sensitive coastal waters which include highly productive fishing grounds and habitats for th endangered Gray Whale, the threatened California Sea Otter and other sea birds and marine live.

No more ocean disposal of radioactive wastes.
Am against the Navy's irresponsible plan for deliberaterly putting more radiation in our oceans.

Sincerely,
Mrs Evelyn Whitney

MRS EVELYN WHITNEY
P O BOX 659
LAKE ELSINOR, CAL.
92330

#649

My family and I want NO more ocean disposal for Nuclear Waste! - Please!!! P.S. ...

[illegible] & family
N.H., Calif.

#650

Sir:

Am concerned about ocean dumping of nuclear wastes + decomissioned nuclear submarines. The ocean must not be further polluted - Already, I avoid commercially raised meat - and do not want to have to add ~~a~~ fish to the list. S. Raphael | L.36

#651

Dear Sir,

6/13/83

I am writing to you in order to express my displeasure over the U.S Navy DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. The idea of dumping any nuclear material in our oceans is absurd, and the people of this nation are not going to stand for it. I dont know if the Navy realizes it or not, but there are great risks in dumping in our oceans. The Navy may build dumps which are supposedly safe, but it only takes one unsuspected phenomenon to cause a serious catastrophe. We are not going to take these chances. We owe ourselves and our future generations the chance to live and enjoy the world that we have been given.

Technology has proven to be a major accomplishment for man, but it also has caused some serious problems. Nuclear power has been one of man's most serious mistakes We must realize nuclear wastes will always be with us, as there is no proper way to dispose of it, and there may never be one.

Please consider the dangers threatening the people and wildlife living along the Pacific coastline who will be in the direct line of a possible nuclear tragedy. I feel this U.S Navy program is inadequate, and I urge you to stop this possible dumping.

Once we lose the environment we have, we will never get the chance to get it back. Please dont allow ourselves to make a serious error with the hidden potenial of nuclear wastes.

Sincerely,

Jim Camenson
3944 Highgate Way
Pittsburg, CA
94565.

830

#652

1404 Oakland Ave
Durham, NC 27705
June 8, 1983

Captain Edward F. Wagner
Office of Chief Naval Operations
Dept. of the Navy
Washington, DC

Dear Sir:

I oppose the dumping of any radioactive materials in the ocean. Although the dollar costs are supposedly less than other methods, have you considered the long-term unknown environmental and health costs? Find a better way to get rid of your obsolete submarines. Better yet, how about not building the subs in the first place?

L.39

Beverly G. Murdock

#653

Bill Evans
Box 267, Lagunitas, California 94938
415 488 9724

Dear Captain Wagner

6 June 1983

I have reviewed the environmental impact report for the sub dumping proposal and find the project undesireable. While agreeing that something must be done with the submarines, ocean scuttling is the product of very poor choices. I encourage the Navy to not proceed and I advise that I will use all my influence as a taxpayer and voter to prevent any dumping from occuring.

Please convey that considered opinion to all decisionmakers on this proposal.

Sincerely

Bill Evans

Bill Evans
Box 975
Laytonville California 95454

#654

Scott Sears
Box 1513
Mendocino, CA
95460

June 10, 1983

Captain E.F. Wagner
U.S. Navy, Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, DC. 20350

Dear Captain Wagner,

I am writing to you to urge you to consider the draft EIS for assessing the environmental implacations of disposal of decommissioned submarine reactor plants be considered inadequate in that it does not seem to

L.39 thoroughly address the possibility & effect of long-term low-level release of radiation. It seems to me that

L.36 more biological research on the true effect of sustained low-level releases into our food chain is absolutely necessary.

Thank you
Scott Sears

#655

1827 Fairview Blvd.
Winston-Salem, N. C. 27107
June 16,1983

Capt. Ed Wagner
U. S. Navy
(OPNAV-22)
Department of Navy
Washington, D. C. 20350

Dear Captain Wagner:

We are writing to ask for your support for the North Carolina Senate joint resolution (DRS JR 2529 LE). You may be aware that this resolution drafted by N. C. Senator Melvin Daniels of Pasquitank County, calls on the U. S. to refrain from ocean disposal of decommissioned nuclear subs off the North Carolina coast.

It is our belief that such dumping would be most disastrous both for now and the future. Surely a safer way of disposal can be found, possibly dryland burial.

Sincerely,

Vivian Grey Sellars
Vivian Grey Sellars
Maria S. Smithson
Maria S. Smithson

#656

Moravian Church in America

BOARD OF CHRISTIAN EDUCATION AND EVANGELISM
Drawer Y, Winston Salem, N C 27108
500 South Church Street • Tel (919) 722-8126

Friday, June 17, 1983

Captain Edward Wagner
United States Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

I am writing to you to express my opposition to the Navy's proposal to bury decommissioned nuclear submarines in the ocean. Several sites off the North Carolina coast have been selected by your Department as well as a site or so off of the California coast.

L.9, F.8 | I believe that it would be a harmful precedent to put anything with nuclear radioactivity into the ocean--even though I realize that this has been done in the past. I think that we must be more creative than we have been thus far in finding acceptable and safe storage sites for radioactive wastes. While the land-based storage sites may be more expensive, they have the advantage of adequate monitoring possibilities as well as retrieval and repair options. The ocean does not give us a second chance.

Surely with the amount of money and brainpower we put into all things related to the military, the people in your Department can recommend something other than ocean burial for nuclear wastes and submarine hulls, etc.

Please let me know what your plans are as time goes by. I will be following this matter and am interested in your recommendations about this.

Sincerely,

William E Gramley

The Rev. William E. Gramley

#657

6/13/83

Dear Captain Edward F. Wagner.

I am foursquare opposed to disposing nuclear subs off the coast of California — or any coast for that matter.

I am convinced that dumping nuclear discards in water is a way of sweeping the dust under the rug. Those containers will not remain wholely intact for the necessary time, they will get lost underwater and eventually will wreck havoc on sea life. Perhaps not in our lifetime but our children's children's lifetime. | L.20 | L.14

Let's deal with nuclear disposal in a straightforward way and not hide it under tons of water.

Thank you for your consideration.

[redacted]
M L Avansino
1520 Union St
Arcata CA 95521

Marylou Avansino

#658

Dear Capt. Edward J. Wagner,

I am writing out of concern about the Navy's plan to dump decommissioned nuclear submarines off our coast of California as well as North Carolina.

I find the idea of adding more radiation to the delicate oceanic environment deplorable. I realize the disposal problem which you face, but dumping in the ocean is not a responsible answer. Perhaps

G.2 protective storage, until a better plan is found, would be a more viable plan. I understand that in 25 to 50 years the short lived radionucleides will have decayed and surely our Naval bases could store the submarines this length of time until a sound disposal plan is studied.

I trust that you will understand my concern for our oceans, and ultimately for all of us.

Sincerely,

Dianne G. Williams
Simi Valley, Ca.

D.G. Williams
4923 Barnard st.
Simi Valley, Ca. 93063

834

#659

G-9-83

Dear Capt Wagner,

According to your Dec 22, 1982 Draft Environment Impact State-
ment, the Navy now intends to carry out ocean disposal of nuclear waste
despite the fact that the United States and five of her allies, as
members of the 53 country membership of the London Dumping Convention passed
a nonbinding resolution to ban such disposal on Feb. 18, 1983

According to the Oceanic Society, the United States despite an additional
moratorium on ocean scuttling passed in 1970 by the federal government, the
Dept of Defense is "a) moving to issue regulations permitting ocean disposal of nuclear
wastes through the EPA, b) advancing towards sea disposal of defueled, decommissioned
nuclear submarines, and, c) pursuing a DOE study on emplacement of high-level
waste in geological formations of the deep seabed" (w/o any protective packaging).

Despite the fact that the 1982 Academy Award-winning (best documentary
short) "If You Love This Planet" (based on lectures to a Harvard audience by the
president of Physicians For Social Responsibility, Dr. Helen Caldicott (MD) on the adverse
medical consequences of nuclear war) has been ludicrously banned for officials'
viewing by the Dept of Defense as "political propaganda", I am sending you
(and, in the future, as many officials as fiscally possible) her book Nuclear Madness
(even though it will probably arrive after the "written statement deadline" of
June 30, 1983) as I feel this book accurately (and using many reputable sources)
explains my opposition to the Navys attempts at ocean disposal of nuclear
wastes

Despite the fact that no adequate nor truly "safe" or "acceptable" means has
yet been discovered to dispose of the mountains of highly toxic nuclear
sewage produced in this country every year, I urge you to consider
G.7 | the noted physicist, Dr. Martin Resnikoff's, proposal of deep underground land
repositories as storage for, among other things, nuclear submarines. Granted,
this a costlier venture than ocean scuttling but considering Presi-
dent Reagan's proposal of one trillion dollars (!) for defense for
fiscal 1983-84, surely something can be done with that money that will
help insure greater safety instead of the impending disaster of nuclear holo-
caust our governments' priorities seem destined to produce unless corrected

Due to the facts that the Navy has no plans for long-term monitoring | J.76
to prevent leakage, vandalism, robbery, etc., that salt water causes rapid | Q.13
corrosion, that all manner of conflicts of interest are involved (Glen Sjoblom,
former Navy chief architect of the sub-scuttling plan, is now Director of the
EPA's Radiation Program), and that even the Navy admits irretrievability (not accept- | W.1
able by the 1972 Ocean Dumping Act), and many other factors too numerous to
enumerate (but so done in the book you are soon to receive) - yet factors
I fear unknown to many public officials (unknown due not too indirectly to
the governments label of "political propaganda" to such excellent and well-documented
media as Dr. Caldicotts aforementioned film) - I hereby state my opposition to,
among other aspects of our country's nuclear obsession, the proposal that
ocean disposal of nuclear waste is "safe" and "acceptable."

Thank you,

Sincerely,

Clifton Troy Todd
2026 W. Grace #4
Richmond VA 23220
(804) 353-4152

#660

P.O. Box 158
Point Reyes, CA 94956
June 15, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Thank you for sending me a copy of the Draft Environmental Impact Statement for the Navy's proposal to scuttle obsolete nuclear submarines in Pacific Ocean waters. I have examined the statement and have two comments to make for your consideration.

First, I believe that the Navy has grossly underestimated the potential dangers of radioactive contamination in the
L.6 | ocean. The experience of the nuclear dumps off the Farallon Islands near San Francisco has clearly shown the potential
L.36 | for concentration of radioactivity in the food chain, to the point where it clearly can become a danger to human health.

A second lesson from the Farallons is that once nuclear
W.1 | waste is dumped in the ocean, it is nearly impossible to recover it. Any mistake that might be made would be permanent.
G.2 | It seems more prudent to find a secure, temporary storage area on land, and to devote resources toward developing a sensible long-term storage strategy.

Thank you for considering my views on this subject.

Sincerely yours,

Michael Carney

Michael Carney

#661

LAWRENCE J. WIELAND, M. D.
2505 LUCAS ST.
EUREKA, CALIFORNIA 95501
TELEPHONE (707) 443-4893

June 15, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the chief of Naval Operations
(OPNAV -22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

We are writing to express our concern regarding proposed dumping of decommissioned nuclear submarines off the coast of California. We are afraid that the radiation will be mutagenic, will contaminate the sea life and enter the food chain. We do not feel the oceans should be used for garbage bins, especially, since the garbage of radiation can be so dangerous to life. | L.43, L.14, L.36

We have a responsibility to future generations to leave an inhabitable, hospitable world. Caring for our environment is paramount in our opinion.

We trust you will consider our way of thinking and beliefs in your decisions and will reconsider and find another method of dealing with radioactive wastes.

We live near the Mendocino coastline and it is intricately related to our lives.

Sincerely,

Dr. & Mrs. L. J. Wieland

Dr. and Mrs. Lawrence J. Wieland

836

#662

264 Swanton Blvd.
Santa Cruz, CA 95060
June 17, 1983

Capt. Edward F. Wagner, U.S.N.
Office of Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Subject: Draft Environmental Impact Statement - Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (December 1982): Review Thereof

Dear Sir:

This letter contains my comments regarding the subject DEIS:

In general, I found the DEIS to contain a comprehensive review of the environmental impacts to be expected from disposal of obsolete nuclear submarines on land or at sea. Although the environmental radiological risk is extremely small for either option, the sea disposal option has less risk and lower cost, and should be selected.

X.2 The DEIS is, as a whole, well written, but there are some matters that deserve further editorial consideration, including the distinction among radiation, radioactivity, and radioactive material (i.e., the term, "radiation" should not be used when the term, "radioactive material" is appropriate). This is particularly significant when addressing the public, many of whom believe that radiation remains as a presence (a "thing"), long after the source is removed. Terms such as "...radiation levels would be very low..." (page 2-13) should be expressed in terms of background level, or otherwise include a frame of reference.

L.32 Throughout the DEIS, conservative situations are assumed to explore the effects of the proposals. Most of these situtations are so extremely conservative that they have no practical meaning; that is, no meaning in a real-time world. Such extreme conservatism should not be used, since it can be misinterpretted by the public. Conservatism recognized by the technician as only an analysis mechanism with no practical effect can be taken by the public as a real-life, practical, and threatening probability. Such situations, if their use is mandatory, should be clearly labeled as being unrealistic and imaginary. An example of such ultra-conservativism is found in DEIS page S-13 in the first three paragraphs.

It would appear that the Summary section of the DEIS is particularly sensitive, since this is the section most likely to be read by the public. Consequently, I have included certain editorial comments and suggestions relating to Summary material:

X.2

Page S-1 2nd Paragraph, 3rd sentence: This sentence could be misunderstood. Suggestion: "...disposal. There would be some mechanical parts remaining in the nuclear reactor compartment that would be radioactive because of previous reactor operation. Therefore,..."

6th Para.: It is suggested that this paragraph be replaced as follows: "A brief description of the way energy is produced in a submarine nuclear reactor may help in understanding how metals in mechanical parts of the reactor become radioactive. The fuel in a submarine's reactor contains uranium clad in a metal casing. Uranium is one of a few materials capable of producing heat from a self-sustaining nuclear chain reaction. When a neutron strikes the nucleus of a uranium atom, the nucleus splits into two or more parts, called fission products (Figure 3). Simultaneously, heat is released, and two or more new neutrons are generated."

Page S-4 2nd Para.: It is suggested that this paragraph be replaced as follows: "The fission products resulting from nuclear fission are usually radioactive. Since the uranium fuel material is contained in a metal casing, fission products are not released from the fuel. However, the neutrons generated by fission can pass through the fuel casing."

3rd Para.: Based on the preceding, delete first sentence. Insert Figure 3 reference at end of second sentence. Underline "nonradioactive" in line 10 of this paragraph.

4th Para.: Last sentence, suggest change as follows: "...this defueling removes almost all radioactive material from the submarine."

6th Para.: Suggest change as follows:

"Prior to disposal, both reactor pressure vessel and the reactor compartment would be sealed. Thus, they act as double containers for radioactive parts of the submarine, and delay the time any of the radioactive atoms in these parts could be released to the environment as the metal corrodes or rusts...."

Page S-6 Figure 5. Callout at lower right; delete "some" since all radioactive atoms decay to stable state with time.

There are several references to USEPA requirements, and compliance with international requirements for disposal of radioactive materials at sea as established by the IAEA under provisions of the London Convention. These requirements are, for the most part, unfamiliar and unavailable to the public. Therefore, it is suggested that the EIS contain a summary of these requirements as an appendix, or even included in Section 2.

Please place my name on distribution to receive a copy of the final EIS. Thank you.

Sincerely,

Harold A. Rogers

Harold A. Rogers

#663

June 21, 1983

Capt. Edward F. Wagner
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D. C. 20350

Dear Sir:

This letter is to protest the "dumping" of nuclear submarines, or for that matter any nuclear waste, into the oceans. To even think of taking a chance of poisoning our oceans, and all they represent, is unthinkable.
*L.6 A case in point is the drums, etc, already dumped and leaking off the Farralone Islands.

As far as disposing of nuclear waste material is concerned, man has a bear-by-the-tail and doesn't really know what to do with it. I'm not opposed to nuclear subs, or nuclear power PROVIDED they find a way to handle the waste. I'm not a/Anti-Nuclear activist, just a concerned citizen that would not like to see this problem handed down to our children's children's .... children.

Ruth J. Alberteon
P.O.Box 995
Sequim, Wa. 98382

*Other issues discussed by Ms. Albertson are side barred in Exhibit 633.

#664

SCENIC SHORELINE PRESERVATION CONFERENCE, INC

4623 More Mesa Drive
Santa Barbara, CA 93110
(805) 964-2492
June 24, 1983

Captain Edward F. Wagner
U.S. Navy
Chief of Naval Operations (OP NAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

Scenic Shoreline has a long and consistent record against ocean dumping of harmful and toxic wastes. We find that the dumping of naval submarines and their highly radioactive reactor plants would present a greater toxic impact than any proposed ocean disposal project to date.

Unfortunately this proposal would also reestablish a precedent for further ocean dumping programs in the face of a strong and growing national concern for providing safe, alternative toxic waste disposal, prevention, and control programs. L.9, F.8

The submarine project is of special concern because of its potential to contaminate extensive ocean areas where toxic wastes disperse widely and also concentrate in food chains reaching humans. L.36

Knowledge is critically insufficient on the effect of deep ocean processes upon submarine disposal, particularly vessel corrosion rates, release and dispersion of radioactivity, and various cumulative impacts. Procedures for monitoring these impacts are also inadequate. Retrival of the submarines from the dump site if necessary, as required by law, is technologically infeasible. L.1, O.13, J.76, W.1, L.7

The cost-benefit comparison between land and sea disposal and other alternative disposal techniques that might minimize radioactive hazards is not adequately considered. O.2

The release of toxic substances to the environment is probably the single most compelling environmental concern in the nation today. Congress in ocean dumping legislation has clearly set forth its intent to exercise far greater protection of sensitive marine resources. This proposed action by the Navy would be a major reversal of enlightened policy.

Cordially yours,

Fred Eissler
President

FE/hj

#665

6-19-83
Box 522
Covelo, CA 95428

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, DC 20350

Dear Captain Wagner,

W.1, L.7, L.53, L.14, L.1 — I am very deeply concerned about the navy's plans to scuttle 120 defueled submarines off of Mendocino Coast. If implemented, long-term, irreversible and cumulative adverse impacts could result. Our sport fisheries might be contaminated by radioactive discharges, as might sea mammals and other ocean-dwelling and -dependent species. I fear that not enough is known about deep sea ecology to anticipate the ways and extent to which this could occur.

L.57, F.15, J.76 — The EIS for this scuttling proposal does not adequately 1) evaluate the probability and potential impact of an accidental sinking of a submarine during towing operations, 2) define a comprehensive monitoring program, nor 3) consider alternative land disposal options for the purpose of minimizing the release of radioactivity into the environment.

A.10 — In a recent study, Dr. Martin Resnikoff predicts that the levels of Cobalt-60 and Niobium-94 will be substantially higher than those suggested in the EIS. If Dr. Resnikoff's predictions are accurate, then only a deep land burial would be the appropriate

G.7 — option-- after a 25-50 year storage period to allow the decay of short-lived radionuclides. This option was not considered in the EIS, but should be seriously developed as an appropriate alternative in the final document.

A summary plea: please do not allow radioactive submarines to be dumped into our ocean.

Sincerely,

James Arthur Ferrera

cc: Gov. George Deukmejian, Congressman Doug Bosco, Assemblyman Barry Keene

#666

June 17, 1983

Captain Edward F. Wagner, U. S. Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

As a concerned resident of Mendocino County, California, citizen of the United States and inhabitant of this beautiful planet, I feel a need to do what I can to help stop the possibility that the oceans will be turned into a radioactive garbage dump. The ocean's eco-system is too fragile and important to our own survival to threaten it with radioactive poisoning. Besides the present proposal by the Navy to scuttle decommissioned nuclear submarines off the California coast there is a new method being considered by the United States, Britain, Japan and other countries for the subseabed "emplacement" of high level nuclear wastes in containers engineered to last 1000 years (high level wastes have half lifes approaching 1 to 2 million years). Since this program does not constitute "dumping" of wastes it is therefore not prohibited under current London Dumping Convention statutes. The subseabed program, if approved, would place into the ocean environment billions of curies of long-lived radioactive wastes. Does the United States, as a world leader, have the right to set such an environmentally disastrous precedent? I don't think so. I believe the United States' responsibility is to show the world it has more concern for the future health, safety and well-being of the planet than that. — L.9, F.8

My main objections to ocean dumping are that once the containers are dumped into the ocean thay will be irretrievable. If the containers are found to leak there will be nothing that can be done to keep the radioactive contamination out of the food chain. It is also my understanding that the Navy has yet to dump anything to the depths considered and have those containers remain intact. We need more research put into finding a safe, permanent solution for radioactive waste disposal. — W.1, L.20

Because of the long term, extremely hazardous effects of radiation I feel that the solution is the abolition of activities that lead to the production of nuclear wastes. Since that seems to be a Pollyanna dream, my next hope would be that a safe, monitorable storage be found. Perhaps as technology advances we will find some use for these current "wastes". — J.76

I have been a scuba diver for over fifteen years. I have seen the beauties and wonders of the oceans. The possibility of losing that magnificent world should not be a risk we can afford to take. For the future of mankind, including the survival of the earth, please reconsider your current plans to use our oceans as a nuclear garbage dump.

Sincerely yours,

Sally Rulison

Sally Rulison

Sally Rulison
P.O. Box 1562
Willits, CA 95490

#667

H. Bomyea
148 Treasony St.
Santa Cruz, Ca 95060

6-22-83

Captain Edward J. Wagner
U. S. Navy
Off. of the Chief of Naval Operations
(OPNAV-22)
Dept. of the Navy
Wash. D.C. 20350

Dear Sir

I am very upset and angry against the Navy's irresponsible plan for deliberately putting more radiation in our Pacific and Atlantic Oceans!

Please do what you can to stop this, for all time.

Sincerely,
H. Bomyea

Ms. Helen Bomyea
148 Treasony Street
Santa Cruz, CA 95060

#668

2533 Buena Vista Rd.
Winston-Salem, N. C. 27104
June 22, 1983

Captain Edward Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Dept. of the Navy
Washington, D. C. 20350

Dear Captain Wagner:

I am writing to express my opposition to the proposal to dump decommissioned nuclear submarines off the coast of North Carolina. I feel that disposal of radioactive material in the ocean is not a wise ecological practice.

Sincerely,

Lehoma Goode

Lehoma Goode

839

840

#669

Captain Edward Wagner, USN
OPNAV-22
Washington, D.C. 20350

Dear Captain Wagner.

The Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants is unacceptable for the following reasons:

It does not address the fact that ocean dumping of radioactive wastes sets a dangerous precedent. The ocean must not become a huge radioactive dump. Ocean dumping is not a solution; in fact, it causes many more problems. L.9, F.8

Not enough research has been done to find a safe, adequate, permanent solution to the problem of radioactive waste disposal. The lack of adequate, conclusive data in the Navy's statement is an indication of the lack of such research.

Manufacturers of nuclear wastes, such as the Navy, must take full responsibility for the safe disposal of such wastes, rather than passing the buck to the state of California and the citizens who live there. The Navy's proposal should be rejected.

Jon Daunt

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616

681

#669a

Captain Edward Wagner, USN
OPNAV-22
Washington, DC 20350

Dear Captain Wagner,

The Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants does not adequately address the following issues:

How low-level radiation enters the food chain. People eat the bottom-feeding shell fish that will be contaminated by the Navy's radiation. L.36.

Transportation hazards, from shipyard to disposal site. L.57

Leakage. Niobium-94 has a radioactive half-life of approximately 20,000 years. No container has yet been devised that will last 20,000 years, and that's only the half life. L.20

Since the Navy has not addressed these issues, then you have no right to dump your radioactive trash in the ocean.

Jon Daunt

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

#669b

Captain Edward Wagner, USN
OPNAV - 22
Washington, DC 20350

Dear Captain Wagner,

The Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants is a sham. The Navy's proposal to dump radioactive materials in the ocean should be rejected.

L.6 We can't afford any more mistakes. The Farallon Islands dump is just such a mistake. The Navy has failed to monitor this dangerous dumping site. Comprehensive monitoring of existing dumpsites should take place before the Navy is granted any more dumpsites.

Worst of all the Navy has arrogantly refused to participate in any dialog with concerned citizens about this proposal. Such arrogant use of power shows that the Navy is not qualified to propose and monitor new dump sites. The Navy's proposal for another ocean dumping site should be rejected

Jon Daunt

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

#669c

Captain Edward Wagner, USN
Office of the Chief of Naval Operations
OPNAV - 22
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

The Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants does not adequately address some very important issues, especially the long-term extremely hazardous effects of radiation.

The issue is cancer. Years from now, perhaps after you're dead, people will be getting cancer because of your submarine reactor plants. To dispose of them in the ocean shows an arrogant use of power on the Navy's part

Sincerely,
Jon Daunt

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

#669d

Captain Edward Wagner, USN
OPNAV-22
Washington, D.C. 20350

Dear Captain Wagner,

The Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants does not adequately address the following issues:

L.20 The depth of the dumping site. No container has yet been devised that will withstand the pressures of the ocean at such a depth. Why does the Navy ignore this fact? The Navy's will automatically spill radioactive material into the ocean.

L.53, L.36 The threat to the fishing industry when radioactivity travels up the food chain and contaminates commercial fish.

Why are no economic impacts given in the Navy's report? The cost of monitoring
J.76 the dumped subs is grossly underestimated, and the cost of escorting the subs out to sea
O.20 is not even included. This shows such gross irresponsibility on the Navy's part that the Navy's disposal request should be rejected.

Jon Daunt

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

#669e

Captain Edward Wagner, USN
OPNAV-22
Washington, D.C. 20350

Dear Captain Wagner,

The Navy's Draft Environmental Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants does not adequately address the following issues:

Monitoring — the Navy has refused to monitor past dumpsites, especially the one at the Farallon Islands. This is in violation of the Anderson Amendment to the Ocean Dumping Act, passed January 5, 1983. The Navy has given no indication that it would do a better job monitoring the proposed site. J.76, L.6

State's rights — your proposal must be approved by the California Coastal Commission (unless you've devised a way around this), and the Commission has already expressed very strong disapproval. The Navy's proposal also violates the 1983 London Dumping Convention. F.11

This sort of irresponsibility on the Navy's part proves that the Navy is not capable of adequately carrying out its dumping proposal. It should be rejected.

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616

Jon Daunt

#669f

Poet: Guy R Beining Brooklyn, NY
Artist: Jabbott Norway, NY

SACRAMENTO, CA PM 23 JUN 1986

Dear Capt. Wagner,
The radiation gets into the bottom-feeding shellfish and causes cancer when eaten. Stop dumping your radio-active nuclear subs off the California coast.

L.36

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

Jon Daunt

Palindrome Press PO Box 232, Pola. NY 13431
PO Box 808, Goodis. FL 33933

Crazy Horse

Capt. Edward Wagner,
U.S.N.
Office of the Chief of
Naval Operations
(OPNAV-22)
Washington, D.C.
20350

#669g

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

H.16

Dear Captain Wagner,
We don't want your radioactive nuclear submarines dumped in our ocean. Shoot them into space. So what if that is expensive. We already have a $200 billion deficit so what's the difference.

Jon Daunt

WITH THE AID OF THE OHIO ARTS COUNCIL
PIRTO PRESS POSTCARDS, SERIES #5
445 Grove St., Bowling Green, OH 43402

#669h

Dear Captain Wagner,
Do us a favor. Stop dumping your radioactive nuclear submarine carcases into our ocean off our coastline. We used to eat fish around here. Not any more, because no one wants to get cancer from your submarines

L.36

JON DAUNT
1402 DRAKE DRIVE #C
DAVIS, CA 95616
U.S.A.

Jon Daunt

844

#670

Dear Captain Wagner—

Please don't dump nuclear wastes at sea. It is a precious resource. The sea (and the earth) belong to us all — now, and for those to come.

Here is a book I hope you will read. You are in a position to do so much — may it be good, and not destructive and harmful.

Sincerely,

Dorothy Lane

DOROTHY LANE
P.O. Box 517
TALMAGE, CA 95481

copy of "The Hundredth Monkey" enclosed.

#671

2120 Royall Dr.
Winston-Salem, N.C. 27106
June 21, 1983

Captain Edward F. Wagner
OPNAV-22
Department of the Navy
Washington, D.C. 20350

Dear Sir,

I am deeply distressed with the Navy's plans to dispose of decommissioned nuclear submarines in the ocean. There are many problems with these plans that were not addressed in the DEIS.

F.19 | ① There is no test data on actual sinkings.

W.1 | ② There is no mechanism discussed for retrieval if problems develop.

L.45 | ③ There is no discussion of the long-term effect of radioactivity.

L.58, F.15 | ④ There is no allowance for increased danger of dumping the submarines in rough seas. The seas near Cape Hatteras are notoriously rough waters.

L.55 | ⑤ There is no mention made of the way that artificial substances, such as submarines, act as reefs which may support marine life in areas where it may not exist otherwise. This effect puts marine life in direct contact with the radioactive chemicals and radiation released.

O.34 | ⑥ There is little consideration of the economic impact on the fishing and tourism industries of the states involved.

L.9, F.8 | ⑦ There is little or no consideration of the precedent that would be set for future ocean dumping of radioactive wastes.

These are only a few of the potential problems that exist with the Navy's plans. I believe that these problems show that much more study is needed before any dumping plans are finalized.

Because the present "solution" to the problem of what to do with these decommissioned submarines is unacceptable, the Navy should scale down production until an acceptable one is found. At the least, the Navy should consider disposal costs as a part of the overall cost of the sub so that the disposal cost would not be a factor in this process. | O.4

Ocean dumping is not a safe option because it leaves future generations a legacy of potential radioactive pollution that cannot be corrected. Please do not endanger our marine life and create a potential for many adverse consequences by finalizing the plans to dispose of nuclear submarines off of our coasts. | L.14

Sincerely,

Kimberly J. Christman

846

#672

SONOMA COUNTY
DEPARTMENT OF PLANNING

Captain Edward F. Wagner, U. S. Navy
Office of the Chief of Naval Operations (OPNAV.22)
Department of the Navy
Washington, D. C. 20350

June 20, 1983

Subject: Draft Environmental Impact Statement (DEIS), Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

Dear Sir:

Thank you for the opportunity to review and comment on the above document. Our concern over the project is primarily due to the close proximity of the proposed Cape Mendocino site to Sonoma County's coastal area. Following are our comments on the Draft EIS:

W.1 1. The DEIS fails to establish the compelling purpose for permanent irretrievable disposal of the decommissioned submarines. To simply state that there is no plan for permanent disposal does not establish the need for the project.

J.9, J.28 2. Chapter 3 and Appendix E of the DEIS are intended to provide a description of the existing environment in the vicinity of the proposed disposal sites. These descriptions lack the specific detail and base data necessary to provide a backdrop against which adverse impacts can be assessed. The oceanographic studies which would provide this base data apparently were not completed at the time of publication of the DEIS. In light of the apparent fact that there is no urgency in the consideration of disposal alternatives, specific sites should be thoroughly studied prior to any disposal decision being made. Studies of ocean currents at the Cape Mendocino site would be particularly important to Sonoma County.

L.7 3. The DEIS repeatedly states that the anticipated amounts of radiation exposure from the project are comparable to or less than what people normally receive from natural background radiation. The DEIS, however, does not address the potential cumulative exposure from all of the submarine reactor compartments taken as a whole in combination with natural background sources, weapons testing fallout and other past, present and future radioactive waste disposal operations.

L.9 4. The determination that an ocean disposal site is "acceptable" for radioactive waste is precedent-setting. The DEIS should address the increased potential for future dumping of radioactive wastes from other sources in the event that the proposed sites are approved.

5. Complete analysis of the impacts of past disposal operations should be provided in the DEIS. L.6

6. The DEIS does not adequately discuss indirect impacts resulting from the project alternatives, such as

a. Potential impacts of radiation exposure on humans, plants, and animals, particularly as a result of bioaccumulation of radionuclides in the food web. L.36, L.14, L.37

b. Potential impacts of the ocean disposal, alternative on the coastal dependent commercial fishing and tourism industries. L.53

7. There appear to be differences in scientific opinion regarding the conclusions presented in the DEIS, particularly with respect to potential radiation exposure. In the absence of agreement within the scientific community it would seem prudent to conduct necessary scientific research for incorporation in the DEIS prior to reaching a decision on "permanent" disposal.

8. The simple fact that the "protective storage" and "land disposal" options allow continual monitoring at relatively low cost and recovery of the reactor compartments in the event that unanticipated impacts result is reason enough to avoid the ocean disposal option. G.2

We request that the above issues be thoroughly addressed in the Draft EIS and an opportunity to comment on the preliminary results of the environmental studies be afforded to us prior to preparation of the Final EIS. As stated in the attached Resolution #71101, the Sonoma County Board of Supervisors has formally requested that the Federal Government ban ocean disposal of radioactive waste and decommissioned nuclear submarines.

We thank you for your cooperation in allowing additional time for comment on the DEIS and look forward to reviewing responses thereto. Please contact Greg Carr of this office (707) 527-2917 if any questions arise regarding this matter.

Yours very truly,

THOMAS E. SOIKE
Planning Director

Gregory N Carr
Greg Carr
Planner II

GC/mmm
Attach.

#672 (Cont)

COMMENTS TO NO.

R. 2 14

Resolution No. -71101

Administration Center
Santa Rosa, CA 95401

February 2, 1982

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SONOMA, STATE OF CALIFORNIA, ASKING THE FEDERAL GOVERNMENT TO BAN OCEAN DISPOSAL OF RADIOACTIVE WASTE AND DECOMMISSIONED NUCLEAR SUBMARINES

WHEREAS, the oceans of the world are vital to all life forms on earth, and

L.53 WHEREAS, the ocean waters off the Sonoma County and California coast are the basis for the County and State commercial and recreational fisheries, and

WHEREAS, the fishing industry constitutes a source of food for the County, State and are important to the economies of the north coast, and

L.14 WHEREAS, the marine environment is a fragile ecosystem that could be altered by the disposal of known radioactive waste, and

L.7 WHEREAS, past radioactive ocean waste disposal have rendered contamination to ocean sediment and the marine environment, and

L.39 WHEREAS, the longterm effect of radioactive waste in the marine ecology are poorly understood and pose a threat to the human food chain, and

WHEREAS, the United States Navy and U. S. Department of Energy are considering plans to sink decommissioned nuclear submarines off the shores of Northern California.

NOW, THEREFORE, BE IT RESOLVED that the Sonoma County Board of Supervisors request that the federal government ban all radioactive waste disposal, including decommissioned nuclear submarines, in ocean waters.

SUPERVISORS:

Adams Aye Putnam Aye Rudee Aye Carpenter Aye Esposti Aye

Ayes 5 Noes 0 Absent 0 Abstain 0

#673

June 17, 1983

Captain Wagner
U.S. Navy, Office of the Chief of Naval Operations
COPNAV-22
Department of the Navy
Washington D.C. 20350

Dear Captain Wagner:

As a resident of central California I am extremely concerned about and protective of the ocean life which inhabits the waters off our coast.

There already is radioactive contamination traveling through the food chains in this area. Strontium-90, Cesium-137 and Plutonium have all been found in high concentrations in the larger fish and ocean fowl. This is a result of so called low level radioactive waste which was dumped in the 1970s as well as the continual discharge of low level wastes from naval vessels at sea. L.6

Presently, the Navy would like to dispose of their old nuclear submarines in the sea off the Mendocino coast. Only two of these subs would add more radioactivity to the seas then all that has been dumped thus far off the U.S. coast up to this time.

I am strongly opposed to the disposing of these submarines in our oceans as well as any other radioactive wastes. The ocean is a living organism, it is where we evolved from and now the Navy wishes to contaminate and pollute her. This is wrong!

I would appreciate your taking my concerns into consideration and I request that you send me a copy of the Draft EIS concerning the disposal of Naval submarine reactor plants.

Sincerely,

Janice Ryavec
4617 Sonoma Hwy.
Santa Rosa, California 95405

#674

MARINE LAW INSTITUTE

246 Deering Avenue, Portland, Maine 04102, 207/780-4474

June 28, 1983

Captain Edward F. Wagner,
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

We have reviewed the Navy's Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled, Navy Submarine Reactor Plants", and offer the following comments. Our primary concern is with certain values and assumptions implicit within the DEIS that show an insufficient awareness of the larger policy context regarding the sea disposal option in which the decision on disposal of decommissioned nuclear submarines must be made

F.8

We are also concerned that the information on fates, pathways, rates and thresholds which is needed to make scientific judgments on possible impacts is not available, given our current understanding of the behavior of radioactive material in the ocean. The Navy must therefore evaluate how the absence of this information is going to affect the balance struck between ocean and land disposal by decisionmakers.

L.1

I. ENVIRONMENTAL POLICY AND THE INTERNATIONAL CONTEXT

In general, the DEIS appears to give insufficient recognition to "the worldwide and long-range character of environmental problems" and its Congressionally imposed responsibility, where consistent with foreign policy of the United States, to lend support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment." 42 U.S.C. §4332.

University of Southern Maine
A UNIT OF THE UNIVERSITY OF MAINE
/
UNIVERSITY OF MAINE
SCHOOL OF LAW
CENTER FOR RESEARCH AND ADVANCED STUDY

Captain Edward F. Wagner
Page 2
June 28, 1983

Effects On The Physical Environment. We take issue with the Navy's apparent position that preparation of a DEIS is not required in this instance, as is indicated by the statement in the Forward that the decision to prepare a DEIS "is based o the anticipated high interest in the disposal method decision rather than the expectation that either option would significantly affect the quality of the human environment."

Scientists have not yet agreed that there exists a threshold level for biological effects caused by ionizing radiation. Under these circumstances it is debatable that intentional manmade contributions to environmental radiation, including the addition of persistent nuclides with half lives ranging into the tens of thousands of years are "insignificant".

Effects On The "Human Environment." Apart from effects on the physical environment, the determination to dispose of nuclear submarines at sea certainly would be a "major Federal action...significantly affecting the quality of the human environment," as those terms are defined in 40 C.F.R. §1508. As 40 C.F.R. §1508.27 notes: "'Significantly' as used in NEPA requires considerations of both context and intensity." With regard to "context", that provision notes that "an action must be analyzed in several contexts such as society as a whole...."

Similarly, the intensity or severity of impacts are to be judged in light of such facts relevant here as:

-Unique characteristics of the geographic area.

-The degree to which the effects on the quality of the human environment are likely to be highly controversial.

-The degree to which the possible effects on the quality of the human environment are highly uncertain or involve unique or unknown risks.

-The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

Examining the action in the context of international relations, it should be noted that the deep ocean beyond 200 miles from the coast, which includes the proposed East Coast disposal sites, is a unique geographic area in that it is generally recognized to be beyond national jurisdiction and to be the "common heritage of mankind."

The DEIS indicates little awareness of this larger context or the larger effects in the international arena. *De jure* compliance with London Dumping Convention (LDC) standards does not guarantee no *de facto* effects on the world human environment. Both national and international law have designated low-level radioactive wastes (as distinguished from natural background or from uncontrollable additions of radioactivity, e.g., from volcanoes or accidental vessel sinkings) as a matter of conern. For comparative purposes, it has been noted that two submarines contain more curies of radioactivity than all radioactive wates known to have been dumped in the ocean by the United States between 1946 and 1970. Similarly, three submarines would contain more curies of radioactivity than is currently ocean-dumped annually by the British, the primary users of ocean disposal for low-level radioactive wastes. In terms of potential available radioactivity in the context of global ocean dumping, the effects of sea disposal are not insignificant.

The United States has not dumped any radioactive wastes in the ocean since 1970 and has been a world leader in efforts to curb disposal of wastes in the ocean. Thus, one factor in determining the severity of this action's
L.9,F.8 impacts, that is, "the degree to which the action may establish a precedent for future action with significant effects or represents a decision in principle about a future consideration", is therefore very high in the international context. Actions since the preparation of the DEIS tend to support this position. A resolution adopted in February at the Seventh Consultative Meeting of Contracting Parties to the LDC (by a vote of 19 to 6 with 5 abstentions), imposes a two year moratorium on the
F.2 dumping of low level radioactive wastes. The United States already has its own moratorium on the dumping of those wastes through January 6, 1985, with Congressional approval of dumping of such wastes required after that date. 33 U.S.C. §§1414(h) and (i) as amended by Pub. L. 97-424 Title IV §424(a), 96 Stat. 2165 (Jan. 6, 1983) (the Anderson Amendment).

The DEIS therefore should at least note the likely effects on the human environment of United States loss of stature and leadership in the LDC forum, and of course
F.2 should deal with the recent U.S. legislation as a potential legal constraint on use of the sea disposal option (*See* 40 C.F.R. §§1502.23 stating that an EIS "should at least indicate those considerations, including factors not related to environmental quality, which are likely to be relevant and important to a decision...")

Cumulative Impacts. Related questions arise concerning cumulative impacts of sea disposal, yet these
are not addressed in the DEIS. It is likely that other F.8
nations will follow the U.S. example and develop low level radioactive ocean waste disposal programs. (For example, what effect will the U.S. action have on the Japanese proposal to dump up to 100,000 curies annually in the Pacific Ocean near Micronesia?)

Even within the national context, the DEIS fails to L.7,L.9
address cumulative impacts sufficiently. Once a precedent is established for sea disposal, disposal of contaminated soils from the Manhattan project or subseabed disposal of high level wastes may follow. Are the relative cost differentials for the alternatives in those disposal options much greater, so that perhaps it makes sense to incur the additional costs of land disposal here, in order to reduce the total curies of U.S. sea disposal? According to Dr. Charles D. Hollister of Woods Hole Oceanographic Institution, "Calculations show that the waters of the oceans are not vast enough to take all of the waste from military and industrial sources accumulated over the next few decades without eventually being contaminated beyond safe limits." ("A Review of Current Science and Technology for Disposal of High-Level Radioactive Wastes Within Geologic. Formations of the Deep Seabed," Nuclear Waste Management: The Ocean Alternative 56, 66 (T. Jackson, ed., 1981).)

Irretrievability. The problem of the admitted
irretrievability of the submarines may make dumping W.1
illegal even after the end of the current moratorium, as
the Anderson Amendment to the Ocean Dumping Act requires F.2
that any permit for sea disposal of radioactive wastes include "a plan for the removal or containment of the disposed nuclear material if the container leaks or decomposes." 33 U.S.C. §1414(i)(1) (E). (*Also see* 40 C.F.R. §§227.11(b)(1), EPA regulation requiring that the materials to be disposed of must decay, decompose or radiodecay to innocuous material within the life expectancy of the containers and/or their inert matrix.)

Even without such domestic legal constraints, the
ethical concerns noted regarding cumulative impacts on the L.7
global commons are exacerbated by the fact that the radioactive commitments are irretrievalble, particularly given the admitted magnitude of uncertainty concerning
deep sea ecosystems. In Chapter 2 of the DEIS, the Navy L.1
notes that "the alternative of disposal with minimum delay would accomplish the objective of safe, permanent and

#674 (Cont)

environmentally acceptable removal of the radioactive material from human activities...without placing the responsibility for disposal on a future generation." That responsibility would seem much easier for future generations to bear, than would having the choice made for them and having to live with any consequences with no forseeable opportunity to revoke a choice deemed in error.

We note other inadequacies in the DEIS as follows:

2. MONITORING

I.12 Land Disposal. The description of the results of monitoring at the Hanford and Savannah River sites as provided in Appendix K is inadequate. The DEIS simply states that "The National Research Council reported that no measurable harm has resulted from these operations." This is a conclusory value judgment as to what constitutes
I.4 "harm" and relies on a report published six years ago. Actual figures of recent measurements should be provided. As such figures are presumably being obtained currently, they must be presented. Similarly, to the extent that there have been very significant changes in monitoring instrumentation and methodology since preparation of the referenced 1975 and 1977 impact statements, they much be noted. (See 40 C.F.R. §1502.22(a).)

Sea Disposal. Of major concern is the proposal for post-dumping monitoring. The DEIS states in Appendix K: "If the analysis presented in this statement were to be corroborated by surveys performed during the period of active disposal, post-disposal surveys would need to be done very infrequently." The term "very infrequently" needs to be quantified for evaluation by commenters. Does "very infrequently" mean once a year, once a decade, or once a century? The implications from the cost estimates
J.76 are very disturbing. Appendix K identifies the costs of a monitoring cruise as $0.8 million and the total monitoring program during and after disposal as costing only $9 million, or roughly 11 monitoring trips in a period of 400 years. We share the concerns expressed by the Oceanic Society in its comments on the DEIS, that the money budgeted for the monitoring program is inadequate and that basing the frequency of post-disposal monitoring on results obtained during the initial disposal period, when the DEIS predicts no release of radioactivity, is inadvisable. For additional comments on monitoring, see the section entitled "Tiering" below.

3. ALTERNATIVES

The Oceanic Society Comments on the DEIS, pp. 18, 21, identify two land disposal options not discussed in the DEIS: 1) disposal in open trenches in an arid or semi-arid environment and 2) burial in a deep-mined repository after long-term protective storage. The Navy H.3, G.7
should address these disposal options (with or without preliminary protective storage) in a revised DEIS that should then be available for further public comment.

4. TIERING

40 C.F.R. §§1502.20 and 1508.28 discuss tiering of impact statements. Tiering is obviously required in this case, particularly if the sea disposal option is pursued; i.e., site specific EIS's will have to be prepared for individual sites after the baseline predisposal monitoring described in Appendix K has been performed. Nowhere does the DEIS allude to what additional or supplemental statement preparation is contemplated or the anticipated scope of those statements. Such information would facilitate review of the adequacy of the existing statement, and possibly evoke helpful comment on the division of analysis between the statements. In addition, the cost analysis should include the costs of additional O.17
EIS preparation, particularly to note any identifiable differential in this area between land and sea disposal.

CONCLUSIONS

Based on the above comments, we disagree with the conclusion stated on the final page of the text of the DEIS that,

> It may be concluded that since both options would have negligible environmental impact, either option could be chosen; however, the only distinct advantage of choosing one option over the other would be the relatively lower cost of the sea disposal option.

Currently available information does not support the conclusion that the impacts on the human environment are negligible. And, even granting that the difference in predicted impacts on human health between the disposal options forms small basis for choosing between them, we do not find cost to be the only, or even the primary, basis for distinguishing between land and sea disposal. Rather, we think a major shift in practice from not using the

#674 (Cont)

Captain Edward F. Wagner
Page 7
June 28, 1983

ocean for radioactive waste disposal to dumping relatively large amounts of such wastes, and a shift in policy away from that articulated by the Council on Environmental Quality ("Dumping of other [low-level] radioactive materials would be prohibited except in a very few cases F.8 for which no practical alternative offers less risk to man and his environment,") should not be undertaken without consideration of the ethical and policy dimensions of the choice, as outlined in Comment 1. above.

Sincerely,

Karen A. Massey
Staff Attorney

KAM/clm

852

#675

Captain Wagner,

My name is Kim Stanley. I am a student attending the University of California at Santa Barbara. I am writing you because of my sincere concern ~~of~~ over the Navy's proposed plan to dump 100 nuclear submarines off the Mendocino coast. I don't want the ocean water that I swim in to become a nuclear garbage dump. Who knows what the effects of 100 submarine reactors containing 62000 curies of radioactivity EACH can be??

L.36 Food chains are involved in the processes of the ocean. Please consider the

L.14 wildlife, and the people - neither of us are expendable

Sincerely,
Kim Stanley

Kim Stanley
6748 Sabado Tarde *A
Goleta CA. 93117

#676

June 25, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Subject: Draft Environmental Impact Statement of Ocean Dumping

Dear Captain Wagner:

I would like to go on record as adamantly opposing the Navy's plan to ocean dump any decommissioned nuclear submarines now or at any time in the future.

In my opinion, it is imperative that the Navy find a safe solution to this problem of its own making. The Navy's Draft Environmental Impact Statement has been called the most misleading, distorted, poorly documented DEIS that some scientists have ever seen. The current plan for deliberately putting more radiation in our oceans is totally irresponsible as there has been no conclusive studies to dispute the 1970 report issued by the Council on Environmental Quality that ocean dumping of any radioactive waste presents a potentially serious threat to the marine environment.

Please keep your radioactive waste out of our oceans!

Yours truly,

Teresa Ballard

Teresa Ballard
390 E. Durham Ferry Rd.
Tracy, Ca. 95376

tmb

#677

Dear Sir,

I am writing to express my concern about the Navy's plans for dumping defunct nuclear subs off the Mendocino Coast in Northern California.

I live in the town of Mendocino and enjoy the ocean in a recreational sense; surfing, diving, and fishing. We are fortunate to have such beautiful clear water, not to mention clean and uncontaminated. L.53

I would worry about the future of the area's water quality if there were nuclear subs lying on the ocean floor out there.

Studies have shown that there is a substantial amount of interchange of materials between the surface and the ocean's floor via currents and upwelling. I don't believe it is safe to sink the nuclear subs off of this coast or any other coast. J.28, J.31

Please search further for a viable alternative.

Thanks,

Danny Barca
Box. 873
Mendocino, Ca. 95460

#678

1 27 83

[illegible] Wilcox
Box 2[illegible]
Talmage, [illegible] 95481

Captain Edward [illegible] USN
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Re: Draft E.I.S. on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

I am writting this letter to express my comments on the Navy's Draft E.I.S.

The very first part of this E.I.S. belies the fact that this report was written not to present accurate information on disposal options, but to portray a very specific option (sea disposal) as being the best alternative and that there was none of the objective impartiality that a report of this significance absolutely requires.
The report begins with the conclusion (??) that there is no significant affect on the quality of the human environment from any disposal method. Reports such as this should present information which is the result of in-depth research considering all facets of the problem — not put forward a conclusion and go about supporting that conclusion with obsolete, incomplete data which is the result of 4th grade quality research. This quality of a report on a topic of this significance is unacceptable.

A proper study of radioactive waste managements would show that there is and has been measurable harm to human health and irreparable damage to the environments as a result of mismanagement and lack of proper research and knowledge.

One of the many good examples of the shockingly low quality research is on page S-10 of the E.I.S which says "After about 100 years ... decay would essentially eliminate external exposure to radiation even if someone were to enter the compartment." First of all, the radiation hazard would exist for many thousands of years and, radiation damage is no more "external" than X-rays stop at the surface of your skin. B.8

This report seems to be written not to inform but to decieve. The analysis given in the report never deals with the correct number of reactor compartments but instead exclusively deals with 100 reactor compartments not the most accurate available number which is stated as being 120 reactor compartments. This error in analysis, using one-fifth fewer reactor compartments than are expected, is indicative of the attention to detail and quality of the report. A.1

There are false statements made about radiation exposure, environmental safety, effects and impacts on the human environments.

The report does not go into the required detail necessary to deal with all known nuclides in the submarines. These

#678 (Cont)

A.10 nuclides which require much more extensive research are
Cobalt-60 and Niobium-94 to mention only two.

The criteria for ocean disposal are not met in the
Pacific Study Area. The Pacific area is used by commercial
J.12 fisherman, produces significant amounts of seafood, is currently
used by man for this purpose and will logically be used as
a ~~food~~ fishing area in the future.

The cost study made in the report does not include certain
necessary costs of submarine disposal. Those costs included and
excluded portray a deceptive view of the actual cost of the
various methods of disposal. Some examples of the cost data
O.22 omissions are: 1. Those costs associated with missle compartment
removal (3.9 million) 2. Costs arising from the declassification of certain
J.76 items 3. Costs of monitoring radioactive safety after dumping
which consider more than just the best case outcome.

The portion of the report dealing with submarine impact upon
reaching the ocean bottom seems to be very poorly researched. The
magnitude of the impact shock on the submarine may be more than
2 g's and the deceleration time interval most probably will
F.19 be much less than the 0.7 seconds stated in the report. Has
the reports "worst case" taken this into consideration or even
the "expected case"?

The EIS states on page 3-6 [C.2.1(3)] that dump sites

should ~~be~~ not be situated in known areas of natural phenomena.
The Pacific Study Area is very near to an active geologic fault J.19 F.22
line (Mendocino Fracture Zone) directly to the north which could
affect the rate of release of radiation from the reactor
compartments to the environment.

The report states that the "overwhelming body of scientific
research and opinion shows that" no harm has been done by
past ocean dumping. This statement is false; first, there are
studies which show that damage to the environment has
occured; secondly, very little study has been done to find L.6
out exactly what changes may have occured to the marine
environment as a result of the past ocean dumping of
radioactive waste.

In regards to the sea disposal option, there are no
measures available to mitigate adverse environmental effects
if the reactor compartments open to the environment.
The submarines, once on the seafloor, are irretrievable, W.1, J.76
difficult or impossible to monitor and could contaminate vast
areas of the Pacific Ocean through radionuclide release and
dispersion by ocean currents and tides. Before the sea
disposal option is considered there should be very extensive
safety experiments to determine risk. Existing waste dump

#678 (Cont)

L.6 sites should be objectively monitored and studied to determine the
effects of nuclear waste on the environment.

In reading the E.I.S. I found that 1970 census data was used
K.5 The 1980 census data was available at the time of the study - Why
was the current data not used? Could the reason be to further
deceive the American public and decision makers?

The adverse environmental effects section is so poorly done that one can scarcely comment on it other than to say "go back to the beginning and try again." Even though comment on this section is barely possible, I will try. The section ~~on~~ says on 4-17 that "...it is not possible to be totally certain that no exposure would occur...". This is more accurately stated: It is <u>impossible</u> to assure that no exposure would occur. The section continues on page 4-18 saying "This was used for simplicity in the mathematical treatment...". Could this be why the report exclusively deals with the effects of 100 submarines and not the more correct number of 120 submarines? On the above mentioned page the report says "...a direct biological path to humans has been assumed in another calculation even though no such path has ever been found...". For your consideration I will show you
a direct pathway which <u>has</u> been found:
T.15 Shrimp live on the deep ocean bottom (dump site) and eat food
from the bottom and water (radionuclides) then you and your
children eat the shrimp for dinner. Is that direct?
Glow in the dark shrimp.

One of the more blatant attempts at the statistical manipulation of data to support the Navy's preconceived conclusion is the population of people used to obtain the per-capita exposure
levels. A logical person would consider those people, for example, L.34
who live within 500 miles of the dump site <u>not</u> "the entire
population of the U.S. West Coast. (30,000,000 persons) This
~~distraction~~ dilution of data approximates fraud with malicious intent. The "maximum-exposed individuals" calculation suffers from extreme data and statistical manipulation.

Quoting from page 4-19 in regards to an exposure pathway "through the water to distant fishing grounds".
The Pacific Study Area is not <u>distant</u> from fishing grounds L.2
but is itself a productive fishing ground.

The E.I.S. states that costal areas will suffer no
adverse impact. This is totally false as there will be some
psycological impact on the costal areas even if, by some O.34
miracle, radioactive contamination does not accrue to the
environment.

The conclusion that the sea disposal option has a
relatively lower cost does not consider the cost of an
adequate monitoring system to inform the people of the rate J.76
of release of radioactivity. The disposal sites should be

#678 (Cont)

monitored for hundreds if not thousands of years.

The whole purpose of the Navy report seems to be to, patently, mislead the public. The E.I.S. considers preposterous options, i.e. disposal in space, and neglects to consider obvious, logical options.

H.2 One such option (not considered) is burrying the reactor compartments in a deep mine repository.

H.3 The most promising option, which was not dealt with in the report (sect's 4.0, 1.4.1c), would be to place the reactor compartments on the land surface in a very dry environment to virtually arrest the corrosive process which the report concedes is the primary source of radiation release to the environment.

The E.I.S. raises unanswered questions and totally ignores many pertinent questions.

A.12 First, has radiation damage affected the rate of reactor compartment corrosion? Is there corrosion product activity within the reactor compartment? If so, how much and what is the corrosion made of Am^{241}, Cm^{242}, Cm^{244}, Pu^{239}, Pu^{238}?

Q.13 Does the water placed into the reactor compartment change the rate of radionuclide solubilization? Is there potential for electrolytic activity which could accelerate the corrosive process and the subsequent release of radionuclides to the environment? Has the study considered the speed of corrosion of piping and welds and their effect on containment?

I was saving the best for last. Why is the worst case one (1) accident? If I were to do something 100-120 times I would expect to make at least one ~~accident~~ mistake. The "worst case" is not one accident, not 100 accidents, but 120 accidents. L.57

I dare you to include the true worst case (120 accidents) in your E.I.S. The "anticipated high interest in the disposal method" which a proper study would cause would most certainly compell the Department of the Navy to consider acting in a logical and responsible manner.

While this letter is long it barely scratches the surface in regards to weak scholarship, serious information gaps, obsolete data and unanswered questions relating to the selection of a disposal option.

Respectfully yours,

James Widmeyer

PS: Please look through the harshness of my comments and see my real concern for the American Public and our environment!

J.W.
Box 254
Talmage Ca. 95481

858

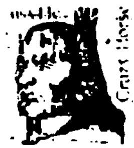
#679

Eight Dead Hoppers

Dear Friends?
We certainly don't want your subs dumped in this beautiful ocean! Why don't you dump them at your favorite Naval Base since you feel they are so nice and safe!!! I speak for many.

QUANTITY POSTCARDS
1402 Grant, San Francisco, CA 94133
Wholesale/Retail (415) 986-8866

EUREKA CA '83



Captain Edward Warner
Office of the Chief
of Navy Operations
Dept. of Navy
Washington, D.C.
20350

#680

6/24/83

Dear Captain Wagner —

This is an appeal to you to do what you can to stop the dumping of radio-active material into our oceans. Please realize the seriousness of these irresponsible actions on the part of the U.S. Navy. As an example, are you aware of the amount of concentrated radioactive material that is now showing up in the larger fish we eat -- who have eaten smaller fish -- who have eaten even more smaller fish — who have eventually eaten hundreds of small bottom feeders -- who are feeding beside these leaking barrels. It goes right up the food chain in ever more concentrated doses.

U.20

L.37

Please do what you can.

Thank you,

Sherry Pinsler
2416 Grant
Berkeley, CA 94703

860

#681

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations (OPNAV-2_)
Department of the Navy
Washington, D.C. 20350

June 28, 1983

Captain Wagner;

To try to cover every element of your D.E.I.S. on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants would require volumes of information and testimonies. We have not the libraries of knowledge at our immediate disposal. We have however, documented, full agenda meetings on these concerns in Humboldt County, as well as the entire hearing in Sacramento, California, February 25th, 1983 via film, recordings and video. These meetings introduced a vast wealth of information and attitudes of both the scientific community as well as the public concerns.

Having studied your D.E.I.S. and the documented testamonies on these concerns in Humboldt County, as well as the hearings in Sacramento, understanding a basic working knowledge of Nuclear Physics and its relation to living tissues (see enclosed), and further alarmed by a recent Nuclear Energy Liability Exclusion Endorsement sent by a Health Insurance Company....we truely feel that any further pollution is most threatening indeed!!!! There is pollution enough without calling on more and we respectfully request that you keep yours and monitor it elsewhere.

Sincerely,

C. N. Rising
C.N. Rising

Barry Q Stewart
Barry Q Stewart

NUCLEAR ENERGY LIABILITY EXCLUSION ENDORSEMENT

(Broad Form)

It is agreed that the policy to which this endorsement is attached does not apply:

I. Under any Liability Coverage, to injury, sickness, disease, death or destruction

(a) with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limit of liability; or

(b) resulting from the hazardous properties of nuclear material and with respect to which (1) any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof, or (2) the insured is, or had this policy not been issued would be, entitled to indemnity from the United States of America, or any agency thereof, under any agreement entered into by the United States of America or any agency thereof, with any person or organization.

II. Under any Medical Payments Coverage, or under any Supplementary Payments provision relating to immediate medical or surgical relief, to expenses incurred with respect to bodily injury, sickness, disease or death resulting from the hazardous properties of nuclear material and arising out of the operation of a nuclear facility by any person or organization.

III. Under any Liability Coverage, to injury, sickness, disease, death or destruction resulting from the hazardous properties of nuclear material, if

(a) the nuclear material (1) is at any nuclear facility owned by, or operated by or on behalf of, an insured or (2) has been discharged or dispersed therefrom;

(b) the nuclear material is contained in spent fuel or waste at any time possessed, handled, used, processed, stored, transported or disposed of by or on behalf of an insured; or

(c) the injury, sickness, disease, death or destruction arises out of the furnishing by an insured of services, materials, parts or equipment in connection with the planning, construction, maintenance, operation or use of any nuclear facility, but if such facility is located within the United States of America, its territories or possessions or Canada, this exclusion (c) applies only to injury to or destruction of property at such nuclear facility.

IV. As used in this endorsement:

"hazardous properties" include radioactive, toxic or explosive properties;

"nuclear material" means source material, special nuclear material or byproduct material;

"source material", "special nuclear material", and "byproduct material" have the meanings given them in the Atomic Energy Act of 1954 or in any law amendatory thereof;

"spent fuel" means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a nuclear reactor;

"waste" means any waste material (1) containing byproduct material and (2) resulting from the operation by any person or organization of any nuclear facility included within the definition of nuclear facility under paragraph (a) or (b) thereof;

"nuclear facility" means

(a) any nuclear reactor,

(b) any equipment or device designed or used for (1) separating the isotopes of uranium or plutonium, (2) processing or utilizing spent fuel, or (3) handling, processing or packaging waste,

(c) any equipment or device used for the processing, fabricating or alloying of special nuclear material if at any time the total amount of such material in the custody of the insured at the premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235,

(d) any structure, basin, excavation, premises or place prepared or used for the storage or disposal of waste,

and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations;

"nuclear reactor" means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material;

With respect to injury to or destruction of property, the word "injury" or "destruction" includes all forms of radioactive contamination of property

CAL-FARM INSURANCE COMPANY
SACRAMENTO CALIFORNIA

Secretary

President

#682

Linda Miller
PO Box 180
Willits, CA 95490

6/27/83

Dear Captain Wagner,

I am deeply concerned about the increasing levels of unnatural radiation in our environment, especially in the ocean.

I have received a copy of the Navy's DEIS on disposal of the decommissioned Polaris subs.

. Through my independent studies, and student studies, I have concluded that our scientists just don't know enough about this unnatural radiation and how it affects our environment, and ultimately how it affects human life and health.

W.1, J.76 I believe it is important to dispose of these subs in a manner in which they will affect the environment the least, and in which they will be monitorable and retrievable. This cannot be done at the bottom of the ocean.

I request that you please not dispose of these subs in the ocean, but choose the land disposal option.

Thank You. Linda Miller

#683

June 25, 1983

Beautiful Mission Santa Clara, founde[d] ... been completely reconstructed and is on ... of great interest on the campus of U[.] Santa Clara.

MRS. E. M. [illegible]
[illegible]

[redacted]

Dear Sir:

L.36, L.14 I am objecting to your plan to ocean dump decommissioned nuclear subs off the coast of California. We fish there all the time and it makes us nervous. Surely if we can go to outer space you fellows can come up with a fail-proof idea for nuclear waste. Maybe places like France.

Sincerely, Mrs. Fossa

C1347

—Greater San Jose Chamber of Commerce, San Jose 13, California—

Captain Edward Wagner
U.S. Navy
Office of Chief of Naval Operations
(OPNAV-22)
Dept. of Navy
Washington, D.C.
20350

#684

Western Surfing Association

Environmental Branch
P.O. Box 2704 #86
Huntington Beach, CA 92647

June 29, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

RE: Draft EIS Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Dear Captain Wagner,

[illegible] wish to go on record in opposition to the deep sea disposal alternative. Obviously, neither alternative (land or sea) is desireable, however, we are strongly opposed to ocean disposal of radioactive materials.

Land disposal has the advantages of monitoring, inspection and retrievability. The fact that it is cheaper to dump reactor compartments in the ocean, out of sight, mind and reach, does not, in our minds, out-weigh the advantages of land disposal.

The cumulative effects of such practices may come back to haunt us in generations to come. Thank you for this opportunity to comment.

Sincerely,

Tom Pratte

Tom Pratte
Director

#685

June 27, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OPNAV-22) Department of the Navy
Washington, D.C. 20350

Re: Asking you to stop ocean dumping and not use DEIS as truthful documentation....

Dear Captain,

In reforence to the Disposal of Decommissioned,Defueled Naval Submarine Reactor Plants, I refuse to let you plant them deep in our ocean waters! Your DEIS is not believable and I feel it would be hard to produce such a report accurately. Using this report to allow contamination of our bountiful sea waters (because it's a cheaper alternative) is wrong!

Your job is to protect your country and its people; that's me. My answer to your dilemma is to send nuclear waste straight to the sun where similar reaction is naturally, continuously happening right now! Your alternatives are limited, but there is choice and don't let money be the reason you destroy my earth and yours! | H.16

AGAIN, please don't use your inaccurate (verifiably so) DEIS to dump Decommissioned, Defueled Naval Submarine Reactor Plants 180 miles off the Mendocino Coast!!! Send it to the sun...

Sincerely, Earth lover
Ocean lover

Lee Ann

Lee Ann Chambers
2 El Capitan Ave.
Mill Valley, CA. 94941

#686

UNIVERSITY OF CALIFORNIA, SAN DIEGO

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO — SANTA BARBARA • SANTA CRUZ

SCRIPPS INSTITUTION OF OCEANOGRAPHY — LA JOLLA, CALIFORNIA 92093

Camilla Ingram, A-002 — 30 June 1983

Captain Edward F Wagner
U.S. Navy
Office of the Chief of Naval
Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner,

I have enclosed my comments on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. I have only addressed those sections relevant to biological questions associated with the sea disposal option.

If you desire further details or references, please feel free to contact me.

Sincerely,

Camilla Ingram
Staff Research Associate IV

Enc.

UNIVERSITY OF CALIFORNIA, SAN DIEGO

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SCRIPPS INSTITUTION OF OCEANOGRAPHY — LA JOLLA, CALIFORNIA 92093

Camilla Ingram, A-002 — 30 June 1983

Comments on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

Study area criteria, C.2.1. (5)

It is not clear from this statement that surface fishery areas would be avoided. L.2

Chapter 3, Affected Environment, 3-12

The statement that no exposure pathway has been identified is misleading. Not enough is known of food chain interactions to know if such pathways do or do not exist. Reasonable scenarios can be hypothesized for transfer of materials to surface waters without employing a vertical chain of predators. One of these is the vertical rise of lipids released from dead benthic organisms. Another is benthic organisms floating to the surface upon death and being consumed by surface organisms. In addition, because of the large vertical ambits of some of the crustaceans and fish present in these areas, it is also possible to have a predator based food chain with only one or two links in the chain. U.2

Chapter 4, Environmental Consequences, 4-9

The basis for the volume of sediment used for dispersal of Nickle-59 or the grams of sediment per gram of animal is unclear. Even if these are reasonable assumptions, the implication that a small additional exposure relative to the normal body burden of Polonium-210 would be negligible does not necessarily follow. Unless sensitivity studies are run on deep-sea organisms, we do not know the limits of their tolerance. The organisms measured by Cherry and Heyraud may be at their upper limit of tolerance. U.22, L.17

Annex to Appendix D, D. Marine Life

The samples taken near the Thresher and Scorpion were far too small and limited in type of organism sampled to allow anyone to draw any conclusions as to the levels of radionuclides in organisms associated with these vessels. Also, the list of radionuclides sampled for appears to be far too restricted, especially considering Appendix C. For example, why weren't Iron-55, Nickel-63 or Carbon-14 analyzed for? J.42, J.56

It is unclear what the condition of the guts were of the two Coryphaenoides analyzed. Generally 50-70% of these fish come up with their stomachs everted, rendering stomach content analyses useless. If these fish were

#686 (Cont)

able to feed on the bait and their stomachs were not everted, then most likely the levels of radio activity measured were for the bait, not the fish.

Appendix E. Description of Ocean Study Areas

J.36 Atlantic. The photos of the Atlantic sites may look superfically similar to photos taken in other areas of the Atlantic, but this is not adequate to allow statements to be made that the quantity and type of organisms are comparable. The biological work done on the sites E-N2 and E-N3 is extremely weak. The data I am aware of outside the Draft EIS as well as that within it do not allow an assesment of the marine life present to be made.

J.9 Pacific. The photos from the Pacific site (W-N) show a much more abundant macrofauna than those from the Atlantic site. The photo analysis study and the results from the trawls and dredges taken by Oregon State University should be adequate to describe much of the megafauna present on the sediment and in the adjacent water column. The macro and meiofauna which are present on or in the sediment are very important constituents of any deep-sea biological system and should be quantitatively characterized.

Appendix H. Description of the Ocean Dispersion Model

J.9 B. The stability and stratification of the bottom boundary layer is over emphasized. In some areas the upper boundary of the bottom boundary layer is highly stratified, but there are other areas when it is very weakly stratified. Such areas would have high vertical eddy diffusion relative to a well stratified upper boundary. Variation of this type can be seen in Fig. 24 of your reference number H.7. Also currents and internal waves continuously affect the vertical dimensions of any benthic boundary layer. The parameters used in your model for the benthic boundary layer, horizontal and vertical eddy diffusion need to be site specific.

General Comments on Appendices H, I, & J

J.20, T.6 There are essentially no data available on uptake, concentration factors or sensitivity of deep-sea organisms (organisms from depths 1000 m). As a result, realistic numbers are not available to plug into the models. Without empirically derived data to input, in my opinion, it will be impossible to believe the numbers generated by any model. It is likely that dosages generated from a realistic input will also be very low, but they can be defended. Dosages based on hypothetical guesses can not be.

Appendix K - Monitoring Program

J.83 Trapping should not be relied upon as the only means of monitoring disposal sites. It should be recognized that trapping will collect only those animals attracted to bait falls. Of the organisms that will be attracted, their arrival rates may vary considerably. For example, slowly motile organisms (primarily echinoderms) will probably arrive after highly motile organisms

(crustaceans and fish) have left.

If the organisms which are trapped are allowed access to the bait, then their body burden will reflect this to a varing extent dependent upon the species. For example for fish this would not be a problem, because the bait can be easily removed from the gut. But for crustaceans such as scavenging amphipods, this would be a major concern. Scavenging amphipods can fill their gut till it occupies at least 95% of their internal volume. J.83

In addition to trapping, a minimal monitoring program should also sample the macro and meiofauna in and on the sediment. These samples should be taken with either a box corer or Ekman corer.

#687

June 28, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

In view of the proposed dumping of used Nuclear Submarines off of the northern California coastline, I wish to comment.

I am aware of the great importance of how these radioactive submarines should be discarded. Their radioactivity will be around for centuries to come. I am sure that you have the coast residents' safety in mind, but I wish for you to imagine for a moment the condition of our beautiful coast in future years: inevitable poisoning of all plant and animal life in the waters as well as along the beaches, entire coastal areas restricted from human habitation, cross-contamination of airborne life inland to the more-populated areas of the north coast counties. I suspect that there is finally no safe place on earth in which to dispose of nuclear waste; no place which is not a part of our earth's ecosystem. Still, I am asking that you spare our beautiful northern California coastline from nuclear poisoning by finding some other location for the dumping of your 120 nuclear submarines.

Very truly yours,

Elizabeth McFadden

Elizabeth McFadden, resident
County of Mendocino
16141 Ridgeview Road
Willits, CA 95490

#688

Capt. Edward Wagner U.S. Navy
Office Cheif of Navel Operations

June 25, 19[illegible]

Dear Sir:

In regard to the navy DEIS on scuttling nuclear subs in the ocean, I have some questions and comments.

Q.13 The DEIS did not mention any corrosion test performed on irradiated metal. Can you safely assume it rusts like non-radiated metal? I understand nuetron bombardment makes metal brittle, raising the possibility it might lose or retain its protective layer of corrosion scale differently, therefore changing the rate of radiation release.

During the scuttling operation described in appendix D, the reactor compartment is to be filled with water to compensate for undersea pressures.

L.50 Why not fill the compartment with oil or other rust retarding liquid to keep the interior from corroding at the same time as the outside? This would postpone the time of initial reactor vessel attack until the hull or bulkhead had been pitted thru, perhaps 40-80 years. To keep sea water out during scuttling, the compartments one-way valves could be fitted with a pressure actuated supply tank of interior liquid, thereby maintaining pressure equality.

To extend the penetration time of the reactor compartment or the reactor vessel even further, would not the use of zinc or other strategically placed sacrificial metals be possible? L.50

One of the by-products of other nuclear reactors is Plutonium, how come its not present in yours? A.11

In view of the fact that we are just only beginning to learn how to use the worlds ocean resources and apparently are going to need them increasingly, it seems irresponsible to jeporadize any of that by irretrievably putting even low level radwaste into it. W.1

Figuring that in 20 years our ocean experience will put us in a better position to make such long term decisions and noting that in that time a whopping 40,000 curies (2/3 of the total present) will have half-lifed away, it would seem best to either dispose of them on land or mothball the subs for 20 years G.2

If it is wise for our military to seek peace thru strength, then let us be consistant by appealing to our citizens concern for maximum safty rather than trying to convince them minimum is sufficient. If during land disposal there is concern something may find its way into

#688 (Cont)

K.9 the natural underground water supply, I suggest looking into the possibility of putting a man-made aquafer beneath the disposal area. A layer of sand sandwiched between layers of clay, drain pipes in the sand layer allow water to be pumped in and drawn out for monitoring any leakage and stopping it before it gets any further.

Thank you for your attention,

Charles B. Williams
3 Betty St.
Ukiah, Ca. 95482

898

#689

WHALE CENTER

June 29, 1983

Via Express Mail

Captain Edward F. Wagner,
U.S. Navy
Office of the Chief of Naval Operation (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Being a nonprofit organization concerned with the conservation of whales and other marine mammals, we are concerned with maintaining a viable environment for all marine life. It is from this viewpoint that we strongly urge the U.S. Navy not to pursue a plan that calls for the sea disposal of one hundred nuclear submarines during the next three decades. The environmental risks involved in such a project far outweigh any monetary savings, and even more importantly, we feel that the precedent set by such a move could have disastrous international ramifications.

O.26
F.8

Numerous problems with the Navy Draft Environmental Impact Statement (DEIS) have been cited. The most disturbing of these include: (1) our lack of knowledge of how radioactivity "migrates" into bottom-dwelling species; (2) the fact that we know very little about deepsea ecosystems and how they might effect speed of corrosion, dispersion of radioactivity, and the possibility of the sunken subs attracting marine life; (3) the fact that the subs would be irretrievable should problems ensue; and (4) that there exist serious questions as to whether adequate monitoring can be done in a deepsea environment and almost nothing is known about the effects of low-level radiation on the marine environment. Surely all these questions should be more thoroughly researched before embarking on a plan with possibly irrevocable consequences.

L.1, Q.13
L.55, W.1
J.76, L.13

The major reason given in the DEIS for consideration of sea disposal over land disposal is an economic one. Land disposal would allow for adequate monitoring and would facilitate corrective action should unexpected problems arise. The greatest danger from terrestrial disposal, ground-water contamination, could be greatly reduced by proper site selection. We must at some point in the near future develop an effective method of disposing our nuclear waste. Burying the problem under 15,000 feet of water is at best an interim measure, and at worst, a very dangerous one. We should not succumb to expediency when the stakes, our marine environment, are so great.

Finally, even if there could be a guarantee of no risk in carrying

(415) 654-6621 ~ 3929 Piedmont Avenue, Oakland, California 94611

out the marine disposal, we would oppose such a program on the grounds that it sets a dangerous precedent, and represents a serious regression in environmental policy. Ocean dumping is not the solution to our problem of dealing with nuclear or any other waste. Approval of this plan will only serve to sanction similar projects, not all of which will be as carefully scrutinized as this one. The oceans must not become a dumping ground.

L.9

We at the Whale Center feel this is a golden opportunity for the United States to demonstrate leadership in the responsible handling of radioactive nuclear waste by refusing to take the easy way out at the expense of the environment. The money to be saved by ocean disposal of obsolete nuclear submarines is infinitesimal when compared to the possible consequences of such an action. Again, we strongly urge the U.S. Navy not to choose the sea disposal option.

O.26

Sincerely yours,

Maxine McCloskey

Maxine McCloskey,
Executive Director

#690

3526 Boundbrook Lane
Columbia, S.C. 29206
June 29, 1983

Captain Edward F. Wagner
U.S. Navy
Office of Chief of Naval Operations
OPNAV-22
Washington, D.C. 20350

Dear Captain Wagner:

I understand the Navy is considering disposing of obsolete nuclear submarines by sinking them in the ocean off Cape Hatteras, N.C. As these submarines corrode in the salt water,
L.20 large amounts of radioactivity would be released in the water, according to a recent Draft Environmental Impact Statement from the Oceanic Society.

As a resident of South Carolina and a native of Wilmington, N.C., I am very concerned about possible contamination of coastal waters.
H.3 It would appear that dry storage, perhaps in a large desert, would be a more appropriate site for disposal of these vessels because the protective shielding currently present would remain intact for a much longer period.

-2-

I am sure you are considering all aspects of this issue very carefully. I urge you to reconsider the plan to dump the vessels underwater. I also oppose dumping them underground for the same reason: corrosion of the metal shield will eventually take place. L.20

I consider this issue to be of grave importance. How we dispose of these ships will be affecting the environment in which we and our children and future generations will live. It is our responsibility to ensure that no unnecessary damage be done to the livability of ~~the world we live~~ the planet.

Please keep me informed as to the status and direction of this policy issue.

Respectfully yours,

Maxine M. Wardlaw

#691

June 28, 1983

Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Attention: Capt. Edward F. Wagner, U.S.N.

Dear Sir:

Subject: Comment on the December, 1982 issue of the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

In conducting the review required by the NEPA (1969), the Navy solicited input on the scope of the DEIS from the public, interested organizations, states and federal agencies. My attention was drawn to this subject after reading two adverse commentaries from (a) The Energy Daily, April 22, 1983 and (b) Sea Technology, April, 1983, page 71. See also Nuclear Waste News, Vol. 3, No. 9, dated May 5, 1983. I thought it suitable to offer the Navy an unsolicited response and am hopeful that my thoughts will be viewed as constructive.

In general, what is presented in the DEIS has adequate technical depth and is well written. However, in a climate of public hysteria relative to nuclear waste matters, I believe the Navy has adopted too narrow a posture in scoping its DEIS. For example, there must be uncertainty in the makeup of congressional committees and their predictable continued support for a selected disposal mode throughout the disposal period. Also, whereas the government may feel confident that it will have a burial site on national soil, the Navy's assumption that international sea disposal laws will not be tightened in the future should be viewed with skepticism. Probably the Navy's strongest defense (long and short range) to challenges on its selected nuclear vessel disposal mode will be the Environmental Impact Statement. Therefore, I believe a broader alternatives section will have the effect of inferring a fuller public participation in the final selection. I recommend expansion of the DEIS to include assessment of other alternatives, by which I really mean, expansion to include those alternatives which will most likely be tossed out as solutions when interested coalitions attack the DEIS. I shall attempt to explain my thoughts on this.

While combat or accidental vessel losses may be considered acceptable risks, it is always objectionable in the public view to deliberately emplace a pollutant in the oceans. I believe this to be behind the Ocean Society's adverse comments to the DEIS, since the sea disposal option raises the ocean radioactivity level a negligible increment. But, what then would the public

like to see?

Clearly, the disposal mode that adds zero man-made radioactive waste to the natural environment is the most desirable. The Navy does not consider this alternative. Thinking out loud, an argument the Navy may have to face up to could go as follows. "Reduction of the Navy's nuclear force by one vessel (~ $500 million) would permit construction of a chemical waste processing facility and eliminate the need for the two DEIS disposal options." Additionally, over the 100 year disposal period, there would then be no waste storage area, land, or sea, and nil accumulation (in the volume sense) of radioactive waste. I believe the Navy should develop a position on this in the DEIS using economic and preparedness arguments. Perhaps a conceptual study on the costs of a solid waste dissolution facility would be in order. H.9

A less costly alternative, not considered, and highly attractive is pressure vessel removal. The Navy states that 99.9% of the disposed radioactivity is bound in the pressure vessel metal matrix, yet it does not address the feasibility, cost, or objections to removal of the pressure vessel only. Such an option suggests land burial of the pressure vessel and sea burial of the remaining boat. Although radiological considerations become more important in this alternative, public opposition is essentially pacified in this approach. H.8

A third alternative not considered is submerged protective storage. This option would permit retrievability but involves inspectibility, corrosion coating, monitoring and perhaps compressed air system mods for remote raising. The ocean laydown area should then be in coastal water where surveillance is easiest. Benefits include future retrievability, continuous monitoring ease, and separation from mothball fleet areas. G.4

I have two other general comments. On the reactor compartment land burial option, increasing the compartment bulkhead thickness to the integrity of the hull appears to significantly extend the date for anticipated release of radioactivity from the pressure vessel. I believe this an advantage to be considered. Secondly, the alternative to solid fill the reactor compartment before sea burial is too quickly dismissed in the DEIS. K.6

Since the purpose of a compartment fill is not radiation attenuation but rather corrosion prevention, there are definite possibilities here to retard radioactivity release. Solutions that can be pumped and set-up solid later (like Safety-Set or the plastics family) may provide a corrosion barrier that has a lifetime in the ocean comparable to the decaying isotope halflifes. At any rate, further study of this concept appears warranted. L.50

#691 (Cont)

Capt. Edward F. Wagner, U.S.N.
June 28, 1983
Page 3

The above comments are submitted by me as an individual and are not to be construed as comment from my employer, Argonne National Laboratory-West.

Respectfully,

Bill Danielson

William F. Danielson
Member, ASNE

WFD:j

The Author

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#692

Elizabeth Rock
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27 June 1983

Re: Draft EIS on Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

To: Captain Edward F. Wagner, USN
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

I appreciate the opportunity to comment on the Draft EIS and submit herewith my comments.

1. Involvement of the public.

a. Early opportunit for awareness and input. The President's Program on Radioactive Waste Management indicates a commitment to full disclosure and participation by the public, and directs improved mechanisms for achieving this. I believe it is most useful and consistent with the President's policy to involve the public early in the process through citizens' committees, study groups and the like. This provides a strong network for the dissemination of information and forum for discussion of issues. A principal advantage for the proponent agency is that issues are aired and adjustments to tentative proposals can be made before they are jelled - or set in concrete. Principal advantages to the public are the longer period for study and acquaintance with the subject, and the opportunity for input early in the development of the proposal. I realize you cannot backtrack at this time, but it is a weakness in the status of the Draft EIS that avenues for public awareness and input early in the process were not utilized. D.3

b. Timing. It is extremely difficult for the public to become acquainted with so technical a subject and to search sufficient additional information within the initial time frame to provide evaluative comment. Notices here appeared Jan. 30, Feb. 11 and 20 for the Feb. 24 hearing. Limited time is also a handicap for thorough review by interested organizations, which must set their own meetings, notify members, secure board or membership approval for submission of comments. It is to the Navy's credit that it responded to requests at the hearing for an extension of time. Perhaps future projects can allow for reasonable public response time.

c. Availability of materials. I believe that related materials relevant to highly technical proposals should be readily available to the public so that interested individuals can develop more background and foundation for their comments. In this instance I am particularly concerned, since the Draft EIS does not contain a detailed description of either land disposal site. The documents which the Draft EIS relies on for detailed site descriptions, Final Environmental Statement, Waste Management Operations, Hanford Reservation, Richland, Washington, ERDA-1538, December 1975 and Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, Aiken, South Caroline, ERDA-1537, September 1977 are not readily available. In addition Sandia documents on submarine disposal at sea are not readily available. Would it be possible to add government depository libraries to the distri- N.13

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N.13 bution lists of Sandia and other research agencies funded by government grants, especially for documents relevant to the libraries' areas? An alternative would be to make a distribution of copies to county libraries in affected areas, in this instance west coast and east coast, and inland adjacent to Hanford and Savannah River. In addition, could either the notice or the Draft EIS contain information as to accessibility?

2. Process. This Draft EIS seems unable to make up its mind whether it is a generic EIS or site specific. The land disposal sites seem intended to be site specific, whereas the ocean areas are described as "typical," (p.S-11) and not "disposal sites" (p. E-1) I believe the following points should be clarified:

- Will the public have an opportunity for comment on the Final EIS?
- If Hanford and/or Savannah River are selected, will there be an opportunity for public comment on the projects, as distinguished from the adequacy of the EIS?
- If ocean sites described in the Draft EIS are selected, will there be a more detailed site specific EIS in connection with the EPA permit process? Will the public have an opportunity for comment on the proposals also?
- If entirely different ocean sites not described in the Draft EIS are selected, will Navy prepare a Draft and Final EIS for such sites prior to applying for the EPA permit, or will the current Final EIS be used as a generic EIS in order to shortcut the specific EIS step.
- Which division of the Navy will make the final decision?
- Will copies of the Final EIS be automatically distributed to those who received the Draft EIS?

3. Intent. The DOE publication, "Nuclear Waste Management Program FY 1981," DOE/NE-0008, indicates the capacity for LLW storage is a near term issue for commercial sites. (p. 207) It also gives an Activity Description for "Defense Waste Management, Long-Term Waste Management Technology, Low-Level Waste" which includes as tasks: "Propose legislation for voluntary transfer of commercial LLW sites to Federal Government; Complete/issue Environmental Assessment to support above legislation; Issue final program strategy document." (p.88) It further gives "Identification of Reference Sites - North Atlantic/North Pacific" as a step in the Activity Description for "Commercial Waste Management, Terminal Isolation Research and Development, Seabed Disposal." Identification of site shows a completion date of the end of FY 82. (p.133) Is it the

L.9 government's intent to use the ocean sites in the Draft EIS for commercial waste as well as for defense waste. If so, it would place all estimates of impacts in question. Has the Navy checked out? The public should know whether the subs and subs only are intended, or if there is an overlapping in the proposed usage which would greatly increase the cumulative adverse impacts. What is the status of the study for commercial disposal?

4. Mishmashes of language uses. These occur especially with such terms as majority, typical, average, maximum, absolute maximum, etc. My comment is related to the Oceanic Society's: "Throughout the DEIS there is a lack of

R.24 consistency in terms describing 'worst' and 'average' case scenarios." (p.15)

Example: p. 1-2, 2d paragraph. "...To simplify the presentation of the radioactivity information while maintaining an accurate description of the amounts involved, one particular reactor plant has been selected to be typical of all. The plant selected is used in a large majority of the submarines, and its operating lifetime and average power level have been chosen to give a maximum radioactivity inventory for the type of reactor installed. It is therefore the most typical representative of all the reactor plants to be disposed of, and has a radioactivity inventory greater than the average of all reactor plants and one that is not significantly different from the absolute maximum of all the plants..."

5. Alternatives. There are a number of possibilities which should be considered in the Draft EIS:

a. Desert sites. This is probably the most important one omitted from serious consideration. H.3

b. Deep sea burial in basaltic formations. H.2

c. Temporary storage and then to long range intermediate depth land sites. G.7

d. Burial as part of the process of land preparation in Basalt Waste Isolation Program at Rockwell-Hanford. H.2

6. Conservation measures: The Draft EIS should make clear whether the submarines are decommissioned because of excessive radiation, outmoded design, fuel exhaustion, or other factors. Possible ways to extend the operating lifetime of the submarines should be considered more thoroughly and placed as conditions on the project.

a. Newly developed techniques. A review should be required annually to assess the possible application of newly developed techniques, including those for HLW to see if the life of remaining submarines can be extended. The review should search especially for: G.3

- Any process to reduce the half-life
- Any process for more efficient power generation with lower amount of radiation released
- Any possibility of replacing the interior of the compartment section while reusing the hull
- Any process to use a liner, layer, curtain, baffle, etc. on the interior which would extend the operating life, or make it possible to recycle the steel
- Any possible re-use of steel for other radioactive processes
- Any possible re-use of the remainder of the vessel apart from the compartment
- Any possible use of the compartment along with other sources for the generation of heat

b. Reduction in need for nuclear submarines. Place more reliance on making the US presence felt through economic, trade, scientific, diplomatic and similar measures than by direct military means.

7. Misleading descriptions. I have commented in 1c on lack of ready availability of the two principal site descriptions. Here I want to stress that without adequate descriptions in the Draft EIS, a highly misleading picture emerges for the reader. The Navy does itself a disservice when the public discovers by consulting DOE or EPA publications the immensity of the activities at the Hanford and Savannah River complexes. I also believe the point should be made that the Final EIS's for these projects are probably far out of date and therefore it is also misleading to rely on them. It should be noted also that no EIS is in itself a guarantee that any action described in it will occur, e.g. monitoring activities may be described but not implemented. Placing reliance on the outdated Hanford and Savannah River EIS's is risky at best. I.4, E.1

8. Cumulative effects. The lack of consideration of cumulative effects is perhaps the most serious deficiency in the Draft EIS. L.7

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a. <u>This and other radioactive waste</u>.

A.17 (1) A key question in the mind of every reader is: Where is the nuclear fuel going? This calls for an answer.

L.6 (2) An inventory of historic dumping sites, records of contamination experience, impacts of past leaks, etc are necessary

E.28 (3) An inventory of other current sites with their impacts is crucial for judging whether Hanford and Savannah are reasonable selections.

(4) Much more spedific material on impacts at Hanford and Savannah River are needed, including cumulative impacts of all uses at the areas. The
E.17 cumulative impacts of fuel manufacturing, reprocessing, research labs, landlord facilities, etc. should include those from adjacent commercial facilities as well as government ones.

(5) All of the above should indicate extent of impact on surrounding areas, e.g. cumulative impacts on the Columbia River, Savannah River, feeder rivers and streams, ground water.

L.10 b. <u>Radioactive and other hazardous waste</u>. There is no coverage of the possible adverse impacts of LLW in combination with other hazardous waste.

c. <u>Radioactive and waste water management</u>. There is no coverage of this combined contamination. Ocean outfall is used, as at San Francisco, and the cumulative effects should be considered. The issue may also be especially important in some locations where ocean outfall alternatives have been dis-
L.10 carded in favor of other waste water treatments because of risk of contamination of the food chain and detriment to the fishing industry, and because of the present limitations of knowledge and control in this field. Sonoma County, as will as its residents could justifiably be highly unhappy to find that, after they non-select ocean outfall, the Navy proposes radioactive contamination.

9. <u>Policy of locating multiple activities at 1 site.</u> I believe there is a fundamental policy which needs to be addressed. It relates to an overall appraisal of benefits and disadvantages of multiple activities as at Hanford and Savannah River. Some aspects are:

Possible advantages: cost effective on an immediate basis
- organization may be simpler to handle, but this is not necessarily the case
- articulation of research with operating agencies may be more effective
- I.3 easier to maintain security

Possible risks and disadvantages:
- creation long range of large scale environmental wasteland
- higher risk if a serious accident setsoff domino effect
- eventually a highly serious reaction from the public and state officials
- higher economic loss if it is necessary to shut down the entire area.

The Governor of Georgia's letter, 7/16/80 in response to DOE correspondence says: "...I wish to go on record again as being opposed to any waste management option at the Department of Energy Savannah River Plant which could potentially endanger the groundwater resources of Georgia. In particular, as I have stated
I.2 to the Department of Energy on many occasions in the past, the State of Georgia is unalterably opposed to a Savannah River Plant radioactive waste management

option involving bedrock storage." (p. B-16, US, NRC, Cross-Statement of the US DOE in the matter of Proposed rulemaking on the storage and disposal of nuclear waste, DOE/NE-0007, Supp. 1, PR-50,51 (44FR61372) I believe this expressed position plus the Washington state referendum illustrate the serious reaction from public and states to decades of multiple activities. This issue calls for attention in the DRaft EIS since the two states' proposed for land sites are ones which have faced this problem.

10. <u>Models for development of estimates</u>: It appears that some estimates in the study are in turn based on models developed from estimates. I believe there probably are problems inherent in the integrity of second and third level guesses. T.1
I hope some of the scientific community will encourage you to address this issue.

11. <u>Average vs concentrated dose</u>. Much of the material on risks of adverse impact seems based on average yearly rates, and does not address the actual ways doses may be timed. Example: S-13 refers to consumption of 145 lbs. of fish per year. Other material in Appendix I relates to 70 year exposure. But the difference in health impact between eating ½ lb of fish each Friday and going on a fishing trip and eating 1½ lb for 14 days in a row are not discussed. The threshholds for harm to the human system are not identified in human kinds of terms. There are lifestyles in the coastal areas which could be subject L.45
to the cumulative effects of a number of kinds of exposure. Indians of the Columbia River area could consume fish, game birds, grains, berries, and be exposed to air, water, etc all contaminated by radiation. I believe the text needs checking to make sure that the tabular material on radiation is related to human activities.

12. <u>Assorted questions</u>.

a. Is the flux used in welding sufficiently different that welds provide a likely place for early leaks in ocean floor disposal? Are the welds likely Q.13
to provide a site for minute organisms to start colonies?

b. I came upon material on Columbia River and on the ponds at Hanford: Haushild, W.L. and others, "Distribution of radionuclides in the Columbia River Streambed, Hanford Reservation to Longview, Washington: transport of radionuclides by streams." Geological Survey Professional Paper 433-O. 1975.
Watson, James E. Low-level radioactive waste management: Proceedings of Health Physics Society twelfth midyear topical symposium, Feb 11-15, 1979. EPA, 1979. This contains several articles on the Hanford waste ponds. Perhaps you should review the material in B-2 & 3. It is difficult to believe that with contaminated birds, plants, ponds, river, blowing sand and grass fires that the LLW radiation will stay neatly in place with no impact.

c. Can we run the risk of not being able to recover a leaking submarine L.20, W.1
from the ocean bed?

d. Can we afford the monitoring which should be done for ocean disposal? J.76

e. B-20 on current uses averages, not worst case storms. Much of the sea bed material may not be realistic when based on limited samplings and quiet J.67
situations.

f. The last paragraph, S-16 should be rewritten to reflect more accurately the environmental consequences given in Chapter 4. The ongoing cost for monitoring disposal at sea should be added. It is not clear from A-13 that continuous J.76
monitoring into the future is covered.

g. Adequate maps of possible geologic and sea bed resources are not included. Since this is a developing field for commercial exploitation, is it certain that J.22
there are no resources in the ocean sites considered?

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Thank you for the opportunity to review the Draft EIS. I shall look forward to seeing the Final EIS and learning of the next steps in the process.

Sincerely,

Elizabeth Rock

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COMMENTS ON THE UNITED STATES DEPARTMENT OF THE NAVY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS.

SUBMITTED TO:

Captain Edward F. Wagner
Office of the Chief of
Naval Operations
OP-NAV-22
Department of the Navy
Washington, DC 20350

June 28, 1983

SUBMITTED BY:

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152 Temple Street, #301
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The United States Department of the Navy's Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (hereinafter DEIS) represents a massive undertaking both in generating various disposal options as well as separately evaluating each of these options. However, the Connecticut Fund for the Environment has major reservations regarding the DEIS.

Our reservations are two-fold. First, we dispute many of the underlying assumptions upon which the DEIS was based. The use of inaccurate and incomplete data prevent the results of the DEIS from being conclusive or reliable.

Second, there is insufficient comparative analysis of alternatives. The alternatives set out in the DEIS are inadequate, with several major viable options having been completely omitted from consideration. In addition, the actual comparison itself, by failing to clearly define the issures, does not allow for a clear basis for choice among the options by either the decision-maker or the public.

Therefore, we strongly urge that additional alternatives be considered and that a more accurate study of each alternative be conducted.

DEIS ASSUMPTIONS DISPUTED BY CFE

The Connecticut Fund for the Environment has major concerns related to any method of disposal eventually selected for the decommissioned submarines. Central to these concerns is the type of waste and thus the type of environmental and health risk involved.

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Radioactive waste poses long-term effects which are released and continued to be released over thousands of years. Therefore, the actual identification of specific harmful effects may not be evidenced until a far distant time in the future. The danger in undertaking any action with such far reaching impact when that impact may continue to occur or even multiply, due to a cumulative effect, is substantial. Any disposal option selected must allow for continued monitoring and provide for remedial action, should the need arise.

Many physicists still assert that there is no acceptable, safe level of radiation over and above what is termed "background" level or the level to which one is exposed in the natural environment. The Navy has relied upon supposed safe level standards set by various regulatory agencies in evaluating the safety of the different alternatives for disposal. It is crucial to bear in mind that this level is not an accepted figure, but rather subject to considerable dispute within the scientific community.

The actual amount of radioactivity contained within the reactors is an additional issue in controversy. Therefore, the problem surrounding the calculation of a safe level becomes two-tiered. First, there is a dispute as to how much radioactivity may potentially be released into the environment. Second, there is a dispute as to what if any level above "background" is safe without risking an adverse impact on the quality of the environment.

Under the current timetable, land disposal of the submarine reactors would occur within approximately three years and sea disposal with approximately five years. Granted, there are

already five decommissioned submarines and more soon to follow. Some disposal option must be identified and implemented. However, entering into any course of action with inadequate information and potential irremedial effects is irresponsible both to the citizens of this nation as well as other throughout the world who will be impacted by any environmental action taken by the United States. Three to five years is insufficient time to conduct the research necessary to adequately assess the effects of several of the Navy's proposed actions. Some type of interim measure must be developed until such time as sufficient technical data is available to compare the impact of each alternative.

One criticism of the methodology throughout the DEIS is the lack of treatment of the cumulative effects of any action, as required under the National Environmental Policy Act. Assessments of the impact of radioactive waste disposal in the oceans neglected to include much of the waste already dumped in the oceans in the past. In addition, the global effects of ocean dumping, where past and present dumping is a factor, were not included in cumulative effect assessments. | L.7 | L.6

Additional study and documentation is necessary regarding the potential risk from occupational exposure to radiation. Any alternative involves the handling and transportation of the submarines therefore the accompanying occupational risk must be discussed. | B.3

ANALYSIS OF ALTERNATIVES

A critical issue inherent in the entire discussion of disposal of radioactive waste is the need for a comprehensive nuclear waste management plan on a national as well as an international basis. Currently, there is inadequate coordination between the Environmental Protection Agency, the National Oceanographic and Atmospheric Commission, and the Nuclear Regulatory Commission. Without this crucial coordination, any accurate assessment of the cumulative effects of a given action is impossible.

N.13 An overriding problem in evaluating the Navy's DEIS has been the atmosphere of secrecy surrounding the research. Several of the studies upon which later studies were based were not released. Without an open approach to what data formed the basis of the studies and how it was arrived at, objective assessment of the available alternatives is not feasible.

N.2 The Connecticut Fund for the Environment believes strongly that the caselaw under NEPA does not permit the comparative costs of the various disposal alternatives to be the determining factor in selection. As is done in commercial situations, the cost of safe and practical disposal should be factored into the construction costs initally and not tacked on as an afterthought at the expense of incurring grave environmental damage.

L.57 The worst case analysis for each of the alternatives was not sufficiently cautious. The potential for accidents and uncertainty related to all of the alternatives must be evaluated in greater depth in order to more accurately predict the actual risk. The Navy's approach to all alternatives for disposal tends to be extremely optimistic. This fails to take into account the potential risk in the manner necessary to select the best and most environmentally sound alternative.

Currently, the five submarines which have been decommissioned

have been "mothballed." The DEIS treats this as a "no action" alternative. Under the National Environmental Protection Act, "mothballing" does have a significant effect on the quality of the environment and as such must be evaluated in the same manner as the other alternatives. The storage of the submarines will still allow for the release of radioactivity, the submarines will have to be transported to the storage site, even if it is a temporary site, and the fuel will have to be removed. "Mothballing" may indeed prove to be a viable, relatively safe alternative either for the short-term or the long-term. However, it must be adequately evaluated. G.5

THE OCEAN DISPOSAL ALTERNATIVE

One of the principal alternatives proposed by the Navy for disposal of the submarines is ocean dumping. Any impact on the oceans must be considered from a global rather than a national perspective in order to calculate the extent of any action taken by the United States and the cumulative effects on life in the oceans. The type of waste which would be disposed will have a potential impact for thousands of years. L.7 The unique characteristic of ocean disposal is the irretrievability of the submarines. W.1 Should information regarding the potential risk of the radiation become available after the dumping has taken place, no remedial action will be possible. Longterm consequences on the ocean ecology could not be prevented. Given that the oceans are a major source of protein for great numbers of the world population, the risk of possible contamination is one we cannot afford to run without more information regarding exactly what the effects of such waste disposal will be over the upcoming centuries. L.1

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Many marine biologists feel that abyssal species, the type inhabiting the ocean areas being considered for the dumping, may be especially sensitive to environmental changes. Estimates of
L.16 the effect of low level radioactive waste on non-abyssal species may therefore not be an accurate indicator of the actual impact on abyssal flora and fauna.

Even if no actual harm results from radioactive waste disposal in the oceans, a question which cannot be resolved at this
O.34 time, the adverse effects to the fishing industry and tourism in the targeted areas could be devastating. Both of the areas currently under consideration, off of Cape Mendocino, California and off of Cape Hatteras, North Carolina, are highly dependent on fishing and tourism. Regardless of what the long-term ecological effects may be, the fear of such effects could greatly harm these states' economies.

The field of marine biology, especially the areas involving deep sea and abyssal species, migratory effects, short circuits in biological pathways, deep-water transport mechanisms, and artificial reef effects, is relatively new and in a constant
L.13 state of flux. Very little currently is known about the effects of radioactivity on marine life or how these effects would be
L.36 transferred throughout the food chain should they occur. At the present time, no proof exists that disposal of the decommissioned submarines would result in parmanent or even temporary harm to the marine environment. However, neither do we know that such harm would not occur. The nature of the waste is such that it would be released gradually as corrosion takes place. The eventual effect itself would not be known possibly for hundreds

of years. The lack of knowledge in this field is a critical factor to be considered in assessing sea disposal. The necessary L.1
scientific data simply does not exist at this time. Any prediction as to what the effects will or will not be is equivalent to guesswork. To potentially cause irremedial damage to the world's oceans based upon what is now a mere hunch is an irresponsible and dangerous form of decision-making. With a proposed three or four submarines to be disposed of annually, the risk may very well not be known until it is far too late to take corrective action.

Many areas will require further research before the ocean disposal alternative can be evaluated effectively. More information is needed about the migratory effect of radioactivity within the marine environment. The "reef effect" which a submarine would L.55
have on the food chain was not considered in the DEIS and could significantly alter the environment. Exactly how much radioactive waste already has been dumped in the oceans and what effect it has had is not known and probably cannot be determined accurately. This information is critical in assessing cumulative effects, as L.6
required by the National Environmental Protection Act.

For several decades, there were large amounts of radioactive waste being disposed of by the United States through ocean dumping. Either inaccurate records or no records were kept of these activities. Instances of dumping in unpermitted areas or in unpermitted amounts were common. There is no reason to assume that only low level wastes were dumped. Throughout that time, other countries also were disposing of radioactive waste in the oceans. Several Western European countries continue to do so at this time. Given that there are no borders on the world's oceans, any

L.7 radioactive disposal must be considered in light of the overall, cumulative effects. The DEIS is fatally deficient in this regard. Not only does it neglect to take into account the dumping currently taking place throughout the world, it ignores the likely outcome of the United States initiating a disposal program as massive as one hundred nuclear submarines, namely encouraging

F.8 other nations currently focusing on the United States for guidance also to engage in ocean disposal of radioactive waste. Any environmental impact statement will be wholly inadequate unless and until this cumulative effect is addressed.

Monitoring the effects of radioactive waste disposal in the ocean presents a unique set of problems. Because of the paucity of past records, accurate monitoring becomes highly unlikely. Of the ninety thousand bundles of radioactive waste allegedly dumped by the United States, core samples from only six have been studied. Three submarines already have been either lost or sunk into the ocean, two of which still contained radioactive fuel

J.85 and were crushed due to the pressure. The U.S.S. Seawolf, sunk by the Navy off the coast of North Carolina, still has not been located, creating a complete barrier to any monitoring activity.

J.76 Because of the above problems, accurate monitoring of radioactive waste already disposed of in the oceans is not a possibility. Therefore, we are forced to rely on models in order to assess doses. Many scientists feel that these models are far too primitive to be used for predictive purposes. This is especially troublesome when we are dealing with a form of disposal that makes the submarines irretrivable should adverse effects develop.

In further evaluation of the ocean disposal, additional

factors must be considered. First, the Navy has historically engaged in considerable ocean disposal of radioactive waste during a time when no environmental impact statements were required. Allowance for these amounts of already existent radioactivity must be made. L.7 Second, the fact that the Navy is uncertain where a submarine will land when actually dropped and what will happen to the hull upon impact with the ocean floor must be considered. The rate of release of radioactivity has been based on estimates of a hull intact. F.19 The portions of the ocean floor determined safest for disposal based on such factors as low current activity and calm seismographic characteristics assume that the submarine will land where it is dumped. This is, as yet, an unproven assumption. Third, the risk of an accident causing a submarine to sink before reaching the appointed dumpsite needs to be investigated further. Fourth, the radioactivity resulting from corrosion product activity, commonly known A.12 as "crud," must be factored into the cumulative radioactive estimates. Fifth, the actual levels of radioactivity contained within the reactor must be determined with a greater degree of A.6 accuracy. Sixth, procedures must be developed to allow for more adequate monitoring of radioactive waste once it is in the ocean. J.76 These procedures will need to be carried out over a period of hundreds of years and not simply decades as proposed in the DEIS. Seventh, the Shepard Model of dispersion, utilized in the DEIS, assumes an equal rate of waste dilution within the ocean. By not taking into account the effect of currents on dilution, the S.22 results may be highly inaccurate. Some method of accounting for the effect of the currents must be used.

U.9

A factor not mentioned in the DEIS is that rattail fish from the Atlantic coast of the United States have been found to contain high levels of americium, a nonnatural breakdown product of plutonium.[1] Additional incidents of this type must be scrutinized and the information must be considered within the context of the Environmental Impact Statement.

One final consideration regarding the proposed ocean disposal of radioactive waste regards the use of the term "low level." there is a tendency to assume that low level radioactive waste is synonymous with low risk. There is no agreement over what constitutes low risk at this point in time. Many individuals fear that the existent regulations promulgated by such groups as the London Dumping Convention and the International Atomic Energy Association are not stringent enough and actually permit a dangerously high level of radioactive waste disposal under the umbrella of low level waste.

The lack of necessary scientific information coupled with the potential for permanent, irremedial damage to the marine ecology leads the Connecticut Fund for the Environment to voice its opposition to the alternative of ocean disposal of the submarines.

THE SURFACE BURIAL ALTERNATIVE

The alternative of surface burial was the principal non-ocean disposal method discussed by the DEIS. Several critical concerns were not addressed in the discussion and must be included in any further evaluation of disposal alternatives.

[1] W.R. Schell and A. Neuissi, "Radionuclides at the U.S. Radioactive Waste Site in the Hudson Canyon, 350 km off NYC," Final Report Contract No. 65-01-4838 (Washington, DC: EPA Office of Radiation Programs, Jan. 1980).

The presence of niobium-94 (Nb-94) was neglected in the DEIS and has a crucial impact on the amount of external exposure predicted from the reactors. Some individuals feel that the risk inherent from the Nb-94 must totally rule out the surface burial alternative of disposal. The fact that this was not even discussed in the DEIS is cause for considerable rethinking of the viability of this alternative. A.10, L.46 G.7

The transportation risk needs to be addressed in greater depth. If the Savannah River site were to be utilized, 7800 cubic yards of swamp would need to be dredged in order to construct a barge slip. If the Hanford site were to be utilized, this would be in direct opposition to the Yakima Indian Nation who already are protesting the continued radioactive contamination of the federal preserve. Such concerns must be dealt with under the requirements of the National Environmental Protection Act. L.57 E.30

A final issue to be investigated regarding surface burial is the potential contamination of ground water. The available potable water adequate for human consumption is an extremely limited resource. Any on-land disposal alternative must thoroughly provide for the protection of this ground water. E.4

THE NEED FOR CONSIDERATION OF ADDITIONAL ALTERNATIVES

As stated earlier, the DEIS is defective not only in the treatment of the proposed alternatives but in the failure to consider additional alternatives. A comprehensive list of all such alternatives is beyond the scope of these comments. However, three potential ones may be suggested at this time. The first is deep underground disposal. Should the uncertainty of the G.7

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long-term effects on the oceans eliminate ocean disposal and the presence of Nb-94 eliminate surface burial, deep ground disposal will need to be investigated. The potential contamination of ground water would become even more important in assessing this alternative along with the possible retrievability of the reactors in the event that safer alternatives are developed.

H.3 The second alternative proposed for further study is open dry-air disposal. Because the radioactivity is released through corrosion and corrosion occurs at a much slower rate in a dry environment, this alternative may provide for the effective retardation of radioactive release while the process of radioactive decay is allowed to occur.

The third alternative is the procedure currently being

G.5 utilized for interim storage, namely "mothballing." Because the DEIS treated this as a "no action" alternative rather than one requiring the preparation of an EIS, further research would be required. This would, however, eliminate the problem of irretrievability.

CONCLUSION

The Connecticut Fund for the Environment opposes the alternative of ocean disposal of the submarines based on the paucity of necessary scientific and technical data required for adequate comparison of the alternatives. CFE strongly urges that additional alternatives be considered and that the methodology used incorporate sufficient measures of the potential risks to the environment--both those known to us today as well as those which remain to be discovered. CFE opposes any action which could potentially cause irreversible environmental harm.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN 29 1983

OFFICE OF THE ADMINISTRATOR

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval
Operations (OPNAV-22)
Washington, D.C. 20350

Dear Captain Wagner:

In accordance with Section 309 of the Clean Air Act, as amended, the U.S. Environmental Protection Agency is commenting on the Draft Environmental Impact Statement on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants. Our specific comments are enclosed.

In general EPA has identified a number of difficulties or deficiencies in the draft EIS:

*E.2 1. No proposed action is presented.

2. Insufficient information was provided to independently estimate potential impacts from either land or ocean disposal alternatives.

G.1 3. The disposal alternatives were not treated equally. Ocean disposal is discussed in much greater detail than is land disposal and quantitative data that might support more careful consideration of protective storage as an alternative, rather than as a "no action" alternative, is not included.

L.53, O.34 4. Social costs and socio-economic effects are not realistically discussed.

O.2 5. Insufficient information is provided to verify the cost figures given for disposal alternatives.

S.25 6. Conservative assumptions, used to assess impact, are based on data that are presented without ranges of uncertainty.

7. The information presented for modeling and monitoring needs to be presented more clearly, discussed in greater detail and, in some cases, corrected.

8. Some of the proposed land disposal methods, especially with regard to the Savannah River Site, need further analysis and explanation.

9. There is minimal discussion of benethic organisms present in ocean disposal sites, and the potential ecological impact on abyssal fauna is not seriously addressed. J.72

10. Many important technical references provided are either out-dated or restricted in their availability. N.13

11. The comparative levels of the small radiation exposures, as estimated by the Navy, for the options of land and sea disposal, do not appear to provide a basis for a decision between the two options. We do, however, have some questions on how the estimated exposures were calculated.

12. Public Law 97-424 amended the Marine Protection, Research and Sanctuaries Act in regard to ocean dumping of radioactive waste. This amendment would clearly affect the ocean disposal option presented in the draft EIS. The final EIS should include a discussion of these statutory changes, which were enacted after the draft EIS was issued. EPA is also reviewing these amendments for possible impact on its ocean dumping regulations. F.2

EPA has environmental reservations concerning the Navy's proposed program. First, although it is clear that the program would dispose of nuclear submarine reactor plants, it is unclear exactly which option will be proposed or how a decision will be made between the various options. Second, it is very uncertain as to whether there is any need to make a decision at this time; D.1 similarly it is not clear there is any need for the ocean disposal option (which is a requirement of EPA's ocean dumping regulations). F.4 Lastly, as the detailed comments indicate, there are numerous calculations and assertions in the draft EIS, which EPA cannot confirm. These circumstances lead to EPA's reservations for this program.

*Other issues discussed by EPA are side barred in Exhibit 694a.

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In keeping with EPA's procedures we have assigned a rating of ER-2 to this draft EIS. This means that EPA has environmental reservations about the proposed Navy program and that additional information should be presented in the Final EIS. Should you have any questions concerning EPA's review of this statement, please call Dr. W. Alexander Williams (382-5909) of my staff or Mr. William R. Curtis (557-7380) of EPA's Office of Radiation Programs.

Sincerely,

Pasquale A. Alberico
Acting Director
Office of Federal Activities

Enclosure

#694 (Cont)

U.S. ENVIRONMENTAL PROTECTION AGENCY

COMMENTS

PERTAINING TO

U.S. NAVY DRAFT ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED, DEFUELED

NAVAL SUBMARINE REACTOR PLANTS

June 1983

TABLE OF CONTENTS

GENERAL COMMENTS

Review comments presented here are of two types: a) either a general statement referring to the entire DEIS; or, b) a summary statement that is followed by more detailed and supportive comment(s) in the appropriate Chapter or Appendix sections of this review summary.

1. On Disposal Alternatives

E.2 There is some ambiguity as to what is defined as the "proposed action." By implication, land or ocean disposal is proposed and interim storage is rejected.

There is a lack of central focus by not presenting any proposed action. Thus, this is a decision document that contains no conclusion(s) and cannot be evaluated for impact of proposed action or analyzed for adequacy of information. The Final EIS should indicate a preferred alternative.

G.1 The alternatives presented are not treated equally. Ocean disposal is discussed in much greater detail than land disposal.

Insufficient information was provided to evaluate the estimates presented of potential impacts by land disposal. The model presented needs improvement.

E.22 The land burial disposal option at the U.S. Department of Energy Savannah River burial site seems beset with barge transit difficulties and minimal available burial depths that together may disqualify this alternative as a viable option. More information may resolve this issue.

Social costs and socio-economic effects are not treated to any real extent. O.34

I.1 It is indicated that the Department of Energy will not prepare an environmental impact statement. This may not be true if land disposal is selected as the proposed action, and the volume of material(s) for disposal, from this and other sources, requires an entirely new site.

From the information and impact estimates provided, it is concluded that neither the land nor sea disposal options, including accident scenarios, would exceed relevant regulatory standards for exposure to individuals, nor constitute an appreciable increase in the radiation dose burden of the human race. In fact, the radiation dose commitments are very small even for the most extreme (pessimistic) scenarios. Therefore, radiation dose commitment would not serve as the only basis for choosing between the land or sea disposal options. Similarly, the presence of other non-radioactive toxic materials in the reactor compartment structure does not appear to have potentially significant environmental impacts and, therefore, would not serve as the only basis for making a choice. However, there are many uncertainties in the analyses leading to these impact estimates. Therefore, the appropriate basis for choice may come down to the social, political and economic cost of the two options (and variations thereof). Social and political costs are not addressed O.34 and while economic costs are addressed, the cost data cited in the

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O.2 DEIS is not sufficiently detailed to permit a completely independent verification of the economic analysis.

2. <u>On Ocean Disposal</u>

L.13 The basic ecological question of what will be the impact from disposal(s) on abyssal fauna is not sufficiently addressed. L.19 There appears to be no familiarity with present-day deep sea ecology. Complex ecological considerations are avoided. T.10 Concentration factors based on marine trace metals analyses are out-of-date and may be lower than values based on current trace metal analyses, thus impacting on dose levels presented.

U.3 More work is needed to be able to evaluate transfer of radionuclides within food chains. U.1 Chemistry data presented are not current and a good base for ecological information is lacking. S.25 Where information is lacking, estimates of data uncertainties should be provided. T.4 Faunal data presented is not sufficient to verify statements, calculations and model assumptions.

Q.5, L.56 Important assumptions pertaining to corrosion, hull integrity and effects of disposal(s) on the abyssal ecology could be tested at locations of previous Navy projects, such as WIGWAM and CHASE, and at known locations of vessels sunk during World War I and II.

J.76 Detailed monitoring plans that incorporate historical data and improved models for contaminant concentration need to be developed.

J.72 There is minimal discussion of benthic organisms that might be present in disposal sites. Discussions of benthic fauna and the

potential impact from disposal on those which might be attracted to sunken submarines should be expanded. J.72 It would be useful if faunal species information from the previous Navy benthic surveys could be described. L.55

Deep water sediment resuspension data should be compared to data extrapolated from laboratory experiments and measurements in shallower water as a first-order approximation of sediment transport near proposed disposal sites. J.9

In preparing a final EIS, the Navy should carefully examine the provisions of the 1982 amendments to the Marine Protection, Research, and Sanctuaries Act of 1972. These provisions are directly applicable to ocean disposal of radioactive waste and may have direct implications for the Navy's cost estimates and basis for decisions. The additional administrative, monitoring, and retrieval requirements are particular areas of the new legislation that may have an impact in this respect. F.2

Navy sensitivity to extensive public concern about discharges of radioactive material to the marine environment from operational nuclear submarines is well known. The Naval Nuclear Propulsion Program has long professed the policy "to reduce to the minimum practicable the amounts of radioactivity released to the environment." Accordingly, the Navy DEIS should indicate how this policy interacts with each of the disposal alternatives being considered, and whether a decision to implement any of the disposal alternatives is likely to impact on this policy. L.30

3. On Models and Dose Commitment

R.4 The discussion of the model used to estimate radioactive releases following disposal at sea, and the justification of its parameter values, was insufficient to evaluate its effectiveness.

There are problems with the ocean dispersion model, as presented in Appendix H.

T.2 Dose to man was computed via a chain of models with insufficient use of present-day modeling concepts and data.

The dose commitment analysis was conducted on crude assumptions, as indicated in subsequent sections of these comments.

4. On References

N.13 Most are of limited circulation and not readily obtainable. There is a failure to use both refereed and current scientific literature. Also, full advantage has not been taken of existing physical and biological data in the scientific literature.

5. On Other Matters

It is stated that with the fuel removed from the reactor, only activation products need be considered. However, all remaining power plant components will be retained in the reactor compartment. Fission products and transuranics are only briefly

A.12 discussed, and it is implied that they would be present in nominal quantities. Is the cladding failure rate presented low enough so that this assumption holds true for all the reactor plants planned for disposal?

K.12 Very little information is provided on external radiation fields, either within or without the reactor compartment.

Additional information may provide a useful perspective.

There is virtually no discussion of the interaction between sorptive minerals of soils or ocean sediments and radionuclides. Near-term engineering barrier concepts designed to protect the biosphere from radioactive materails appear adequate. However, the long-term considerations should consider both the natural barrier and the interaction of components of the geologic media with the corrosion products taken into solution in groundwater. K.8

We also recommend that units be used consistently in the final EIS. Some units are in metric terms and others are in English terms (fathoms, feet, etc.) X.1

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COMMENTS ON THE SUMMARY

1. General

N.9 There is no discussion of retrievability.

N.5 There is ambiguity between the terms "practical choices" and "proposed alternatives."

T.16 No comprehensive food chain analysis was attempted, rather a worst case hypothetical analysis is considered.

L.19 Information on deep sea ecology presented is far from state-of-the-art.

A.2 A clear statement is needed pertaining to the expected levels of radioactivity at the time of disposal.

More information and emphasis is needed with regard to potential risks/accidents during transportation to land disposal sites.

N.8 It is inappropriate to compare radiation health effects from submarine disposals with television viewing since: a) the conditions of TV viewing are not described; b) methods of the National Academy of Science are ascribed to without reference; c) the risk factors used in this comparison are not indicated, nor is this particular calculation presented later in determining risk factors; and d) the organs exposed to radiation are quite different.

2. Specific

A.15 Page S-6 The statement that "....defueling removes most of the radioactivity from the ship" has no meaning.

A.12 The statement "defueling removes all the uranium and fission products" assumes there would be no leakage

diffusion as a result of a small amount of fuel element cladding failure leaving some fission products or uranium within the pressure vessel, after the fuel elements have been removed. A.12

Also, there is no discussion of decontamination procedures for the reactor vessel after defueling. A.20

Page S-7 Placing a ship in protective storage is based on existing procedures, established from many years of mothballing ships. However, placing a deactivated nuclear submarine in protective storage while delaying its ultimate disposal is significantly different. The mothballing of a ship is intended to maintain its condition for future use. The protective storage of a deactivated nuclear submarine would not require the preparation needed to restore it to service in the future. X.1

Page S-10 The term "average individual", although defined in the glossary, is somewhat confusing. Some reference to the exposed population is needed. P.6

The estimated dose given is not really for an "average individual" since it involves some very conservative assumptions that are not realistic and would not be expected to be "average" conditions. There is no indication of the extent of conservatism in the dose number presented. The dose estimates L.32

#694 (Cont)

L.32 provided represent a series of "worst case" assumptions which represent neither "average" nor "realistic" conditions.

The radiation dose via drinking water from land disposal at the Hanford site will likely be zero. At the Savannah River Plant, the dose would be less than 0.006 mrem/yr. Thus, "realistic" dose levels should be estimated.

N.6 It should be indicated where the average individual is located in relation to the burial ground for the stated dose of 0.006 mrem/yr.

Page S-11

J.3 The term "study areas" is used with regard to ocean disposal locations rather than direct consideration of specific disposal sites. There is too much ambiguity in this approach and it appears to be somewhat evasive. This is especially true in view of the Ocean Dumping Act requirement for a site specific impact assessment.

O.19 It is suggested that the Navy identify the additional research and cost necessary for such a site specific assessment at East or West Coast sites as part of the cost estimates for land and sea disposal.

X.1 The section attempting to describe the units of radiation exposure is extremely misleading. The comparison of an erg to the lifting of a mosquito is not appropriate.

The analogy drawn between millirem and whole body temperature is inappropriate. Using this, the $LD_{50/30}$ would raise the temperature only 0.001°C. X.1

The relevance of the assertion "...to stay within 200 n.m. of the U.S. coast, since this is the zone of economic control established under the United Nations Law of the Seas" is not clear. It is suggested that the advantage, if any, be explained better or deleted from the EIS. J.18

Page S-17

The statement that "the submarine would be towed to the disposal location and sunk in a controlled flooding operation" is not completely accurate. It implies that sinking is controlled throughout the descent. Rather, it is a free-fall operation after flooding is initiated while the sub is at the surface. F.18

It is also stated that "when the submarine comes to rest on the ocean bottom, it would be intact." A more accurate statement would be that the sub will probably be intact. F.19

In the ocean disposal section, exposure is described for a "typical" person, based on "realistic" assumptions. Such is not the case for the exposure discussion in the land disposal section. N.4

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Page S-13 The potential for radiation exposure to the public may not be significantly changed by protective storage. Occupational exposures, however, could increase.

H.14 The statement "ultimately the submarine must be disposed of by land burial or sinking in the deep ocean" is only an assertion, based on current options available. The possiblity of some other alternative cannot be precluded.

O.34 It is stated that the impacts considered included "use of resources such as land or materials, impacts on animals or the ecology, radiological effects on the general public or on shipyard workers, and relative costs." It is noted that the final of the four impact areas is "costs", not economics and not socio-economics. This orientation is evident throughout the EIS in that the entire economic and socio-economic issue is confined to costs per se.

Page S-14 B.5 The data in Table 1 are not really comparable since the dose numbers have varying degrees of "conservatism." For example, the airline flight dose would only be equivalent in conservatism to the disposal doses, if one assumed flight altitudes were at several hundred thousand feet for a duration of several years while subjected to peak solar flare activity.

Table 1 also invites comparisons of doses, but the three dose numbers have varying degrees of "conservatism" or "realism" and are not really comparable. The words "conservative estimate", shown in parentheses, need to be clarified since the concept of conservatism is a very subjective one, unless expressed quantitatively. L.32

In this case, since both the land and sea doses pertain to unrealistic scenarios with unknown magnitudes of conservatism, then any comparison of numbers is equally "unrealistic." If the doses were presented with an indication of uncertainty (conservatism), such as one or two standard deviations, it is likely that there would be no basis for distinguishing between the numbers. N.1

Page S-16 It is stated that there is no significant environmental impact from any of the disposal methods and that radiation exposures are so small under any option that such exposures provide no basis for selection. The principal determinant is stated to be cost. O.3 Yet details of the various cost analyses are not presented here, or subsequently in Appendix A, in sufficient depth to make meaningful evaluations of their validity. O.2

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COMMENTS ON CHAPTER 1 "PURPOSE AND NEED FOR ACTION"

1. General

It is stated that "this DEIS provides the information necessary to assess the impact of each available course of action and will serve as the basis for making a final decision on the method to be used." This implies that the options have already been adequately researched and that no additional information is needed to either assess impact(s) or make the decision based on cost(s). However, in the next paragraph, it is stated that this DEIS "is being prepared so that disposal methods can be identified and evaluated well in advance of any need." This could be interpreted to mean that additional research is not only needed, but anticipated, especially since there are several indications of incomplete studies mentioned in this document. Thus, the question arises as to the real purpose of this document. Is it a real environmental impact statement or a "trial balloon"? Does the Navy feel that this document contains all the information needed to adequately assess impact to the ecological and human environment(s), and to determine costs? J.9

Throughout this document the problem of submarine nuclear reactor disposals is treated as if the need will only span the final decades of this century. Nuclear submarine disposal may be a continuous problem and, correspondingly, the release of radionuclides may be continuous. Figure 1-1, therefore, is

misleading. Consideration should be given to additional disposals beyond the limited time frame covered in this document. N.12

The Navy's "no action" alternative considers total ship storage only. No discussion of other types of protective storage for submarines, including possibilities for sectioning portions of the vessels for storage and thereby eliminating costs for use of pier spaces, etc. is included in this DEIS. Could there be other options to support more careful consideration of protective storage as a realistic alternative rather than as a "no action" alternative? G.4

2. Specific

Pages 1-3 to 1-5 — The presentation of the characteristics of the radioisotope inventory in Table 1.1 and the consequences as a function of time in Figure 1-2 might be enhanced by some additional information that could be helpful to understanding contemplated action. For instance, it would be clearer to show that the principal component is cobalt-60, a gamma emitter with a half-life of 5.26 years, as contrasted to the next significant component, nickel-63 which is a beta emitter, in both Table 1.1 and Figure 1-2 by giving their remaining radioactivity after some time period (i.e., 100 years). A.4

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15

A.6 Two assumptions in Table 1.1 appear unrealistic. First, maximum activity ("worst case") is presented for "the most representative plant" - which is undefined. Secondly, estimates are for six months after shutdown. It is not clear what ranges of uncertainty or conservatism are involved.

A.9 The listing for cobalt-60 in Table 1.1 is misleading since the gamma energy is given as 2.82 MeV, when usual emissions are 1.33 and 1.17 MeV. Using the data in Table 1.1 could create errors in dose calculations. Also, gamma emitters are usually characterized in terms of predominant photopeak energies.

The data listed in Table 1.1 and the information contained in the text do not allow for an independent verification of the radioactive inventory. It must be assumed that the Navy analysts have done a professional job in deriving the data.

A.5 Results could be accepted with greater confidence if the text contained a brief outline of the procedures used in the calculations, and if a listing were given of the names of computer codes employed (or of equivalent or similar generally available computer codes in common use for such calculations).

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Page 1-8 Reference 1.1 for Chapter 1, Lederer et al., Table of Isotopes, 6th Edition, 1967, is somewhat out of date. The Navy should use the more recent version, Lederer, C.M. and V.S. Shirley, editors, Table of Isotopes, 7th edition, John Wiley & Sons, Inc., New York, 1978. Several of the half-lives listed in Table 1.1 have been revised; however, the revisions do not significantly affect the conclusions in other parts of the DEIS which depend on Table 1.1. A.8

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COMMENTS ON CHAPTER 2 "ALTERNATIVES"

1. General

O.33 It is noted in the comparison of land and sea disposal options, that the disadvantages listed for land disposal are technical. Those listed for sea disposal appear to be political only. It should be explained how technical and political factors will be balanced so that an objective criteria for decision-making can be applies.

E.4 Discussion of potential adverse effects from land disposal on groundwater should be included.

2. Specific

E.33 Page 2-5 It is stated that the backfill covering the reactor compartment would be a minimum of four feet at the Savannah River site. Since this is a very humid site with some 47 inches of annual rainfall, this depth of cover seems small. After a few hundred years, when the pressure hull has corroded away and collapsed into the empty reactor compartment, it seems likely that the pressure vessel and steam generator would protrude above the terrain. This may not be an acceptable "burial" even though the residual radioactivity would be small.

E.14 The Final EIS should more specifically discuss the area within the site that is being considered for land disposal and its hydrogeological characteristics.

The costs cited in Section I.B. do not include accident scenarios. Comparison should be made between the costs associated with accidental sinking of the reactor compartment on a barge for the land disposal option and accidental premature sinking of the entire submarine under tow for sea disposal. O.26

Also, as noted in comments on Appendix A, it is difficult to accept that preparations for land disposal would not result in larger occupational radiation doses than would the sea disposal option. G.6

Pages 2-5 and 2-12 There appears to be some inconsistency in the use of rems units. In one instance rems per year is used, at other times rems are reported in total exposure units. Over what time period does total exposure refer to? B.9

The words "active, inactive, inactivation, and activity" (also see pages A-2 and A-12) should be avoided when discussing nonradiological aspects of what is primarily a radiological problem, or else the words should be clarly defined in their different meanings. For example, activity and activation are defined in the glossary with respect to radioactivity and radioactive materials. The words inactive and inactivation are not defined. Since decommissioning is defined as removing a ship from active service, then inactivation would seem to X.2

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#694 (Cont)

mean decommissioning. In any case a ship would be "inactivated" before disposal so the comparisons between worker dose for active versus inactive disposal are further confused. It would seem preferable to refer to taking ships out of service (decommissioning) for immediate disposal (active) or disposal after storage (inactive). X.2

Page 2-8 In section D, the sorptive properties of the soil should be included as a natural barrier to mitigate adverse effects of radionuclide releases to the environment by groundwater. Since nickel-59 is the long-term radionuclide of consequence, the retardation to migration factor effected by various geologic media should be compared, to determine the ratio of the rate of water movement to the rate of radionuclide movement. E.16

In the last sentence, it is stated "No routine maintenance of the earth cover would be required." This is probably an incorrect statement as pertains to the Savannah River site in view of the annual rainfall and the actual experience at that site. E.35

Page 2-9 In section H, use of the total reactor volume in calculating radioactivity concentrations for low-level burial is questionable. What are the concentrations based on the mass of the components? The appropriateness of comparisons with NRC proposed waste concentration limits for land burial, on pages 2-9 and 2-10, is also questioned. Dividing the total activity by the total volume of the reactor compartment, including void spaces, seems to justify disposing of any specific activity source as any waste class - as long as a large enough container is used. NRC criteria are not directly applicable at DOE facilities. Their use is voluntary. E.32

Page 2-10 Table 2.1 should show the actual or estimated concentration of radioactivity per cubic centimeter of waste metal (not empty volume). E.32 Also, footnote 2 should be clarified to give the actual activity of one cc of cobalt-60. E.34

Page 2-11 It is stated that "a check valve or one-way valve in the reactor compartment bulkhead would ensure that the reactor compartment pressure would be equal to the pressure in adjacent compartments during the sinking." The possibility of malfunction by a mechanical device cannot be discounted. Thus, the statement should be qualified.

Additional information should be provided on the check valve which shows how completely it would seal off the reactor compartment. F.21

It is also stated that "complete flooding would occur in less than a minute"... It is doubtful that

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F.17 100% flooding of all spaces and equipment would be achieved that quickly and that some collapse would not occur prior to 100% flooding.

L.51 Would the reactor and reactor compartment be filled with water treated to reduce corrosion?

F.23 Also, the possibility that a free-falling submarine would impact upon a previously emplaced sub, a rocky outcropping, or some other object(s) cannot be ignored. Thus, the discussion of reactor compartment integrity should include discussion of such possible effects.

F.19 Additional information is needed to demonstrate that the settling velocity is to be expected as stated, and that impact on the bottom would be as stated.

O.2 Page 2-12 It is stated that detailed cost estimates for disposal are provided in Appendix A. The information provided in Appendix A is not sufficiently detailed.

L.32 The statement that seawater already contains these stable elements ---- has no antecedant for the word "these." Also, does the statement ---- based on a very conservative estimate ---- apply to both average and most-exposed individual? If so, then average is not really average but an overestimate by some unknown degree of conservatism. Therefore, the distinction between "average" and "most-exposed" is

a function of subjective conservatism and not any real world conditions. L.32

Page 2-13 In item 2, it would be useful to cite quantitative values in support of the phrase"... very low external radiation levels...". F.1

Sub-section E "Retrievability and Inspectability," indicates that the hull could be inspected which implies that it is resting on the sea floor, i.e., not embedded. Discussion of embeddment on impact appears in the Comments on Appendix D.

It is stated, that retrievability would not be feasible with current technology. That statement is incorrect since current deep sea salvage capabilities exist to recover a 4,000 ton submarine from water depths of 17,000 feet. W.1

In section D, the natural barrier consisting of ocean sediments and its capabilities for radionuclide retention should be included in the multiple barrier concept. F.32

Page 2-14 In section II.1.1.d, the statement that "No new regulations are needed." seems at odds with the statement in the following subsection 2.d. that an EPA permit request may would be required. Such a permit request may necessitate rule-making procedures on the part of EPA. F.7

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#694 (Cont)

L.1

Page 2-15 An additional advantage for the no action alternative would be the time gained to develop data on sediment composition, chemical environmental factors, deep sea ecology, deep sea currents, sediment resuspension, and other information to enhance selection of the best ocean disposal site utilizing the natural barrier concept to its full potential. Such data could be obtained in the next few years and the required information would be available prior to decision-making regarding disposal options.

COMMENTS ON CHAPTER 3 "AFFECTED ENVIRONMENT"

1. General

More information is needed to adequately describe the "affected environment" in the ocean study areas. For example, matters dealing with human population densities and the definition of affected populations needs to be treated differently for ocean waste disposal sites than land disposal sites. Distances within which an affected population might be defined could be much greater for ocean areas than for land sites. There is no population information presented for either ocean study area and no discussion of this aspect in the chapter. L.48

The level of detail and quality of presentation is not uniform. The discussion of land sites directly addresses questions of specific environmental impact, while the ocean "study areas" are only generally described. The land sites are well studied, monitored DOE facilities at which the local environment and ecology are well known. The land sites have already been narrowed down to specific locations while the ocean sites remain vague and the relationship between the ocean study area and a potential ocean dumpsite is not resolved in this document. J.3

There is excessive citation of recent technical reports and summaries which have not undergone careful review and critical evaluation since they are not readily obtainable (i.e. Sandia Report # 82-1005 which contains data essential to understanding the DEIS). N.14

#694 (Cont)

J.7 At the Hanford land disposal site, the contamination of ground water is apparently not a problem. It is not clear that this is true at the Savannah River site. Some comparison of data is needed.

J.10 More detailed studies of the physical and biological characteristics of the ocean study areas are needed, especially near-bottom circulation studies in the Atlantic.

J.25 An issue not addressed is why it is desireable to select an ocean disposal site at depths of 4,000 m., where bottom water circulation is slower. Has the Navy considered whether currents could be an asset in diluting radionuclide releases?

2. Specific

E.11 Page 3-4 — If the groundwater table is within 40 to 50 feet of the surface at the Savannah River site, a 30 foot diameter reactor compartment buried there could be within 5 to 10 feet of groundwater. This seems to be a narrow margin of separation.

J.10 Page 3-6 — Two references to IAEA criteria are identified as "rules" or "requirements" for dumpsite selection. Actually, the criteria for dumpsite selection in IAEA Information Circular #205/Add./Rev.1 are "recommendations."

J.19 Pages 3-6 to 3-9 — The criteria listed in Section II A appear comprehensive, however, one additional criterion

that may be considered would be the ability to monitor the site remotely. J.19

Page 3-7 — Figures 3-5 and 3-6 display isobaths without units - probably meters, but they should be identified. X.1

Page 3-9 — In the paragraph starting "These IAEA..." the last sentence states "Continental margins are excluded to avoid...". The continental rise is, by definition, part of the continental margin. The northern study area (E-N2) lies within the Atlantic Continental Margin. J.16

Page 3-10 — Many researchers recognize the Western Boundary Undercurrent as extending upward to a depth of 1000m off Cape Hatteras (see Richardson and Mauss, 1971). The DEIS states a depth of 3500m for this current. J.5

The statement made in the last paragraph concerning the Atlantic Study Areas, "None of the life are used by man or are a part of the food chain leading to man.", is questioned since there is very little knowledge of what inhabits the sites or of what potential pathways might be. A similar comment applies to the statement about the Pacific Study Area, the sixth paragraph of Section C. T.21

Also, the fact that any fishing is done in the study area would raise questions as to its use as a disposal site. L.2

#694 (Cont)

Page 3-11 In paragraph 8, regarding biology and fisheries, the unit cited - "fish catch per unit effort" - is not defined in the text or in the Glossary. J.71

The descriptions of ocean sites are rudimentary and the discussions of ecologies in the regions is scant. J.9

On pg. 3-10 it is stated that "some animal life is present." On pg. 3-11, "...photographs indicate that the population density is low relative to near-shore areas, with none of the sea life used by man or part of the food chain leading to man." Both statements are not based on any substantial evidence in this document. J.68, T.21

The Pacific ocean study area is identified as being at least 40 miles (64 km) south of the seismically active Mendocino Fracture Zone. EPA contractor report 520/1-82-003 ("Identification and Evaluation of Low-Level Radioactive Waste Siting Criteria for Candidate Disposal Areas off the West Coast of North America") suggests using a separation distance of 124 miles (200 km) for potential ocean disposal sites from earthquake epicenters, volcanoes and active sea floor spreading zones. F.28

Data on the clay-mineral content for both Atlantic and Pacific ocean study areas should be included to document sorptive properties for radionuclide retention in the sediments. J.75

COMMENTS ON CHAPTER 4 "ENVIRONMENTAL CONSEQUENCES"

1. General

Estimates for the ocean disposal option are based upon a series of models which make use of best guesses in order to describe processes poorly understood. Although best and worst case values are used, there is no discussion of how valid the models are or how reasonable the estimates made from using these models are. J.20, T.3, L.31, L.1

Environmental impact stresses risk of radiation exposure to man to the almost total omission of any consideration of ecological impact in the proximity of disposal sites. L.13

More discussion is needed on how to calculate activity concentration when the waste is an integral part of the containment material. E.32

There is no consideration of the adequacy of containment offered by the hull and structure for any other hazardous waste materials (i.e., toxic waste, metals, etc.) which might require containerization. H.11

The focus is on possibile alterations to the physical-chemical environment with little discussion of the effects to local deep sea biota. L.13 The supportive material in the referenced appendix is especially weak for the ocean option. Little is offered other than out-of-date references, unreviewed reports, casual observations and ecological studies not completed in time for inclusion in this document.

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E.32 Clarification is needed to determine whether mass and volume of containment can be used in calculations when the waste material is not homogeneously distributed throughout the containment.

L.60 The possibility of a submarine sinking while under tow to the disposal site in an area where recovery might be impracticable, and the effects of such an accident, are not realistically discussed.

L.62 Also, what would be the likelihood (quantitatively) of premature sinking and/or loss of the tow ship during transport in the sea disposal option? What specific measures would be taken in either event?

F.19 Additional information is needed to verify that the holes in the hull would prevent crushing of the hull from occurring.

F.25 The Navy should consider conducting some kind of full scale test.

O.30 What would be the relative occupational hazards to shipyard workers and others involved in disposal, from either the land or sea options, from other than radiological hazards (i.e., smoke inhalation, asbestos exposures, and occupational accidents)? Could these effects be more significant, in a relative sense, than radiological hazards?

2. <u>Specific</u>

B.6 Page 4-1 No radiation exposure rate is given for the exterior surface of the reactor hull compartment after removal of fuel. This parameter is needed to estimate external exposure.

30

E.3 Do the terms reactor "vessel" and reactor "plants" mean the same thing? If so, there should be a statement indicating that to be the case.

E.16 Page 4-2 The mitigation effected by the sorptive clay minerals should be mentioned in paragraph 4.

K.2 Also, it should be mentioned that niobium-94, even though minor in initial occurrence, will also be released in the long-term with nickel-59.

K.1 Page 4-3 In Table 4.1, the column "Total Release Over all Time" should be supplemented by a footnote indicating that these releases include radiodecay before and during release time.

X.2 Page 4-4 First line should read " 1.2 mrem per year."

K.7 Page 4-5 Lead, nickel, chromium, cobalt and cadmium are among the solid waste metals that might be buried, in addition to radioactive materials. The effect from disposal of these solid waste metals should be addressed in assessing environmental impact. The third paragraph states that the corrosion of lead shielding would not result in maximum concentrations of lead in wells and streams that exceed EPA water quality standards. Although this may be a plausible conclusion, it could not be independently verified because of insufficient data in Chapter 4 and in Appendix F.

006

#694 (Cont)

Page 4-9 The cited reference supporting the contention that there will be no radiological effects at the predicted levels in the site is not fully applicable. The effect of any dosage on deep sea species is not really known. The effect of chronic low dosage in terms of genetic load was not considered. The actual dosages to deep sea fauna cannot be correctly determined without good values for concentration factors, specific activity, and biological half-life in the species concerned. This document, then, should estimate ranges of values and provide degrees of uncertainty, based on the available data. L.12

Dose per organism is calculated to be 0.3 rad/year and then compared to the dose to a shrimp organ (hepatopancreas) of 195 mrem per year. A more reasonable comparison would include possible bioaccumulation of nickel-63 from the disposal of submarines to local organisms. Reference 4.21 presents a Ni concentration factor of 100 to 1000 times. So, comparable doses might be 195 rem/yr in shrimp and 30 to 300 rad/year from nickel-63 releases. L.15

Page 4-11 It is noted that no data are presented from any monitoring of the discarded SEAWOLF reactor components that were disposed of by free fall off J.85

the Atlantic coast in a submarine-like hull in 1959. It could be useful if the Navy included some discussion in the final EIS of its attempts to locate the site. J.85

Page 4-12 For the "expected containment" conservative estimates presented in Tables 4.2 and 4.3, it is suggested that general corrosion rates of 5 mils/yr. for low alloy steels, 0.5 mils/yr. for the stainless alloys, and a penetration rate of 150 mils/yr. by pitting be used. Combining these rates with the one change made as indicated by the asterisk in Table 4.2, and applying a pitting factor of 2 to the corrosion rate for low alloy steels (they never do corrode <u>truly</u> uniformly) the times in Table 4.2 might change to: Q.7

10 yrs. for partial penetration of the reactor vessel

25 yrs. for reactor compartment to be penetrated by general surface corrosion

25 yrs. to establish sea bottom currents through the reactor vessel.

1000 yrs. for release to be 99% complete

Page 4-13 Table 4-4, sums the various isotopes to obtain "total curies." This procedure is poor practice and should be avoided by leaving out the totals. L.25

#694 (Cont)

33

Corresponding comments in the text would need modification.

L.26 Page 4-14 Total released curies for Ni-63, Ni-59 and Co-60 are given in Table 4.5. Accuracy beyond two significant figures is questioned.

L.29 The comparisons of the releases in Table 4.6 with the U-238, Th-232 and K-40 discharged in the oceans each year is not a useful argument, since the concentrations of these isotopes in ocean water are more or less at equilibrium, i.e., the annual input equals the annual output via sedimentation. Table 4.7 on page 4-15 is difficult to understand and is misleading because of the equilibrium of the natural isotopes. It is recommended that the supporting text (from last paragraph on page 4-11 to the middle of page 4-15) and Table 4.7 be deleted.

U.6 Page 4-15 On the other hand, the discussion in sub-section (c) is excellent and is a powerful argument that deserves exploitation in the dose calculations in Appendix 1. Marine biota cannot distinguish between an atom of radioactive Ni-59 and the 700,000 atoms of the five stable isotopes of nickel. Hence, the organisms must become heavily burdened with nickel to acquire a small amount of radioactivity. The same arguments would apply to the long term ingestion exposures from land disposal. Table 4.8

34

on page 4-16 presents compelling data in support of this argument.

The "Relative Ingestion Exposure per Curie" in Table 4.7 uses concentration factors derived from reference 4.21. Reference 4.21 does not show how these concentration factors for Th, U, Ni, and C were obtained.

Page 4-17 In Section 4, it is stated that radiation exposure to the public from release of radioactive material from submarine disposal at sea would probably be zero. It is also just as probable that dose to the public from burial of reactor compartments would be zero. Such statements should be stated in the Summary of this DEIS to provide a basis of perspective for the meaning of "conservatism" in dose estimate discussions. L.32

Page 4-19 In the third paragraph, a calculation is cited which yields an annual estimated exposure of 2.4 mrem per year from potassium-40 from consumption of fish. This is a dubious hypothetical result, because the average human diet results in an equilibrium body burden of K-40 (about 140 grams for "standard" man). The average daily intake is about 3.3 grams and the biological half-life is about 30 days. Most potassium in the diet comes from cereals, tubular L.29

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L.49 vegetables and meat. Substituting fish in the diet does not alter the body burden of potassium. It would be best to delete the discussion of the exposure to K-40.

L.33 Page 4-20 The estimated average background radiation dose of 100 mrem/year in coastal areas is too high. Current estimates are about 75 mrem/year (NCRP Report #45, 1975 and U.S. EPA/ORP/SEP Report 80-12, 1981).

F.17,F.19 Page 4-21 Among engineered improvements to minimize radioactivity release, are listed "modifications....to insure that the entire submarine would be flooded uniformly and early in the sinking operation, thereby avoiding crushing of any compartment." Achieving full flooding of a compartment containing machinery and piping in a naval vessel is probably achievable only under slow and deliberate operations in a static condition (i.e., in a dry dock). Past experience has indicated that a significant time period was required after each attempt to full flood vessel compartments in dry dock to allow venting to occur, after which topping off to achieve full flooding was again required.

L.51 In item (3) at the top of the page, it would be helpful to know whether the reactor compartment is to be filled with demineralized water or sea water.

COMMENTS ON APPENDIX A "COST ANALYSIS"

1. General

The methods used appear to be correct and in virtually all respects complete. The relative costs appear plausible. However, because the results are shown only in summary form, it is not possible to verify their accuracy. O.2 The principal shortcoming is the absence of any estimates of the cost consequences of accidents, such as the sinking of a submarine in route to the disposal area. O.26

There is insufficient information given for the cost estimates. Although costs for each activity are presented (Table A.4), the underlying details from which these estimates are made are generally not included in this document. The basis for these estimates, in terms of assumptions used and the original data sources, should be fully described so that the validity of the estimates can be confirmed. O.2

There is an economic benefit associated with this storage option that should be included in the cost analysis. That benefit is the economic value of having a "mothballed" sub which could be used in the future. A quantitative estimate of this benefit should be subtracted from the cost for this option so that a true cost comparison of alternatives can be made. O.5

Another benefit related to the storage option is the likelihood that, if needed, a mothballed nuclear submarine could be refurbished quicker than a new nuclear submarine could be G.3

G.3 constructed. The potential for mothballing of nuclear submarines
for future use, and the economic benefit of such an option,
should be discussed in this DEIS.

The validity of the uniform assumption that all capital
expenditures are spread over ten disposed submarines appears to be
0.2 an oversimplification. The expected lifetimes for each capital
expenditure should be analyzed separately. It also appears that
the cost of capital was not considered in prorating (annualizing)
capital expenditures.

The treatment of cost benefits is limited to that of direct
costs. No evidence of social-economic considerations are
L.53 apparent. Costs related to public reaction with regard to ocean
disposal of nuclear submarine reactors, or costs related to the
effect of ocean disposal on other uses of the ocean are not
0.9 presented or discussed. Furthermore, salvage costs should be
looked at with respect to the overall effect on U.S. economy.

The true costs of an ocean monitoring program may be
appreciably higher than estimated since additional research and
J.76 development may be needed to gain a sufficient understanding of
that environment to make meaningful interpretation of data and
monitoring program design possible.

2. <u>Specific</u>

0.14 Page A-3 Are the cost estimates based on using one ocean
disposal site?

0.1 In Table A.1, since all submarines will be
inactivated before disposal, the two column headings

should be "Immediate Disposal" and "Disposal After 0.1
Storage."

Page A-7 The assumption that instrumentation, used to measure
ship attitudes and accelerations during disposal,
would be recoverable for use in ensuing disposals is
not conservative. The expectation that only 0.24
one-time costs would suffice for ten or more
disposals is not realistic since some will fail and
some will be lost in use.

More than one-time costs may be needed to qualify a
sea disposal site. The NEA Consultation and
Surveillance Mechanism requires the suitability of 0.28
ocean dumpsites to be reviewed at least every 5
years.

Page A-9 The data for "flooded free fall" gives a unit
disposal cost of $1.1 million, based on 10 disposals
at the rate of 3 per year. In Table A.1 and Table
A.4 a unit cost of $5.2 million for 100 submarines
at the rate of three per year is cited. This 0.16
variance is not explained.

Page A-12 Data in Table A.4 supplements data in Table A.1 but
is still not clear, especially in comparison with
data in Table A.2. The manner of presenting the
data in these Tables needs to be improved.

Page A-13 Sea disposal differs from the other alternatives in
that there is the necessity to "qualify" a sea

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disposal site (at a cost of $6 million) and to
continue to monitor the area environment (at a
present-value cost of $9 million). The first is an
"up-front" cost, and the the second is properly
treated inasmuch as a commitment is made to this
monitoring program as soon as disposal of submarines
is initiated. The cost comparisons in Table A.4
show these fixed costs amortized, presumably over
0.15 the disposal of 100 to 120 nuclear-powered
submarines (although this is never specified in the
cost analysis). What would be the effect of early
abandonment of this option, before completing
0.23 planned disposal of all submarines? Have these
costs been extended for possible multiple sites
0.15 which may be needed for 100 submarines?
The terminology of Table A.4 is confusing. For
0.1 example, what is the cost of <u>inactivation</u> of an
<u>inactive</u> ship?

Page A-16 Another consideration is the value of scrap metal.
According to the DEIS, sea disposal sacrifices about
3,000 tons of metal, but this would cost more to
salvage than it would be worth as scrap (p. S-14).
On the other hand, scrapping is shown to have a net
value of $300,000 per ship in Figure A-3. The value
of scrap fluctuates widely. In wartime, its
enchanced value has justified pulling up trolley

tracks. Would possible fluctuations in the price of 0.12
scrap affect the choice of disposal methods?
The range of variation in scrap prices is shown
below for exported scrap steel in the 1970-1980
decade, indicating a variation in price of the order
of 2:1.

<u>Average Prices of Steel Scrap, No. 1 Heavy Melting</u>

<u>Year</u>	<u>$/short ton</u>
1970	43.37
1974	102.46
1975	84.53
1976	72.85
1977	61.19
1978	74.50
1979	100.05
1980	102.20

Source: U.S. Bureau of the Census, <u>Statistical Abstract of the United States: 1981</u>

Page A-17 Although the possibility of accidents is discussed,
no estimates of the cost implications of accidents
is given. The discussion of accidents under "Other
Environmental Impacts," mentions only the
radiological risks as being insignificant. Thus,
the decision is being made on the assumption that
either no accidents will occur or that the cost of 0.26
such accidents do not affect the choice. The
difference in the final cost of sea disposal and
"land/sea" disposal (with the reactor compartment
buried on land) is on the order of tens of millions

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0.26 of dollars. If the accidental sinking of a submarine required more than one salvage operation, this might alter the balance.

3. Additional Comments/Questions

0.29 What would be the feasibility of conducting "test" disposals by each method to better identify actual cost factors?

0.2 How well does Navy really believe the stated costs to be accurate, as calculated?

How much of the expenses are a result of the typical level of quality assurance used today by the Navy in its nuclear program? Would there be any expected cost reductions from such experience and how would it affect relative costs of land and/or sea disposal?

J.76 What indication is there that future costs of land or sea monitoring might offset present overall cost tradeoffs? How has this been considered?

0.8 For land disposal, detailed information on the availability of equipment for anticipated transport should be included. Is the equipment needed available from Government or would commercial equipment be needed? Cost comparisons?

E.21 Is shipment by barge up the Savannah River really feasible? What special efforts by the Corps of Engineers would be necessary to provide for such transportation (such as river level control and dredging) and what would the costs be? What is the validity of cost assumptions for land disposal if all shipments are made to Hanford (or vice versa) and how does this affect costs?

Land Disposal: Capital costs for jacks, rollers, and some barge equipment is mentioned, as well as a new barge slip at Savannah River. However, there is no reference to design, licensing, construction, operation, and decommissioning of a dismantling facility. The text indicates that this would be normal shipyard work. 0.6

Sea Disposal: A cost to "qualify" a sea disposal site is included, but it is not clear that this includes such costs as international consultations under the London Ocean Dumping Convention, etc. There is no reference to the cost of possible additional corrosion studies specific to sea disposal. 0.28

Both: In neither case is there reference to a difference in cost in the protected storage of existing decommissioned submarines. 0.13

How does the sea disposal option restrict the reuse of onboard equipment, and thereby result in higher costs for new equipment procurements? Are some items salvageable, under one disposal option or another, that could save the Navy money? 0.12

What is the cost of preparing for sea disposal? Of that amount, what costs result from preparing the reactor compartment(s) and cooling system(s) for sealing so as to maximize containment? What does sealing provide in terms of reduced environmental releases of radionuclides and dose effects to man and the environment, and is such an expenditure worth it? 0.21

If sea disposal is chosen, what amount of time and effort would the Navy foresee as being required to identify and select potential sea disposal sites that meet the criteria of IAEA, and the requirements 0.18

906

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F.2 imposed by the recent amendments to the U.S. Ocean Dumping Act? How would this time and effort impact on feasibility of disposal and/or costs?

O.27 The cost estimate of $6 million to "qualify" an ocean disposal site seems extremely optimistic. Oceanographic research is very expensive. Probably several expeditions would be required to obtain an adequate data base. Such qualification efforts would have the extra benefit of advancing the science of oceanography substantially.

COMMENTS ON APPENDIX B "LAND DISPOSAL"

1. General

More discussion should be given to possible accidents during transportation to the disposal sites (i.e., barge collisions and/or sinkings) and the scenario associated with such situations. The brief discussion presented does not draw upon available statistical information regarding previous accidents with barges carrying "dangerous" cargoes. E.20

The discussion of burial site operations should be expanded to include detailed specifics on the method(s) to be used in burying reactors. E.6

2. Specific

Page B-1 Anticipated "events" and principal "events" are referred to, which are termed "activity" on pages A-12 and A-13. Standardized, uniform terminology should be used in this DEIS.

Page B-3 The "Ruppert Sand", characterized as the primary soil type at the Hanford site, should be further discussed in terms of texture and mineral composition since both are important considerations at burial sites. I.5

Page B-4 Geologic formations at depth are mentioned, but no identification of the geologic formation comprising the burial site or its soil texture and composition are discussed.

#694 (Cont)

E.20

Page B-10 The discussion on the preparation for transport, appearing in Section III.C., is thorough and reflects careful planning. This contrasts with the discussion in Section III.D.1 as regards "Transit Routes" which seems much more casual. In particular, the discussion regarding the route to the Savannah River Plant seems almost irresponsible. The statements imply insufficient investigation, i.e., "Preliminary discussions with an experienced operator of barges and tugs indicate that a reactor compartment could be barged up the Savannah River without unsurmountable problems. This operator has frequently moved barges up this river." Does the Savannah River have licensed river pilots? When were the last soundings in the channel made? The same comments applies to sub-section b. on page B-12. It appears that the trip up the Savannah River would be marginal. The feasibility of passage under the fixed bridges at River Miles 61.5 and 119 needs thorough verification before the Savannah River burial site can be considered as a realistic alternative, especially with regard to a 1 1/2 foot clearance. Have delays, or other effects, from heavy rains been considered?

E.27

Page B-12 It should be noted that passage on the Columbia river was severely disrupted in 1981 when Mount St.

Helens erupted. Mount St. Helens continues to be active. E.27

E.26

Page B-13 The discussion of barge operations does not appear to be based on very careful investigation and planning. Tug boat criteria should be specified in detail. Is the described barge ballasting procedure a routine operation? What are the possibilities of other problems? The use of a twin screw, twin engine tug would not only be desirable, but probably necessary.

In view of the complications that would follow from a river navigational problem, it would appear to be prudent for the Navy to include a trial run up each of the rivers with a dummy load. This would slightly increase the cost of the land disposal options, but might avert some serious and embarrassing complications.

Page B-15 Line 9, the sentence should read "...that gravel in the grounding pad be adjusted" (not grounded pad). X.1

Page B-18 "Special grounding techniques" to ensure that barges remain stable and level are mentioned, but not described. E.26

Pages B-18-B-20 The section (III.D.6.a.) on the overland route at the Hanford site is thorough and appears to be based on careful investigation and planning. The corresponding sub-section b. for Savannah River is

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less thorough. One gains the impression from the casual treatment of this and other material relating to the Savannah River Site, that it is not considered by the Navy as a viable alternative. If this is the case, it should be so stated.

Page B-22 Figure B-5, does not show the railroad crossings mentioned in the text.

I.9 Page B-23 In Section III.E.1, the burial conditions appear marginal.

Page B-24 The maximum temperature of 530° F mentioned in the sixth paragraph is extremely conservative since the few kilowatts released from radioactive decay would be dissipated by conduction through the metallic hull and bulkheads. However, design capability to withstand the 27 psia mentioned at the end of the paragraph appears inconsistent with 7.4 psi differential mentioned in the last paragraph.

E.19

Page B-26 B-27 Section G. should contain comments on the adequacy of long term surveillance and monitoring at shallow land burial sites, even though these responsibilities would belong to DOE. The Navy should verify that adequate security would be maintained, records and files of disposals preserved, and durable markers installed at the site.

I.13

I.15

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In Section IV.A., it is not clear whether the cost of demurrage (25 days) allows for loading, unloading and round-trip tow.

Page B-30 In section IV.C.2., the possibility of transferring legal custody of the shipment to a commercial organization does not seem realistic. If for no other reasons, security and navigational safety would seem to call for the use of naval tugs and a naval escort. If so, this should be included in the cost analysis. What is meant by "transfer of legal custody" and what are major conditions in a contract with a commercial tug company?

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COMMENTS ON APPENDIX C " DOSE COMMITMENT ESTIMATES, LAND DISPOSAL"

1. General

P.3

The model presented to estimate exposure from land disposal is too simplified. It is a presentation of a worst case scenario that does not reflect realistic risk assessment(s).

The analysis of dose commitment to a general population is based on oversimplified assumptions. For example, radionuclide rates of release were based on the assumption that the reactor compartment will be buried in a saturated zone, so that once the compartment wall is corroded the radionuclides would be released in an accelerated rate, as might be assumed for an ocean disposal area.

Geological retention of radionuclides was neglected in this analysis, thus exaggerating dose commitment estimates by several orders of magnitude.

The DOE Savannah River Laboratory developed a simulation model for predicting dose commitment to general populations from disposals at the Savannah River site. It should be used in this document.

P.10

The minimum flow of 7,500 cfs at the Savannah River Plant must be really minimum annual average flow since minimum flow near the Savannah River Plant may be below 1000 cfs.

2. Specific

P.3

Page C-1 The assumption that corroded materials would reach the Columbia River is extremely unlikely and

unrealistic. Assumptions that adsorption on soils, deposition on stream beds, and water treatment systems would not remove radionuclides are unrealistic. Accordingly, estimates based on these assumptions are of little value. P.3

Page C-4 It is stated that the size of corrosion products would prevent air transport. The size distribution (AMAD) should be given to support this statement. P.22

It is assumed in the water pathway that the activity from ten reactor compartments is released to a stream or aquifer. There is no adequate basis given for limiting the attributable source to ten reactor compartments. P.7

An estimate of fresh water fish consumption of 6.9 kg./yr. is used in reference C.2. Average current estimates of fresh water fish consumption range from 0.11 to 0.85 kg/yr., as reported by Rupp in <u>Health Physics</u>, volume 39, pp. 165 - 175, 1980. P.8

Page C-5 Dose conversion factors used are basically those of ICRP-2 and should be updated to reflect the more commonly used ICRP-30 models and improved metabolic parameters. Also, what is the degree of conservatism in the dose conversion and concentration factors? T.33

#694 (Cont)

X.1 — Page C-10 The Ni-59 concentration for release from 10 submarines into water flowing at 20 cubic feet per second is 3.75 x 10^{-8} μCi/ml. rather than 3.4 x 10^{-8} μCi/ml., or 37.5 times higher than for the average calculation.

E.32 — Page C-12 What is the volume of metal in comparison to the contained volume of empty space?

P.14 — Page C-14 What is the basis for the statement that "several thousand years after disposal" are required to make agricultural intrusion credible?

L.49 — Page C-16 Subsection C, concerning exposure due to potassium-40, is logically incorrect and should be ommitted. The body burden of K-40 is essentially in equilibrium because of the daily intake in the diet and would not be enhanced as estimated in this section.

P.16 — How conservative is the calculation for Am-241? Is there any real basis for their comparison, i.e. do these numbers involve the same degree of conservatism?

L.32 — Also, the conservative assumptions for Section IV provide no basis for comparison with the dose from K-40.

COMMENTS ON APPENDIX D " DESCRIPTION OF THE SEA DISPOSAL METHOD"

and

COMMENTS ON ANNEX TO APPENDIX D "RADIOLOGICAL ENVIRONMENTAL MONITORING AT SITES OF NUCLEAR-POWERED SUBMARINE THRESHER AND SCORPION SINKINGS"

I. General

The sea disposal alternative method only considers a "free fall" mode, yet costs for other methods are presented in Appendix A. Thus, more discussion is needed. — F.24

Relevant cost data associated with monitoring THRESHER and SCORPION should be made available to provide a means of evaluating the cost of a monitoring program for the ocean alternative. Such cost information could also provide a more realistic comparison of costs for use in selecting disposal alternatives. — J.82

In Appendix B it is stated that there is contaminated piping beyond the reactor compartment which would be cut away and stored in the reactor compartment for disposal. In Appendix D, no mention of radioactive material outside the reactor compartment occurs. Is there such material? If so, it should be discussed in this section as to how it will be disposed. — F.35

Model testing and computer simulations reported are a sound approach to predicting full-scale trajectories and ship attitudes in free fall descent. However, the model scales appear quite small and confident predictions from model tests at small scales are not well based. — F.19

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F.19

Data on the planned sinking of submarines (project THURBER, on page D-5) and project CHASE (planned sinking of conventional ships containing obsolete munitions) should be presented for comparison with the estimates given here for controlled, free-fall sinkings.

2. Specific

F.14

Page D-2 Regarding the statement referring to Figure D-1, that "The submarine would be towed.... the maximum stable towing speed in this configuration": On page 2-1, Pearl Harbor, Hawaii is designated among others as a shipyard for final preparation of submarines for land disposal. Others sections mention that it is desirable to stay within 200 nautical miles of the coast of the U.S. Estimated over-water routes ranging from 250 to 6000 miles to the disposal site are given (page 2-10). The distance from Peal Harbor to areas within 200 miles of the U.S. is minimally 2,000 miles. It doesn't seem logical to tow, by cable, an unmanned submarine (4,000 tons), as shown in Figure D-1. The instability of a partially submerged submarine and the speed limitations of the towing vessel (less than 9.5 knots), can result in loss of tow, collision, or

L.62

other credible accident(s) resulting from of possible severe water and/or weather conditions. The impact of this scenario should be addressed in more detail.

F.36

Page D-8 In describing the confidence in impact effects the range is given as ± 50%. This seems a rather broad range with respect to testing criteria, yet it is followed by the statement that this is considered "to be a reasonable accuracy for a dynamics problem in geotechnical engineering." Inadequate information is provided regarding the impact and cratering effects associated with the scuttling of submarines. Section VI of Appendix D addresses the subject, but does not provide information useful to an assessment of impact effects in the abyssal environment.

F.26

The geochemical properties of sediments in the test areas off Port Hueneme, California, do not greatly resemble those of abyssal plain pelagic sediments. The test site in a sandy shelf area 4 miles off the coast is of interest to impact effects in general, but has little application to the deep sea. The tests in 1200 ft of water 30 miles west of Port Hueneme were conducted in the Santa Barbara Channel, an enclosed basin of the continental borderland (see Emery, 1960, for a description of the environment). Sediments within this basin are anoxic, but that may be the only similarity between the basin deposits and those of abyssal plains. Santa Barbara sediments are described in detail in Hulsemann and

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Emery (1961), Berger and Soutar (1970) and Soutar and Isaacs (1974). These are hemipelagic deposits which contain significant contributions of terrestrial sediments contributed by turbidity currents and biogenic components derived from the productive coastal waters off southern California. The two areas under consideration (Pacific and Atlantic sites) contain pelagic clays and minor amounts of distal turbidite sediments. One would expect that an object the size of a nuclear submarine which arrives at the seafloor at a velocity of 40-45 ft/sec, intact, will become embedded in the sediments as a result of impact forces. The extent of embeddment will depend upon the attitude of the hull as it strikes the bottom. Under conditions described, the hull would arrive at the seafloor at a pitch angle of 1-5°, bow up. Without questioning the determination of model attitudes, one must consider the effects of a real sinking and the control of the descent of a large object. The disposal of the SEA WOLF reactor was an example of a disposal effort in which the descending platform may not have followed a planned trajectory. More detailed explanation is needed of the basis for the Navy's conclusious on settling

Q.13

F.19

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velocity, attitude and depth of penetration into the seafloor sediment.

F.19

On 30 August, 1982, in a presentation before the National Advisory Committee on Oceans and Atmospheres in Washington, D.C., representatives of the Navy (James Mangeno and Carl Schmidt) described the procedures for "disposal." In this commentary, they indicated that the hulls might penetrate 10-30 feet into the seafloor upon impact, but that the deceleration, in the range of 2-4g, would not exceed structural designs of the hulls - thus ensuring integrity of the hull and retention of radioactivity within it.

Burial upon impact has significance which is not addressed in this DEIS. The sediments in the sites examined become anoxic at some depth below the sediment-water interface. Estimates of galvanic effects caused by partial embedment of a steel hull in anoxic sediments (negative Eh) and segments exposed to oxidizing conditions above the sediment are discussed in the Sandia Report Appendix (Appendix N, Karlin et al., 1982). The question of impact burial depth seems critical to the entire discussion related to fate and effects and well as "monitorability" since the latter would certainly be hampered by deep embeddment. Cratering research has

Q.13

J.77

#694 (Cont)

shown that impacts which have sufficient velocity to displace materials do so by "overturning" the materials adjacent to the impact site. The ejecta from such impacts are excavated from deeper strata, while the rim of craters represents the overturning of strata such that the area adjacent to the impact has inverted stratigraphy as a result of the "peeling back" of strata. Cratering studies in seafloor materials have confirmed this relationship (see Appendix D references). The possibility that a scuttled hull might embed itself to a depth equal to its diameter has not been adequately addressed in this DEIS. Significant aspects of the disposal rationale depend upon the ultimate configuration of the hulls (buried, partially buried, etc.) Q.13

Page D-9 It is noted that maintenance of hull containment integrity is not 100% certain. Such a statement provides rational for conducting trial sinkings before initiating "full-fledged" disposals would provide meaningful data on hull containment integrity, F.25 the possibility of collisions with previously emplaced subs on the bottom at impact, F.23 and short-term ecological impacts(s) could then be obtained.

How conservative is the 10% allowance for horizontal displacement? How is this considered to be conservative? F.30

Page D-10 Skepticism is expressed about achieving the disposal pattern shown in Fig. D-5. The use of the term "disposal" raises a question regarding the technique for "discharging" decommissioned submarines. The term disposal implies..." an orderly or systematic placement, distribution or arrangement," while another meaning is stated as "....a discarding or throwing away." (Grove, 1971, p. 654). F.29 The placement configuration displayed in Figure D-5 suggests that a controlled distribution of hulls can be provided within a given area. The uncontrolled descent of a hull, with some hydrodynamic surfaces removed, has been described as providing an impact site location within 1500' of a release point in 15,000 ft. water depth (p. D-9). It appears that these estimates were developed following evaluations of tests performed off California and with model experiments. Certainly one question regarding the evaluation would be the determination of proposed actual trajectories of the scuttled submarine hull. The "orderly" placement implied requires defense to

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F.23 ensure that subsequent disposals would not impact on top of a previously scuttled hull.

3. Additional Comments

To generate good information on what has happened around SCORPION and THRESHER, the following could apply:

J.62 (1) Develop a numerical model incorporating release rates, currents, sediment adsorption and food chains to guide research at the sites.

(2) Monitor the sites periodically to quantify unknowns in (1).

J.44 (3) Publish these findings in public, peer-reviewed scientific literature.

J.63 In discussing the THRESHER and SCORPION sites on page D-A 1, would it be possible to describe the conditions of the reactor compartments and their physical location relative to the sediment-water boundary (e.g., are they deeply buried)? This would allow a better feeling for comparisons made with the compartments to be dumped.

J.39 The statement on page D-A2, that there is "little or no mixing of the Western Boundary Undercurrent with the Continental Shelf water along the entire north Atlantic coastline" needs to be documented.

J.51 On page D-A8, it is indicated that the pore water in the core sediment samples was drained. In order to get complete data, it is necessary to analyze the pore water.

J.49 Also, were analyses conducted for the presence of transuranic isotopes?

X.1 On page D-A9, there appears to be a typographic error in Figure

D-A5 with regard to the station numbered 48 or 4B. No such station is listed in Table D.A2. X.1

On page D-A11, what is the stability of the magnetic Co-60 material in deep-sea conditions? That is, will it dissolve? At what rates? Will it form other compounds first? What about under oxidizing and reducing conditions? Is the magnetic material much more resistent to degradation than other corrosion products from the reactor vessel, etc? Could these other corrosion products have been more readily dispersed than the magnetic material, leaving it alone to be observed? J.52

Studies of the THRESHER and SCORPION sinkings are cited to demonstrate, in part, that no ecological effects were observed. There are some inadequacies with these studies:

1) The data presented cannot be used to establish a budget of radionuclides leaked to the environment. In addition, there is no documentation of the term "statistically" significant. J.54

2) "State-of-the-art" techniques used in monitoring the sites should be discussed, especially as to what they were and what accuracy of measurement was provided. J.55

3) It is not meaningful to say that no ecological effects were observed from only mud samples and deep sea photographs. Were other collection techniques used, and if so, what were they? J.57

J.58 4) It is doubtful that spiders were found in the site, as described on page D-A2.

J.59 5) The discussion of animal life observed between pages D-A4 and D-A6 is suspect. This section appears to be comparing animal counts in a published photo atlas of a mid-Atlantic Ridge hard bottom area to the site, which is noted as being a soft bottom environment.

J.65 6) There is no indication as to whether the water samples taken were upstream or downstream of debris.

J.38 7) The claim on pg. D-A11 that there is minimal bioturbation below five centimeters is not well substantiated. Measured bioturbation is not well studied with small cores.

J.60 8) Levels of instrument background should be specified in section IV.C on page D-A16.

COMMENTS ON APPENDIX E "DESCRIPTION OF OCEAN STUDY AREAS"

1. General

The description of these two areas is only an oceanographic description. To fulfill EIS requirements for specific sites, additional information should be included for evaluation of economic and population impacts. This Appendix is only a partial site description. L.53 Also, since there is definite uncertainty in determining the Navy's meaning of "study areas" with respect to potential "disposal sites," any future revision of this document should clearly address this ambiguity. J.3

It is important that any physical description, including measured oceanographic parameters, match the model being considered for use in predictive analysis. Much of this type of information is related to ocean currents, and the methods of current measurement are critical to the use of derived data. This appendix lacks any information on the current measurement techniques. Such information may be contained in Sandia report 82-1005. It would be beneficial to include more specific information on current measuring techniques, contained in the Sandia report, in this Appendix. F.33

Both descriptions present an adequate preliminary account of the physical environment at each location, based on old studies and site specific investigations. J.9 The ecological aspects are virtually absent but it is indicated that such data is still being worked up. It should be stated whether the final EIS will include L.19

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L.19 results of ongoing studies and how they might impact on the information provided in the DEIS.

J.70 The basic reference for oceanographic techniques is a 1969 engineering handbook which does not cover most of the techniques that are briefly described, and does not contain anything approaching a state-of-the-art description of a deep sea ecological study.

It is stated that coring, netting and trapping "...provide the necessary material for... development of estimates of the density of life on the sea floor and in the water column." Coring can be biologically quantitative, but applies only to smaller size infauna or sessile organisms. Netting and trapping are not considered to be of much quantitative value. It is also the flux of life through the disposal sites that is of importance in transport processes, not just the standing stock in the site. Further research is needed to develop improved procedures for quantitative evaluations of deep sea ecology.

J.9 Apparently no effort was made to look into historical data, especially for physical properties, currents and biological activity. A large amount of data is maintained at the National Oceanographic Data Center and pertinent, applicable information should be included.

2. Specific

J.18 Page E-1 — It is not clear how the 200 n.m. exclusive economic zone requirements are relevant to siting criteria.

What is the basis for acquiring "realistic" data for "realistic" analysis of ocean pathways in contrast to unrealistic analyses provided for the land disposal option? X.1

Page E-5 — The statement that "sites should be remote from continental margins" should be quantified. EPA contract report #520/1-82-003 suggests that a separation of 200 km would be reasonable. F.28

Page E-6 — The statement that "sites should be away from areas containing active geologic phenomena ..." should be quantified. EPA contract report 520/1-82 003 suggests that separation of 200 km is reasonable.

Pages E-6 to E-19 — Differences in amounts and types of clay minerals with respect to their retention of nickel-59 should be investigated since Ni-59 is the radionuclide of most concern in the long term. J.9

Pages E-19 to E-31 — There is no indication of clay mineralogy in the Tertiary sediments. The sediment composition and texture should be described, for use as a first-order estimate of radionuclide retention. Using manganese occurrences to identify oxic and anoxic conditions in cores is an excellent approach, but pH and Eh measurements, if available, should be included with the data for confirmation. J.69

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J.9 Page E-19 It is stated that the plots of deep current data for the the Hatteras Abyssal Plain are applicable to the lower Continental Rise. This is not precisely true, and there is a lack of deep current information in this region.

F.28 Page E-30 The "study area" may be located too close (70 - 150 km) to the Mendocino Fracture Zone. EPA contract report #520/1-82-003 suggests a minimum separation of 200 km.

J.9 The technology for determining critical erosion stress values is not yet well established. Numerous studies have been conducted in the laboratory, however, all <u>in-situ</u> measurements, especially at great depths, have not agreed with laboratory results. The values presented are indicative of the order of magnitude only.

The limitations on sediment shear strength for the penetrometer measurements should be discussed, since these results are important in deciding whether there are differences between samples and regions.

3. <u>Additional Comments/Questions</u>

J.20 In general, many of the references cited in the Sandia report (Talbert, 1982) are selected from the technical literature dated 1960's, 1970's. There have been major studies relevant to both regions which were not cited in the Sandia reports in the DEIS. These

omissions suggest a cursory evaluation of published information which weakens an objective assessment. References to refereed journal contributions would indicate an awareness of oceanographic research (beyond that of the Sandia contractors) relevent to the sites in question, or abyssal processes in general. Examples are two recent papers in the AAAS journal, SCIENCE, (Keer, 1982; Stuiver et al, 1983). Although these contributions came too late for inclusion in the printed DEIS, the research is highly relevant and should be included in a final EIS. Other papers, such as Tucholke (1980), are germane yet uncited in this document. J.20

<u>Microbiological Effects</u>: Examination of the Sandia Reports and other documentation related to the DEIS theme failed to disclose any study related to bacterial (microbiological) studies associated with research directed toward environmental impacts of the sea disposal alternative. There are numerous studies addressing this topic, most of which stress the importance of introduced substrates to the marine environment and colonization effects. Discussions with Dr. Rita Colwell, University of Maryland and others, suggest that this topic is one which should be considered. The description of the sessile benthos associated with the debris from the SCORPION sinking (p. D-A4) suggest that hull surfaces are colonized by abyssal benthos. From Colwell, et al (1980), the importance of this activity may be stated as follows - "The establishment of a primary microbial community on substrates is a prerequisite for subsequent attachment of marine macroorganisms..." Numerous papers by Cowell, H.W. Jannasch of Woods Hole, Ruth Turner of Harvard and others, might be considered in a final L.54

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assessment of the importance of abyssal activity. Additional information on recent studies regarding deep sea microbial processes may be found in Ernst and Morin, (1982).

J.9 On page E-17, Figure E-10 shows an extension of the Hatteras Transverse Canyon reaching north of 35° N latitude (lower left center of figure). This feature has been described in detail by Rona et al. (1967). From that information, the canyon head is found at 34° 11'N, 72° 46'W. Although this may seem a trivial point, the question of sediment transport and canyon biota associated with this feature require some careful attention.

On page E-19, last paragraph, there is a statement of benthic fisheries exclusion "on the basis of energy requirements." This is not clear in the context presented. What does this statement mean?

L.2 No attempt is made to provide state-of-the-art information on the biological components of the deep bottom ecosystem, how these components survive, the relation of the deep ecosystem to the rest of the ocean, and how various components transfer or concentrate the radionuclides in question (E-11, 19). The species named are but a few (about 10) of the hundreds known from the deep north Atlantic, and do not count those yet to be described because they are too small to be noticed or too big and fast to be caught by conventional methods. Does the fact that any fishing is done in Area W-N (Pacific) preclude its potential use as a disposal site?

J.9 No biological data were collected from the areas in question, except for photographs. Little can be discerned from photos, except

the few big slow creatures that live on the mud's surface. No attempt was made to use the volumes of data from similar areas of the Pacific and Atlantic to infer what is present and its importance. J.9

Appendix D of the Sandia report, (SAND 82-1005), Vol. II by D.L. Stein, is a good report that does not seem to be considered in this DEIS. Although the author states otherwise, it appears that a number of species are exploited on the margins of the area in question and above it. Nothing is known of their concentration factors, their productivities (although Stein makes some good guesses), or their proclivities to migrate or congregate near old submarine hulls. J.11 T.22

The above analysis should be done for the Atlantic. J.9

Quality of the marine disposal sections relative to sedimentology and sediment geochemistry is good but a bit variable. There are two important subjects which have been neglected.

1. Uptake and subsequent remobilization of radionuclides from sediments have not been addressed, except in passing in Appendix H. Presumably much of the activity released from the compartment will pass directly to the sediment as particulates or via the water to be sorbed onto particulates and then to the sediment. These processes are included in the model presented in Appendix H but are never developed in themselves. The stabilities of these materials on or in the sediments, the rate of release to the water/sediment system of the particulates and the interactions there (e.g., distribution ratios, bioturbation) will be important to developing an overall view. R.7

2. Large scale views of the study areas, through bathymetry and sub-bottom profiling, provide one part of the overview. Small scale sampling and photography provide another. Lacking is a mid-scale view. This could best be provided by side-scan sonar imaging. At a radioactive waste disposal site in the western Atlantic (3800m), remote sensing (plan-view sonar imaging) revealed an extremely complex terrain of massive slump blocks [Ryan, 1981]. Similar surveys of the study areas are necessary.

J.9

Also, there appears to be an imbalance in the materials presented for ocean disposal. Although there are two sites in the Atlantic, more information is presented for the Pacific site.

On page E-19, it was stated that several "promising locations" within the study area were found. These should be discussed more fully and located on the chart. Contrasting the "promising" sites with those that are rejected would provide an understanding of the practicalities of the criteria applied; the difference required between acceptance and rejection.

J.9

On page E-19, statements on the section regarding the Lower Continental Rise Study Area (E-N 2) gloss over or omit the reservations expressed on page 496 of SAND-82-1005/II. In this report it was stated that side-scan sonar, detailed bathymetry sub-bottom profiling and long cores should be utilized to determine if this area is subject to mass wasting or slumping processes. In the DEIS this point is not addressed, although Figure E-10 certainly alludes to the problem of the site being less quiescent than one may want.

On page E-20, current meter data discussed in the site descriptions should include maximum current velocities observed. Certainly, in nearshore waters, most bottom sediment transport occurs as short-lived, episodic events. J.66

Information on the geochemical properties of sediments from the study areas is completely lacking. For any reasonable estimate of the potential transport of radioactive contaminants from the source, basic information on the sediment properties such as its redox character, bulk density and porosity, bulk chemistry mineralogy, pore water chemistry, cation exchange capacity, etc., is required for each study area.

Depth distributions of nuclear weapons testing-derived radionuclides such as Co-60, Cs-137, Pu isotopes, etc., in sediment cores from the study areas, may provide some useful information on the behavior of these radionuclides exhibiting different geochemistries in the sediment column. Further, the sediment radionuclide data may also help identify the important processes by which the radioactive contaminants can be redistributed vertically. Considering that some of the radioactive contaminants such as Ni-63 and Co-60 are associated with corrosion particulate matter, bioturbation may prove to be an important transport mechanism, especially in the vicinity of the sediment water interface. J.9

Data on the stability and leachability of corrosion particulate matter in the sediment/pore water environment are also necessary. Further, information on the interactions of the released radionuclides

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with surrounding sediment would be useful for evaluating the radionuclide retention characteristics of the sediments from the ocean study area.

Information on the movement of suspended solids as a function of the prevailing bottom water currents in the study areas may be useful in evaluating the potential transport of particulate corrosion products.

COMMENTS ON APPENDIX F " CORROSION OF STRUCTURAL ALLOYS"

1. General

Actual corrosion data from submarine structures long submerged Q.4
in the sea would be of major interest in corroborating this
theoretical discussion. Currently operational submersibles could
probably recover meaningful samples from the barge used for J.42
disposal of SEAWOLF reactor in 1959, THRESHER which sunk in 1963,
and SCORPION which sunk in 1968.

How successful are field and lab corrosion studies, such as
described in this document, at predicting the actual rate of
corrosion of large structures in the marine environment? By what Q.3
factors, typically, do these small-scale studies conform or
disagree with actual experience with larger objects? Were any
experiments conducted to evaluate corrosion rates in wet or dry Q.1
soils?

This Appendix is vague about biofouling effects on the field
experiment. Was there any detected fouling in terms of bacterial
film or larger organisms on the panels submerged in the Pacific?
In the Annex to Appendix D it is mentioned that the hulls were Q.12
covered over large areas by moss animals. Has any effort been
made to determine the turnover rate of fouling organisms in the
deep sea over the surface of a corroding object for a long time
period?

The Navy has done a conservative job of estimating the release to the deep sea environment by corrosion processes of radioactive isotopes following the sea disposal of decommissioned defueled naval reactor plants.

In evaluating the role of corrosion on environmental impact of sea disposal, the Navy has relied on extensive studies of corrosion in the deep sea of two types of materials: carbon and low alloy steels, which corrode at similar rates, and corrosion resistant alloys such as type 304 stainless steel and Inconel 600, both of which corrode at similar rates and primarily by pitting. Corrosion of the carbon steel is relatively uniform. The Navy assumes for estimating the time of penetration of the carbon steel hull, a maximum corrosion rate of this material that is factor of 2 greater than their calculated average corrosion rate. This assumption is entirely consistent with measured data, with one exception. The austenitic alloys corrode locally by a pitting process rather than by a general corrosion process, and this pitting phenomenon is likely to continue for an indefinite period of time. The maximum pitting rates are considerably greater than the average corrosion rates. This is recognized by the Navy in their estimates of release rates.

Assuming that long-lived nickel isotopes are the major concern, for release from irradiated stainless steel, the Navy has assumed that the nickel is released at approximately the rate at which the stainless steel is corroding by a pitting reaction. This assumption is apparently germane in that the radioactive nickel is likely to be randomly dispersed throughout the austenitic stainless steel grains and will be released to the

environment at approximately the rate at which the material itself is corroded. There further has been some evidence in the literature that pitting reactions in stainless steel result in transporting the nickel ions out of the pits, so that the assumption that the nickel isotopes would enter the environment by this mechanism is conservative and realistic.

2. Specific

Page F-2 The carbon and low allow steel corrosion rates used for estimation are listed in Figure F-1 and Table F.1 of Appendix F and are at least a factor of 1 1/2 to 2 greater than the measurements actually made by Kendig at BNL. They appear to be conservative, and are also conservative with respect to the Navy's own referenced data as shown in Figure F-4.

The basic premise on which this document rests is that the vast majority of the radionuclides present in the vessel are an integral part of the structure itself, and that these radionuclides can be released to the environment only through the relatively slow process of metallic corrosion. Thus, the corrosion rate data presented in Table F.1 are of vital importance. These data appear to be a reasonable summary of the published literature for deep ocean corrosion of the various alloys listed in Table F.2.

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Q.6

Pages F-3 to F-16

Several times in Appendix F, it is concluded that it would be conservative to use the average long-term corrosion rates from Table F.1 in calculating the corrosion release of radionuclides. To be conservative, it would be more proper to use the maximum long-term rates shown in the Table as 5 mils/year and 0.5 mils/year. In a similar manner, a pitting factor of 46 is applied to the uniform or weight loss corrosion rate to give the average rate at which the corrosion resistant alloys are penetrated by pitting. This is an acceptable procedure for determining the time for general penetration of a section by many pits, but is inadequate for determining the time of first penetration of the barrier by the deepest pits. It is also admitted that the maximum pitting factor is approximately 200. A value on that order is born

out by the data in reference F.2 (pages 133-137). Why, then, does Navy insist on using the average values for a calculation which they claim to be conservative?

Page F-6

The more detailed data listed in Table F.3 and the references cited from which those data are extracted are adequate. The column labeled "Adjusted average" in Table F.3, however, needs clarification. It is stated that these average values were adjusted to account for temperature and oxygen concentration differences between the site where they were generated and the study area. The problem is that there were two study areas, one in the Atlantic, one in the Pacific. According to Figures E-8 and E-17, the dissolved oxygen values in the deep Atlantic are about twice what they are in the deep Pacific (see also Table F.4). The temperature data for the two sites Figures E-6 and E-15 are similar. It is well-known that dissolved oxygen plays a major role in determining the corrosion rate of plain carbon and low allow steels in seawater (see reference F.16). The major role of dissolved oxygen is also

Q.11

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Q.11

revealed in the equation (from reference F.9) used to make the adjustments. That equation is:

corrosion rate (μ m yr^{-1}) =

$$21.3 + 25.4\ (O_{2}\gamma + 0.356(T))$$

where O_2 is the dissolved oxygen concentration in ml/l and T is the temperature in ^{o}C. From the coefficients in the above equation (25.4 for O_2 vs. 0.356 for T) one can see that when O_2 and T are both numerically between one and ten, as they both are in the deep ocean, the oxygen term predominates. Therefore, there should be two columns of adjusted average figures - one for each site. At the very least, it should be specified for which site the adjustment has been made.

Q.8

Page F-7 What is the meaning of the statement that "values for corrosion resistant alloys.... are considered to be conservatively high...."? What is the extent of conservatism?

Q.10

Pages F-7 to F-18 Balancing the lack of conservatism in using average values is the fact that a linear model for the variation in depth of penetration with time is used. The first equation on page F-7 is a good example of this. In that equation, D = 46 (2.2 + .3(t - 1)), the average weight loss data (term in brackets) is multiplied by the pitting factor to get D, the depth of penetration by pitting. It is

Q.10

correct that the rate of weight lost from a metal corroding by pitting in seawater tends to be linear with time. It is rare, however, to find the depth of penetration to be linear. It is either much faster than linear in the case of corrosion by tunneling in the direction of gravity (as shown in references F.2 and F.5), or it is slower than linear in the more usual case of spherical or hemispherical pits. In the latter case, the weight loss, or volume of the pit, increases linearly with time. One could write that:

$$\text{wt. loss or volume} = 4/3\pi\ r^3 = At + B$$

where is the radius of the pit at time, t, and A and B are constants. If the depth of penetration is about equal to the radius of the pit, then the above equation solved for r can be written: $r' = A't^{1/3} + B'$ where A' and B' are different constants. Thus, the penetration rate falls off with the cube root of time. An excellent discussion of this can be found in the book by Godard et al., "The Corrosion of Light Metals," John Wiley, New York 1967.

Based on the above discussion, the use of an average, rather than the maximum pitting factor and a linear model for the penetration tend to balance each other, and the calculated penetration times (see page F-18) may be reasonably accurate. It

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Q.10 would be conservative, however, to use both the maximum pitting factor and the linear penetration model. Because this is not done, the term "conservative" does not describe the calculation.

L.24 Other than in two examples given in page F-18, the wall thicknesses of any of the corroding components is not given. This omission makes it impossible to actually check calculations.

Pages F-15 and F-16

Q.13 In the discussion of galvanic effects, galvanic corrosion is refered to as being confined to the region of the dissimilar metal junction. In fresh water, where the conductivity is low, galvanic attack does tend to be concentrated within a few millimeters of the two-metal junction. In seawater, however, the conductivity is high enough to permit accelerated galvanic effects to be spread out over 50 to 100 feet. It could be that this apparent contradiction is caused only by the poor writing. For instance, it is never defined what distances are actually meant when using the terms "near" to or "remote" from the galvanic junction.

L.51 Also, in Appendix D, page D-1, it is mentioned that the reactor compartment will be "filled with water" prior to leaving the shipyard but does not state whether that will be fresh, brackish or sea water.

The differences in the internal corrosion rates could be substantial depending upon what kind of water is in the reactor compartment. L.51

Q.9 In summation, Appendix F was poorly written. Section F-IV-A on Corrosion Theory is particularly poor in this regard. The discussion of Crevice Corrosion on page F-14 and the accompanying diagram, Figure F-5, are quite inadequate. Figure F-5 is actually wrong. A far better figure and discussion are given in the book "Corrosion Engineering" by Fontana and Greene, 2nd Edition, 1978, McGraw Hill, pages 41-43.

L.51 It is recommended that Appendix F be rewritten and that the Navy clarify its intentions about 1) the water for filling the reactor compartment and 2) the check valve. F.21

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COMMENTS ON APPENDIX G "ESTIMATED RADIOACTIVE RELEASES FOLLOWING DISPOSAL AT SEA"

1. General

The discussion of each set of conservative assumptions, as well as the baseline assumptions, are explained in detail. However, the models themselves are not adequate. In any revision of this document, substantial effort should be expended to improve these models.

It appears that approximations of the basic models over small intervals were made by analytic functions. The principle

R.5 attribute of this procedure is that it is easy to conduct parametric studies for a wide range of model parameters.

R.6 Apparently, however, this was not done. This disadvantage of this approach is that the solution technique is not especially accurate or even efficient. It is disturbing that no mention is made of this or any rationale provided for the approach taken. Thus, it is important to evaluate the claim that the approximations are "reasonable."

R.8 No documentation was provided for the way the value of leakage and coagulation coefficients were selected. The references for

S.29 these and many other parameters appear to be given in unpublished and hard-to-obtain technical reports. Some effort should be made

R.9 to justify the values employed, as well as to provide a reasonable range.

Three factors that might affect the corrosion release model calculations, and dose commitment calculations for sea disposal are:

a) Galvanic corrosion. If the reactor compartment is filled with seawater and the exposed area of corrosion resistant alloy is 10 or more times greater inside the compartment than the exposed area of low alloy steel, then galvanic corrosion could substantially increase the corrosion rate of the low alloy steel. On the other hand, if this were the case, the corrosion resistant alloy would be protected from pitting and crevice corrosion by the hull acting as a sacrificial anode. In this latter case, the hull would corrode faster than calculated but the reactor vessel and its attendant piping would last 10 or 100 times longer. Considerably more would have to be known about the details of construction inside the reactor compartment before any firm conclusions could be drawn. R.10

b) Corrosion inhibition. A fairly simple way to slow down all corrosion reactions within the reactor compartment would be to fill the compartment with deaerated fresh water before leaving the shipyard. Various appropriate L.51

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L.50

corrosion inhibitors (to reduce hydrogen evolution, for example) could also be added to the water if desirable. This may, in fact, be what is intended, but the document does not specifically say so.

F.21

c) Check valve failure. On page D-1 it is mentioned that the forward reactor compartment bulkhead will be fitted with a check valve to allow inward flow of water (this would be seawater) for pressure compensation as a vessel sinks. No further information is given about the valve. In particular, what will be its materials of construction? How reliable and corrosion resistant will the valve be? This is important because a severely corroded or stuck-open valve would constitute immediate loss of the reactor compartment as a containment vessel.

2. Specific

F.19

Page C-1 The statement "that tests have demonstrated that decommissioned nuclear submarines would remain intact when emplaced on the deep ocean bottom" was not rigorously demonstrated in Appendix D for the free-fall disposal method.

It is misleading to label conditions as "best estimates" when they are conservative and unrealistic. U.13

Page G-2 In Table G.1 and footnote, the radionuclide content and activity level of "crud" deserves better definition. Is "crud" free of transuranic isotopes? A.14 A.12

Page G-3 Calculated results for pit penetration by corrosion are presented. Verification by obtaining samples or presenting data from SEAWOLF, THRESHER and SCORPION would be useful. There is no discussion of this data in comparison to the corrosion rate estimates provided in Appendix F. R.15

Page G-4 Is it realistic to assume all corrosion products are transportable and no credit is taken for settling? R.12 Again, is it realistic to assume a current flow through the reactor vessel in 400 years? R.13 In Section 3, what does "unrealistically high" mean in contrast to section 2 which is also "unrealistic"? R.23

Pages G-7 and G-11 There are substantial differences between the best and conservative estimates in figures G-2 and G-3. Discussion is needed. R.16

In Table G.2 and Table G.9, the column heading "Approximate Time when Maximum Occurs" needs a unit to be shown. Undoubtedly it is years but it should be so labelled. X.1

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R.17

Page G-23 — Equation G2 is misleading in that it indicates that the number of modeled components for each of the barriers is the same. In the subsequent discussion, this does not appear to be true. Therefore, each of the sums in this equation should have a different range.

R.20

Pages G-27 to G-30 — The material presented for the models as represented in equations G5 thru G8 and G10 thru G12 are not sufficient to evaluate how effectively they describe the basic processes. More material is needed.

R.21

There is no discussion of the meaning of the ϕ and γ in equations G14 thru G17.

COMMENTS ON APPENDIX H " DESCRIPTION OF THE OCEAN DISPERSION MODEL"

1. General

Where the preceeding Appendix uses conservative values as well as "best" values, and includes a discussion of the derivation or assumptions involved, this Appendix is deficient in these aspects. No numerical information on sensitivity analysis is given. No data or descriptive information on how the values of key parameters were arrived at is provided, except for reference to Sandia report 82-1005 which is not readily available. Some extraction of data from this report, or other references, on the oceanographic measurements used and sources of numerical values for key parameters and sensitivity analysis would be helpful. S.33 S.27 S.29 N.14

This Appendix does not acknowledge differences in the quality of the estimates that went into the model computations. The reader is simply referred to some referenced literature, often not in a reviewed journal. S.9

When dealing with an area the size of the Pacific ocean, the use of first order estimates or approximations is probably justified. However, on-site predictive capability requires much greater precision. As a result, it is doubtful that the estimates for exposure in the study area are well-modeled by the approach taken. S.10

The model should be tested on a point source, not a diffuse source isotope like Rn-222. S.11

#694 (Cont)

S.30 Appendix H cites 17 references, of which only 6 can be considered to be available in the open literature. This Appendix is vague in its use of S.31 multichapter and multiauthor works which are cited without reference to the specific relevant material; such is the case for reference H.7, H.8 and H.9. Reference H.10 is cited in support of the contention that the sediments in the S.32 Pacific site are like Fuller's earth in their adsorptive capabilities (page H-10). Reference H.10 is over 10 years old and does not in any manner address adsorbtion of radionuclides by natural marine sediments in 4,000 meters of water.

The model is used to make assertions that are probably beyond its predictive capabilities. It is not proven that it can accurately predict the dosage encountered in a disposal field of S.12 100 submarines, and it is unlikely that it can accurately predict the exposure at a specific coastal site. The magnitude of S.25 probable error should be calculated in addition to computations of probable doseage and efforts should be made to validate the model, S.11 either through experimental point source release or detailed studies of accidental point source releases.

There are two levels of difficulty with this section. The first deals with the very fundamental issue of how one goes about parametizing horizontal advective and turbulent diffusive S.13 effects. Apparently, in the approach taken here, the horizontal advection is treated as a constant for all space and time, as is the horizontal diffusivity. These ideas are not in the mainstream of present thinking by oceanographers. Secondly, even if the

parameterizations can be justified, their actual applications are done improperly, since it is physically and mathematically S.14 incorrect to specify separate diffusion equations for different geographic and geometric components.

It is difficult to evaluate Tables H. 3 to H. 9 without running a similar model. This model is a <u>gross oversimplication</u> S.1 of what happens in the ocean. It represents long term averages and as such uses large mixing length scales, presumably because the mean velocities used are <u>low</u> and the x,y diffusivities are S.3 high (horizontal). Smaller space and time scales would be appropriate to run too, in both 2 and 3 dimensions using more appropriate values for the smaller scales. By that, one could S.4 suggest v's of up to 20 or 30 cm/sec and x,y diffusivities of $10^3 cm^2/sec$ rather than $10^7 cm^2/sec$.

Also, it would be useful to model the Atlantic sites as well as the Pacific site. This would allow comparison of the J.32 sensitivity of the model to various factors and give at least an idea of the range of effects.

2. <u>Specific</u>

Page H-3 If the potential for biological transport is as low as indicated, this should be emphasized in the analysis of impacts from the sea disposal alternative.

Page H-10 The single paragraph at the end of section IV is S.27 much too brief, particularly in that it gives no

S.27 numerical information on the sensitivity analysis performed. Computations should be included to verify the statement "these calculations demonstrated that the hypothetical disposal of submarines would not produce significant environmental effects even in the vicinity of the disposal."

S.28 Page H-13 A reference or discussion to describe how concentration patterns were calculated is needed to verify the statement "the radionuclide concentrations are predicted, by the calculations, to decrease to less than one percent of the bottom value at about 385 meters above the ocean floor."

J.30 Data on the critical bottom current velocity which would be energetic enough to resuspend sediment in the ocean study areas is needed.

S.5 Pages H-13 to H-15 The purpose of comparing the model results with those of Sheppard is questioned since the physical processes are different.

S.6 It is also noted that the Sheppard model has not passed any peer review.

S.7 Page H-19 The model is used to predict exposure which occurs at the edge of a basin of complex geometry, biology and sediments. Thus, as radionuclides are advected or diffuse into progressively more coastal environments, the parameters of the model should

change. Terms for advection and diffusion (eddy) certainly are not conservative at the edge of a continent. S.7

From examining the footnote in Table H.6 the only parameters which are assumed to change near the continent are bottom boundary layer thickness, particle settling velocity, and maximum vertical diffusivity in the bottom boundary layer. Directional components of horizontal diffusivity, horizontal current velocities, vertical velocity, and the coefficient of detrital removal do not change. Realistic use of values would produce markedly different results. S.34

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COMMENTS ON APPENDIX I "DOSE COMMITMENT CALCULATION METHODS, SEA DISPOSAL"

1. General

The information presented appears sound. However, to evaluate the numbers in the Tables, more discussion/information is needed.

T.5 In computing food chain transfer, the important concepts of concentration factor and specific activity have been used uncritically.

T.1 Models used employ estimates for release and transport as presented in Appendices G and H. It is not clear if dose commitment was estimated assuming a full range of parameter values. In other words, there is no discussion of potential or real compounding of errors which might result from errors of estimation at several steps in the chain of calculations.

T.26 It is not clear where the biomass is supposed to be coming from in the dose calculations. T.22 No data exist on concentration factors for deep sea organisms. U.10 If the fishes in sites are sediment feeders and the clays adsorb (K_d) extensive amounts of the particle-active radionuclides, they could build up high body burdens. What happens if one feeds directly on them? What happens to whales that ingest these fish?

2. Specific

Page I-6 — T.27 The presentation in Section III A, Ingestion Pathways, is very naive, illustrating what very

little knowledge exists of what lives in the sites or what potential pathways might be. Some pathways are quite plausible (albacore in the Pacific site) other are next to impossible (molluscs in the Atlantic sites). T.27

Page I-6 to I-9 — The equations which appear in subsections A-C, and the definitions of the units associated with the various factors, appear to have some problem with the dimensions, i.e., they do not appear to yield the dose, D, in dimensions of rems. Perhaps the difficulty lies in the definition of the units associated with each factor, which are somewhat confusing. T.8

Page I-9 — Apparently some corrosion products remain which are "not removable by system flushing." Does this mean that some effort is made to decontaminate the reactor systems in conjunction with defueling and preparation for disposal? Further explanation should be included. T.9

Page I-12 — Section D, (Tables I.4 to I.8): Although the dose commitment is stated to be a 70 year dose commitment, data from references I.5 and I.14 would be only 50 year dose commitments, and, if used, should be so indicated. T.29

#694 (Cont)

T.31

Pages I-13 to I-15 — The entries in Tables I.3, I.4 and I.5 do not take into account the dilution factors due to the corrosion release of stable elements (as discussed on page 4-15). For example, the entries Ni-59, Ni-63 might be reduced by a factor of 700,000 and Co-60 by 25,000.

COMMENTS ON APPENDIX J "DOSE COMMITMENT ESTIMATES, SEA DISPOSAL"

1. General

Dose commitment may be more crucial to children than adults, thus, comparative calculations for children should be included. U.14

2. Specific

Page J-1 — Since these dose commitments were based on maximum calculated radionuclide concentrations for the critical (maximum exposed) groups of people, the whole concept of "average individual" in this section loses meaning. U.12

Page J-2 — Pathway evaluations use adult intake parameters which are stated to yield dose commitments within a factor of 2 for those using teen, child or infant parameters. There is no indication of whether the factor of 2 is positive, negative, or a combination of both for various age groups. U.14

Page J-5 — The footnotes to table J.1 highlight the continuing contradiction in terms. "Best estimate" dose commitments were calculated using "conservative" assumptions, so they are higher than would be expected. Meanwhile, the "conservative" dose commitments were calculated to be "extremely conservative." What is presented in reality is a "conservative" dose and a "very conservative" dose, U.13

#694 (Cont)

U.13 neither of which have any relation to "best estimate" or reality.

U.12 Page J-6 Again the concept of "average" individual is at best a misnomer.

L.33 Page J-21 An estimated average background radiation dose of 100 mrem/yr in coastal areas is too high. Current estimates would be about 75 mrem/yr (see NCRP Report No. 45, 1975 and U.S. EPA/ORP/SEP-80-17, 1981 for more recent data).

U.11 Page J-22 What is meant by the statement that dose commitment estimates associated with biological transport would be expected to be "significantly less" than the estmates provided here?

U.16 Page J-25 Were the physical transport mechanisms chosen to "best" represent the transport of radionuclides or to "maximize" the transport?

L.32 Page J-26 Section 1 is called "Expected" Disposal Conditions, but there is no way that "conservative" estimates and "maximum" organ dose commitments can represent "Expected" conditions.

COMMENTS ON APPENDIX K " MONITORING PROGRAM"

1. General

The planning presented is practical and feasible, only if submarines emplaced by the uncontrolled free fall method, and dependent on remote instrumentation for emplacement location, can be located with 100% certainty.

The land disposal monitoring program is based on existing procedures, well documented and maintained. The ocean disposal monitoring program is deficient. The material presented in Section IV (Sea Disposal Monitoring) is very brief. No detailed or general statements relative to the number, frequency or distribution of measurements to be made are presented. There is also no indication that the measurement program is or will be matched to the analytic models used in Appendix H for the ocean dispersion model. J.76

The monitoring of a sea disposal site may serve to reassure the public, as well as addressing concerns about potential hazards. Addressing public anxieties is an important matter, thus monitoring must be carried out professionally and thoroughly.

This Appendix reflects little detailed planning for the sea disposal monitoring program. Perhaps this is as routine as indicated in the second paragraph on page K-3. The non-oceanographer who is not familar with oceangraphic research might feel more reassured if more details were given. J.78

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Sampling and analysis should provide for the detection of transuranic isotopes, even though the DEIS does not indicate their presence in the radioactive inventory.

Also, sampling and analyzing for the natural radionuclides would be worthwhile for comparison reasons. The extra effort would also advance the basic understanding of the concentration balance between sediment and biota for several natural radioactive isotopes.

There are markedly unequal treatments for the land and ocean options. For land, there are ongoing monitoring programs at the
J.78 DOE sites which would not be appreciably changed by the addition of submarine reactors. For ocean, the discussion of monitoring is inadequate and there is no discussion whether monitoring in the deep sea would be seriously hampered by the lack of data on ecology. Deep sea monitoring should include radiological monitoring of the environment and its biota, and should determine impact upon local fauna.

This Appendix does not really present a monitoring program. Further information should be provided on types of monitoring arrays, instruments, spacing of samples with respect to time and area, and other information needed to adequately assess conditions before, during and after disposal(s).

The description of environmental monitoring for the sea
J.76 disposal option does not provide an adequate description of how the monitoring would be carried out, nor is it clear that a monitoring program can be carried out for the cost the DEIS

indicates. It is suggested this section be expanded considerably, bringing in a descriptive discussion of the various techniquies that have been used in the past and those that may be available in the future. For example, the Navy used the manned bathyscape TRIESTE for the THRESHER and SCORPION Surveys, and these must have been quite expensive considering the cost of the support vessels. It is suggested that the Navy study the possibilities of emerging technology that may be more economical for conducting such surveys, such as unmanned untethered programmable vehicles, at depths of more than 4000 meters. Such a discussion would add to the credibility of this monitoring program section.

2. Specific J.76

With regard to Section IV.A Pre-Disposal Monitoring.

Seafloor photographs will only provide limited information on the distribution of infaunal organisms.

Information on spatial and temporal sampling should be added to section IV.A.b.

Sections IV.A.c. and d. will also need to be supplemented with data on pathways between the abyssal environment and the abyssal fauna to determine food chain transport potential.

Trawling and trapping techniques only, as planned in section IV.A.d., will not provide samples of the full range of animal species present in dumpsites and may preferentially trap mobile forms which have spent little time in the disposal area.

Monitoring should include detection of significant

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#694 (Cont)

effects in faunal composition and the collection of fauna for radionuclide analyses. Further research is needed to develop improved procedures for quantitative evaluations of deep sea ecology.

With regard to Section IV.B Monitoring During Active Disposal:

The program should be expanded to measure alterations in the benthic fauna and determine if changes are a result of an alteration to the physical environment or from an alteration to the chemical-radiological environment, particularly after corrosion has occurred.

J.76 With regard to Section IV.C Monitoring After The Period of Active Disposal:

It is suggested that a program be developed to verify that models used can ascertain whether:

a) data are consistent with release values predicted by the models and corrosion studies presented in this document,

b) with time, the dispersion model can correctly predict dispersion away from the dispoal area,

c) stable and radioisotope materials from submarine disposals effect biota as predicted,

d) there are compositional changes in the fauna due to dispoal activity(ies), and

e) radiological and non-radiological effects on the environment can be distinguished.

COMMENTS ON APPENDIX L "FLOODPLAIN/WETLANDS ASSESSMENT"

1. General

From the information provided, it appears that the impact on land disposal sites is acceptable.

The construction and operation of a barge slip on the Savannah River Plant at Ellenton Landing appears to be practical and poses no adverse imparts.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 29 1983

OFFICE OF
THE ADMINISTRATOR

Captain Edward F. Wagner
Office of the Chief of Naval
Operations (OPNAV-22)
Washington, D.C. 20350

Dear Captain Wagner:

On June 29 I transmitted to you EPA's comments on U.S. Navy's Draft Environmental Impact Statement for the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. I am enclosing additional supplemental comments which were not sent to you at that time. These comments represent additional review work that was in progress when our comments were sent.

Although these comments are late, I believe they will be useful to you and I would appreciate it if they are considered by the Navy to the extent practical.

Sincerely,

Pasquale A. Alberico
Acting Director
Office of Federal Activities

Enclosure

*Other issues discussed by EPA are side barred in Exhibit 694.

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SUPPLEMENT TO

SUMMARY

U.S. ENVIRONMENTAL PROTECTION AGENCY

PERTAINING TO

U.S. NAVY DRAFT ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED DEFUELED

NAVAL SUBMARINE REACTOR PLANTS

U.S. Environmental Protection Agency

July 1983

GENERAL COMMENTS

More uniformity in terminology is needed. For example, the terminology that is used to describe the components of the submarines is not the same from one section to the next. This makes it difficult to follow the different scenarios. Also, different words and numbers are used to describe the distribution of the radioactivity among the components. Some of the terms that are used are "nearly 100%", "greater than 98%", "99.9%", etc. It would be helpful to have the information in Table C-1 included in Chapter 1 and then have the numbers there used consistently throughout the sections. X.2*

Another confusing element is the terminology used to describe the degree of conservatism for a calculation or approximation. Some of these are "unrealistically high", "yield pessimistic results", "significant overestimate". Also, the amount of conservatism present is different from one series of calculations to another.

There is disparate amount of space given to the three options for dealing with the decommissioned submarine. The order is ocean disposal, land disposal and protective storage. The reader gets the impression that protective storage will have much less risk associated with it than the other options. This view is reinforced by statements such as that given on p. 1-7, "These ships can remain in protective storage for an indefinite time without hazard to the environment". There is still some risk involved in storage, including sabotage, accidents en route to the storage site, accidents at the storage site, etc., and the probabilities of these occurring would be about the same as those described for land and ocean disposal.

SPECIFIC COMMENTS (Chapters 1-4)

Page 1-2 Data on the absolute maximum amount and the average amount in the inventory would be helpful. A.6

From the information available, the amount of radioactive material in the adherent film can be calculated to be 62 curies (62,000 x 0.1%). Data on the breakdown of the radionuclides in this material would be of interest. A.14

Page 2-8 Was consideration given to the placement of barriers in the soil around the submarines to reduce the migration of corrosion products? K.11

Page 2-11 Some information on the dumping that has been conducted at the North Atlantic Dumpsite by some of the OECD nations might put the proposed ocean disposal of submarines in better perspective. J.33

*Other issues discussed by EPA are side barred in Exhibit 694.

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APPENDIX C

GENERAL COMMENTS

Stated in the introduction, the review does not consider retardation and diminution of the radionuclides by absorption by soil particles or deposition in stream or river beds. It is perfectly acceptable to consider scenarios such as this in the absence of specific data. However, in the United States we have had long experiences with radionuclides from nuclear facilities discharged into rivers such as the Columbia, Hudson, Cattaraugus Creek, Clinch, etc. where a vast amount of information is available showing that radionuclides do accumulate in sediments near points of discharge and eventually migrate down river in association with particulate material or in solution. Fish concentrations are more often related to concentrations in sediments rather then to concentrations in solution. Nickel is known to associate with suspended material and sediments. If the activity is accumulated in the river sediments, different exposure pathways require discussion in addition to the pathways considered in this section. Some effort should be expended to explain the dose from exposure to dried river sediment beds in the future, from consumption of bottom feeding organisms and water fowl and from recycling by aquatic vegetation and nearshore plants, to name but a few additional pathways. P.4

Most of the assumptions in this Appendix appear to be conservative providing we accept the corrosion release model used to estimate times and the barriers penetrated. It is questioned whether structural material subjected to neutron fluxes and recoils resulting from the decay of activated products within the material will corrode at the same rate as unactivated, uncontaminated material. Simple experiments could have been conducted by immerging activated stainless steel and other activated components into fresh and seawater, and measuring the release of radionuclides to the water to verify the assumptions related to releases of activities and to provide more realistic estimates of the rates of corrosion. One would feel more comfortable in accepting the corrosion model in both the land and sea disposal options if such data existed and could be evaluated. Q.2

No man made structure can be guaranteed to last indefinitely and the Navy DEIS does not attempt to hide this fact. Material will decompose and the most likely mechanism leading to the transfer of activity from the vessel components and ultimately to man will be

our failure to isolate the sources from ground and running waters. Presumably enough is known of the geological properties at the disposal sites to guarantee that isolation from ground and running water can be achieved for many years. There are, however, always the unknown factors of what may happen when the site is no longer recognized as a waste disposal area, or when geological alterations to the landscape occur.

SPECIFIC COMMENTS

Page C-6, section IV C

The period for the long-term buildup in soil should not be 15 years. This figure is based on the average lifetime of a light-water reactor. The value should be much higher. In actual practice the buildup does not continue indefinitely but is balanced by leaching and percolation through the topsoil. The NRC model allows for soil removal only by radioactive decay, but one can introduce an additional term to account for leaching. P.11

The "transfer coefficient" for nickel should be called the concentration factor (B_v) in keeping with the terminology of Appendix 1. It represents plant uptake from soil. X.1

Page C-8, Section IV D

"Transfer coefficient in milk" should be "transfer coefficient to milk". X.1 The value of 0.0067 day/liter from Ref. C.2 is too high. A more appropriate "average" value is 0.001 day/liter (see Y.C. Ng, 1982; <u>Nuclear Safety</u>, 23:57-71). Use of this value would reduce the total dose estimate (page C-9) somewhat. P.10

Page C-8, Section IV E

"Transfer coefficient in meat" should be "transfer coefficient to meat". X.1 The value of 0.053 for Ni from Ref. C.2 is incorrect. A more appropriate "average" value would be 0.002 day/kg (see Y.C. Ng, 1982; <u>Nuclear Safety</u>, 23:57-71). Use of this value would reduce the total dose estimate (page C-9) substantially. P.9

#694a (Cont)

Page C-9, Section IV F

X.1 Accepting the printed estimates at face value, it would be better simply to say that the estimates are comparable. To say that the estimate is "conservative by a factor of more than 2 to 1" is not really meaningful.

Page C-10, Section V

The dose estimates in this section may have to be revised to reflect changes in Sect. IV.

Page C-12, Section VIII A

P.12 Accepting the parameters values from Ref. C.1 in toto, there seems to be a major error or inconsistency in Part 5. logically the source term, s, would seem to be the product of the total curies (120) times an availability factor f_c. Thus,

$$S = C \times f_c$$

$$S = 120 \text{ Ci} \times 9.6 \times 10^{-6}/\text{yr}$$

$$S = 1.15 \times 10^{-3} \text{Ci/yr}$$

If this is so, a complete revision is required for page C-13 (and other parts of this Appendix).

Page 13, Section VIII A

In Part 8, the PDCF values can't be verified without the values from Tables C-8 and C-9 in Ref. C.1.

APPENDIX D AND ANNEX

GENERAL COMMENTS

F.21 It is indicated that the reactor compartment will be sealed at the shipyard and completely filled with water to assure that the compartment would not be damaged by submergence pressure after the submarine is sunk. The forward reactor compartment bulkhead would be fitted with a one way valve (check valve) to permit inward flow for pressure compensation during free fall from the surface. Some description of the valve's integrity, its size, corrosion rate etc. should have been given to assess the possiblity of its failure during impact with the sea bottom or for some other reason.

A.18 Failure of the valve will expose the inner container to the outside environment. Some heat will be generated within the enclosed area of the reactor pressure vessel (from radioactive decay). Is the amount of heat generated sufficient to cause expansion of the contained water causing the valve to rupture?

J.45 The Annex reviews the monitoring efforts undertaken at the accident sites of the THRESHER and SCORPION submarines. The monitoring was minimal; the sample sizes could have been increased, especially the water samples to provide more convincing evidence that ^{60}Co was not detectable in the samples of water, marine life or debris. The reason for not detecting the radionuclide in the water was apparently because a small sample was obtained which led to concentrations below minimum detectable limits which ranged from 3 to 10 pCi/l. With these limits of detection, the 100 meters of bottom water over the 3000m² THRESHER sites surveyed could have contained from 9-30 mCi of ^{60}Co and not have been detected. More description is needed of water sample sizes and methods of analyses. Thus, the conclusions of insignificant releases cannot be verified until additional, more precise environmental data is provided.

J.46 It is assumed that the value of 236 pCi/l of ^{40}K in the water at the SCORPION site is a misprint. If not, the ^{40}K in this water is only 72% of that in sea water and one would question either where this sample came from, or the precision and accuracy of the entire analytical program.

J.61 On page D-A12 it is stated - "Corrosion that occurred after the sinking does not represent a significant source of ^{60}Co found in the sediments". The implication of this statement is that some corrosion has occurred to account for a small fraction of the estimated ^{60}Co inventory in the collected sediments. This was a perfect opportunity to compare real environmental data with corrosion rate models, over an 11-14 year period, to assess if the predicted levels agree with the measured concentrations. Such comparisions should be made and included in this report to add credibility to the models used. In as much as Ni^{59} and Ni^{63} are the critical radionuclides in many of the scenarios, some effort should be made to determine their concentrations in these sediments and assess if the environmental levels agree with the release rate model. Is there fractionation between ^{60}Co and ^{63}Ni after release to the environment, or are the relative levels in the sediments in agreement with those expected from the models? This type of data could have strengthened many of the arguments used in the scenarios.

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SPECIFIC COMMENTS

X.1 Page D-1 Description of the containment is clearer in Appendix G than here.

Page D-6 Radionuclide analysis data are so poorly presented in the Annex, that definitive conclusions cannot be drawn.

F.27 Page D-8 Actual and predicted values for sandy floor drops should also be included.

X.2 Page D-A3 Figure D-A.1 does not show Brown's Bank.

J.53 Page D-A6 It is not clear whether the "small magnetic oxide particles" were unique to the THRESHER and SCORPION or whether they would be found in submarines to be prepared for future disposal. If there were a rupture of the reactor compartment (a scenario that is addressed in Appendix G), would such magnetic particles be released at the disposal site?

J.45 Page D-A7 The water samples collected were much too small to yield meaningful data on the radionuclides. The stated detection limits of the method were from 3 to 10 pCi/L. Concentrations of these levels would not be expected; this is indicated from the concentrations that are given in Appendix H.

J.48 These data are of no value for establishing that no leakage had occurred. The data also lack credibility because the values for potassium 40 in areas of the THRESHER and the SCORPION are so different. This would imply that the seawater differed greatly in potassium concentration.

APPENDIX E

GENERAL COMMENTS

This section provides an oceanographic description of three potential disposal sites in the deep ocean, two in the Atlantic and one in the Pacific. Technical site selection criteria, as defined by the technical authority for the international convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters, interpreted and extended by Hollister and Heath, are satisfied at all three sites surveyed.

SPECIFIC COMMENTS

Page E-7 Some information as to the size of the food can would give a better indication of the dimensions of the cones and craters. X.1

Page E-11 Information is provided as to where but not when the measurements were taken. Also for completeness, dates of sampling should be included in Figures E-6, 7, 8, 15, 16, and 17.

APPENDIX G

GENERAL COMMENTS

This Appendix describes the mechanisms leading to the release of radionuclides into the marine environment from the disposal of 100 submarines. We are asked to evaluate the methodology used to estimate the rates of release to the deep ocean for two conditions of containment. Two scenarios are described for each condition of containment. To assess these releases we must 1) accept that the corrosion rate models and pitting phenomena reasonably describe the events that will occur with time; 2) that the radioactive corrosion products are released from the metals as transportable particulates; 3) that the concentrations associated with the structural components are reasonably well documented, and 4) the release models developed for each scenario account for all the ensuing processes following disposal. Under the expected containment (best estimate) scenario the radionuclides in the reactor vessel could not be released into the environment until both the reactor compartment and the reactor vessel containment structure were penetrated by corrosion. The conservative estimate for this scenario increases settling times and leakage coefficients between the vessel and compartment. The net effect is to increase the concentration of mobile radionuclides in the reactor compartment at the time of penetration by corrosion. The minimum containment best estimate scenario assumes the surfaces of all radioactive structures are exposed to sea water and release of soluble material occurs simultaneously as corrosion occurs. Average corrosion rate estimates are used for this scenario while maximum corrosion rates are used with the conservative estimate model. This scenario is only applied to the release of material from 1 submarine, whereas the expected containment scenarios consider release from 100 disposed submarines. The minimum containment scenario is applicable to the result of an accident in transit or a mishap during disposal at the disposal location. No information was provided in the entire text on the thickness of L.24

#694a (Cont)

L.24 each contaminated structure and other pertinent information, such as the total activity of each radionuclide in the structural material/per unit area, or per unit weight along with appropriate surface areas, and /or volumes for conversion purpose. It was, therefore, impossible to check any of the release estimates in this section. It is recommended that either tables of representative data be added to this section in order to check the results, or sample calculations be made with the actual values used for specific radionuclides.

X.2 Table C-1 on p. C-2 has information that should be included in Chapter 1.

L.24 To verify the corrosion numbers presented, more data is needed. No information is given on thickness or size of the components that are undergoing the corrosion.

SPECIFIC COMMENTS

R.11 Page C-3 The corrosion of low alloy components is described, but "low alloy" is not defined.

APPENDIX H

GENERAL COMMENTS

S.2 S.8 The ocean disposal model describes the horizontal transport and diffusion as standard Gaussian plumes and the vertical transport as the one-dimensional diffusion-advection equation. The greatest deficiency in this model is the use of single long-term average horizontal velocities. Uncertainties in the vertical diffusivities, vertical velocities in the mid-depth region and settling water provide additional potential errors.

S.23 The choice of single long-term average velocities (Table H-1, p. H-9) of (v) e-w = +0.19 cm/s (to east) and (v) n-s = -1.12 cm/s (to south) will result in the case chosen of advecting the released radionuclides out to sea, away from the coastline. Because the release takes place in the benthic or bottom layer 4,000 meters below the surface, the radionuclides will generally remain in their well-mixed region with little vertical velocity unless variable currents advect the nuclides in towards shore and shallower waters.

APPENDIX I

GENERAL COMMENTS

The Navy has used the concentration factor approach for the various exposure pathways defined in IAEA-211; adult dose conversion factors compiled from several different references; usage factors from several sources; accumulation factors from the IAEA report, and the dose commitment equations from information presented in IAEA, NRC and

BNWL reports. Some updating of accumulation factors could be incorporated in the report but the end result, that is computed dose rates, will probably change very little. It might be preferable to see cumulative doses compiled along with dose rates since these only relate to the mrem/70 yr per pCi ingested in the first or maximum year of exposure. T.10 U.17

SPECIFIC COMMENTS

Page I-4, Section III A

The cultivation of plants on contaminated silt that accumulates in tidal areas that are later reclaimed, represents an "indirect" pathway that is subject to a concentrating process rather than a dispersion process (as far as the soil is concerned)? U.23

Page I-5, Section III C

Add "or dilution" to end of the line so that the sentence ends, "... to considerably greater dispersion or dilution processes." X.1

Page I-5, Section IV

In the estimation of dose commitments for exposure to a specified concentration, the duration of exposure must be stated. In the calculations presented in Appendix J, a duration of one year is given as the period of exposure. Simply add "for a specified time period" at the end of the sentence.

Page I-6, Section IV-A

Strictly, since the unit for D_I is rem, D_I is the dose equivalent commitment. (The IAEA regards this as the committed dose equivalent.) The expression, in actuality, gives the collective dose equivalent commitment (collective committed dose equivalent) since P, the number of persons, is in the expression.

It may be more straightforward to introduce a constant coefficient into this expression to account for the conversion of U, the concentration factor, into appropriate units. This would also apply to subsequent expressions where U appears. X.2

Page I-6, Section IV B

The expression gives the collective dose (equivalent) commitment. X.1

942

#694a (Cont)

T.23

Page I-7, Section IV C1

The expression gives the collective dose equivalent. In this instance, the collective dose equivalent is being calculated (rather than the collective dose equivalent commitment).

Page I-7, Section IV C2

This expression gives the dose equivalent (not the dose commitment) as intended.

Page I-8, Section IV C3

X.2

This equation gives the collective dose equivalent. It may be more straightforward to include a constant coefficient in the expression to take care of the needed units conversion for U, the concentration factor.

Page I-8, Section IV C3

T.25

The value chosen for the density, 2.65×10^6 grams per cubic meter, is not necessarily conservative. This paragraph is not clear. There may be a more appropriate approach to calculate external exposures to the shoreline.

Page I-9, Section V. A, and page I-10, Table I-1

T.7

A reference for the specific nuclides listed in Table I-1 is needed.

Page I-12, Section V. C, and page I-13, Table I-3

T.10

The IAEA is in the process of revising the concentration factors (CFs) shown in this table. They were deemed to be inadequate because they are usually for whole organisms and they do not provide an indication of the range of values that are encountered. The current plans are to update the information by including recent published data, CFs for edible and nonedible tissues, and best estimates, maximum, and minimum values.

Page I-12, Section V. D, and page I-14, I 15; Tables I-4 and I-5

T.33

It would be worthwhile to compare or take into account the ingestion and inhalation dose factor available in ICRP Publication 30.

T.30

Page I-16, Section V. D, Table I-6

The factor for Ni-59 and Hf-181 should not be zero (0.0). They (or daughters) emit photons. (See D.C. Kocher, 1979; NUREG/CR-0494.)

Page I-17, Section V. D, Table I-7

The factor for Ni-59 and Hf-181 should not be zero (0.0). They (or daughters) emit photons. (See D.C. Kocher, 1979; NUREG/CR-0494.)

Page I-18, Section V. D, Table I-8

The factor for Ni-59 and Hf-181 should not be zero (0.0). They (or daughters) emit photons. (See D.C. Kocher, 1979; NUREG/CR-0494.)

APPENDIX J

GENERAL COMMENTS

X.2

It would be useful to condense this Appendix since there is much repetition, particularly in comparing the dose estimates with NRC and EPA guidelines and with exposures due to natural background radiation.

SPECIFIC COMMENTS

Page J-1, Section I

X.1

The dose commitment (dose equivalent commitment) in mrem per year results from exposure to the maximum concentration for a year. The duration of exposure should be stated when referring to a dose commitment. It is proper to state that the dose (equivalent) rate in mrem per year results from an exposure to the maximum concentration without specifying the duration of exposure.

U.18

The second part of this paragraph (on P. J-2) is not clear at all. What the author is trying to say is that the dose commitment (70-yr via ingestion or inhalation) that results from an exposure to the maximum concentration for a year is equal to the dose received in the 70th year following continuous exposure to the maximum concentration for 70 years.

Page J-24, Section III D2 (and Page J-25, Table J-16)

U.24

The apparent importance of C-14 via biological transport from sediments is doubtful. This result is a consequence of the specific activity approach that was used for the calculations. Marine fish derive their carbon from the food web (and water) rather than from sediments. (Ultimately the origin of the carbon

#694a (Cont)

U.24 is atmospheric CO_2.) Some of the carbon of marine fish may be derived from sediments, but it would be from the carbon from the organic matter that settles out from the water column.

Page J-32, Section III E3, par. 2

U.15 The wisdom of calculating a collective dose that is based on a population and a conservative dose estimate is questioned. Fundamentally the collective dose can be estimated as the product of the population and the (realistic) average dose to an individual within the population. In any event, there is no further reference to the population dose estimates that are reported here and elsewhere in Appendix J. Clarification is needed.

APPENDIX K

GENERAL COMMENTS

J.76 The description of sea disposal monitoring needs to be expanded.

SPECIFIC COMMENTS

Page K-3

J.78 It is suggested that the sentences in paragraph 1 be changed to read "Sampling and analysis of bottom water for fallout- and natural- radionuclide levels and for stable nuclides of those elements that are expected to have radionuclides induced in the submarine structures. This would include analyses for gamma, beta, alpha, and x-ray emitting radionuclides and a group of stable elements dissolved in the water and present in the suspended particles."

It is suggested that the sentences in paragraph 2 be changed to read "Sampling and analysis of sea floor sediments for fallout- and natural-radionuclides levels and for stable nuclides of those elements that are expected to have radionuclides incuded in the submarine structures. This would include analyses for gamma, beta, alpha, and x-ray emitting radionuclides and a group of stable elements associated with the sediment particles and present in the interstitial water surrounding the particles."

It is suggested that the sentences in paragraph 3 be changed to read "Collection and analysis of fish and benthic invertebrates for fallout- and natural-radionuclides levels and for stable nuclides of those elements that are expected to have radionuclides induced in the submarine structures. This would include analyses for gamma-, beta-, alpha-, and x-ray-emitting radionuclides and a group of stable elements. The fish and invertebrates would be collected from the sediment surface and overlying water by trapping or other appropriate means."

It is suggested that the following sentence be inserted after sentence 2 in paragraph 6. "Collection of samples would be made using techniques that minimize contamination with radionuclides or stable elements from outside sources. Sample size would be adequate to ensure that increased concentrations of constitutents above those of background levels could be detected with the analytical techniques available."

NOTE: These suggestions are made because it is imperative to have information about background levels of the radionuclides of concern to distinguish the existing burden from that from the disposal of the submarines. Also, the data on radionuclide concentrations can be compared to those from other sources to obtain a better understanding of the geochemical and biological processes that are taking place at the site. Concentrations of stable elements can be used to identify biotic and abiotic compartments that may be expected to accumulate the radionuclides of concern. Also, the data on stable and radionuclide concentrations can be used to calculate specific activities and thus obtain information on the maximum concentration of radionuclides that can be expected in the different compartments. J.78

It is suggested that the last sentence in paragraph 6 be changed to read "In addition, similar samples and measurements would be made in a grid around the submarine. These data would be used to detect releases from the submarine, to verify the primary direction of flow of radionuclides from the point source, and to establish whether unexpected horizontal currents have resulted in dispersion of the radionuclides outside of the predicted area."

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#695 (Part 1)

30 June 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

The enclosed Joint Comments of National, State and Local Organizations Opposing Ocean Dumping of Obsolete Nuclear Submarines is submitted in response to the Department of Navy's request for comments on its Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (December 1982), on behalf of more than 100 conservation and citizen organizations across the country.

These Joint Comments were developed by the Oceanic Society and the Center for Law and Social Policy based on the deliberations of the Oceanic Society Scientific Committee, comments from state agencies, and concerns raised during the Navy's public hearings on this DEIS during February 1983. They represent an abbreviated statement of the more detailed comments submitted this same date on behalf of a national coalition of 26 environmental and other citizen organizations. A complete list of organizations which support these comments is included as Appendix A.

Respectfully submitted,

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JOINT COMMENTS OF NATIONAL, STATE AND LOCAL ORGANIZATIONS OPPOSING OCEAN DUMPING OF OBSOLETE NUCLEAR SUBMARINES

June 30, 1983

The United States Navy should not dispose of more than 100 obsolete nuclear submarines in the sea during the next three decades. Our oceans are too important to endanger as an experimental dumping grounds for radioactive wastes. Nor can we afford to repeat at sea the waste management mistakes we have made on land by acting on inadequate information. The marine environment is an essential element of our planet's life support system. We cannot risk persistent radioactive contamination of this "common heritage for all mankind."

Scuttling these outdated nuclear submarines at sea would, as documented by Navy data, place more than 6 million curies of radioactivity on the ocean floor. This is 60 times the level of radioactivity America dumped at sea from 1946 to 1970, the year this country ended nuclear waste disposal in the marine environment. Neither the Administration's record of conservation action nor calculations presented in the Navy's December 22, 1982 Draft Environmental Impact Statement (DEIS) warrant revision of current U.S. policy and a return to ocean disposal of our radioactive waste.

Since the DEIS was released, 13 key issues have emerged as the strongest arguments against sea disposal of these radioactive submarines. Taken together, these concerns create a compelling case for protecting the ocean from disposal of any radioactive waste. The range of national, state and local organizations from across the country joining in these comments reflects strong public support for safeguarding the sea.

Our opposition to sea disposal of these ships is based on information gathered from state agencies, marine scientists and local organizations as well as deliberations of the Oceanic Society's Scientific Committee and an analysis of legal, regulatory and policy issues conducted by the Center for Law and Social Policy. Our principal concerns include:

(1) Unanswered questions on biological pathways -- especially on potential short cuts through the food chain -- which could carry radioactivity from the ocean floor toward human consumers. |U.1

Scientific research shows radioactivity can migrate from nuclear waste dumps into marine life and that some species of food fish bioaccumulate radioactivity. Studies suggest these fish may represent a mechanism for movement of radioactivity toward human beings. Additional understanding is needed of the potential for radioactive contamination of swordfish caught off Cape Hatteras and albacore caught off Cape Mendocino. |L.37

(2) Inadequate knowledge of deepsea life and ecosystems is a significant limit to understanding potential environmental impacts of nuclear waste disposal in the ocean. |L.1

#695 (Part 1) (Cont)

(2)

Until we know more about deepsea ecosystems and how radioactivity reacts in the deep ocean environment, it is difficult -- if not impossible -- to accurately predict potential effects. Q.13, A.13, L.55 Additional research is needed to answer questions on Navy predictions of corrosion rates of sunken submarines, availability of radioactivity from the subs, dispersion or concentration of radioactivity, and whether the ships will serve as "artificial reefs" attracting marine life to the disposal site.

J.76 (3) Monitoring techniques are inadequate to gauge environmental impact in the deepsea environment.

A 1982 Rand Corporation report for the National Oceanic and Atmospheric Administration (NOAA) warns:

> ". . . environmental information required is difficult to obtain, the long-term reliability of ocean measurement and monitoring systems is poor, and the remote nature of deepsea disposal sites makes traditional sampling and laboratory analysis methods inefficient, somewhat ineffective, costly and time consuming."

A multi-year research program designed to fill these gaps in monitoring technology has -- despite Congressional recommendations - yet to begin, and the NOAA division which commissioned the Rand report may be "reorganized" out of existence by the Reagan Administration. Even if adequate technology were available, the monitoring program described in the DEIS is inadequate to either protect marine environmental quality or meet requirements recently added to the Ocean Dumping Act.

L.7 (4) Cumulative environmental impacts from incremental increases in radioactivity entering the marine environment have not been examined -- let alone adequately addressed -- in the Navy DEIS.

Federal regulations require comprehensive consideration in a DEIS of release of radioactivity into the marine environment from the proposed disposal program as well as other past, current and probable sources. Neither the DEIS nor scientific data cited in support of it assess ocean dumping of obsolete nuclear submarines in a context of cumulative release and effects. Sources of radiation affecting the ocean range from routine operation of naval and commercial nuclear reactors to accidental discharge of radioactivity; abandoned and current land and sea disposal sites; and fallout from atmospheric testing of nuclear weapons.

W.1 (5) Irretrievability of sunken submarines from depths of 4,000 meters makes impossible removal of these sources of radioactivity if, as has happened in the past, unexpected problems arise.

Existing U.S. law requires that any radioactive waste dumped in the sea must be retrievable. Yet, in the DEIS, the Navy admits these submarines cannot be brought back from the ocean floor with available technology. Developing equipment to raise sunken submarines from the W.1 deepsea bottom is an expensive task not considered in the DEIS. Nor is the cost of using this technology reflected in the Navy's financial assessment.

(3)

(6) Calculations used in forming Navy cost estimates are inadequately supported in the DEIS, calling into question a $2 million per ship saving claimed for sea disposal of these wastes.

Data released by the Navy does not adequately describe the basis for computing sea and land disposal expense estimates. Nor does the DEIS include sufficient financial support for comprehensive, long-term monitoring of the ocean disposal site. Costs for an improved monitoring program may well eliminate the cost advantage claimed for sea disposal. J.76

(7) Accidental sinking of a submarine on the continental shelf while in transit to a sea disposal site is more likely than admitted in the Navy DEIS.

The Navy claims it is "highly improbable" that a submarine will sink while being towed to an ocean disposal site. Yet data cited in the DEIS on towing reactor compartments to land disposal sites presents an accident rate of 0.3 per 100 trips of an average 500 mile length. This calculation implies at least one ship will be damaged -- and perhaps sunk -- during the sea disposal program. Oceanic Society Scientific Committee members warned this figure, which is apparently based on national accident statistics, may not accurately reflect severe weather conditions frequently found off Cape Hatteras, North Carolina and Cape Mendocino, California. If disposal site weather is considered, panel members felt the probability of accidental sinking would increase. L.57, L.61

(8) Potential economic impact on coastal fishing and tourism is not considered in the DEIS.

Commercial fishermen, coastal business leaders and elected officials from North Carolina, California and South Carolina are concerned sea disposal of outdated nuclear submarines will have a significant negative effect on the local economy. The Navy DEIS does not consider potential economic impact on commercial fishing and coastal tourism in these states. California officials warn Japanese purchases of sablefish from state fisheries dropped by 50 percent after press coverage of conditions at the Farallon Island nuclear waste dumpsite off San Francisco Bay. Substantially smaller amounts of radioactivity were dumped in this location than those found in the obsolete submarines. O.34

(9) Alternatives which could slow or reduce release of radioactivity to the environment have not been considered in the DEIS.

Only sinking of the entire submarine at sea and burial of the ship's reactor compartment on land are considered as alternatives in the Navy DEIS. Oceanic Society Scientific Committee members suggested the land disposal option might be modified to place the reactor compartments in above ground surface trenches in an arid environment where corrosion -- and thus release of radioactivity -- would be minimized. Other alternatives include storing the compartments in specially designed buildings or mothballing the subs until radioactivity H.3 declines to the point that shipyard workers can safely dismantle the reactor and related radioactive materials. Nuclear wastes remaining at that time could be buried in deep mined repositories. G.7

(10) Sea disposal of the Navy's nuclear submarines will open the ocean to resumed dumping of low-level radioactive wastes.

L.9 F.8 If the Navy wins approval of the "ocean option," the U.S. will have its first sea disposal site for nuclear wastes which meets current international standards. Once that site is being used for disposal of submarines, other agencies -- and perhaps corporations -- could apply for permits to dump low-level radioactive wastes. As current land disposal sites fill, pressure for opening the ocean for nuclear waste dumping will grow.

(11) Ocean dumping of these submarines, as currently described in the Navy DEIS, violates federal environmental law and regulations designed to protect ecological quality.

E.2 The National Environmental Policy Act (NEPA) requires than an environmental impact statement (EIS) be prepared by federal agencies to accompany "every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment" (Section 102 (2) (c)). NEPA created a council -- the Council on Environmental Quality (CEQ) -- "to review and appraise the various programs and activities of the federal government in light of the policies set forth in (NEPA)" (Section 204 (3)). The Navy's DEIS violates NEPA, the interpretive regulations which have been implemented by CEQ, and judicial decisions. Many of the scientific and technical concerns expressed in the preceeding pages represent examples of instances where the Navy has failed to satisfy the requirements of NEPA and CEQ regulations.

(12) Ocean dumping of these submarines violates the letter and spirit of the U.S. Ocean Dumping Act and international measures.

F.2 A two-year moratorium on sea disposal for American nuclear waste was recently added to the Ocean Dumping Act through enactment of the "Anderson Amendment" introduced by California Congressman Glen Anderson to provide additional time for scientific study of this issue. A resolution echoing this amendment was approved despite opposition of the United States at a recent meeting of the international treaty organization which governs waste disposal at sea. Further, as detailed above, the current Navy DEIS describes a sea disposal program with irretrievable waste and an inadequate monitoring program. Both of these features fail to meet federal standards.

(13) A wide range of technical workshops, studies and reports from state officials, federal agencies, the international community and the private sector support the need for further research and monitoring.

L.7 Incomplete and inaccurate information limits our understanding of past ocean dumping of nuclear waste and presents a serious obstacle in front of efforts to determine actual or potential hazards. Data developed and discussed in the DEIS does not provide enough evidence to provide sufficient certainty that public health and environmental risks are adequately understood. The Rand Corporation report cited earlier included a series of findings and recommendations which the Navy has largely ignored.

Conclusion

The 11 factors cited in these comments present a compelling case for rejecting sea disposal of the Navy's obsolete nuclear submarines during the next three decades. The DEIS does not contain arguments of sufficient strength to merit reversal of current U.S. policy and resumption of ocean disposal of our nuclear wastes. F.8

Part of the pressure for a quick, inexpensive solution to the Navy's growing stockpile of obsolete nuclear submarines stems from limits imposed by the SALT arms limitation treaty. Old submarines must be retired to make way for newer, more deadly additions to the fleet. But this restriction does not justify premature action reopening the ocean to radioactive waste disposal.

The Navy estimates it will save $2 million per ship by sinking these submarines at sea and cites this as the sole benefit of rejecting land disposal. Even if this projected savings is attained after an adequate monitoring program is developed, it is an inadequate justification for reversing current American policy. Land disposal allows economical monitoring and permits action to correct defects in the Navy's planning should problems arise. These two benefits of terrestrial disposal far outweigh the projected ocean dumping savings.

Our oceans play an important role in shaping our weather, feeding our people and supporting life on our planet. We cannot afford to risk the marine environment for the minimal savings projected by the Navy. Until we can guarantee the safety of sea disposal for hazardous wastes like obsolete nuclear submarines, the Navy should not proceed with its "ocean option."

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#695 (Part 1) (Cont)

JOINT COMMENTS OF NATIONAL, STATE AND LOCAL ORGANIZATIONS

OPPOSING OCEAN DUMPING OF OBSOLETE NUCLEAR SUBMARINES

The following national, state and local organizations have signed onto these comments as of 6 P.M. EST June 29, 1983:

National

The American Cetacean Society, San Pedro, CA; American Humane Society, Washington, DC; American Society for the Prevention of Cruelty to Animals, Washington, DC; Center for Environmental Education, Washington, DC; Clean Water Action Project, Washington, DC; Critical Mass Energy Project, Washington, DC; Environmental Defense Fund, New York, NY; Farallon Foundation, Bolinas, CA; Friends of the Earth, San Francisco, CA; Fund for Animals, New York, NY; Greenpeace, USA, Washington, DC; Hudson River Sloop Clearwater, Inc., Poughkeepsie, NY; International Fund for Animal Welfare, Washington, DC; Marine Mammal Fund, San Francisco, CA; National Resources Defense Council, New York, NY; National Audubon Society, New York, NY; Nuclear Free Pacific, San Francisco, CA; Nuclear Information Resource Service, Washington, DC; Ocean Education Project, Washington, DC; Oceanic Society, Stamford, CT; Sierra Club, San Francisco, CA; Southwest Research and Information Center, Albuquerque, NM; Union of Concerned Scientists, Cambridge, MA; United Methodist Church Joint Law of the Sea Project,Washington, DC; United Methodist General Board of Church and Society, Washington, DC; Wilderness Society, Washington, DC; and the Whale Center, Oakland, CA.

State

Atlantic coast - - CONNECTICUT: Connecticut Audubon Society, Fairfield, CT; Connecticut Fund for the Environment, New Haven, CT; Connecticut Sierra Club Chapter, Hartford, CT; and Long Island Sound Taskforce, Stamford, CT. MASSACHUSETTS: Atlantic Center for the Environment, Ipswitch, MA; Amherst Disarmament Coalition, Amherst, MA and American Institute of Buddhist Studies, Amherst, MA. NORTH CAROLINA: Artists and Musicians United for a Safe Environment, Durham, NC; Community Alliance for Nuclear Disarmament (CAN-Disarm), Winston-Salem, NC; Conservation Council of North Carolina, Chapel Hill, NC; North Carolina Coastal Federation, Newport, NC; North Carolina Peace Network, Cary, NC; North Carolina Public Interest Research Group, Durham, NC; and Religous Coalition to Reverse the Arms Race, Greensboro, NC. SOUTH CAROLINA: Energy Research Foundation, Columbia, SC; Environmentalists Inc., Columbia, SC; Palmetto Alliance, Columbia, SC; Charleston Palmetto Alliance, Charleston, SC;and the Runz Group, Charleston Area Sierra Club, Charleston, NC.

Pacific coast - - CALIFORNIA: Association of Former Coastal Commissioners, Carmel, CA; Ban Ocean Nuclear Dumping (BOND), Mendocino County, CA; California Coast Alliance, Sacramento, CA; Coastsiders for a Nuclear Free Future, Montara, CA; End Nuclear Dumping in the Pacific, Los Angeles, CA; Environmental Defense Center, Santa Barbara, CA; Friends of the Sea Otter, Monterrey, CA; League for Coastal Protection, San Fransisco, CA; Nurses for Social Responsibility, Los Angeles, CA; Nuclear Resistance Coaltion, Los Angeles, CA; Planning and Conservation League, Sacramento, CA; Pacific Coast Federation of Fisherman's Associations, Inc., Sausalito, CA; Point Reyes Bird Observatory, Stinson Beach, CA; Scenic Shoreline Preservation Conference, Santa Barbara, CA; and Senic Shoreline Preservation Council, Santa Barbara, CA. OREGON: 1000 Friends of Oregon, Portland, OR; Oregon Shores Conservation Coalition, Salem, OR.

Local

Pacific coast - - - CALIFORNIA: All Us Mollusks, Albion, CA; Amigos de Bolsa Chica, Huntington Beach, CA; Bay Chapter of the Sierra Club, Oakland, CA; Carmel Chapter of the Sierra Club, Carmel, CA; COAST, Cotati, CA; Coast Action Committee, Pt. Arena, CA; Committee for Green Foothills, Palo Alto, CA; Committee to Bridge the Gap, Los Angeles, CA; Concerned About Ocean Dumping, Humbolt County, CA; Corralitos Chapter of California Native Plant Society; Ecology Center of Southern California, Los Angeles, CA; Friends of the Ballona Wetlands, Playa del Rey, CA; Great Pacific Ironworks, Ventura, CA; Kensington Chapter, California Native Plant Society; Loma Prieta Chapter of the Sierra Club; Los Angeles Chapter of the Oceanic Society, Los Angeles, CA; Los Angeles Chapter of the Sierra Club, Los Angeles, CA; Madrone Chapter of the Audubon Society, Santa Rosa, CA; Marin Conservation League, San Rafel, CA; Northern California Regional Conservation Committee of the Sierra Club, Stockton, CA; North Coast Environmental Center, Arcata, CA; P(eople) A(ccess) C(oast) E(nvironment) [PACE], San Francisco, CA; Palo Alto Chapter of the Sierra Club, Palo Alto, CA; Redwood Chapter of the Sierra Club, Santa Rosa, CA; Redwood Alliance, Arcata, CA; Sacramento Chapter of the California Native Plant Society, Sacramento, CA; San Diego Chapter of the Oceanic Society, San Diego, CA; San Francisco Bay Chapter of the Oceanic Society, San Francisco, CA; San Luis Obisbo Chapter of the California Native Plant Society; Santa Barbara Coast Watch, Santa Barbara, CA; Sausalito Chapter of the California Native Plant Society, Sausalito, CA; Save Our Shores, Santa Cruz, CA; Save the San Francisco Bay Association, Berkeley, CA; Sonoma County Planning Department, Santa Rosa, CA; Sonoma County Tommorrow, Santa Rosa, CA; South Bay Conservation Group, Los Osos, CA; Southern Mendocino Action Committee, Point Arena, CA; Stop Pershing II Unification Committee, Sacramento, CA; Ventura Chapter of the Sierra Club; and Wetlands.

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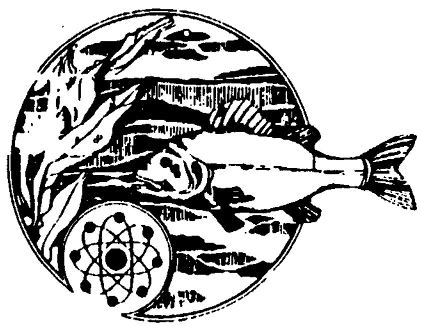
Other: - - - Asian Pacific American for Nuclear Awareness, Los Angeles, CA; Campaign for Economic Democracy, Education Fund, Santa Monica, CA; Committee to Preserve Assateaque Island, Towson, MD; Lake Superior Region Radioactive Waste Project, Madison, WI; Microneisan Support Committee, Honolulu, HI; Pacific Concerns Resource Center, Honolulu, HI; and Political Animal Welfare Action Committee, San Francisco, CA.

#695 (Part 2)

JOINT COMMENTS OF
ENVIRONMENTAL AND OTHER CITIZEN ORGANIZATIONS
IN RESPONSE TO
THE DEPARTMENT OF NAVY'S
DRAFT ENVIRONMENTAL IMPACT STATEMENT
ON THE
DISPOSAL OF DECOMMISSIONED, DEFUELED
NAVAL SUBMARINE REACTOR PLANTS

- 30 JUNE 1983 -



Submitted by the Center for Law and Social Policy
and the Oceanic Society on behalf of:

American Cetacean Society
Ban Ocean Nuclear Dumping
CAN-Disarm
Center for Environmental Education
Clean Water Action Project
Committee to Bridge the Gap
Critical Mass Energy Project
Environmental Defense Fund
Farallon Foundation
Friends of the Earth
Greenpeace, U.S.A.
Hudson River Sloop Clearwater, Inc.
National Audubon Society
Natural Resources Defense Council
Nuclear Free Pacific
Nuclear Information Resource Service
Ocean Education Project
Oceanic Society
Palmetto Alliance
Scenic Shoreline Preservation Conference
Sierra Club
Southwest Research and Information Center
Union of Concerned Scientists
United Methodist Church Joint Law of the Sea Project
United Methodist General Board of Church and Society
Wilderness Society

30 June 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

In response to the Department of Navy's request for comments on its Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (December 1982), this document contains the analyses and comments of a national coalition of environmental and other citizen organizations.

These comments were prepared under the leadership and coordination of the Center for Law and Social Policy and the Oceanic Society, in conjunction with the invaluable assistance of the participants in the coalition of organizations which are listed on the cover, mentioned in the "Introduction" of our comments (Part I) and described in Appendix A.

Respectfully submitted,

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#695 (Part 2) (Cont)

EXECUTIVE SUMMARY

On 22 December 1982 the Department of Navy published a Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. According to the DEIS, during the next 30 years more than 100 of the Navy's 120 nuclear powered submarines now in service will be decommissioned. The Navy's principal disposal alternatives are to either sink the entire submarine at sea or remove the reactor compartment -- which contains approximately 62,000 curies of radioactivity -- and bury that one section of the ship on land. The Navy requested that public comments on its DEIS be submitted by 30 June 1983.

The national coalition of environmental and other citizen organizations, on whose behalf these comments are being submitted, believes that the Navy's DEIS does not provide a sound basis for considering sea disposal of its obsolete nuclear submarines. Our oceans play an essential role in shaping weather, feeding our people and supporting life on our planet. They are too important to permit them to be used as experimental dumping grounds for radioactive wastes. Given the extremely hazardous nature of radioactive wastes, their disposal into the oceans is fraught with potentially irreversible consequences. Those substances can cause irreversible effects on species, ecosystems, biological processes, and can contaminate food chains that result in hazards to human health. Absent substantially stronger technical and scientific analyses based on comprehensive environmental data, the Navy's consideration of the "ocean option" is an inadequate basis for reversal of current U.S. policy and a return to sea disposal of American radioactive waste.

Part I of our comments describes the organizations which comprise the coalition. Past activities of coalition participants, prior to and since the release of the DEIS, are discussed. Those activities include participation in congressional hearings, state hearings, public workshops and the Navy's public hearings, the preparation of a coalition-endorsed critique of a General Accounting Office study of the hazards of past U.S. dumping practices, and the Oceanic Society's preparation of a Briefing Report outlining the issues to be addressed in the Navy's DEIS and subsequent convening of a Scientific Committee which led to the publication of the Oceanic Society Scientific Committee Report. Part I of the comments also describes summarily the Navy's DEIS.

Part II of our comments provides pertinent "Background". Past radioactive waste dumping practices in the United States from 1946 to 1970 are discussed, as are other nations' dumping practices from 1949 through the present. Part II then describes the Ocean Dumping Act, our domestic law governing ocean disposal of radioactive wastes. Important amendments to the Act were adopted in January 1983. Those amendments include a two-year

moratorium on approving any permits for radwastes and new requirements for environmental and economic assessments and state/citizen participation rights. Part III then describes the London Dumping Convention (LDC), the international treaty governing ocean disposal of radioactive wastes. The United States is a party to that treaty, along with 51 other nations. At the most recent meeting of the parties to the LDC in February, 1983, a two-year international moratorium resolution and scientific review mechanism were adopted in relation to radwaste disposal.

Part III of our comments discusses eleven scientific and technical considerations that are not adequately addressed in the DEIS. These issues include difficulties in monitoring deepsea ecosystems; potential pathways for transport of radioactivity towards humans; site-specific questions; potential availability of radioactivity in the deep ocean environment; cumulative impacts; indirect effects; faulty cost estimates; irretrievability of submarines from depths of 4,000 meters; alternatives not considered in the DEIS; potential for accidents; and other deficiencies in data in the Navy document. The Navy's failure to answer these scientific and technical considerations is a significant shortcoming in the DEIS. It deprives citizens and members of Congress of information which is essential to making an informed decision among alternative disposal methods.

Part IV of our comments discusses the National Environmental Policy Act (NEPA), the related Council on Environmental Quality (CEQ) regulations and interpretative caselaw -- applying those legal requirements to the DEIS. In a wide range of areas, the DEIS violates the letter and spirit of NEPA and the CEQ regulations.

Part V of our comments contains a brief discussion of other studies, reports and workshops which support the position that it is premature to reverse the U.S. existing policy of non-ocean dumping of radioactive wastes.

In Part VI, we conclude that even if the Navy is able to prepare a Final EIS that technically satisfies the procedural requirements under NEPA and the CEQ regulations -- which is unlikely -- the substantive policy and purpose of NEPA and sound national policy consistent with recent Congressional actions dictate that the Navy postpone further EIS action on permanent disposal of their obsolete submarines. Further research and studies are essential. The existence of substantial scientific and technical information gaps and uncertainties supports this position. The recent amendments to the Ocean Dumping Act -- which imposed the moratorium with the requirement that further studies be undertaken -- and the recent action under the London

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Dumping Convention -- which adopted a similar international moratorium and scientific review -- also support this position.

Without a delay to undertake needed research, it is our view that the Navy's Final EIS will run the likely risk of illegally serving as a pro forma ritual preceding a predetermined result. To correct those deficiencies, a supplemental DEIS must be prepared, with its preparation awaiting the accumulation of relevant data during the two-year moratorium period. These corrective measures are necessary to meet both the letter and spirit of NEPA and the concerns of Congress which underly the recent amendments to the Ocean Dumping Act.

FOREWORD

"Between 1946 and 1970, the United States disposed low-level radioactive waste (LLW) at four sites in the Atlantic and Pacific Oceans. The Environmental Protection Agency (EPA) monitored each site between 1974 and 1978, recovered three waste containers, and obtained samples of sediment and biota. While some sediment samples showed evidence of container leakage, these and other measurements did not suggest any potential harm to marine or human life. Nevertheless, the ultimate impact of past disposal remains uncertain because of the trace quantities present and the difficulty of scientifically measuring impact on marine organisms."

Triplett, Mark, et. al, "Monitoring Technologies for Ocean Disposal of Radioactive Waste," Rand Corporation Report prepared for the National Oceanic and Atmospheric Administration, R-2773-NOAA (1982) at 1.

"It has been a practice on the Pacific Coast to dispose of low-level waste by jettisoning containers of it onto the bottom of the sea in designated disposal areas. There is no evidence that this disposal practice has resulted in any inimical effect upon the environment; but neither is there evidence that harmful effects cannot eventually result from it."

"The concern here is not with any magnitudes of disposal already undertaken, but rather with understanding the implications of the continuing and increasing use of the oceans as a receptacle for disposal. History is replete with cases in which unrestricted pollution of various kinds, rapidly developing from innocuous beginnings, has subtly damaged or destroyed resources before understanding and controls could be developed." (emphasis added)

National Academy of Sciences/National Research Council, Disposal of Low-Level Radioactive Waste Into Pacific Coastal Waters, (1962) at viii.

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ON THE
DISPOSAL OF DECOMMISSIONED, DEFUELED
NAVAL SUBMARINE REACTOR PLANTS

I. INTRODUCTION

On 22 December 1982, the Department of Navy announced the release of its Draft Environmental Impact Statement (EIS) to assess the environmental implications of alternatives that could be used to dispose of decommissioned, defueled naval submarine reactor plants. 47 Fed. Reg. 57085. In response to the Navy's request for comments on the DEIS, this document is being submitted on behalf of the following organizations: The American Cetacean Society, Ban Ocean Nuclear Dumping (B.O.N.D.), CAN-Disarm, Center for Environmental Education, Clean Water Action Project, Committee to Bridge the Gap, Critical Mass Energy Project, Environmental Defense Fund, Farallon Foundation, Friends of the Earth, Greenpeace, U.S.A., Hudson River Sloop Clearwater, Inc., National Audubon Society, Natural Resources Defense Council, Nuclear Free Pacific, Nuclear Information Resource Service, Ocean Education Project, Oceanic Society, Palmetto Alliance, Scenic Shoreline Preservation Conference, Sierra Club, Southwest Research and Information Center, Union of Concerned Scientists, United Methodist Church Joint Law of the Sea Project, United Methodists General Board of Church and Society, and Wilderness Society. (These organizations, which are

hereafter referred to as the "coalition", are described in "Appendix A" which is attached.)

A. Coalition Activities

Prior to and since the release of the DEIS, many of the organizational participants in the coalition have been actively involved in the development of responsible ocean and nuclear waste management policies that provide for effective control of all sources of pollution of the marine environment. Our oceans play an essential role in shaping our weather, feeding our people and supporting life on our planet. Given the extremely hazardous nature of radioactive wastes, their disposal into the oceans is fraught with potentially irreversible consequences. Radioactive materials are among the most dangerous pollutants for the marine environment because they are long-lived and can accumulate in certain parts of the system or in marine organisms. These substances can cause irreversible effects on species, ecosystems, biological processes, and can contaminate food chains that result in hazards to human health.

Numerous members of the coalition have participated in Congressional oversight hearings that have been held since the late 1970s on the subject of ocean disposal of radioactive wastes.1/ In August of 1982, fifteen of the coalition participants endorsed a detailed critique of a General Accounting Office study which presented incomplete, inconsistent and erroneous findings and conclusions concerning the hazards of past low-level radioactive waste disposal by the United States.2/ Internationally, two of the coalition members -- Friends of the

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Earth and Greenpeace -- have participated in the meetings that have been held under the London Dumping Convention (which is described in Part II(C), below).3/

In January 1982 the Navy issued a "scoping notice" which announced its intention to prepare the DEIS which is at issue here. 47 Fed. Reg. 2151, 14 January 1982. Several of the coalition participants -- including the Center for Law and Social Policy, Friends of the Earth, Greenpeace, and The Oceanic Society -- submitted comments in response to that notice. On 7 August 1982 the California Legislature's Joint Committee on Fisheries and Aquaculture held hearings at which the Navy's interest in the ocean option for disposal of retired nuclear submarines was a central concern. Again, several members of the coalition testified and/or submitted written statements for that hearing record. On 19 October 1982 the House Committee on Merchant Marine and Fisheries convened a hearing in Manteo, North Carolina to review the Navy's proposal to release a DEIS on submarine disposal. Disposal of Decommissioned Nuclear Submarines, Hearing before the Committee on Merchant Marine and Fisheries, House of Representatives, 97th Cong., 2d Sess., No. 97-47. CAN-Disarm, the Center for Law and Social Policy, and Greenpeace representatives testified at those hearings and the Oceanic Society submitted a written statement.

In December 1982, the Oceanic Society issued a Briefing Report which alerted conservationists, coastal citizens and elected officials to scientific and technical questions which needed to be answered in relation to the Navy's forthcoming

DEIS.4/ On 3-4 February 1983, the Oceanic Society impaneled an independent Scientific Committee to assess the Navy's DEIS. The final report of that committee was published on 13 March 1983, and its findings and conclusions serve as the principal source of the technical and scientific concerns contained in Part III of these comments. Final Report, Oceanic Society Scientific Committee Report on [Navy's DEIS], 13 March 1983 (hereafter referred to as the "Scientific Committee Report").5/

As part of the DEIS comment process, the Navy convened public hearings at four locations along the Atlantic and Pacific coasts in February 1983. 47 Fed. Reg. 57085, 57086 (22 December 1982). An overwhelming majority of speakers at these sessions spoke against sea disposal of obsolete nuclear submarines. Opposition to ocean disposal was voiced by conservationists; elected local, state and federal officials; commercial fishermen; coastal business interests; disarmament and freeze groups; scientists; and individual citizens. In tandem with participation in the public hearings, many of the coalition members, among others, submitted requests to the Navy to extend the DEIS written comment deadline from 31 March 1983 to 30 June 1983. In late March the Navy granted that request. During the extended comment period, The Oceanic Society and other members of this coalition also convened a series of citizen workshops focused on the DEIS in Boston, MA; Washington, D.C.; Winston-Salem, NC; Beaufort, NC; Charleston, SC; Eureka, CA; and Seattle, OR. Additional briefings were presented at sites along the California coast.

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B. The Navy's DEIS

According to the DEIS, during the next 30 years 100 of the 120 nuclear powered submarines now in service will be decommissioned. Five additional submarines have already been taken out of service and placed in storage. The principal source of concern is radioactivity which, during operation of the submarine's propulsion system, accumulates in the stainless steel equipment which comprise the vessel's reactor and steam generator. This machinery is located in a section of the sub called the reactor compartment which extends between two watertight bulkheads in the center of the submarine.

Of the 62,000 curies6/ of radioactive materials remaining in each defueled submarine, the DEIS reports 99.9 percent "is an integral part of the corrosion resistant alloy forming the plant components." DEIS, at 1-2. Since corrosion of these metal components will be a major mechanism for release of this radioactivity to the environment, the DEIS states: "Most of the radioactive nuclides would have decayed to stable atoms before they could possibly be released to the environment by the slow corrosion process." Id. Cobalt-60, Nickel-63, Carbo-14, Nickel-59, Niobium-94 and Technetium-99 are among the long-lived radionuclides expected to persist in the submarines and be released to the environment.

The Navy proposes to either sink the entire submarine at sea or remove the reactor compartment and bury this one section of the ship on land. If the land alternative is selected, the remaining, non-radioactive section of the sub would be scuttled

at sea or scrapped. In either land or sea disposal, the DEIS states that corrosion resistant metals used in the hull and reactor plant will produce slow rates of corrosion and allow the bulk of radionuclides to decay to stable elements before these substances can be released.

Land disposal sites considered in the DEIS are existing nuclear waste disposal facilities at the Savannah River Plant, South Carolina and the Hanford Site, Washington. "Generic" sea disposal sites considered in the DEIS include a "Lower Continental Rise Area" some 220 nautical miles due east of Cape Hatteras, North Carolina; a "Hatteras Abyssal Plain Area" some 280 nautical miles southeast of Cape Hatteras; and a site some 160 nautical miles west of Cape Mendocino, California. Designation of a sea disposal site would come from the U.S. Environmental Protection Agency, according to the DEIS.

The DEIS concludes that neither sea nor land disposal would damage the environment. Sea disposal is characterized as less expensive (by $1.9 million per submarine); requiring less shipyard work; isolated from human activity; requiring an Environmental Protection Agency permit; non-retrievable; and arousing more controversy than land disposal. Land disposal is summarized as permitting retrieval for up to 200 years; not requiring new regulations; utilizing existing waste disposal sites; more expensive than sea disposal; and requiring more shipyard work. The Navy's Draft Environmental Impact Statement does not indicate a preferred disposal option or proposed course of federal action.

As detailed in the following sections of these comments, the coalition believes that the Navy's DEIS does not provide a sound basis for considering sea disposal of its retired nuclear submarines. Our oceans are too important to permit them to be used as experimental dumping grounds for radioactive wastes. Absent much better technical and scientific information and analyses, the DEIS's consideration of the "ocean option" does not merit reversal of the United States' current radioactive waste non-dumping policy. As spelled out more fully in the "Conclusion" portion of our comments (Part VI), we recommend that the Navy refrain from moving forward with the preparation of a Final EIS at this time. Instead, the Navy should join with other federal agencies -- and with the international community -- in an effort to resolve outstanding scientific and technical uncertainties related to ocean disposal of radioactive wastes. Following the completion of that effort, a revised DEIS should be prepared which is based on informed scientific and technical analyses and information.

II. BACKGROUND

A. Past Dumping Practices

Wastes containing radioactive properties have been generated since World War II from nuclear weapons, commercial reactor programs and other civilian uses. Radioactive wastes are classified according to the level of radioactive contamination into low-, medium- and high-level waste. Since the mid-1940s low and medium-level waste has been dumped into the oceans after being packed in concrete lined barrels. Highly radioactive wastes arising from nuclear reprocessing has generally been stored in cooling tanks, pending a decision as to the ultimate method of disposal. As mentioned in the Navy's DEIS, two U.S. nuclear-powered submarines, the Thresher and the Scorpion, have been lost at sea. In addition, one U.S.S.R. nuclear-powered submarine is known to have sunk at sea.

It is impossible to make an accurate estimate of the amount of radioactive waste which has reached the marine environment through past dumping practices. From 1946-1970, the oceans off our U.S. coastline were used as dumpsites for such wastes. Available records indicate that approximately 90,000 cannisters, with an estimated total activity of 95,000 curies, were dumped at sites in the Atlantic, Pacific and Gulf of Mexico -- with 99.5 percent of that amount dumped prior to 1963.1/

Certain European countries have dumped radioactive waste at sea for many years; yet only three of these operations still continue. Between 1949 and 1966 the United Kingdom disposed of an estimated 45,000 curies of radioactivity in a variety of

Atlantic Ocean sites, but primarily in the Bay of Biscay and the Hurd Deep, a mere 20 miles north of Guernsey, one of the Channel Islands. In the mid-1960s member nations of the Organization for Economic Cooperation and Development (OECD) nominated the Nuclear Energy Agency (NEA) to supervise the dumping operations, and in 1967 a 4 kilometer deep area in the Atlantic Ocean, 700 kilometers to the northwest of the Spanish coast, was designated as the European dump site. Eight countries carried out a total of 28 dumping operations at this site between the years 1967 and 1982, representing more than 96,000 tons of waste containing over 1,000,000 curies of radioactivity. In 1974, France, Italy, West Germany and Sweden withdrew from the operation, opting for land storage of radioactive waste products. 2/ In the fall of 1982, the Netherlands announced that it would phase out ocean dumping of radioactive wastes. At present, only the United Kingdom and Switzerland have filed formal permit notifications with the NEA for dumping operations during the summer of 1983.3/

B. The Ocean Dumping Act

In 1970, the Council on Environmental Quality (CEQ) issued a report which concluded that ocean dumping of low-level radioactive wastes presented a very serious and growing threat to the marine environment. Ocean Dumping: A National Policy (1970), at vi-vii. In that report the CEQ recommended dumping of low-level radwastes be prohibited, except in a very few cases where there exists "no alternative offering less harm to man or the environment...[and] only when the lack of alternatives has been demonstrated." Id., at vii.

Soon after the CEQ report was published, the Marine Protection, Research and Sanctuaries Act ("Ocean Dumping Act") of 1972 was enacted. 33 U.S.C. §1401 et seq. Pursuant to Title I of the Act, as enacted in 1972, no permits may be granted for dumping any high-level radioactive waste in the ocean or beneath its seabed. Permits for low-level wastes were permitted only upon a determination that "such dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." Id., at §1412. In addition to listing specific considerations that the EPA Administrator must meet in making permit determinations, the Act as originally enacted also requires the Administrator to apply the standards and criteria binding upon the United States under international agreements. Id.

Regulations and criteria pursuant to the Ocean Dumping Act were published initially in October 1973, with the most recent substantive revisions thereto published in January, 1977. 40 C.F.R. Part 227. Among other provisions, those regulations define high-level radioactive wastes, specify various permitting criteria and require that all non high-level radioactive materials must be packaged or containerized to prevent their direct dispersion or dilution in ocean waters. In relation to CEQ's recommendation that the ocean be considered a dumpsite of last resort, the regulations also require a finding prior to any permit approval that "[t]here are no practicable alternative locations and methods of disposal...available,...which have less adverse environmental impact or potential risk to other parts of the environment than ocean dumping." Id., at §227.16(a)(2). 4/

In January 1983, amendments to the Ocean Dumping Act were enacted into law. Amendments to Sec. 104, Public Law 97-424, 6 January 1983. (Those amendments are attached to these comments as "Appendix B".) The pertinent provisions of those amendments make two significant changes to existing law. First, there is a two-year moratorium on the approval of any permits for ocean disposal of radioactive wastes, although limited "research" dumping might be permitted. Id., §104(i)(1). Second, following the expiration of the moratorium on January 6, 1985, any permit application must be accompanied by a "Radioactive Material Disposal Impact Assessment." Id., §104(i)(1). The assessment must address a variety of enumerated environmental and economic issues (discussed more fully below), include determinations by affected states that the proposed action is consistent with approved Coastal Zone Management Programs, and include comments and results of consultations with state officials and public hearings in affected coastal states. 5/

With respect to the two-year moratorium that is now in force, the adoption of that prohibition on radwaste disposal at sea reflects the view that a less hurried time frame for assessment and selection of the ocean option is appropriate. A principal objective of the moratorium, as evidenced by the legislative history, is to provide time for the completion of more detailed research into the uncertainties and possible impacts of such disposal.6/ Presumably EPA would be the lead

agency in directing such focused research efforts, with the Navy, NOAA, DOE, FDA and other appropriate federal agencies participating in such efforts.

Pursuant to the new requirements placed upon a permit applicant in relation to the Radioactive Material Disposal Impact Assessment, certain environmental and economic considerations must be addressed in detail. While several of these considerations track the requirements of NEPA, some are more specific, i.e., the requirement that the assessment include: "an analysis of the resulting environmental and economic conditions if the containers fail to contain the radioactive waste material when initially deposited at the specific site; a plan for the removal or containment of the disposed nuclear material if the container leaks or decomposes...[and] a comprehensive monitoring plan to be carried out by the applicant...." Id., §104(i)(1)(D),(E) and (J), respectively. With these specific requirements now in place, any EIS assessment of proposed ocean disposal options must include a detailed discussion of such assessments and plans.

C. The London Dumping Convention

Coinciding with domestic efforts leading to the enactment of the Ocean Dumping Act, the United States was a leading force behind the adoption of the 1972 International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter ("London Dumping Convention" or "LDC") which has since been ratified by the U.S. and 51 other countries. U.S.T. 2403, T.I.A.S. No. 8165, 29 December 1972. Consistent with our

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domestic law, the LDC prohibits dumping of high-level wastes, with low-level waste disposal allowed only if certain procedures have been met, including criteria for dumping that have been established by the International Atomic Energy Agency (IAEA), and special permit approval by the Organization for Economic Co-operation and Development's (OECD) Nuclear Energy Agency (NEA). Id., Art. IV and Annexes I, II and III. 7/

At the February, 1983 Seventh Consultative Meeting of the Contracting Parties to the LDC, a moratorium resolution (similar to the one now in place under our domestic law) coupled with a scientific review mechanism was adopted by a vote of 19 nations in favour, with 6 opposed (including the U.S.) and 5 abstentions. Report of the Seventh Consultative Meeting, paras. 7.1--7.46, Annex 3 and Annex 6, LDC 7/12, 9 March 1983. (Attached hereto as "Appendix C" is a copy of that moratorium resolution and the scientific review mechanism.) That resolution called for an immediate two-year suspension of ocean dumping of radioactive wastes pending presentation of scientific studies to a future meeting scheduled for February 1985, at which time further action will be taken. Id. During the first year of the two-year moratorium, the International Maritime Organization, the secretariat for the LDC, and the IAEA will solicit scientific and technical information. Following a status report to the next scheduled consultative meeting (February 1984), an intersessional meeting of experts will be held under the auspices of the LDC, with the results of that meeting forwarded to the February 1985

consultative meeting at which time the LDC parties will take whatever further action is deemed appropriate.

While the moratorium resolution is not legally binding on the United States, the international scientific review of ocean disposal of radioactive (and the potential for subsequent amendments to the LDC) should be taken into consideration by the Navy as it considers the ocean disposal options. That global review offers the United States further opportunities to increase its understanding of scientific and technical considerations along with parallel efforts pursuant to our domestic moratorium.

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III. SCIENTIFIC AND TECHNICAL CONSIDERATIONS

A. Introduction

This section of our comments summarizes scientific and technical concerns which are not adequately addressed in the Navy's DEIS. These issues include difficulties in monitoring deepsea ecosystems; potential pathways for transport of radioactivity toward humans; site-specific questions; potential availability of radioactivity in the deep ocean environment; cumulative impacts; indirect effects; faulty cost estimates; irretrievability of submarines from depths of 4,000 meters; alternatives not considered in the DEIS; potential for accidents; and other deficiencies in data in the Navy document. The Navy's failure to answer -- or characterize as unanswerable -- these scientific and technical considerations is a significant shortcoming in the DEIS. It deprives citizens and members of Congress of information which is essential to making an informed decision among alternative disposal methods for these defueled, decommissioned naval nuclear reactor plants.

Many of these questions concerning ocean disposal of radioactive wastes have never been adequately addressed. From 1946 to 1970, while America dumped nuclear waste in the sea, federal policy was based on the belief the oceans were large enough to disperse and dilute long-lasting radioactive contaminants. This assumption suggested radioactivity from waste disposal operations would diffuse evenly throughout an ocean

basin, diluting contamination to harmless levels. Instead, the limited research conducted to date indicates radioactive materials are adsorbed by the sediments where they remain relatively concentrated. 1/ The degree to which these concentrations would occur near scuttled nuclear submarines and its effect on marine life in the area has not been adequately documented in part due to the expense and technical difficulty involved in deepsea research. These and other concerns are addressed in the following sections.

B. Monitoring

Neither currently available scientific technology nor the monitoring program proposed in the DEIS are adequate to accurately gauge incremental environmental impacts of obsolete J.76
nuclear submarines on the deepsea floor. The authors of a little known, 1982 Rand Corporation report to the National Oceanic and Atmospheric Administration (NOAA), which we cite herein in support of a number of important concerns, warned: 2/

> ...environmental information required [for monitoring] is difficult to obtain, the long-term reliability of ocean measurement and monitoring systems is poor, and the remote nature of deepsea disposal sites makes traditional sampling and laboratory analysis methods inefficient, somewhat ineffective, costly, and time consuming.

These and other considerations raised in the Rand report are not J.76
adequately addressed in the Navy's DEIS.

A primary point in the Rand report is that "[d]eep sea disposal of radioactive wastes, whether LLW [low-level wastes] or [high-level wastes] places some severe demands on monitoring capabilities." Id., at 3. The report's authors stated that "the most significant transport pathways for radionuclides are not fully known" and noted "the small quantities of radionuclides that may escape (especially from existing LLW disposal sites) make it difficult to detect transport and assess its effect on the marine environment." Id., at 3.

The report also warned (at 42):

> Even though deep sea organisms are sparser than their shallow water counterparts, the potential exists for rather rapid transport of released radionuclides. The dominant nutrient flow in the deep ocean is from the surface to the sea floor, but some species may be upwardly mobile to the extent that rapid transport from the sea floor to the surface (i.e., toward commercial fishing regions) could occur. In addition, some metabolic processes of deep sea organisms could release upwardly mobile particles (e.g., lipids and eggs). The total radionuclide transport potential of deep sea biology may be small relative to physical oceanographic processes, but rapid migration could occur and could potentially enter commercial species.

The deepsea environment is often considered an attractive potential nuclear waste disposal site due to its remoteness from human activity and the low density of marine life typically found on the sea floor at great depths. Yet both of these "assets" pose significant challenges to marine monitoring technology. The factors which have limited human activity on the deepsea bottom also influence the technology required to survey and monitor these sites; identify and pinpoint leakage of radioactivity; and

determine probable impacts of any such occurrence, the report stated. Id., at v. The fact that deepsea biology is very sparse -- i.e., biota are patchily distributed -- creates a different monitoring problem. Efforts to understand both population dynamics and species interaction are, the authors stated, hampered by the extensive time intervals and large surface area which must be covered during sampling. "Large variations in species present at any point make it very difficult to meaningfully assess population dynamics," they concluded. Id., at 43.

"Furthermore," the report's authors noted, "little is known about the physiological processes of deepsea species, and without solid baseline data it would be virtually impossible to identify biological effects of released radionuclides." Id., at 47. They emphasized that "bioaccumulation studies will be most important for monitoring existing LLW disposal sites." Id., at 50. They also noted (Id.,at 62):

> At present, there is no method for rapid and accurate detection and identification of escaped radionuclides in the water column. Existing technology in oceanography depends on the operation of devices or vehicles from surface ships which can collect large volume water samples of data at very slow rates.

Technology developments are needed, the report continued, to extend available monitoring capabilities by adapting geological, biological and physical oceanographic instrumentation and sampling devices to the particular needs of low-level radioactive waste disposal sites. The principal authors of the report currently predicted millions of dollars and several years will be needed to develop these technological improvements.

Future monitoring activities would benefit, the report concluded, from the following technological developments (Id., at 19):

- o Site mapping/container location -- enhanced capability for locating containers in rough terrain.
- o Container integrity -- improved methods for detecting leaking or damaged containers in-situ.
- o In-situ radiation measurement -- improved sensitivity for in-situ radiation detectors.
- o Non-disruptive sediment sampling -- sampling methods that do not disturb the distribution of radionuclides in the upper few centimeters of sediment cores.
- o Measurement of sediment resuspension and overlying water movement -- correlation of sediment resuspension with water mass movement.
- o Waste container recovery -- improved capability for locating and retrieving specific containers.
- o Biomass surveys -- better information on the species present and possible radionuclide transport pathways.

To date, a drive to develop these technological improvements has not been launched, nor has the Navy proposed starting such an effort before the first submarine would be scuttled.

Until these improvements are completed, it will be difficult -- if not impossible -- to adequately study or monitor deepsea ecology. The same problems which make monitoring difficult also impair research assessing current environmental conditions and interaction between deep sea life. Many of these monitoring improvements, then, will be needed to provide an adequate description of deepsea ecology.

The biological uptake, retention and tissue distribution of radioactive materials is specific to each element and its chemical form as well as the species. Organisms can directly assimilate radioactive elements from the surrounding seawater or they may indirectly assimilate them after they have been concentrated by chemical or physical mechanisms, or through intermediates in the food chain.

To date, the bulk of data measuring these relationships is not directly applicable to the submarine program because of differences in organisms and radioisotopes studied. Many laboratory and field studies on bioaccumulation of radioactive elements have utilized coastal or shallow water species and not the deep-water species likely to be found at the sites studied for disposal of obsolete nuclear submarines. In the past, scientists have assumed the accumulation process worked in a similar -- although slower -- manner for abyssal species. This, however, has not been adequately verified in light of the behavioral and metabolic differences between shallow and deep sea

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species. Little is presented in the DEIS itself which indicates this relationship is as simple and direct as once believed.

L.7 Difficulties in monitoring and evaluating environmental change at old nuclear waste dumpsites off the American coast underscores our concern. The Rand report stated (Id., at 1): 3/

> Between 1946 and 1970, the United States disposed low-level radioactive waste (LLW) at four sites in the Atlantic and Pacific Oceans. 1/ The Environmental Protection Agency (EPA) monitored each site between 1974 and 1978, recovered three waste containers, and obtained samples of sediment and biota. While some sediment samples showed evidence of container leakage, these and other measurements did not suggest any potential harm to marine or human life. Nevertheless, the ultimate impact of past disposal remains uncertain because of the trace quantities present and the difficulty of scientifically measuring impact on marine organisms.

(Footnote in original.)

Efforts to gauge ecological impact at these locations have often been hampered by inexact or missing records as well as apparent disposal outside the designated dumping grounds. The Rand report noted (Id., at 17):

> The AEC commissioned two studies of the Pacific-Farallon sites, one in 1957 and one in 1960; the Atlantic dump sites were surveyed in 1961. Surface ships towed underwater cameras and obtained over 11,000 photographs of the sites. However, not one of the more than 75,000 radioactive waste containers was located.

A more recent effort to find nuclear waste dumped in Massachusetts Bay also failed to find a single drum. 4/

The findings which have been reported by EPA, however, have included some surprises. As summarized in the Rand report (at 18):

> With regard to the fate of disposed radionuclides, the EPA found:
>
> o Containers have leaked some of their contents to the environment.
>
> o ^{239}Pu and ^{240}Pu levels in disposal site sediments range from 2 to 25 times the maximum expected level due to fallout. 1/
>
> o ^{137}Cs levels in sediments range from 3 to 70 times the expected fallout level. 2/
>
> o Concentrations found to date do not appear to represent a risk to man or to the marine environment. 3/

(Footnotes in original.)

In an effort to overcome the failure of past monitoring programs, the Navy points to an alleged lack of environmental impact from the accidental loss of the nuclear powered submarines THRESHER and SCORPION as well as the "planned" disposal of an experimental reactor from the SEAWOLF. The Navy argues the THRESHER and SCORPION represent "worst case" accidents in severe conditions. Samples taken near these wrecks do not show high levels of radioactivity, a finding which the Navy claims signals a lack of environmental impact. DEIS at D-A17.

Members of the Oceanic Society Scientific Committee, hereafter referred to as the Scientific Committee, felt data from the THRESHER and SCORPION wrecks are insufficient, as presented J.43

J.43 in the DEIS, to substantiate conclusions that nuclear submarines cannot damage the marine environment or human health in the future. Additional information is needed to determine if the reactor compartments of these submarines have been located and, if so, whether the compartments are open to the marine environment. Locations of sampling stations at the accident sites must be described in the DEIS in relation to the wreck's reactor and reactor compartment. Because of adsorption into sediments as well as some dispersal potential in ocean currents, it is critical to ascertain the precise proximity of sampling stations to the THRESHER and SCORPION wreckage and the breached or unbreached reactor compartments. Without this information the Navy data simply cannot be evaluated since samples collected near debris which is not related to the nuclear reactor and cooling system are not expected to contain detectable levels of radioactivity. Further, if the reactor compartment has not been breached, then corrosion would be the primary mechanism for release of radioactivity and the hull would continue to contain radioactivity until the fifth or sixth decade of the 21st century. At that time the reactor compartment would be open to the marine environment by corrosion, according to rates projected in Table 4-2 of the DEIS (at 4-12).

Although sea disposal of the SEAWOLF's experimental reactor was planned, the actual dumping operation did not proceed

according to plan. The reactor was not sunk as expected and repeated efforts by the Navy to locate it have failed. J.85

Within this context of missing reactors, incomplete dumping records, unexpected concentrations of radioactivity near past disposal sites and gaps in currently available monitoring technology, the Navy has proposed in the DEIS a substantially inadequate monitoring plan. The Navy must provide a detailed description of plans to implement a sustained monitoring proposal which is adequate in terms of identifying evolving ecological impact, duration of the monitoring effort, and commitment of Navy funds on a long-term basis. Further, the DEIS must reflect the degree of development needed to attain viable deepsea monitoring technology describing the costs and time needed to complete that effort. J.76

The Rand report defined monitoring as the (at 7):

> ...systematic time-series observations of predetermined pollutants or pertinent components of the marine ecosystem over a length of time sufficient to determine the (1) existing level, (2) trend, and (3) natural variation of parameters of the water column, sediments, or biota. 1/

(Footnote in original.)

Biological monitoring, the report stated, "directly measures radionuclide transport through the food chain and assesses the potential for such transport by quantifying relevant deep sea populations and their behavior patterns." Id., at 42. Monitoring of an ocean nuclear waste disposal site, the report notes, should continue "as long as necessary," Id., at vii. In this case, monitoring should continue while long-lived radionuclides -- such as Niobium-59 -- continue to decay during thousands of years.

As described in Appendix K of the Navy DEIS, a sea disposal monitoring program would consist of three phases: pre-disposal, during disposal and post-disposal. The Navy also stated: "[t]he results of these analyses and their evaluations would be published periodically for public information and review." Id., at K-1. Sea disposal would require a new monitoring program which could "be performed using existing, proven technology." Id., at K-1.

The Navy goes on to assert (Id., at K-3):

> All the major components of the monitoring program listed above have been successfully utilized by the Navy and the oceanographic scientific community for a number of years and no significant difficulty is anticipated in implementing such a monitoring program at a disposal site.

Although the Rand report was completed almost a year before the DEIS was released for review, the Navy fails to address any of the needs for technological improvement cited in the report for NOAA.

Equally disturbing, in describing the duration of monitoring after ocean disposal, the Navy stated (at K-3):

> Monitoring surveys after the period of active disposal would be similar in scope and cost to those performed during the disposal period. The frequency of these surveys would be determined by the results of earlier surveys. If the analysis presented in this statement were to be corroborated by surveys performed during the period of active disposal, post-disposal surveys would be needed very infrequently.

(Emphasis added.)

By describing both duration and frequency of monitoring in ambiguous terms, the Navy calls into questions its ocean dumping expense estimates as well as the cost savings claimed for sea instead of land disposal.

A more fundamental problem is whether an ill-defined monitoring program is sufficient to safeguard marine environmental quality. If, based on initial post-disposal studies, monitoring continued "very infrequently" with current technology, then long-ranged problems may well be missed by the Navy. Questions raised in the Rand report also raise doubts as to whether an initial "all clear" would stem from inadequate technology or a true absence of ecological damage.

The "best estimate" for corrosion described in Appendix G of the DEIS suggests the reactor compartment would be penetrated within 100 years and that bottom currents would begin flowing through the reactor itself within 400 years of disposal. This estimate is used in DEIS Figure G-2 to show release of radioactivity to the environment as occurring in +/-100 and +/-400 years (at G-7). Comprehensive monitoring programs, then, must extend beyond short-term studies to include releases of radioactivity projected for 100 to 400 years from now. Yet the monitoring program described in Appendix K of the DEIS proposes only a $9 million budget for monitoring "during and after the period of active disposal" (at K-3). The Navy's proposal to determine the frequency of post-disposal monitoring based on J.80 intial results -- results from a period when the DEIS predicts <u>no release of radioactivity to the marine environment</u>-- is clearly inadequate.

Members of the Scientific Committee concluded the monitoring program as reflected in the DEIS is inadequate to measure J.76 evolving ecological effects. Absence of a comprehensive monitoring program makes it impossible to assess the relative merits of the sea disposal alternative. The ocean option cannot be considered, members said, in the absence of an adequate monitoring program.

In revising the DEIS, the Navy must consider and describe in detail the scope and costs of long-term monitoring of submarines on the deep ocean floor. Specific attention must be given to locating monitoring stations within 25 meters of the reactor J.81 compartment and in a network of sites where the plume of radioactivity from a submarine can be monitored. Details of plans for biota sampling, sediment sampling, use of submersibles and development of in-situ monitoring equipment must be considered. The Scientific Committee concluded the level of funds proposed in the DEIS is inadequate to support a sound monitoring program let alone develop needed monitoring technology. Combined costs of

these efforts alone may well outweigh modest savings ascribed to sea disposal by the Navy.

The DEIS must also be revised to consider institutional impediments to conducting monitoring programs for very long (400+ J.79 year) periods. Experience during the past three decades has demonstrated the difficulty in retaining records for -- let alone continuing monitoring programs of -- nuclear waste placed in the marine environment. To a significant degree, records of nearly 100,000 curies of radioactive wastes dumped at sea from 1946 to 1970 are inadequate or missing. Research and monitoring at old American dump sites is virtually nonexistent following the limited success of expensive retrieval efforts conducted at a few locations. 5/

Only when the Navy has filled these gaps in scientific understanding and monitoring technology can we predict the breadth and severity of impacts of nuclear submarine disposal in the oceans. At this point, based on the DEIS, it is premature to consider the oceans as a disposal medium because we simply cannot L.39 estimate the consequences. Because technology for radioactive waste disposal, monitoring and storage on land is currently more fully developed, this alternative should be used for the disposal of the submarines. This is especially true when dealing with the impacts of unexpected events or accidents at great depths in the ocean.

C. Pathways for Radioactive Migration

Pathways for radioactivity to migrate through the marine environment from ocean dumpsites toward human consumers of seafood and seaweeds has been inadequately considered in the DEIS. Existing significant scientific information on movement of radionuclides from radioactive wastes to the water column, sediments and marine organisms has not been considered by the Navy. The potential for vertical and horizontal migration of radioactivity is a common concern at all locations studies for sea disposal.

Scientific Committee members noted studies conducted for the U.S. Environmental Protection Agency and others demonstrate the existence of possible pathways for radioactivity to migrate from low-level radioactive waste into rattail fish (grenadiers). Work by Schell and Nevissi done under contract to the EPA, for
U.9 example, shows migration of one radionuclide from waste drums into bottom sediments, bottom dwelling invertebrates, and to these fish. 6/ Several research reports show migration of radioactivity from wastes into the marine environment. Other scientists suggest pathways for vertical migration of radioactivity may also exist. These studies serve as a warning that biological pathways for radioactivity have not been adequately assessed. Further investigations are necessary, and all this research must be considered in a revised DEIS.

L.14 The Scientific Committee also noted that the artificial reef effect has not been considered adequately in the DEIS. Experience

with radioactive waste dumpsites, oil platforms, and ships sunk at sea has established that any new structure placed on the continental shelf attracts and holds new and more abundant communities of fishes and invertebrates. The processes at work in this phenomenon, commonly called the "artificial reef effect," are enhanced food supply in the form of fouling organisms and algae that grow on the new hard substrate and enhancement of habitat by creating spatial heterogeneity. Increased spatial heterogeneity gives small fish and mobile invertebrates places to hide, and the structures seem to provide larger fish with landmarks which allow them to establish a "home range" or territory in an otherwise featureless environment.

The potential for an artificial reef effect in the deep ocean presents unanswered ecological questions. Among them is whether this will occur when decommissioned nuclear submarines are placed on the abyssal plain. Consideration of the possible occurrence of this phenomenon and a detailed examination of its role as a biological pathway must be greatly expanded in revising the DEIS. Specific attention must also be paid to the artificial reef effect in the context of accidental sinking on the continental shelf and identifying potential short cuts in biological pathways.

Some Scientific Committee members also felt the DEIS should be revised to include a Specific Activity assessment of sea U.6
disposal. The Critical Pathways assessment utilized in the DEIS

does have greater acceptance and use because it is simple in theory, easily understood and simpler to explain. The Specific Activity approach is more abstract but has its place in this case where parameters in the food web are as poorly known as they are for the pathways of radionuclides from the abyssal depths of the ocean to humans. The Specific Activity approach may also be of use when pathways cannot be easily monitored. However, standing alone, it would not provide adequate understanding as to the amount of radioactivity moving through the food chain. Specific Activity studies would complement Critical Pathways assessments.

In compiling the DEIS, the Navy relied upon a theoretical model for physical-biological transfer proposed by Robinson and Mullin at a Sandia National Laboratory Workshop in 1981. 7/ Based on this model, the Navy predicts that biological transport of radionuclides from ocean bottom to the surface will be one-thousandth of the physical transport. The Navy does not note in the DEIS that this theoretical model was severely criticized by other working groups at the Sandia workshop. According to J.A. Musick, Senior Marine Scientist at the Virginia Institute of Marine Science: "The Robinson-Mullin model is predicated on nuclides entering the water above a disposal site with the subsequent transport of the nuclides in the water away from the site." 8/ The DEIS appears to utilize a similar model in Appendix H even though the Navy notes: "It is anticipated that a large fraction, perhaps as high as 95 percent of the corrosion

product particles carrying radionuclides would settle to the ocean floor either through direct deposition or by removal by the detritus particles" (at H-2, H-3).

Dr. Musick, in reviewing the Navy DEIS, wrote (at 2):

> If this assertion be true, nuclide ocean dispersal models based on simple eddy diffusivity seem to be inappropriate. Rather bioaccumulation within the benthos and subsequent concentration within benthopelagic predators may provide a more important pathway for dispersal of nuclides like Ni-59 away from abyssal dump sites.

U.5

Dr. Musick also notes the development of an exposure pathway model in Appendix I of the Navy DEIS is based on an equilibrium situation for isotope release (at 5). This might be justified, he continues, if isotopes went into solution and were dispersed according to the eddy diffusion models criticized earlier in his review. However, he asks, if -- as the DEIS asserts -- the major isotope released is Ni-59 in the form of corrosion particles which sink into sediments close to the submarine, will this radioisotope become concentrated near the ships?.

In revising the DEIS, the Navy must address these concerns and conduct a more complete review of available scientific research on pathways for migration of radioactivity from disposal sites toward humans. Further, the Navy must identify those areas where disagreement exists within the scientific community and identify questions which cannot be answered with currently available information.

D. Site Specific Concerns

An array of site-specific concerns has emerged during discussions of potential pathways for migration of radionuclides through the marine environment. Disposal of obsolete nuclear submarines off the North Carolina coast could, scientists say, be transported by benthic currents or fish toward shallow waters. Concerns cited for the Cape Mendocino, CA site include impact on fisheries and potential seismic activity near the dumping site.

The Lower Continental Rise site studied off North Carolina is, according to Dr. Musick, a region heavily influenced by the Western Boundary Undercurrent (WBUC), a factor which receives insufficient attention in the DEIS. Dr. Musick writes that the WBUC is characterized by a dense layer of suspended particle matter called a nepheloid layer which currents maintain and carry to the southwest. Dr. Musick noted (at 3):

J.4, J.5

> Gardiner and Sullivan (1981) recently discovered that such nepheloid layers in the deep sea may be subject to frequent and sudden increases in density caused by benthic storms. These density increases may be caused by resuspension of sediments during the passage of severe atmospheric storms. Radionuclides adhering to sediment particles could be resuspended by benthic storms and carried by the nepheloid layer toward the continental slope to the southwest off North Carolina. The E.I.S. states that the WBUC is deeper than 1800 m. This is incorrect. The WBUC sweeps to within the 1100 m isobath off North Carolina (Rose and Menzies, 1968). Physical transport of radionuclides adhering to sediment particles transported by benthic storms might be orders of magnitude higher than that calculated on the basis of eddy diffusion models in the E.I.S. Models including inputs for transport mitigated by benthic storms directly to the 1000 m isobath off North Carolina should be included in the final E.I.S.

In revising the DEIS, the Navy must also explain how this site -- with its currents and benthic storms -- can meet the oceanographic criteria described in Appendix E. (at E-5, E-6).

Dr. Musick continued (Id., at 3):

> Radionuclides introduced into the nepheloid layer could enter benthopelagic food webs. Such webs are probably very important in the deep sea (Marshall and Merrett, 1977; Sedberry and Musick, 1978) and the biomass of benthopelagic organisms may equal or exceed that of benthic organisms in some deep sea regions. U.5

The dominant benthopelagic predator and scavenger on the lower continental rise off North Carolina is the large rattail fish, Coyphaenoides armatus, which may amount to 90% of the biomass of fishes deeper than 2000 m. Id. Dr. Musick wrote (Id.):

> We have suggested that C. armatus may migrate to boreal latitudes to spawn, as one of its congeners is known to do (Musick and Sulak, 1979). Most macrourids including C. armatus lay large numbers of pelagic eggs that probably develop in the upper part of the thermocline. These eggs may provide a means by which radionuclides could be transported from the abyss into epipelagic ecosystems. Also, it is significant that C. armatus has been shown to concentrate Ni (at least in its liver) (Grieg et al, 1976) because Ni-59 is the isotope of critical interest in the current E.I.S. U.5

To date, he noted, scientists have never captured any individuals with ripe gonads nor have they been able to capture more than a few individuals. Id.

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Reviewing of this potential transport mechanism, Dr. Musick wrote (Id., at 4):

> In summary, C. armatus could concentrate Ni-59 while near the dump-site, then subsequently migrate to boreal latitudes where its nuclide-contaminated eggs could be introduced into epipelagic food webs. The significance of such a transport route is not clear because of lack of information about residence time of individual fishes and nuclide uptake rates. We currently have sufficient data to estimate standing stocks of C. armatus near the Lower Continental Rise Area but not to estimate production or flux through the area.

U.5

Dr. Musick warned that radionuclides transported into the nepheloid layer and subsequently carried to near the 1000 m isobath could be incorporated into mesopelagic, benthopelagic or benthic food webs there. "All three food webs can lead to transport upslope and ultimately to resources consumed by man." Id. Most fishes (and many zooplankters) in the mesopelagic zone (100 m - 1000 m) make vertical migrations toward the surface at night where they are subject to predation by tuna, billfishes and other predators (Marshall, 1979). Id.

According to Dr. Musick, some dominant benthopelagic fishes (such as Nezumia bairdii and Coryphaenoides rupestris, make seasonal upslope migrations from depths below 1000 m to depths of 500 to 1000 m. While upslope these species are subject to predation by large epipelagic predators such as blue sharks (Prionace glauca) and sword fish (Xiphias gladius). Sword fish are taken in a long-line fishery along North Carolina's

continental slope during cooler months, Dr. Musick reported. Id., at 4, 5.

The red crab (Geryon quinquedens) fishery is also cited by Dr. Musick who noted (Id., at 5): "The species is the object of a developing fishery and is one of the most important underdeveloped resources off the East Coast."

"In general, the Lower Continental Rise Area [off North Carolina] is a very poor choice for a nuclear waste site," Dr. Musick concluded. "The area is subject to strong periodic currents that sweep toward the 1000 m isobath off North Carolina. In addition, large migratory fishes are fairly common there." Id., at 6.

At the second site studied off Cape Hatteras, the Hatteras Abyssal Plain Area, additional study is needed to determine the frequency of periodic turbidity currents, nature of bottom currents, and survey benthic and benthopelagic nekton. Dr. Musick argues the Hatteras Abyssal Plain site has lower biomass and diversity than the Lower Continental Rise site. Further, he suggests large migratory predator-scavengers like C. armatus may be rare or absent from the deeper site. Id., at 7. The deep ocean, after sufficient study, may contain safe disposal sites for noxious wastes, he argues.

Even from this perspective, Dr. Musick stated additional study of the Hatteras site is needed (Id.) and concluded (Id., at 5): "The information given in the E.I.S. and supporting documents (Talbert, 1982; and Appendices) about the biology of the Atlantic sites is woefully inadequate. Even much of the pertinent biological literature has not been cited."

Concerns centered on the dumpsites studied in the DEIS off Cape Mendocino involve both biological and geological issues. Pacific coast fishermen have testified that the disposal of these submarines could affect an existing albacore fishery. California Attorney General John van de Kamp has warned of potential economic impacts on state fisheries (see Section G, herein) and warned the proposed dumping grounds are near an active fault line. He stated: 9/

J.19

> The DEIS recognizes that an active fault line lies only 40 to 80 miles away, but concludes that '[i]ts associated seismicity does not extend into the study area.' DEIS, E-30. There is no indication whatsoever on what studies such a conclusion is based, and we do not believe that the limited coring samples taken at the site are sufficient bases for the conclusion... The recent discovery of the Hosgri fault, only when construction was nearly complete on the Diablo Canyon nuclear power plant, should serve as a highly visible and pertinent caution in this area.

E. Availability of Radioactivity

Radioactivity contained in the Navy's obsolete nuclear submarines will, according to the DEIS, be made available to the environment through corrosion of the ship. The Navy's analysis, as well as others, predicts a ship sunk at sea appears to have a substantially higher rate of corrosion than a reactor compartment buried on land. Despite this, the Navy predicts the bulk of the submarine's radioactivity will have decayed before corrosion allows ocean currents to move through the scuttled submarine.

The Navy's deepsea corrosion rates are a matter of serious concern. The Rand report on monitoring ocean nuclear waste disposal sites stated (at 28):

> Predicting corrosion rates for these radioactive waste containers will be difficult because there is little deep ocean corrosion information available, and the complex interactions of the chemical, thermal, radiological, and physical environment are difficult to predict.

Two prime concerns centered on availability of radioactivity from the sunken submarines surfaced in the Scientific Committee Report.

First, corrosion rates in the DEIS were mainly obtained from values found in the literature. Additional consideration is needed to determine if there is an active electrode coupling among the Fe surface, the FeO(OH) layer, the Fe_2O_3 layer, the $FeBO_3$ layer and sea water. The DEIS must also be revised to reflect whether lattice damage has occurred in the alloy crustal Q.13

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Q.13 spacing due to radiation damage and if so, what effect this will have on corrosion rates. Rates of corrosion should also be specified for weld and piping materials, including data on the depths of welds.

At the Pacific site, anaerobic conditions exist a few centimeters below the sediment surface. Corrosion would be much greater there due to sulfide producing bacteria. The DEIS must be revised to show this mechanism has been considered. The potential for bacteria to alter the complex of the radioactive materials and making them more soluble and available for biological uptake also merits close attention.

A.12, A.13 Second, corrosion product activity, more commonly referred to as "crud," is formed as the result of interaction between reactor coolant and interior metal surfaces of the reactor, primary piping, pumps and steam generators. The DEIS states crud accounts for 0.01 percent of radioactivity in each submarine. Data for land based reactors, however, suggests these corrosion product deposits may be a much more significant and serious source of radioactivity: a source which could easily become available to the marine environment. In revising the DEIS, data from land based reactors must be considered and supplemented with analyses of crud from shipboard nuclear reactors. Composition of the crud must be described and alpha emitting radionuclides found in these materials must be identified. 10/

F. Cumulative Impacts

Neither the DEIS nor scientific research cited in support of it consider disposal of decommissioned nuclear submarines within the context of cumulative sources of radioactivity. This is a significant omission which makes it difficult, if not impossible, to adequately consider the incremental increase in radioactivity entailed in land or sea disposal of decommissioned nuclear submarines. Council on Environmental Quality regulations require consideration of cumulative impacts in preparing environmental impact assessments. (See part IV (D) 5, herein.) Revision of the DEIS must incorporate adequate data, information and discussion to address this issue. L.7

In considering the sea disposal option, the Scientific Committee report concluded consideration of cumulative impacts should begin with development of a comprehensive register of all radioactivity known or reasonably expected to enter the marine environment. This global inventory should include, but not be limited to, past, present and potential levels of radioactivity from: weapons testing (atmospheric fallout); historic U.S. and foreign radioactivity waste operations; accidental losses of nuclear materials (including submarines); sea disposal of low level wastes under IAEA standards; other U.S. and foreign proposals for low level waste disposal; implacement of high level wastes in the seabed; operation of and/or discharges from civilian and military reactors; processing and reprocessing plants' discharges; scientific experiments; accidental release;

natural background levels of radioactivity; and proposed disposal of decommissioned nuclear submarines as well as other military or civilian wastes.

L.27 This assessment should include an estimate of the marine environment's capacity to assimilate radioactivity without damage. This estimate must be based on sound science and will, in all probability, require additional research. Assessment of cumulative impacts should include descriptions of past, present and projected effects both in terms of human health and specific components of the marine ecosystem.

G. Indirect Effects

O.34 Indirect effects of sea disposal of nuclear submarines -- such as impact upon commercial fishing or shoreline tourism -- is not adressed in the DEIS. Yet this concern has been cited by elected officials, conservationists, and business leaders both during the Navy's 1983 public hearings and in comments submitted on the DEIS. Government officials of North Carolina, South Carolina and California agree economic effects of the Navy's "ocean option" must be assessed in the DEIS.

California Attorney General John van de Kamp's warning that "[c]onsumer avoidance or rejection of California's fisheries products could economically devastate California's coastal fisheries industry" reflects the principal concern cited by state officials considering indirect effects of sub disposal. Id., at

3. Van de Kamp notes in comments to the Navy on the DEIS (at 7):

> Finally, the DEIS is inadequate in its failure to even mention the possibility of consumer avoidance or rejection of fish caught off the Mendocino coast after the scuttling of nuclear submarines... As a more analogous example, we have been advised that Japanese purchases of sablefish from California fisheries dropped by almost 50% after press accounts of the Farallon Islands dumpsite, and that public fear of contamination may have been the cause of the decline. O.34

John Harville, Executive Director of the Pacific Marine Fisheries Commission, supported the California Attorney General's concern, advising that: 11/

> Decreases in consumer demand for fish products will have a crippling effect on our fishing industry which we are working so hard to develop and maintain. The most frightening aspects of the proposal to scuttle at sea are that the action would be irreversible and could lead to further, more dangerous dumping at sea.

In assessing indirect impacts of nuclear submarine disposal on commercial fisheries, the Navy should resolve the California Attorney General's concern that fish productivity estimates for the Cape Mendocino site are low. Specifically, van de Kamp charged (Id., at 6):

> The data on which that statement relies, however, show only that the site is of a lesser relative productivity than other extraordinarily rich sites in waters closer to the shoreline; the figures demonstrate that the site considered by itself is still a highly productive one for albacore fishing. The data also fail to reflect the fact that albacore, like all tuna, migrate over long distances: the significant questions is whether they feed at or near the site prior to being caught elsewhere. The emphasis of the DEIS only on catches at the site is therefore misleading and inaccurate. J.12

(Emphasis in original).

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Data available from the same sources as those cited in the DEIS as showing little or no albacore landings from the Mendocino
J.12 site also shows very significant catches of these fishes during more recent seasons. 12/ Had the Navy held public hearings in coastal California communities, additional information on the albacore fishing near this site might have been received.

California's Department of Fish and Game has also reported
T.19 some 80,000 pounds of grenadier were landed in Eureka -- the market closest to the proposed dumpsite -- during 1982. 13/ Since this species has been shown to concentrate radioactivity from low level radioactive waste dumped in the sea, the DEIS must address this concern. This fish is in the same family as C. armatus and may pose for the California location the same kinds of questions listed by Dr. Musick for the Lower Continental Rise site off North Carolina.

The Navy's revision of its DEIS should also reflect the extent to which the U.S. public considers sea food taken from waters used for disposal of nuclear submarines to be undesirable or unacceptable. Potential indirect impacts on shoreline tourist industries must also be quantified in revising the DEIS.

H. Cost Estimates

O.2 Estimates of costs cited by the Navy for ocean and land disposal are inadequately supported in the DEIS. Scientific Committee members felt the $2 million per ship savings claimed for sea instead of land disposal might well be eliminated by
J.76 expenses for an adequate ocean monitoring program. Consideration of indirect economic impacts to coastal tourism and commercial fisheries would further reduce the projected cost difference between sea and land disposal.

In general, Scientific Committee members characterized consideration of the land alternative in the DEIS as sketchy and O.7 inadequate. In revising the DEIS, the role of civilian contractors currently operating low level waste disposal sites at Hanford and Savannah River must be clarified with specific consideration given to additional cost factors resulting from: profit margins of economics operating the sites; payments to the O.2 State of Washington for a perpetual care and maintenance fund; payment of a percentage of gross to the State of Washington; and use of a commercial site versus available federal sites. Cost projections, apparently based on 1975 and 1978 Environmental I.4 Impact Statements, must be revised to reflect current data. Additional details of cost estimates projected for disposal of the submarine hull (through scuttling or scrapping) after removal of the reactor compartment must be provided. Additional consideration must be given to: justification of or alternatives to welding the hull back together after the reactor compartment is removed to permit sea disposal; estimating expense for O.12 "declassifying" obsolete submarines to permit scrapping operations; and reflecting income from sale of non-radioactive hulls as scrap in cost estimates.

I. Irretrievability

The Navy concedes in the DEIS that retrievability of nuclear W.1 submarines from depths of 4,000 m is not feasible with current technology. In light of scientific questions on the potential environmental impact on ocean disposal of these submarines, the Scientific Committee concluded retrievability is an important requirement. Current federal law also requires that nuclear wastes sunk at sea be retrievable.

Two factors combine to make it unlikely these ships could ever be removed from the deepsea floor. First, the sheer size of these submarines makes retrieval of the subs a technically difficult and quite expensive prospect. Second, by the time release of radioactivity reaches a point where retrieval is needed, extensive corrosion may have occurred throughout the ship, compounding the already imposing technical difficulties of working at 4,000 meters.

While the Navy may, with sufficient funding and time, be able to develop technology to meet this challenge, it has clearly not done so to date. Until obsolete nuclear submarines can be retrieved from the ocean bottom, the Navy should not pursue sea disposal. 14/

J. Alternatives Not Considered

Alternatives which could slow or reduce release of radioactivity to the environment have not been considered in the Navy's DEIS. Only sinking of the entire submarine at sea and burial of the ship's reactor compartment on land are considered as alternatives in the Navy DEIS. The Scientific Committee report suggested the land disposal option might be modified to place the reactor compartments in above ground surface trenches in an arid H.3

environment where corrosion -- and thus release of radioactivity -- would be minimized. As noted in the DEIS, the reactor compartment provides a substantial barrier against instrusion and pollution. Corrosion is recognized as the principal mechanism for release of radioactivity to the environment. The surface disposal alternative is not mentioned in the DEIS but must be considered in revising that document. Other alternatives that must be explored in the DEIS include storing the compartments in specially designed buildings in arid or semi-arid environments or H.3
mothballing the submarines until radioactivity declines to the point that shipyard workers can safely dismantle the reactor and related radioactive materials. Nuclear wastes remaining at that time could be buried in deep mined repositories. G.7

In revising the DEIS, the Navy must address Dr. Marvin Resnikoff's concerns that the environmental analysis is "fatally flawed in its estimates of the initial radioactivity present in the reactor taken out of service. 15/ Working with data from commercial power pressurized water reactors, Dr. Resnikoff calculates levels of Cobalt-60 will be greater than Navy estimates by a factor of 6 and that levels of niobium-94 will be greater than those cited in the DEIS by a factor of 100. Id., at 3. He continued (Id.): A.10

> These two underestimates by the Navy radically alter the disposal options. Because Co-60 emits penetrating gamma radioactivity, higher Co-60 levels imply higher occupational exposures in the case of immediate dismantlement and argue for continued storage, on the order of 20 to 50 years.

#695 (Part 2) (Cont)

Higher Nb-94 levels argue for deep underground disposal rather than surface disposal because Nb-94 is also a strong gamma emitter and has a 20,000 year half-life.

K. Potential for Accidents

Accidental sinking of a submarine on the continental shelf while in transit to a sea disposal site is more likely than admitted in the Navy DEIS.

The Navy claims it is "highly improbable" that a submarine will sink while being towed to an ocean disposal site. Yet data cited in the DEIS on towing reactor compartments to land disposal
L.57, L.61 sites presents an accident rate of 0.03 per 100 trips of an average 500 mile length. This calculation implies at least one ship will be damaged -- and perhaps sunk -- during the sea disposal program. Scientific Committee members warned this figure, which is apparently based on national accident
F.15 statistics, may not accurately reflect severe weather conditions frequently found off Cape Hatteras, North Carolina and Cape Mendocino, California. If disposal site weather is considered, panel members felt the probability of accidental sinking would increase.

L.60 The Scientific Committee also felt the impact of a "worst case accident" on the continental shelf merits additional consideration, especially in terms of predicting human health effects and the accident's impact on commercial and recreational fishing as well as coastal tourism. Whether the predicted 3 rem

exposure to a population of 30,000 is considered an acceptable exposure rate must be addressed.

The difficulty of sinking a complete submarine without mishap has also been inadequately discussed in the DEIS. By the F.19 Navy's own admission, they have yet to scuttle any submarine without unexpected difficulties leading to implosion and breaking up of the ship. Even a less serious miscalculation could lead to malfunction of the untested one-way valve which is supposed to equalize pressure between the flooded reactor compartment and the slowly filling ship. As California Attorney General van de Kamp argued (at 8):

> It seems clear to us, however, even assuming the validity of the remainder of the DEIS, that the conclusion will depend substantially upon the operation of the one-way valve. Yet, the DEIS contains no discussion whatsoever of the construction or operation of such a valve, or whether such valves have themselves withstood ocean corrosion for extensive periods. If the valve allows escape of water caused solely by corrosion, the conclusions of the DEIS are completely incorrect, and the release of radionuclides into the marine environment may occur much sooner than the DEIS concludes.... Without a complete analysis of the one-way valve system proposed by the DEIS, and a demonstrated history of its containment abilities over a lengthy period in the marine environment, we again believe that the DEIS is inadequate under federal law. F.21

L. Other Deficiencies in the DEIS

A significant weakness in the DEIS is the Navy's failure to use similar terms and a consistent format for presenting information to the public and members of Congress. This lack of

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consistency makes it difficult for a non-technical individual to accurately compare considerations presented for and against the two disposal options examined by the Navy.

The strength of considerations presented in the DEIS is further undercut by internal inconsistencies between supporting research and the DEIS Summary which makes it difficult to evaluate assumptions and conclusions. In the Summary, for example, consumption of 145 pounds of seafood per year is used in a "worst case" calculation, DEIS, at S-13. But the supporting data in Appendices I and J of the DEIS cite a variety of quantities in grams per day for use in computing the effects of seafood consumption, (Id., I-11 and J-33) and there is no formula presented for conversion of the maximum consumption of 179 g/day into millirems per year of exposure. T.11

X.1 Inconsistency is also found within sections. Differences in organization in DEIS Tables 4-1 and 4-4 make it difficult to weigh the difference in radioactivity release between land disposal of one reactor compartment and sea disposal of one submarine. Id., 4-3, 4-13.

U.19 The DEIS can also be criticized for utilizing inappropriate standards in discussing human health impacts. In Appendix J, for example, the DEIS states the maximum individual exposure from an accident is less than the EPA drinking water requirement "that prevents any individual from receiving a total body or any organ exposure of more than 4 mrem per year. Id., at J-17. If this

drinking water standard is applicable, the DEIS should note that the actual individual exposure in a worst case accident appears to be very close to the 4 mrem limit (3.9 mrem by one Scientific Committee member's calculation).

Another significant deficiency in the DEIS is the failure to include error terms in the presentation of data. This omission makes it difficult -- if not impossible -- to confidently consider data presented in the DEIS. This deepens confusion surrounding "worst case" calculations, a portion of which some Committee members believe may be off by up to nine orders of magnitude. The very fact that qualified independent scientists have difficulty in understanding and replicating many of the calculations relied upon in the DEIS does not bode well for the critical evaluations required of decision makers and regulators and provides little hope for meaningful participation by even the most interested representatives of the general public. S.25 R.24, U.21

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IV. NEPA: LEGAL, REGULATORY AND CASE LAW CONSIDERATIONS

A. Introduction

This section of our comments addresses the adequacy of the Navy's DEIS in terms of the existing legal and regulatory framework. The consistency of the Navy's DEIS with the purposes of Congress in enacting the National Environmental Policy Act (NEPA) 42 U.S.C. §4321 et seq. (1970), and in requiring the preparation of an environmental impact statement for "major federal actions significantly affecting the environment" is examined in light of relevant case law (Part B). Further, the requirements for the preparation of an adequate DEIS as expressed in regulations of the Council on Environmental Quality (CEQ), the Department of Defense (DOD), and the Navy are considered with the benefit of interpretive case law (Part C). These framework considerations are then applied to issue specific aspects of the Navy's DEIS (Part D).

B. The Statutory Mandate

The spirit in which the National Environmental Policy Act was enacted is captured in the resounding declaration of purpose found in its opening paragraph.1/ To carry out this purpose Congress issued a mandate to the Federal Government to "improve and coordinate" its

> plans, functions, programs and resources to the end that the Nation may --
>
> (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
>
> (2) assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings;

> (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences....

42 U.S.C. §4331(b)(1),(2). 2/ The scope of this mandate must be kept in mind when assessing the adequacy of the Navy's DEIS under NEPA and the pertinent regulations.

In order to ensure that federal agencies would follow this mandate to protect the environment and to be sure that environmental concerns would be "integrated into the very process of agency decision-making", Andrus v. Sierra Club, 442 U.S. 347, 350 (1979), Congress provided for the preparation of environmental impact statements (EIS). NEPA requires that all agencies of the federal government shall include a detailed environmental impact statement in every "major Federal action significantly affecting the quality of the human environment." 42 U.S.C. §4332(2)(c).3/

The Navy acknowledges in the foreword to the DEIS its duty under NEPA to prepare an EIS "prior to a major federal action that might significantly affect the quality of the human environment." (emphasis added) The foreword continues, stating that the decision to prepare the DEIS "is based on the anticipated high interest in the disposal method decision rather than the expectation that either option would significantly affect the quality of the human environment."4/ Thus the Navy appears to acknowledge that the submarine disposal is a major federal action, but not that such an action may significantly affect the environment.

While the purpose of this disclaimer is unclear to us, it is clear that the environmental impact statement process must be followed by the Navy and that no prior disclaimers as to the significance of environmental affects can be used to abort that process at a later stage. Moreover, the Navy's disclaimer as to the potential environmental significance of its action does not obviate the requirement that it comply with the procedural requisites of NEPA and the related CEQ, DOD and Navy regulations. The courts have consistently held that agencies which voluntarily proceed under a particular regulation will be required to adhere to that regulation.5/ We trust that the Navy will not attempt to block challenges to the adequacy of its DEIS by claiming that it did not have to fully comply with CEQ regulations because this was not an action which might significantly affect the quality of the environment.

The determination as to what constitutes a "significant effect" has been liberally applied by the courts. Skillern, Environmental Protection: The Legal Framework, at 35-36 (1981). While it is clear to us that the magnitude of the Navy's action (disposal of 100 submarine reactor plants over 30 years) as compared to past radioactive waste dumping by the U.S. suggests potentially significant environmental effects, recent Congressional action reinforces this conclusion. The two-year moratorium placed on ocean dumping of low-level radioactive wastes by the recent amendments to the Ocean Dumping Act strongly implies a Congressional determination that specific proposals to dispose of radioactive wastes in the ocean might significantly

F.2

affect the quality of the environment. We acknowledge that the moratorium requirement was passed after the date of the Navy's DEIS but it nevertheless is applicable to the Navy as it proceeds with the EIS process. F.2

The Supreme Court has stated that an EIS is only the "outward sign that environmental values and consequences have been considered." Andrus v. Sierra Club, 442 U.S. at 350. Ultimately, what NEPA seeks are environmentally better administrative decisions. The EIS was not intended by Congress as an end in itself but rather, as CEQ regulations state (40 C.F.R. §1500.1(c)):

> The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore and enhance the environment.

Thus, while the comments in the following section will focus on the procedural requirements for preparing an adequate DEIS -- and the Navy's failure to meet those requirements -- those comments should be placed in the broader policy context in which NEPA was enacted.6/

C. The CEQ Regulations

1. General Requirements

Compliance with NEPA is governed by the CEQ regulations (40 C.F.R. §1500.1 et seq.), and the agency procedures implementing NEPA and the CEQ regulations.7/ The detailed procedures to be followed in preparing an environmental impact statement are those found in Section 1502 of the CEQ regulations. Implementing regulations such as those of the DOD implictly defer to CEQ §1502 in this regard. 32 C.F.R. §214, Enclosure I,(D)(3).

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In determining the importance to be attached to CEQ regulations the Supreme Court has held that "CEQ's interpretation of NEPA is entitled to substantial deference." Andrus v. Sierra Club, 442 U.S. at 358. This is because "the construction of a statute by those charged with interpreting it should be followed unless there are compelling indications that it is wrong." Sierra Club v. Sigler, 695 F.2d at 972 (5th Cir. 1983), citing FCC v. WNCN Listeners Guild, 450 U.S. 582, 598 (1981). Therefore, the CEQ's interpretation of NEPA is binding on agencies preparing EISs unless those challenging the CEQ regulations can show that the regulation conflicts with the language or legislative intent of NEPA or judicial instructions. Id..

Although the Navy states in the foreword that the DEIS was prepared in accordance with the format recommended by the CEQ (§1502.10), it is our position that the entire set of CEQ regulations apply to the Navy's DEIS. The Navy, if it chooses not to follow any portion of those regulations, is obligated under Sigler to provide "compelling indications" that CEQ has interpreted NEPA incorrectly. In assuming the adequacy of the Navy's DEIS we will therefore limit our inquiry to CEQ regulations and interpretive caselaw. Department of Defense or Navy regulations which are less strict than CEQ regulations (if any) are superceded by CEQ regulations and therefore without effect.

2. Purposes Of The Environmental Impact Statement

The Navy's DEIS contains numerous defects which not only violate specific sections of CEQ regulations but which erode the purposes which the "detailed statement" is intended to serve. The first purpose for preparing an EIS which is strained by the Navy's DEIS is that of the CEQ requirement that an EIS serve as "an action-forcing device" which ensures a "full and fair discussion of significant environmental impacts." (40 C.F.R. §1502.1) The Supreme Court has recognized that the EIS serves as the procedural means by which environmental concerns are interwoven into the substance of agency decisions. Weinburger v. Catholic Action of Hawaii, 102 S.Ct. 197, 201 (1981); Andrus v. Sierra Club, 442 U.S. at 350.

A related objective of the EIS requirement is to permit the Court to determine whether the agency has made an objective good faith effort to take into account the values NEPA seeks to protect. This imposes an obligation on the agency to "explicate fully its course of inquiry, its analysis and reasoning." Massachusetts v. Andrus, 594 F.2d 872, 883-84 (1st Cir. 1979), citing Silva v. Lynn, 482 F.2d 1282, 1284-85 (1973). It is our position that the Navy has not met its obligation to fully explain "its course of inquiry, its analysis and reasoning." As discussed in Part III of these comments, our technical and scientific analysis points to significant gaps in information, internal inconsistencies in supporting research, the failure to provide error terms and other errors, omissions and inadequacies. N.7

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The requirement in NEPA to prepare an environmental impact statement has led some courts to characterize NEPA as an "environmental full disclosure law" which informs Congress and the public of the environmental costs involved in a project. Massachusetts v. Andrus, at 883; Catholic Actions of Hawaii, 102 S.Ct. at 201. In serving this "full disclosure" purpose the EIS "must be written in language that is understandable to non-technical minds and yet contain enough scientific reasoning to alert specialists to particular problems within their field of expertise." Environmental Defense Fund v. Corps of Engineers, 348 F.Supp. 916, 933 (N.D. Miss. 1972). It must not be composed of statements "too vague, too general or too conclusory." Environmental Defense Fund v. Froehlke, 473 F.2d 346, 348 (8th Cir. 1972). With respect to this purpose of providing Congress and the public with full disclosure of the environmental costs associated with disposal of the submarines the Navy's DEIS fails quite conspicuously. Part III of our comments points to several instances in which the DEIS makes statements "too vague, too general or too conclusory" given available information regarding the availability of radioactivity following disposal, pathways to man and the marine environment, cumulative impacts and other matters.

A third major purpose of the EIS is to crystallize issues by comparing the "problems involved with the proposed project and the difficulties involved in the alternatives". Monroe County Conservation Council v. Volpe, 472 F.2d 693, 697 (2d Cir. 1972); see also, Natural Resources Defense Council v. Grant, 355 F.Supp.

280 (E.D.N.C., 1973). The EIS insures that agency officials will be familiar with the trade-offs in choosing a course of action. Citizens to Preserve Wilderness Park, Inc. v. Adams, 543 F.Supp. 21, 24-25 (D. Neb. 1981). Once again, our technical view of the DEIS describes the failure of the statement to examine reasonable land disposal options. Because of this shortcoming the Navy's DEIS fails to fulfill this third purpose in preparing an EIS.

D. Issue Specific Considerations

1. Alternatives

The Navy's DEIS fails to meet the requirements under NEPA, the CEQ regulations and interpretive caselaw for the discussion of alternatives. The Navy addresses only two major disposal alternatives in Chapter 2 of the DEIS. These alternatives, shallow land burial and disposal at sea, do not encompass the full range of reasonable alternatives available to the Navy. The Navy fails to discuss other viable options with less potential for significant environmental effect. In particular the Navy fails to discuss the option of temporary protective storage to allow radioactivity to decay substantially prior to disposal. M.1
The Navy also fails to discuss placement in an arid or semi-arid location in order to slow the rate of corrosion -- the principal dynamic by which radioactivity is released to the environment. H.3

Section 102(2)(c)(iii) of NEPA provides that a DEIS must address "alternatives to the proposed action." CEQ regulations explain that these should be "reasonable alternatives which would

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avoid or minimize adverse impacts." 40 C.F.R. §1502.1. Further, CEQ regulations insist that the preparing agency

> Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

40 C.F.R. §1501.14(a) (emphasis added). 8/ While the Navy does include a section which discusses alternatives that were eliminated from consideration it does not discuss the alternatives suggested in our technical analysis. Moreover, the Navy's discussion of the alternatives is too sketchy to qualify as a "rigorous exploration" of these options. This is required by Navy guidelines for the promulgation of environmental impact statements, especially for alternatives such as the ones we suggest, which might avoid or mitigate adverse environmental effects.9/

H.1

Courts interpreting the requirement for consideration of alternatives have repeatedly pointed to that discussion as the crux of the environmental impact statement.10/ Without a discussion of alternatives in sufficient detail to allow informed comparison by Congress and the public, a central purpose of NEPA is not met and the statement may be held inadequate. Natural Resources Defense Council v. Morton, 458 F.2d 827, 834 (D.C. Cir. 1972); Alaska v. Andrus, 580 F.2d 465, 474 (D.C. Cir. 1978). The presentation of all reasonable alternatives allows the agency itself to balance the benefits and environmental risks of the proposed project with those of alternative courses of action. Calvert Cliffs Coordinating Comm. v. AEC, 449 F.2d 1109, 1114 (D.C. Cir. 1971). In this regard CEQ regulations require

that environmental impacts and the alternatives be presented in comparative form in order to "sharply defin[e] the issues and provid[e] a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. §1502.14.

Agency officials, Congress and the public must be aware of the trade-offs necessary if a particular action is taken. Citizens to Preserve Wilderness Park, Inc. v. Adams, 543 F.Supp. at 24. An inadequate discussion of the alternatives presented in a DEIS, and failure to include reasonable alternatives hampers this balancing process and therefore frustrates a primary purpose in preparing an EIS. An inadequate discussion of alternatives also hampers an agency in developing appropriate mitigation measures as required by the CEQ regulations. See, 40 C.F.R. §1502.14(f). Failure to discuss reasonable alternatives may lead to action with unnecessarily adverse consequences.

In determining whether an alternative should have been explored by an agency in an impact statement the courts have applied a rule of reason. While an agency is not expected to make a "crystal ball inquiry" the courts have identified several relevant considerations in determining whether an alternative should have been evaluated. The court in City of New York v. United States Department of Transportation, 539 F.Supp. 1237, 1280 (S.D.N.Y. 1982) summarized these factors, stating that "what is reasonable in a given case depends not only on the projected safety of the principal proposal but on several other highly pertinent factors as well." These factors include (Id. at 1280-81):

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[1] whether inquiry into a particular alternative serves a regulatory purpose under the agency's substantive mandate. Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, Inc., 435 U.S. 519, 550-51, 98 S.Ct. 1197, 1215 (1978);

[2] whether the inquiry would be infeasible or excessively expensive. Natural Resources Defense Council, Inc. v. Morton, 458 F.2d at 837-38;

[3] whether the agency was aware of the alternative at the time of its evaluation. Vermont Yankee, 435 U.S. at 551-54, 98 S.Ct. at 1215-17; and

[4] whether there was a reasonable basis at that time to believe that that alternative might mitigate harmful side-effects of the principal proposal. Id. at 554, 98 S.Ct. at 1217.

When the list of alternatives presented by the Navy is evaluated in light of these four considerations, it is clear that the other alternatives we have identified are "reasonable" and should not have been excluded from consideration. The alternatives identified in Part III of these comments are not "infeasible" nor are they "excessively expensive" when the full costs of sea disposal including monitoring are calculated. In addition, it is difficult to imagine that Naval experts were unaware that above ground semi-arid or arid disposal would greatly retard corrosion rates, thereby mitigating one of the "harmful side effects" of the sea disposal option. Under the City of New York test, knowledge of the potential for such mitigating effects requires consideration of the alternative. Similarly, the Navy's acknowledgement in the DEIS that significant radioactive decay clearly can be expected to take place within a relatively short time should have led to the exploration of a temporary protective storage option. Such an

action, because of its mitigating effects, should not be considered a "no action" alternative.

2. Uncertainty

It is a central theme of these comments that the Navy's DEIS has been prepared without sufficient knowledge of the potential adverse impacts of disposal at sea. Lack of information concerning deep sea ecosystems, availability and migration of radioactivity and the cumulative effects of past sea disposal place a veil of uncertainty over the Navy's prediction of "no significant impact." L.2

The CEQ anticipated that agencies would be faced with incomplete or unavailable information in deciding whether to proceed with a proposed action. While agencies cannot be expected to have all necessary information in hand before taking an action with potentially significant adverse impact, neither can they be permitted to blindly proceed with an assertion of no adverse impact, without acknowledging the paucity of their data.

In this regard, CEQ regulations require that, at a minimum, an agency preparing a DEIS must "always make clear that [relevant] information is lacking or that [scientific] uncertainty exists." 40 C.F.R. §1502.22 (emphasis added). See also, OPNAVINST 6240.3E §4402(h). If the information is "essential to a reasoned choice among alternatives" the agency is required to go further and include the information in the DEIS unless it can show that the costs of obtaining such information are "exhorbitant" or its acquisition is beyond the scientific state of the art. 40 C.F.R §1502.22(a),(b). If the agency is

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able to make this showing it must explicitly "weigh the need for the action against the risk and severity of possible adverse impacts" before proceeding in the face of uncertainty. 40 C.F.R §1502.22(b).

Case law supports the need for agencies to disclose scientific uncertainty and "the extent to which environmental effects are essentially unknown" as "one of the functions of a NEPA statement." Scientists Institute for Public Information v. A.E.C., 481 F.2d 1079, 1092 (D.C. Cir. 1973). Failure to disclose uncertainty may cause an EIS to be ruled inadequate. Natural Resources Defense Council, Inc. v. Nuclear Regulatory Commission, 685 F.2d 459 (D.C. Cir. 1982) (per curiam) [hereinafter cited as NRDC v. NRC]. In NRDC v. NRC the Court held that a generic table which was to be included in each EIS for a proposed light water nuclear reactor violated NEPA's mandate to disclose uncertainty. The table provided a zero-release figure for nuclear waste disposal and did not reflect evidence in the record that many experts found long-term waste disposal to be an issue of substantial scientific uncertainty. The court characterized environmental risks (uncertainty) as environmental costs that must be weighed in the NEPA balance and included in an EIS. NRDC v. NRC at 479. The court identified various sources of environmental risk including the "underlying randomness of nature [and]...human uncertainty over either the character of both random and nonrandom phenomena or the ability of future technology to cope with these phenomena." Id. Risks may also result simply from lack of knowledge, in which case the

agency must "reveal that which it knows and that which it does not know." Id. Further, if the costs of uncertainty -- i.e., the costs of proceeding without more and better information -- have not been considered the courts may determine that the agency decision to proceed was arbitrary. Kleppe v. Sierra Club, 427 U.S. 390, 410 (1976). Strykers Bay Neighborhood Council, Inc. v. Karlen, 444 U.S. 223..

As discussed in Part III, above, it is our view that information "essential to a reasoned choice" is missing from the DEIS and that scientific uncertainty as to effects of sea disposal is substantial. The costs of obtaining the information appear to be neither exhorbitant nor are the means to obtain it beyond the state of the art. It is no defense for the Navy to argue that the disposal of the submarines does not pose potentially significant adverse effects, since it is the information necessary to make that determination which is missing from the DEIS. The DEIS fails to meet even the minimum requirements under CEQ regulations and case law to reveal lack of information or existing scientific uncertainty. The Navy has not recognized, much less weighed, the uncertainty surrounding the ocean disposal option stemming from (1) a lack of scientific data, (2) responsible conflicting scientific opinion and (3) the underlying randomness of nature and the ability of future technology to cope with this randomness. D.2

3. Worst Case Analysis

An agency that decides to proceed in the face of uncertainty is required by CEQ regulations to "include a worst case analysis

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and an indication of the probability or improbability of its occurrence." 40 C.F.R. §1502.22(b)(2). See also, OPNAVINST 6240.3E §4402(h). As discussed in the preceding subsection the Navy has proceeded in the face of uncertainty which it does not acknowledge. If the Navy insists on proceeding despite those uncertainties, it must prepare an adequate worst case analysis. This worst case analysis must evaluate the adverse impacts resulting from at least one towing accident in which a submarine was lost in coastal waters. L.60

The leading case since the effective date of the CEQ regulations that deals with the "worst case analysis" requirement is Sierra Club v. Sigler, 695 F.2d 957 (5th Cir. 1983).11/ The Sigler case involved a challenge to the adequacy of an EIS on a proposed deepwater port in Galveston Bay. The court held that a worst case analysis discussing the total cargo loss of a supertanker in the bay was necessary. Id. at 972-73. The court rejected attempts to characterize the worst case analysis as too speculative, quoting Scientists Institute for Public Information v. AEC, 481 F.2d 1079, 1092 (D.C. Cir. 1979):

> [T]he basic thrust of an agency's responsibilities under NEPA is to predict the environmental effects of proposed action before the action is taken and those effects fully known. Reasonable forecasting and speculation is thus implicit in NEPA, and we must reject any attempt by agencies to shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects as 'crystal ball inquiry.'

Sigler, 481 F.2d at 970.

The Court noted further that "CEQ's interpretation of its worst case regulation makes it quite clear that the Sierra Club's

catastrophic worst case analysis is precisely what the CEQ intended." Id. at 972. Quoting CEQ explanatory material, the court stated that "all known possible environmental consequences of agency action" are to be covered including analysis of a "low probability/catastrophic impact event." Id. at 972 (emphasis in original).

It is clear that CEQ regulations and recent case law require that the environmental effects of a worst case occurrence be determined to the fullest extent possible. It is equally clear, as stated in Part III of these comments, that the DEIS inadequately addresses the impact from the loss of a submarine reactor plant near populated coastal areas. DEIS, at 4-24. L.60

4. Description of the Affected Physical Environment

The inability of the Navy to describe the affected physical ocean environment is to a significant degree responsible for the inadequate discussion in the DEIS of the environmental effects of submarine disposal. Lack of information concerning the deep seabed environment in which ocean disposal would take place makes it extremely difficult for the Navy to confidently predict the outcome of ocean disposal.

CEQ regulations impose an obligation on the preparing agency to "succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration." 40 C.F.R. §1502.15. See also, OPNAVINST 6240.3E §4402(e). Failure of the DEIS to adequately describe the affected physical environment results in a failure to meet at least two purposes in preparing an impact statement. The first failed purpose is that of enabling those who did not have a part in the compilation of the statement to understand and consider meaningfully the factors involved. See, e.g., Izaak Walton League of America v. Marsh, 655 F.2d 346 (D.C. Cir. 1981), cert. denied 454 U.S. 1091 (1982); NRDC v. NRC, supra, 685 F.2d 459 (D.C. Cir. 1982). The second failed purpose is that of setting forth sufficient information to allow the decisionmaker to consider the environmental factors necessary to make a reasoned decision. See e.g., Adler v. Lewis, 675 F.2d 1085 (9th Cir. 1982). Of course, as discussed earlier, other inadequacies in the DEIS as well cause it to generally fail to meet the purposes in preparing a DEIS, but the inability to describe the affected physical environment is so basic as to influence virtually every other section of the document.

J.9

It is well established that once sites are chosen a site-specific EIS must be prepared to supplement the non-site-specific or programmatic EIS. Environmental Defense Fund, Inc. v. Andrus, 619 F.2d 1368, 1378 (10th Cir. 1980). The Navy, while indentifying land disposal sites in Chapter 3, Part I of the DEIS, only identifies "Ocean Study Areas" in Chapter 3, Part II. If it decided to proceed with the ocean disposal option, the Navy would be required to submit a dumping permit application to EPA, meeting the requirements of the Ocean Dumping Act. EPA would then assess prospective ocean disposal sites and prepare a site-specific DEIS and EIS, to supplement the Navy's EIS. 40 C.F.R. §228.6(b). For reasons discussed earlier, however, we believe that Navy should attempt to identify sites more narrowly, thereby allowing it to provide an adequate description of the

physical environment. Without such an attempt, the Navy's EIS is doomed to inadequacy.

5. Effects and Consequences

The Navy's DEIS, in addition to neglecting to provide an adequate information base with which to evaluate alternate courses of action, fails to discuss the effects and consequences of alternatives in the manner prescribed by CEQ regulations and the Navy instruction manual. Those rules contain provisions that describe the ways in which an EIS must address the environmental consequences of alternative actions (40 C.F.R. §1502.16), and the specific kinds of environmental effects that must be included in an EIS. (40 C.F.R. §1508.8 - Effects and 40 C.F.R. §1508.7 - Cumulative Impacts); see also, OPNAVINST 6240.3E §§4402(f)(3)(d)(f). In accordance with the philosophy underlying NEPA, CEQ regulations require a discussion in the DEIS of "any adverse environmental effects which cannot be avoided", the "relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources..." caused by implementation of each alternative. 40 C.F.R. §1502.16(a),(b). This discussion must include a description of direct, indirect and cumulative impacts.

a. Direct effects

Direct effects are defined by CEQ as those effects that "are caused by the action and occur at the same time and place." 40C.F.R. §1508.8(a) The discussion of these effects dominates the discussion in the Navy's DEIS. As discussed earlier in this

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L.1 section and other sections of these comments, the Navy's analyses are generally inadequate because of the lack of a sufficient data base.

b. Indirect effects

Indirect effects are defined by the CEQ as those which are "caused by the action and are later in time or farther removed in distance, but are still reasonably forseeable." 40 C.F.R §1508.8(b). These indirect effects, as with direct and cumulative effects, may be "ecological...aesthetic, historic, cultural, economic, social or health." 40 C.F.R §1508.8(b). Failure to discuss significant indirect effects of an agency proposal may result in an EIS being held inadequate. See, e.g., Coalition for Canyon Preservation v. Bowers, 632 F.2d 774, 783 (9th Cir. 1980).

CEQ regulations are helpful in determining what constitutes a "significant" impact. Whether an action has significant effects for the environment requires considerations of both context and intensity. With respect to context, "the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests and the locality." 40 C.F.R. §1508.27(a). With respect to intensity or "severity" of impact the agency must consider, both "the degree to which the effects on the quality of the environment are highly controversial," and "the degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration." 40 C.F.R.

§1508.27(b)(4)(6) (emphasis added). See also, OPNAVINST 6240.3E, §4401, §4402a.(1)(b)(2).

Thus, indirect social or socio/political impacts that arise out of a change in the physical environment caused by the proposed action are properly considered in an EIS. Metropolitan Edison Company v. People Against Nuclear Energy, 51 U.S.L.W. 4371, 4373 (1983).12/ Public concern over these effects on the environment must be considered although no weight is assigned to such concern by CEQ regulations. City of New York v. United States Department of Transportation, 539 F.Supp. at 1273.

The requirement in 40 C.F.R. §1508.27(b)(6), that an agency consider the extent to which an action may establish a precedent for future actions is particularly important in the area of ocean disposal of radioactive wastes. As discussed in Part II of our comments, radioactive waste dumping in the ocean by the U.S. has not occurred since 1970. A determination by the Navy to dispose of radioactive submarine plants in the ocean would signal an end to the policy not to utilize the oceans as a waste bin for our radioactive wastes. It can be expected that other federal agencies, such as DOE and NRC, will more readily pursue the ocean option once it has been opened by other agency action. F.8, L.9 Accordingly, the precedential effect of the Navy's selection of an ocean disposal option must be given special consideration in its EIS analysis.

c. Cumulative impacts

The requirement that agencies consider the precedential effect of a proposed action is vital to an evaluation of cumulative impacts. The Navy's proposal in the DEIS to dispose of radioactive waste in the ocean is not only important for the policy precedent which it sets, as discussed earlier, but also for the cumulative environmental impacts that can be expected to result. CEQ regulations explicitly require that a DEIS consider all other "past, present and reasonably forseeable future actions...", whether by the agency preparing the DEIS or others. 40 C.F.R. §1508.7. 13/

L.7

The courts have repeatedly recognized the importance of discussing cumulative impacts in an impact statement. See, NRDC v. NRC, 685 F.2d at 489-90; Kleppe v. Sierra Club, 427 U.S. at 410; Natural Resources Defense Council v. Calloway, 524 F.2d 79, 88 (2d Cir. 1975). In Green County Planning Bd. v. Federal Power Commn., 559 F.2d 1227, 1232 (2d Cir. 1976), cert. denied, 434 U.S. 1086 (1978), the court stated that:

> [A]n agency is required to consider the full implications of each decision in light of other potential developments in the area, and to prepare a comprehensive impact statement if several prospects are significantly interdependent.

The same general philosophy was exhibited by another circuit court in Swain v. Brinegar, 517 F.2d 766, 775 (7th Cir. 1975):

> NEPA is clearly intended to focus on the 'big picture' relative to environmental problems. It recognizes that each 'limited' federal project is part of a large mosaic of thousands of similar projects and that cumulative effects can and must be considered on an ongoing basis.

The need to focus on the big picture is particularly pressing in a case such as this, in which a major redirection of national radioactive waste disposal policy may be involved. As detailed in Part III of our comments, the Navy DEIS is deficient in its

analysis of the cumulative effects of past and future radioactive waste disposal at sea. No effort has been made to consider the cumulative effects of past radioactive waste disposal in U.S. coastal waters prior to 1970. Nor has the Navy attempted to assess the potential for radioactive waste disposal by other federal agencies, or the Navy itself, in the future. 14/ Beyond domestic aspects of the "cumulative" considerations under NEPA, the Navy also should evaluate the cumulative impact of ocean submarine disposal when added to the worldwide disposal of radioactive wastes. The United States, as a nation that has refrained from dumping since 1970, is likely to influence the actions of other nations by any resumption of radioactive waste disposal at sea. L.7

6. Cost Comparison Of Alternatives

The Navy provides a 17-page cost/benefit analysis of the various disposal options considered in the DEIS. CEQ regulations do not require that a cost/benefit analysis be included in every EIS, and the courts have not imposed such a requirement. See, e.g., Columbia Basin Land Protection Ass'n v. Schlesinger, 643 F.2d 585, 594 (9th Cir. 1981). However, the CEQ regulations do require that when a cost/benefit analysis is prepared it shall "discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values and amenities." 40 C.F.R. §1502.23. Moreover, the "merits and drawbacks" of the various alternatives should not "be displayed in a monetary cost/benefit analysis...when there are important qualitative considerations." Id. O.31

0.31 The Navy's DEIS fails to give sufficient consideration to important qualitative factors, and at the same time underestimates the costs of both the sea disposal option and the land disposal option. Underestimation of costs of the sea and land disposal options result from a failure to include cost estimates of an adequate monitoring plan over the span of significant radioactivity. Cost projections also appear to be out of date and should be revised to reflect current figures.15/

The DEIS fails to adequately discuss the relationships between the cost/benefit analysis and "unquantified environmental impacts, values and amenities" because the DEIS fails more broadly in its discussion of unquantified environmental impacts. Because the Navy concludes, without sufficient data or rigorous evaluation, that there are no significant environmental impacts from either disposal option, the faulty cost analysis which finds sea disposal less expensive becomes decisive. The Navy is locked into its conclusion by the faulty analysis of qualitative factors and quantitative costs that precede it. The revision of the DEIS which we urge in our concluding section (Part VI) will no doubt effect the cost/benefit analysis and possibly the conclusions therefrom.

V. OTHER POLICY CONSIDERATIONS

As discussed in Part II of these comments, the Navy's Draft EIS comes at a time when increased domestic and international concerns over ocean disposal of radioactive wastes have led to the adoption of moratoriums pending further scientific review. Many of the scientific and technical policy concerns of the coalition of organizations on whose behalf these comments are being submitted were detailed in a critique of radioactive waste ocean disposal that was released publicly in August 1982. GAO Critique, cited at n.2 in Part I, *supra*. The findings and conclusions of that critique were that (*Id.*, at 4):

- the incomplete and inaccurate information that plague the issue of past ocean dumping of nuclear waste presents a serious problem which requires more complete elaboration in order to determine actual or potential hazards;

- there is not enough hard evidence to provide sufficient certainty that public health and environmental hazards will not result from past dumping practices;

- a good monitoring program of previous used sites off the U.S. coastline is both necessary and useful (1) to provide empirical data concerning such matters as toxicity, transport, and critical pathways, fates and effects of the radioactive materials, (2) to assure the public that such past dumping does not present any public health or environmental hazards, and (3) to provide scientific data which will contribute to responsible policies and regulatory requirements for the future; and

- a good monitoring program of "test" sites off the U.S. coastline, unmodified by prior dumping activities, is both necessary and useful (1) to provide baseline data that will increase our knowledge of the physical, geochemical and biological processes of the marine environment and routes back to man; and (2) to provide scientific data which will contribute to responsible policies and regulatory requirements for the future.

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In reaching those findings, recommendations and conclusions, that August 1982 critique included consideration of such studies, reports and workshops as: the Federal Plan for Ocean Pollution, Research, Develoment, and Monitoring, Fiscal Years 1979-83, NOAA, et al. (1979); the National Marine Pollution Program: Federal Plan 1981-85, NOAA, et al.; Disposal of Low-Level Radioactive Waste into Pacific Coastal Waters, National Academy of Sciences/National Research Council (1962); Biological Effects of Atomic Radiation, National Academy of Sciences (1960); Proceedings of [an Estes Park] Workshop on Scientific Problems Relating to Ocean Pollution, NOAA (1979); IAEA Advisory Group Meeting on Low-Level Radioactive Waste Dumping, Montego Bay, Jamaica (1978); Research and Environmental Surveillence Programme Related to Sea Disposal of Radioactive Waste, OECD/NEA (1981); and the Draft Program Plan for Monitoring Radioactivity in the Oceans, EPA (1981).

Since the release of that critique, the 1982 Rand Report, referred to and quoted in Part III of these comments, was brought to our attention. That report, as well as the earlier studies, reports and workshops mentioned above, the domestic and international moratoriums and their parallel scientific reviews, support the continuing validity of the conclusion contained in our August 1982 critique, i.e., (GAO Critique, at 36):

> ...at present it is premature to reverse the existing U.S. policy of non-ocean dumping of radioactive wastes. Unless and until a more accurate assessment of the hazards of past dumping has been completed, and unless and until past dump sites and "test" sites have been monitored in order to provide empirical data and a sound predictive capability and validation system, no serious

> consideration should be given to the use of the oceans as a disposal medium for radioactive wastes.

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VI. CONCLUSION

It is our position that even if the Navy is able to prepare a Final EIS that technically satisfies the procedural requirements under NEPA and the CEQ regulations (which is unlikely given the substantial and numerous deficiencies in the DEIS), the substantive policy and purpose of NEPA and sound national policy consistent with recent Congressional actions dictate that the Navy postpone further action on disposal of submarine reactor plants.

F.3

In determining whether a DEIS should be delayed to await new information, the Ninth Circuit court has identified three factors that should be considered: "(1) the consequence of delay; (2) the present state of information relative to environmental factors; and (3) the relevance and probative value of the information which may be gained by delay." Adler v. Lewis, 675 F.2d 1085, 1098 (9th Cir. 1982), citing Jicarilla Apache Tribe of Indiana v. Morton, 471 F.2d 1275, 1281 (9th Cir. 1973).

Using this three-part test we assert that, first, the consequences of delay are not significant in light of the two-year moratorium recently placed on radioactive waste ocean dumping by Congress in the amendments to the Ocean Dumping Act. Second, the present state of information relative to the ocean disposal option is not well developed. This is evidenced by (1) the substantial scientific and technical information gaps and uncertainties detailed in Part III of our comments, (2) by the amendments to the Ocean Dumping Act -- which imposed the ocean dumping moratorium with the requirement that further studies be

undertaken, and (3) by the recent action at the Seventh Consultative Meeting of the London Dumping Convention, in which a similar moratorium on radioactive waste dumping in the ocean and a scientific review was approved by a large majority of the voting members. Finally, the relevance and probative value of the information which may be gained by delay is clear. During the remainder of the two-year moratorium research and studies should be undertaken in the U.S. to determine the effects of ocean disposal of wastes. In tandem with this effort, research will be undertaken internationally to specifically determine the effects of ocean disposal of radioactive wastes. These studies could prove invaluable to an informed choice by the Navy with respect to the ocean option as well as the land options, temporary protective storage option and/or "no action" option. In this regard, we have identified in Part III of these comments several important areas in which research by the Navy, or other appropriate agencies, should be undertaken as we seek to better understand the impacts of radioactive waste disposal at sea.

F.3

Without a delay to undertake needed research, it is our view that the Navy's EIS runs the very likely risk of illegally serving as a pro forma ritual preceding a predetermined result.1/ The DEIS released by the Navy fails to address relevant factors required by NEPA and the recent amendments to the Ocean Dumping Act, and inadequately discusses other issues in the manner prescribed by the CEQ regulations. To correct these deficiencies, a supplemental DEIS must be prepared, with its preparation awaiting the accumulation of relevant data during the

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two-year moratorium period. These corrective measures are necessary to meet both the letter and spirit of NEPA and the concerns of Congress which underly the recent amendments to the Ocean Dumping Act.

* * *

FOOTNOTES

I. INTRODUCTION

1/ Ocean Dumping and Pollution, Hearings before the Subcommittee on Oceanography and the Subcommittee on Fisheries and Wildlife of the Committee on Merchant Marine and Fisheries, 95th Cong., 95-42 (11 July 1978); Oceanography Miscellaneous - Part 2, Hearings before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 96th Cong., 96-53 (1980); Ocean Dumping Off the Pacific Coast, Hearings before a Subcommittee of the House Committee on Government Operations, 96th Cong., 2d Sess., (1980); Waste Dumping, Hearings before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 97th Cong., 1st Sess., 97-20 (1981).

2/ Monitoring of Past Radioactive Waste Ocean Dumpsites and "Test" Sites Is Needed To Provide Effective Assurances That There Are No Undue Hazards to Human Health and the Environment, and to Assist in the Development of Future Policies, Center for Law and Social Policy (prepared on behalf of 15 national environmental organizations), 3 August 1982 (hereafter referred to as the "GAO Critique"). A copy of that analysis has been transmitted separately to the Navy.

3/ Friends of the Earth, International, participated as a Non-Governmental Organization (NGO) observer at the Fourth Consultative Meeting of the Contracting Parties to the London Dumping Convention (1979); and Greenpeace, International, participated in a similar capacity at the Sixth (1981) and Seventh (1983) Consultative Meetings.

4/ See, Oceanic Society Briefing Report on Ocean Disposal of Obsolete Nuclear Submarines as Proposed by the United States Navy, prepared by the Oceanic Society, November 1982.

5/ The Oceanic Society has transmitted separately to the Navy a copy of that Final Report.

6/ A curie is the quantity of radioactivity which undergoes 37 billion disintegrations per second, equivalent to the radiation intensity of 1 gram of radium.

II. BACKGROUND

1/ See, Oceanography Miscellaneous -- Part 2, Hearings Before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 96th Cong., 2nd Sess., 96-53 (1980) at 360. While existing records indicate that the wastes were principally low-level, there is evidence that high-level waste was also dumped off our coastline. Id. at 270; A. Joseph, United States Atomic Energy Comm'n, United States' Sea Disposal Operations: A Summary to December 1956 (WASH-734) (August 1957)

at 4; Waste Dumping, Hearings Before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 97th Cong., 1st Sess. 97-20 (1981) at 388-91.

2/ For a historical review of dumping practices by the United Kingdom and other Western European nations since 1949, see, Review of the Continued Stability of the Dumping Site for Radioactive Waste in the North-East Atlantic, NEA/OECD (April 1980) at 31; Interim Oceanographic Description of the North-East Atlantic Site for the Disposal of Low-Level Radioactive Waste, NEA/OECD (Paris 1983) at 8-12.

3/ During 4-16 July 1983 the United Kingdom plans to dump 4,200 tonnes of radioactive wastes (containing 2,200 curies of alpha particles, 100,000 curies of beta/gamma and 70,000 curies of tritium); Belgium's proposed dumping operation, scheduled for 6-11 September 1983, would result in the dumping of 3,290 tonnes of radioactive waste (containing 115 curies of alpha particles, 1,800 curies of beta/gamma and 600 curies of tritium); Switzerland's proposed dumping operation, also scheduled for 6-11 September 1983, would result in the dumping of 1,200 tonnes of radioactive waste (containing 20 curies of alpha particles, 4,400 curies of beta/gamma, and 12,800 curies of tritium). NEA Notifications (1983).

4/ Even prior to the enactment of the Ocean Dumping Act, this concept was adopted in the Atomic Energy Commission's regulations that were revised in response to the CEQ Report. See, 10 C.F.R. §20.302(c), adopted December 4, 1971.

5/ Another provision of the recent amendment requires both houses of Congress to pass a resolution in support of any preliminary permit approval by EPA. If the resolutions are not passed within 90 legislative days, the EPA's approval is voided. In light of the Supreme Court's recent decision in Immigration and Naturalization Service v. Chadra, 462 U.S. ___, (23 June 1983), the constitutionality of that provision is uncertain.

6/ See, H.R. Rep. 562, 97th Cong., 2d Sess. 9 (1982).

7/ See, the International Atomic Energy Agency (IAEA), Revised Definitions and Recommendations Concerning Radioactive Wastes and Other Radioactive Material, INFCIRC/205/Add.1/Rev.1, August 1978; Decision of the OECD Council of 22 July 1977, C (77) 115 (Final).

III. SCIENTIFIC AND TECHNICAL CONSIDERATIONS

1/ Dayal, R., et al., Radionuclide Redestribution Mechanisms at the 2800 Meter Atlantic Nuclear Waste Disposal Site, Deepsea Research 26A (1979), at 1339; Duursma, E., et al., Theoretical, Experimental and Field Studies Concerning Reactions of

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Radioisotopes With Sediments and Suspended Particles of the Sea, Netherlands J. of Sea Res. 6 (1973), at 297.

2/ Monitoring Technologies for Ocean Disposal of Radioactive Waste, hereafter referred to as the Rand Report, Soloman, Kenneth A., et al., (January 1982) at vii.

3/ As described in the Rand Report, low-level radioactive waste disposal in the ocean consisted of contaminated equipment, tools and clothing. Wastes were generally packed in a concrete or other matrix and placed in 55-gallon drums. Some of the drums imploded because of hydrostatic pressure during disposal.

4/ Personal communication from Environmental Protection Agency acting director, Paul Keogh.

5/ GAO Critique, supra, Part I, n.2 at 16-28.

6/ Schell, W., and A. Nevissi, Radionuclides at the U.S. Radioactive Disposal Site in the Hudson Canyon, EPA/ORP (1980).

7/ Mullin, M. M. and L. S. Gomez, 1981, Biological and related chemical research concerning subseabed disposal of high level nuclear waste: Report of a workshop at Jackson Hole, Wyoming, Jan. 12-16, 1981. SAND 81-0012.

8/ Musick, J. A., Comments to the United States Department of the Navy on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, Marine Resource Report, #83-2, Virginia Institute of Marine Science, (1983).

9/ van de Kamp, J. R., Comments on Draft Environmental Impact Statement, Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, Attorney General, State of California, (1983).

10/ A series of specific questions concerning availability of radioactivity can be found on page 11 of the Scientific Committee's report. The report was submitted to the Department of the Navy under separate cover.

11/ Barville, John P., Comments on the Draft Environmental Impact Statement to the Navy, Pacific Marine Fisheries Commission, (1983).

12/ Annual Catch of Pacific Albacore Caught by U.S. Jig Vessels, National Marine Fisheries Service (Southwest Fisheries Center) annual reports 1973-1980; A. P. Majors, A. L. Coan, N. Bartoo, F. Miller, Summary of 1981 North Pacific Albacore Fishery Data, National Marine Fisheries Serivce (Southwest Fisheries Center) annual reports (1973-1980).

13/ Unpublished California State Department of Fish and Game fish landings in Eureka, California, (1982).

14/ At the 15-17 June 1983 meeting of the National Research Council's Marine Board, RADM (retired) Nathan Sonenshein, Global Marine Development, Inc., presented a feasibility design concept for controlled placement of submarine reactor compartments on the ocean floor. That concept provided for the potential conversion of the R/V Glomar Explorer to permit soft landed seabed emplacement of the compartments at a precisely known location, with the ability to retrieve the compartment if required. Mr. Sonenshein's proposal was presented in the context of his views that the Navy's planned sinking approach (1) represented "uncontrolled flooding" that could lead to implosion of the inner chambers of the submarine and (2) would greatly increase the likelihood of irretrievability, which he contended was a significant deficiency in the DEIS ocean option.

15/ Marvin Resnikoff, Ph.D., Comments on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants, prepared for Greenpeace, U.S.A., (1983).

IV. NEPA: LEGAL, REGULATORY AND CASE LAW CONSIDERATIONS

1/ See, 42 U.S.C. §4321, in which Congress stated that its purpose in enacting NEPA was:

> To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation....

2/ This section contains three additional paragraphs which expand upon the ends to which the federal government is to carry out this mandate from Congress.

3/ The applicability of NEPA requirements to the Navy is indisputable. The Navy's inclusion within the NEPA mandate has been upheld even in the face of a claim for a "national defense" exemption. Concerned About Trident v. Rumsfeld, 555 F.2d 817, 823 (D.C. Cir. 1977)(per curiam).

4/ The Navy's decision to prepare a DEIS in this case despite its disclaimer as to the potentially significant impact of the submarine disposal is consistent with its environmental protection manual (OPNAVINST 6240.3E) which requires the preparation of a DEIS for actions "which are potentially controversial in environmental effects." §4101(d)(7).

5/ See, e.g., Sierra Club v. Sigler, 695 F.2d 957, 966 (5th Cir. 1983) in which the court held that a federal agency which voluntarily proceeded under new mandatory CEQ regulations could

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not claim in subsequent litigation that only the earlier CEQ Guidelines applied, citing NRDC v. Callaway, 524 F.2d 79 (2d Cir. 1979).

6/ CEQ regulations state that: "The provisions of the Act [NEPA] and of these regulations must be read together as a whole in order to comply with the spirit and letter of the law." 40 C.F.R. §1500.3.

7/ Department of Defense Regulations, 32 C.F.R. §214, and Department of Navy Regulations, 32 C.F.R. §775 are the implementing regulations applicable to this DEIS. The Navy's instruction manual OPNAVINST 6240.3E further explicates Navy regulations.

8/ The CEQ regulations further require that the agency "include reasonable alternatives not within the jurisdiction of the lead agency" as well as a discussion of "the alternative of no action". 40 C.F.R. §1502.14(c),(d).

9/ See, OPNAVINST 6240.3E §4402(f)(3)(d) which states "A rigorous exploration and objective evaluation of the environmental impacts of all reasonable alternative actions are essential, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects."

10/ See also, CEQ regulations, 40 C.F.R. §1502.14, which calls the discussion of alternatives section the "heart" of the EIS.

11/ See also, City of New York v. United States Department of Transportation, 539 F.Supp. 1237 S.D.N.Y. 1982 in which the court invalidated a DOT final rule governing the transportation of radioactive materials through populated areas because, similar to Sigler, the agency had failed to consider a "credible" worst case scenario. Id. at 1241-42.

12/ In this case petitioners argued that Edison should not be allowed to restart a reactor at Three Mile Island until it considered the psychological effect in an EIS of such an action. The court held that psychological health effects that arise only out of a perception of risk need not be considered. There must be a reasonably close causal relationship between a change in the physical environment caused by the proposed action and the effect at issue. The court emphasized that "where an agency is asked to consider effects that will occur if the risk is realized, for example, if an accident occurs at TMI-1, is an entirely different case." People Against Nuclear Energy, 51 U.S.L.W. at 4373, n.9.

13/ See also, OPNAVINST 6240.3E §4402(a)(2), which states:

> The long term impact of the action should be considered. An objective overview should be maintained toward the magnitude of environmental effects of both the immediately contemplated action and of future actions for which the proposed action may serve as a precedent, and which may result in a cumulatively significant impact.

14/ The Department of Energy issued a scoping notice in February, 1983 for the disposal of radioactive wastes and residues left over from the Manhattan Project, which included an option of sea disposal. See, 48 Fed. Reg. 4522 (1983). This indicates the potential for radioactive waste disposal in the ocean by U.S. agencies. Military disposal of radioactive wastes might include future disposal of reactor plants from nuclear aircraft carriers. Subsea bed disposal of high level radioactive wastes is also being explored as an option. The Navy should recognize the potential for future disposal, thereby acknowledging that its submarine disposal is unlikely to be an isolated event.

15/ Other cost factors associated with the sea disposal option and not considered in the DEIS are further discussed in Part III of these comments.

V. OTHER POLICY CONSIDERATIONS

VI. CONCLUSION

1/ See, Calvert Cliffs' Coordinating Comm. v. AEC, 449 F.2d at 1128.

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APPENDICES

"APPENDIX A" Description of Organizations Submitting Comments

"APPENDIX B" Amendments to Section 104 of the Ocean Dumping Act (6 January 1983)

"APPENDIX C" Moratorium Resolution and Scientific Review Mechanism Adopted Under the London Dumping Convention (14-18 February 1983)

#695 (Part 2) (Cont)

"APPENDIX A"

AMERICAN CETACEAN SOCIETY, whose headquarters is in San Pedro, CA, has a membership of several thousand persons and is dedicated to the protection of marine mammals and the marine environment. BAN OCEAN NUCLEAR DUMPING (B.O.N.D.) is a coalition of nuclear awareness citizen groups in Mendocino County, CA, opposed to ocean disposal of nuclear wastes. CAN-DISARM is a non-profit non-membership organization based in North Carolina working for nuclear disarmament, publishes a bi-monthly newsletter and provides a support and resource center for those who are interested in this goal. CENTER FOR ENVIRONMENTAL EDUCATION is located at 624 9th Street, N.W., Washington, D.C. 20001, with approximately 550,000 supporters concerned with the biological diversity and ecosystem integrity of the seas. CLEAN WATER ACTION PROJECT is a non-membership organization with headquarters at 733 15th Street, N.W., Washington, D.C. 20005, and other offices located throughout the eastern and midwestern U.S. COMMITTEE TO BRIDGE THE GAP is a Los Angeles-based environmental research group with approximately 1,500 participants. CRITICAL MASS ENERGY PROJECT, a non-membership group which has subscribers to its monthly journal and legislature reports comprising about 4,500 persons is located at 215 Pennsylvania Avenue, S.E., Washington, D.C. The ENVIRONMENTAL DEFENSE FUND, whose principal place of business is 475 Park Avenue, New York, NY, has a membership of approximately 50,000 persons and a 700-member Scientists' Advisory Committee, including members residing in 18 foreign countries. FARALLON FOUNDATION is a non-membership, non-profit public interest corporation, located at P.O. Box 9, Bolinas, CA 94924, which is committed to public education and scientific research on radioactive waste management and environmental protection. FRIENDS OF THE EARTH, whose principal place of business is at 124 Spear Street, San Francisco, CA 94105, has a membership of 32,000 persons and is affiliated with "sister organizations" in 12 foreign countries. GREENPEACE, U.S.A., whose principal office is 2007 R Street, N.W., Washington, D.C. 20009, is a national organization composed of local membership groups with 300,000 sponsors and donors. HUDSON RIVER SLOOP CLEARWATER, INC., is a non-profit organization with 5,000 members, offices at 112 Market Street, Poughkeepsie, NY, and supporting organizations all along the Hudson River. The NATIONAL AUDUBON SOCIETY, whose principal place of business is 950 Third Avenue, NY, NY 10022, has a membership of approximately 500,000 persons, including members in more than 100 foreign countries. The NATURAL RESOURCES DEFENSE COUNCIL, whose principal office is at 122 East 42nd Street, New York, NY, and which has additional offices in Washington, D.C., and San Francisco, CA, as well as nine regional chapters, has 45,000 members. NUCLEAR FREE PACIFIC, whose principal place of business is at 942 Market Street, Room 712, San Francisco, CA 94102, is a coalition of environmental, disarmament and human rights groups that are located throughout the Pacific Basin. NUCLEAR INFORMATION RESOURCE SERVICE is a non-membership information clearinghouse organization with offices at 1536 16th Street, N.W., Washington, D.C. The OCEAN EDUCATION PROJECT is a non-

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membership group operating at 100 Maryland Avenue, N.E., Washington, D.C. The OCEANIC SOCIETY, whose principal place of business is Magee Avenue, Stamford, CT 06902, and which has an additional office in San Francisco, CA, has 70,000 members. The PALMETTO ALLIANCE, located at 2135 1/2 Devine Street, Columbia, SC 29205, is a state-wide public interest group incorporated as a non-profit organization to promote awareness of energy safety issues, particularly nuclear wastes. SCENIC SHORELINE PRESERVATION CONFERENCE is a non-membership organization whose principal office is 4623 More Mesa Drive, Santa Barbara, CA. The SIERRA CLUB whose principal place of business is at 530 Bush Street, San Francisco, CA, has a membership of approximately 350,000 persons, including persons residing in 62 foreign countries. SOUTHWEST RESEARCH AND INFORMATION CENTER, located at P.O. Box 4524, Albuquerque, NM 87106, sponsors public interest research projects, and is the parent organization of the 6,500 member National Campaign for Radioactive Waste Safety. The UNION OF CONCERNED SCIENTISTS with its headquarters and principal place of business at 26 Church Street, Cambridge, MA, is supported by 150,000 sponsoring members living both within the U.S. and abroad. UNITED METHODIST CHURCH JOINT LAW OF THE SEA PROJECT is sponsored by the Church's General Board of Global Ministries and the General Board of Church and Society, is located at 100 Maryland Avenue, N.E., Washington, D.C. The membership of the United Methodist Church is ten million persons. UNITED METHODIST GENERAL BOARD OF CHURCH AND SOCIETY, located in Washington, D.C., is the program agency responsible for seeking implementation of United Methodist Church policy on social concerns. The WILDERNESS SOCIETY's principal place of business is at 1901 Pennsylvania Avenue, N.W., Washington, D.C. 20006; it has a membership of approximately 77,000 persons.

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"APPENDIX B"

Amendments to Section 104 of
the Marine, Protection, Research and Sanctuaries Act of 1972
(the Ocean Dumping Act), Public Law 97-424
January 6, 1983

[illegible]

"APPENDIX C"

Moratorium Resolution and Scientific Review Mechanism
Concerning Ocean Disposal of Low-Level Radioactive Wastes

Seventh Consultative Meeting of Contracting Parties
To The London Dumping Convention
14-18 February 1983, London

RESOLUTION LDC 14(7)
DISPOSAL OF RADIO-ACTIVE WASTES AND OTHER
RADIO-ACTIVE MATTER AT SEA

THE SEVENTH CONSULTATIVE MEETING,

RECOGNIZING that the marine environment and the living resources of the sea are of vital importance to all nations,

RECOGNIZING that the London Dumping Convention plays a decisive role as a means of protecting the marine environment,

CONSIDERING that the Convention should continue to be an effective global forum for the Contracting Parties in which to pool the advances of science and technology in their efforts to combat marine pollution,

OBSERVING the increasing concern of a growing body of public opinion with regard to the dumping of radio-active substances,

RECOGNIZING that the practice of dumping radio-active substances at sea is limited to a small number of countries and that some of them have suspended such dumping,

NOTING that, given the present state of research on the matter within international bodies, it is considered necessary to carry out programmes to extend current knowledge of dumping zones,

CONSIDERING that the Seventh Consultative Meeting had decided to refer proposals for the amendment of Annexes I and II of the London Dumping Convention regarding the dumping of radio-active wastes and other radio-active matter at sea to an expert meeting on radio-active matters related to the London Dumping Convention,

CALLS for the suspension of all dumping at sea of radio-active materials pending the presentation to the Contracting Parties of the final report of the expert meeting on radio-active matters related to the London Dumping Convention.

(MORE)

"APPENDIX C"
(cont.)

MECHANISM FOR THE PREPARATION OF AN EXPERT MEETING ON
RADIO-ACTIVE MATTERS RELATED TO THE LONDON DUMPING CONVENTION

1 Under the auspices of the Consultative Meeting of Contracting Parties to the London Dumping Convention, a meeting will be held of experts from Contracting Parties, international and inter-governmental organizations and non-governmental organizations knowledgeable in such fields as marine ecology, oceanography, radiological protection, marine geochemistry and marine mathematical modelling.

2 The task of the above meeting is to:

.1 review the scientific and technical considerations relevant to the proposals for the amendment of the Annexes to the Convention related to the dumping of radio-active wastes submitted by Kiribati/Nauru and the Nordic States; and

.2 to report thereon to the Consultative Meeting.

3 In order to prepare for this meeting IMO and IAEA will be invited to request information on the subject matter from Contracting Parties, Member States and relevant organizations. In addition, IAEA will be invited to convene an inter-agency meeting with invited experts to put together information for the above discussions. IMO, UNEP, ICES, IOC, UNSCEAR, WHO and NEA will be invited to send experts and to participate in this inter-agency meeting. A status report, including a listing of all material received, will be submitted to the Eighth Consultative Meeting.

#695a

CENTER FOR LAW AND SOCIAL POLICY

1751 N STREET N.W. WASHINGTON D.C. 20036 202 872 0670

Alan Houseman
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30 June 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

* F.34 In the 85-page "Joint Comments of Environmental and Other Citizen Organizations In Response to the Department of Navy's [DEIS] on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants" which we are submitting to you this same date, there is a reference (at 2) to a detailed critique of a General Accounting Office study. Footnote 2, which follows that textual reference, indicates that we will provide you with a copy of the GAO critique. Attached is a copy.

Sincerely,

Clifton E. Curtis

CEC:tp

Attachment

Monitoring of Past Radioactive Waste Ocean Dumpsites And "Test" Sites Is Needed To Provide Effective Assurances That There Are No Undue Hazards To Human Health and The Environment, And To Assist In The Development of Future Policies

(A Critique of the GAO Radioactive Waste Ocean Dumping Report's Incomplete, Inconsistent, and Erroneous Findings and Conclusions)

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This Paper Has Been Endorsed By The Following Organizations:

Center for Environmental Education
Clean Water Action Project
Committee to Bridge the Gap
Critical Mass Energy Project
Environmental Defense Fund
Friends of the Earth
Greenpeace, U.S.A.
Hudson River Sloop Clearwater, Inc.
National Audubon Society
Natural Resources Defense Council
Nuclear Information Resource Service
Oceanic Society
Southwest Research and Information Center
Sierra Club
Union of Concerned Scientists

*Other issues discussed by Mr. Curtis are side barred in Exhibit 695 (parts 1 and 2).

EXECUTIVE SUMMARY

In January 1981, Senator William Roth, Jr. asked the General Accounting Office (GAO) to investigate the United States past program of radioactive waste disposal at sea. In response to that request, the GAO issued a report in October 1981 entitled "Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized." It was hoped that the GAO Report would clarify issues; instead, it is permeated with inadequate documentation, misrepresentation of evidence, and failures to acknowledge the existence of other pertinent evidence. GAO's defective conclusions flow from this invalid analysis.

The GAO Report's principal findings and conclusions are three-fold:

- the Federal Government has no complete and accurate catalogue of information on how much, what kind, and where low-level nuclear waste was dumped because detailed records were not required;
- the overwhelming body of scientific research and opinion shows that concerns over the potential public health and environmental consequences posed by past ocean dumping activity are unwarranted and overemphasized; and
- although the Environmental Protection Agency has been slow in developing low-level radioactive waste ocean dumping regulations, its current approach is sound. Nonetheless, improvements are needed in developing specific dumpsite monitoring requirements.

An analysis of an issue as complex and controversial as ocean dumping of radioactive wastes must be done with documentation and an accurate representation of all the pertinent evidence. The Report falls far short in both those tasks. This paper analyzes the GAO Report and examines the pertinent evidence. Contrary to GAO's findings and conclusions, we find that:

- the incomplete and inaccurate information that plague the issue of past ocean dumping of nuclear waste presents a serious problem which requires more complete elaboration in order to determine actual or potential hazards;
- there is not enough hard evidence to provide sufficient certainty that public health and environmental hazards will not result from past dumping practices;
- a good monitoring program of previously used sites off the U.S. coastline is both necessary and useful (1) to provide empirical data concerning such matters as toxicity, transport, and critical pathways, fates and effects of the radioactive materials, (2) to assure the public that such past dumping does not present any public health or environmental hazards, and (3) to provide scientific data which will contribute to responsible policies and regulatory requirements for the future; and
- a good monitoring program of "test" sites off the U.S. coastline, unmodified by prior dumping activities, is both necessary and useful (1) to provide baseline data that will increase our knowledge of the physical, geochemical and biological processes of the marine environment and routes back to man; and (2) to provide scientific data which will contribute to responsible policies and regulatory requirements for the future.

In arriving at these findings, this paper addresses each of the GAO Report's principal findings and conclusions. Part I describes past and present U.S. policies and activities in relation to ocean dumping of radioactive wastes. It mentions briefly the statutory and regulatory framework that has developed, and notes the fact that since the issuance of a Council on Environmental Quality report in 1970 the United States policy has been not to use the oceans as a repository for radioactive wastes. It also references the reasons for EPA's current interest in the ocean option. It is in this context that the GAO Report -- to the extent it serves as support for a reversal of U.S. policy on this important issue -- requires rebuttal.

Part II explains why there is a need for more complete information on past dumping practices. While complete and accurate data are not available, that does not negate the need for better information than now exists in order to (1) adequately assess actual or potential hazards from past U.S. dumping, and (2) formulate sound policies for the future. The GAO Report incorrectly assumes that all past dumping was low-level radioactive waste, that at most only low-risk waste remains, and that it presents low-risk to the marine environment and humans. As shown in this paper, evidence that high-level waste was dumped off our coastlines is in the public record. Similarly, evidence exists concerning the high-risk nature of some low-level radioactive wastes. Given that the specific

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types of nuclear material are unknown and that available records indicate that some high-level and/or high-risk waste was dumped, it is an unsound and risky leap of faith for GAO to conclude that we need not be concerned about what was dumped.

Part III describes technical studies, testimony in public hearings, workshop findings and recommendations, and international criteria, guidelines and programs to show that U.S. efforts to date have not provided effective assurances that past dumping poses no hazards to the marine environment or humans. The limited surveys and studies that have been previously undertaken with respect to past U.S. dumping are not sufficiently conclusive to lay such an important concern to rest. Additional targeted research and monitoring, which will test the validity of present preliminary assumptions, is necessary if our government is committed to providing assurances of safety.

Part IV describes the various domestic and international evidence which show that both past dumpsites and "test" sites off the U.S. coastline can provide useful and important information as the United States formulates responsible policies for the future regarding ocean dumping of radioactive waste. The GAO Report urges the EPA to rely on international guidance as the basis for future policy decisions. Both Parts III and IV show that while the U.S. can benefit from lessons learned internationally, such guidance is no substitute for research and monitoring that is focused on past dumpsites and "test" sites off our coasts. The Report also reprimands EPA for not having revised already its ocean dumping regulations to incorporate international guidance. Since U.S. policy dating back to 1970 has been not to use the ocean as a radioactive waste dumpsite, GAO's criticism rings hollow. More importantly, such a recommendation places the "cart before the horse." Given all the findings set forth in this paper, analysis of information gathered from monitoring past dumpsites and "test" sites -- as well as of information resulting from other domestic and international ocean research and monitoring activities -- must be viewed as a prerequisite to any formal revision of this nation's regulatory program in relation to the ocean option.

FOREWARD

"[A]lthough EPA does not recommend the past dumping practices and would not permit those activities to be done the same way today, our preliminary evaluation of their environmental consequences indicates no harm to man or the marine environment. It should be clearly recognized, however, that the information we have collected is not encyclopedic. It does represent a pioneering first step in developing general monitoring programs for both abandoned and active dumpsites, but more information is desirable from a scientific and public health point of view."

Hearings before the House Subcommittee on Oceanography, 96th Cong., 96-53 (1980), at 351 (testimony of Dr. Roger Mattson).

"Existing [radioactive waste] disposal sites provide an excellent experimental situation to study the physical, chemical, and biological processes that incorporate, transform, and accumulate radioactive elements and cause these toxic substances to migrate from the disposal cannister to biological recepters (including humans)."

NOAA's National Marine Pollution Program Plan (2nd 5-Year Plan, Covering 1981-85), (September 1980) at 42.

"It has been a practice on the Pacific Coast to dispose of low-level waste by jettisoning containers of it onto the bottom of the sea in designated disposal areas. There is no evidence that this disposal practice has resulted in any inimical effect upon the environment; but neither is there evidence that harmful effects cannot eventually result from it.

"The concern here is not with any magnitudes of disposal already undertaken, but rather with understanding the implications of the continuing and increasing use of the oceans as a receptacle for disposal. History is replete with cases in which unrestricted pollution of various kinds, rapidly developing from innocuous beginnings, has subtly damaged or destroyed resources before understanding and controls could be developed." [emphasis added]

National Academy of Sciences/National Research Council, Disposal of Low-Level Radioactive Waste into Pacific Coastal Waters, (1962) at viii.

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by Clifton E. Curtis 1/

Introduction

In January 1981, Senator William Roth, Jr. asked the General Accounting Office (GAO) to investigate the United States past program of radioactive waste disposal at sea. This program was discontinued in June of 1970; however, there has been recent discussion by U.S. government officials of reviving the practice of ocean dumping. Senator Roth's request to GAO was made in response to these discussions and his concerns about the possible health and environmental hazards that may result from ocean dumping. He requested the GAO to address three issues:

- the adequacy of Federal efforts to identify the extent and locations of radioactive wastes dumped by the U.S. Government and private industry;
- the effectiveness of Federal efforts to assure that nuclear waste already dumped into the ocean poses no undue hazard to the health of U.S. citizens or to the environment; and

1/ Mr. Curtis is an attorney with the Center for Law and Social Policy, Washington, D.C. Since 1978 he has represented environmental organizations in the U.S. and western Europe on matters related to ocean disposal of radioactive waste. During that time Mr. Curtis has been a member of the EPA/Dept. of State Ocean Dumping Advisory Committee. He served as an Advisor on the U.S. delegation to the Third Consultative Meeting of the London Dumping Convention (1978), represented Friends of the Earth, Int., at the Fourth Consultative Meeting (1979), and Greenpeace, International, at the Sixth Consultative Meeting (1981). Mr. Curtis is also a member of the National Research Council's Marine Board. He was assisted in the preparation of this paper by: Darcey Rosenblatt, a volunteer who completed her Masters in Marine Affairs, Univ. of Washington, in 1981; and Jim McLeod, a law student intern at the Center during the summer of 1982 from Vermont Law School.

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- the extent of Federal efforts to assure that any future ocean dumping is done safely and in an environmentally acceptable way. 2/

In October 1981, the GAO issued its report entitled "Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized." 3/ It was hoped that the GAO Report would clarify the issues; instead, it presents an incomplete and misrepresented picture of the facts and reports involved, and derives its conclusions from this inaccurate presentation. The major conclusions of the GAO Report are as follows:

- the Federal Government has no complete and accurate catalogue of information on how much, what kind, and where low-level nuclear waste was dumped because detailed records were not required;
- the overwhelming body of scientific research and opinion shows that concerns over the potential public health and environmental consequences posed by past ocean dumping activity are unwarranted and overemphasized; and
- although the Environmental Protection Agency has been slow in developing low-level radioactive waste ocean dumping regulations, its current approach is sound. Nonetheless, improvements are needed in developing specific dumpsite monitoring requirements. 4/

Included in this third conclusion is the premise that the monitoring of past ocean dumpsites to aid in developing future policy is of little benefit.

2/ Letter from the Honorable William B. Roth, Jr., to the Honorable Elmer B. Staats, Comptroller General of the U.S. General Accounting Office (Jan. 8, 1981).

3/ United States General Accounting Office, Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized, EMD-82-9 (October 1981) at (i) [hereinafter cited as GAO Report].

4/ Id. at cover page.

In a discussion of methodology the GAO Report states that its

> basic approach was to obtain the most diverse set of views on each issue and evaluate the evidence supporting each view. Accordingly, [they] obtained the views of over 30 nationally and internationally prominent scientific authorities on nuclear and other hazardous waste disposal techniques . . . . The experts, for the most part, were from Government agencies, national laboratories, oceanographic research organizations, universities, and nuclear industrial societies. 5/

The Report also states that interviews were conducted with various organizations knowledgeable about any sort of ocean dumping. A list of these organizations is given (GAO Report, Appendix I) and the major agencies are mentioned in the text, but beyond that there is only one case (Dr. Jackson Davis, at 14) where any of the experts is given a direct citation. In addition, the views of some of the organizations that were specifically referenced, as well as several studies used in support of GAO's findings and conclusions, were misinterpreted or misrepresented.

It is our belief that an analysis of an issue as complex and controversial as ocean dumping of radioactive wastes must be done with documentation and an accurate representation of all the pertinent literature and authorities. The GAO Report falls far short in both of these tasks.

In light of the information that is given in the GAO study and an examination of other sources, which will be mentioned -

5/ Id. at 5.

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the course of this paper, we consider the GAO analysis to be incomplete and its principal conclusions to be defective. We find that:

- the incomplete and inaccurate information that plague the issue of past ocean dumping of nuclear waste presents a serious problem which requires more complete elaboration in order to determine actual or potential hazards;
- there is not enough hard evidence to provide sufficient certainty that public health and environmental hazards will not result from past dumping practices;
- a good monitoring program of previously used sites off the U.S. coastline is both necessary and useful (1) to provide empirical data concerning such matters as toxicity, transport, and critical pathways, fates and effects of the radioactive materials, (2) to assure the public that such past dumping does not present any public health or environmental hazards, and (3) to provide scientific data which will contribute to responsible policies and regulatory requirements for the future; and
- a good monitoring program of "test" sites off the U.S. coastline, unmodified by prior dumping activities, is both necessary and useful (1) to provide baseline data that will increase our knowledge of the physical, geochemical and biological processes of the marine environment and routes back to man; and (2) to provide scientific data which will contribute to responsible policies and regulatory requirements for the future.

A discussion of each of these findings follows, presented in the context of Sen. Roth's request and the GAO's findings and conclusions.

I. Background: Past and Present U.S. Policies and Activities

As indicated in the GAO Report, during the 40's, 50's, and 60's, the oceans off our U.S. coastline were used as dumpsites for radioactive wastes. Available records indicate that approximately 90,000 cannisters, with an estimated total activity of 95,000 curies, were dumped at sites in the Atlantic, Pacific and the Gulf of Mexico -- with 99.5 percent of that amount dumped prior to 1963.[6/]

In 1970, the Council on Environmental Quality issued a report which concluded that ocean dumping of any radioactive waste presented a very serious and growing threat to the marine environment.[7/] In that report CEQ recommended that the prohibition against dumping high-level radioactive wastes be continued, and that the dumping of low-level waste be prohibited, except in a very few cases where there exists "no alternative offering less harm to man or the environment . . . . [and] only when the lack of alternatives has been demonstrated."[8/]

Soon after the CEQ Report was published, the Marine Protection, Research and Sanctuaries Act ("Ocean Dumping Act") of 1972 was enacted.[9/] Pursuant to Title I of the Act, no permits may be granted for dumping any high-level radioactive waste in the

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6/ Oceanography Miscellaneous -- Part 2: Hearings Before the Subcommittee on Oceanography on the House Committee on Merchant Marine and Fisheries, 96th Cong., 96-53 (1980) [hereinafter cited as November 1980 Hearings], at 360.

7/ Council on Environmental Quality, Ocean Dumping: A National Policy (October 1970), at vi-vii.

8/ Id. at vii.

9/ Pub. L. 92-532, Oct. 23, 1972; 33 U.S.C. §1401 et seq., as amended.

ocean or beneath its seabed. Permits for low-level radioactive wastes may be granted under the Act only upon a determination that "such dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."[10/] In addition to listing specific considerations that the EPA Administrator must meet in making permit determinations, the Act also requires the Administrator to apply the standards and criteria binding upon the United States under international agreements.

Regulations and criteria pursuant to the Ocean Dumping Act were initially published in October 1973, with the most recent substantive revisions thereto published in January 1977.[11/] Among other provisions, those regulations define high-level radioactive wastes, specify numerous permitting criteria and require that all non high-level radioactive materials must be packaged or containerized to prevent their direct dispersion or dilusion in ocean waters. In relation to CEQ's recommendation that the ocean be considered a dumpsite of last resort, the regulations also require a finding prior to any permit approval that [illegible] no practicable [illegible] methods of disposal . . . available . . . which have [illegible] adverse environmental impact or potential risk to other parts of the environment than ocean dumping."[12/]

10/ Id. at §1412.

11/ 40 C.F.R. Part 227.

12/ Id. at §227.16(a)(2). Even prior to the enactment of the Ocean Dumping Act, the Atomic Energy Commission revised its regulations in response to the CEQ recommendation. See 10 C.F.R. §20.302(c), adopted Dec. 4, 1971.

In tandem with the enactment of a domestic law on dumping, the U.S. was a leading force behind the adoption of the 1972 International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter ("London Dumping Convention"), which has since been ratified by the U.S. and 47 other countries.[13/] Consistent with domestic law, the Convention prohibits dumping of high-level radioactive wastes and requires special permits for the dumping of low-level wastes, with the added understanding that the contracting parties take full account of any recommendations of the International Atomic Energy Agency (IAEA) in seeking a permit. During the past several years the IAEA has established detailed criteria for ocean dumping of radioactive waste (e.g., dumpsite depth must be at least 4,000 meters (2.5 miles), they must be between 50° south and 50° north latitude, and permit requests must be preceded by detailed environmental assessments).[14/] These and other criteria have not been added to our domestic regulations.

Within the past year, some EPA and other government officials have expressed a renewed interest in using the oceans as a dump-

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13/ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, U.S.T. 2403, T.I.A.S. No. 8165 [hereinafter cited as the "London Dumping Convention" or "LDC"].

14/ The IAEA Revised Definition and Recommendations of 1978 Concerning Radioactive Wastes and Other Radioactive Material, INFCIRC/205/Add. 1/Rev. 1, IAEA (August 1978). These criteria were issued in relation to two provision of the LDC, i.e., Annex I (para. 6) and Annex II (Section D).

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site for low-level radioactive waste.[15/] Since [illegible] of 1981, EPA officials have advised members of Congress and [illegible] individuals that revisions of the existing regulations would soon be released.

The proposed changes to the EPA regulations which have surfaced in draft form[16/] suggest that the primary purpose behind the radioactive waste revisions is to incorporate international criteria agreed to by the U.S. and other parties to the London Dumping Convention. It appears that EPA officials recognize that permits for such dumping cannot be approved absent express inclusion of those criteria in our domestic regulations.

EPA interest in revising its regulations appears to be driven in part by federal agency interest in the ocean option. The Navy is considering the ocean as a disposal site for decommissioned nuclear submarines, and expects to issue a draft Environmental Impact Statement on that subject this summer.[17/] At the

15/ In addition to this interest in low-level radioactive waste dumping, the Dept. of Energy (DOE) is engaged in a long-term research program begun in the mid-1970's to assess the feasibility of implanting high-level radioactive waste beneath the seabed. Phase II of the DOE's Seabed Disposal Program (SDP) consists of technical and environmental feasibility studies due to be completed by 1986-88. While SDP studies can provide scientific data and research that will benefit decisionmakers concerned with disposal of low-level wastes, that program is not of direct concern in the context of this paper because (1) it is focused on high-level radioactive waste seabed emplacement and (2) decisions as to the efficacy of such disposal are several years from resolution.

16/ Environmental Protection Agency, Ocean Dumping: Revision of Regulations and Criteria, 40 C.F.R. Parts 220-229, draft of Feb. 5, 1982.

17/ Permanent Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants; Intent to Prepare a Draft Environmental Impact Statement, 47 Fed. Reg. 2151 (1982).

same time, the Department of Energy is advancing a proposal to dispose of thousands of cubic yards of contaminated soils and other radioactive materials remaining from the Manhattan Project and nuclear energy programs.[18/]

However, the most noticeable reason that EPA has presented in recent months in support of the regulatory revisions concerning ocean dumping is the conclusion that such dumping will not harm the marine environment or man. This position is anchored in the belief that past dumping has been harmless.

In stating this view, some EPA and other Administration officials have referenced the GAO Report to bolster their view that the oceans are an appropriate medium for the disposal of radioactive waste. A recent example of such a reference occurred at the June 16, 1982 hearings before the House Subcommittee on Water Resources, when an EPA official cited the GAO Report as evidence that a two-year moratorium on ocean dumping of low-level radioactive waste was unnecessary.[19/]

It is in the context of these recent developments in U.S. policy concerning ocean dumping of radioactive waste that the GAO Report requires rebuttal. To the extent the Report serves

18/ U.S. Dept. of Energy, Description of the Formerly Utilized Sites Remedial Action Program, ORO-777 (Sept. 1980).

19/ Testimony of EPA's Steven Schatzow before the House Committee on Public Works and Transportation's Subcommittee on Water Resources, June 16, 1982, prepared testimony, page 6. The proposed moratorium was the subject of an amendment adopted by the House Merchant Marine and Fisheries Committee. As the committee report indicated, it was proposed because "[t]he uncertainties associated with radioactive waste disposal remain a major concern, and the Committee regards additional research as necessary." H.R. Rep. No. 562, 97th Cong., 2d Sess. 9 (1982).

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as support for the reversal of U.S. policy on this important issue, the credibility of the debate will be distorted and ill-served.

II. <u>The Need Exists For More Complete Information On Past Dumping Practices</u>

At present the EPA has prime responsibility for collecting all available information on past U.S. dumping of nuclear waste. One of the more frustrating aspects of analyzing past ocean dumping is that complete data are simply not available, because there were no regulations in effect when the dumping took place requiring that complete records be kept, because in some cases records were destroyed in the intervening time, or because such information has not been retrieved from agency and other archives. Speaking to this point, a former EPA Assistant Administrator stated in the fall of 1980:

> Today, the records of the ocean dumping activities consist primarily of documentation drawn from the [Atomic Energy Commission] AEC licenses and from logs indicating the general nature and quantities of the materials, the estimated radioactivity, and the coordinates of the dumping locations . . . . But, because they were regarded primarily as garbage, precise records were apparently not kept of the specific contents. 20/

In light of this information limitation the GAO recognizes that, the "lack of accurate and complete data, in the records available at [Department of Energy] DOE, [Nuclear Regulatory Commission] NRC, and the [Department of Defense] DOD has made

20/ <u>Ocean Dumping of Radioactive Waste Off the Pacific Coast: Hearing Before a Subcommittee of the House Committee on Government Operations</u>, 96th Cong., 2nd Sess., at 56 (1980) (statement by David Hawkins, Assistant Administrator for Air, Noise and Radiation; Environmental Protection Agency) [hereinafter cited as October 1980 Hearings].

EPA's task a virtual impossibility." 21/ Thus, the Report qualifies EPA's efforts to gather information as adequate. While there does exist some information to dispute this claim, more importantly there is a significant distinction between EPA exercising an adequate effort under the circumstances, and EPA having the necessary information to sufficiently analyze actual or potential hazards of the past program and make future policy. This distinction is one that the GAO Report overlooked.

After repeatedly showing that the nature, amounts and locations of waste dumped at sea are unknown, the Report still finds that "DEFICIENCIES IN THE AVAILABLE DATA HAVE LITTLE IMPACT ON DETERMINING WHETHER THE WASTES PRESENT POTENTIAL ENVIRONMENTAL OR PUBLIC HEALTH CONSEQUENCES." 22/ It is difficult to understand how this conclusion can be drawn from an equation with so many unknowns. Certainly, assumptions can be made as to the magnitude of those unknowns, but it must be acknowledged that in a situation where a number of unknown factors are involved, errors in assumptions can have an impact on determining consequences.

One critical assumption the GAO Report makes concerning the nature of nuclear waste dumped is a particularly pertinent example of the preceding argument, i.e., that all waste dumped was low-level waste. The term "low-level" implies that there is a lower risk factor involved in dumping this material than in dumping materials classified as high-level or transuranic waste. But, the terms of reference in the Report are not always so precise.

21/ GAO Report, <u>supra</u> note 3 at 9.

<u>22</u>/ <u>Id</u>. at 7.

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defined and thus this distinction is not always clear. In any event, there is substantial evidence that the past U.S. dumping program involved more than just low-risk waste,[23/] yet this possibility does not seem to enter into GAO's analysis.

The GAO Report defines three classes of radioactive waste: high-level; transuranic; and low-level.[24/] These classes are, in effect, derived from the source of the waste product and thus do not give a quantitative or qualitative picture of the material's risk potential. Although the report does mention that low-level waste can be "highly contaminated,"[25/] by continually using the term low-level and claiming that deficiencies in the data have little impact on determining the environmental and health consequences, GAO gives the erroneous impression that past dumping involved only lower risk material.

A more quantitative definition is given by the Atomic Energy Commission in its 1955 report on Radioactive Waste Disposal

23/ See Waste Dumping: Hearings Before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 97th Cong., 1st Sess. 97-20 (1981) at 388-91 (testimony of Michael Pogodzinski) [hereinafter cited as September 1981 Hearings]; and M. Herz, "Some Like It Hot: Reactivating Waste Alternatives," Oceans, Vol. 15, No. 2 (1982), at 63. See also, infra notes 27-31 and accompanying text.

24/ "High-level wastes included (1) spent or 'used' reactor fuel which will be classified as waste if not reprocessed and (2) the by-products coming out of a reprocessing plant which contain highly toxic nuclear fission products . . . .

"Transuranic waste results predominantly from reprocessing spent fuel and fabricating plutonium to produce nuclear weapons. These are man-made radioactive elements that, like high-level waste, have lives of thousands of years . . . .

"Low-level nuclear waste is generally considered to be any radioactive waste that is not high-level or transuranic waste." (footnotes omitted.) GAO Report, supra note 3, 1-2.

25/ Id. at 2.

Practices in the Atomic Energy Industry. "Materials are considered 'high level' when the emitted radiation intensity is so strong as to materially reduce the time a person can be near the radiating body (quantitatively 2 rems or more per hour) and low-level wastes" can be handled directly without undue consideration given to time of contact (or up to 50 millirems per hour).[26/] It is important to note that the licenses issued to disposal companies stated that the radiation level at any accessible surface on the container shall not exceed 200 millirems per hour -- four times the level permitted under the AEC standard.[27/] While activity at the surface of a package does not determine, by itself, whether the enclosed wastes are high-or low-level, GAO fails to even consider such information to be relevant to its analysis.[28/]

Evidence that high-level waste was dumped off our coastlines can be found in various sources. For example, the above 1955 AEC Report, cited by Hon. Glenn Anderson in congressional hearings, described the procedures used for processing high-level waste at a facility, Bettis Field, in Pittsburg, Pennsylvania.[29/] Packaged high-level wastes were shipped from Bettis Field to a Navy dock in Earle, New Jersey. Congressman Anderson discovered that, "[i]n 1955 alone Bettis Field packaged 740 high level drums for ocean disposal."[30/]

26/ A.B. Joseph, Radioactive Waste Disposal Practices in the Atomic Energy Industry -- A Survey of the Costs (1955) at 2-3.

27/ November 1980 Hearings, supra note 6, at 266.

28/ Under current Nuclear Regulatory Commission and Environmental Protection Agency regulations, the source of the waste is the principal factor in determining whether it is high-or low-level. See 50 C.F.R. Part 50, App. F(2) (NRC); 40 C.F.R. §227.30 (EPA).

29/ November 1980 Hearings, supra note 6, at 270.

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Another AEC Report states that "reactor fuel samples and other reactor experiment materials and by products of isotope production," -- materials of "fairly high specific activities" -- were dumped into the ocean.31/ And congressional hearings held last year in Boston revealed that on at least one occasion "considerably hotter than normal" radioactive waste was dumped in Massachusetts Bay.32/

These points are especially significant in that 25 percent of the 275-300 waste containers examined by the EPA have been damaged in some manner.33/ The possibility that a substantial percentage of the 90,000 cannisters that were dumped may be damaged -- and that some of them represent a potential high-level risk -- points to the significant impact that deficiencies in available data can have on determining the environmental and health consequences of past dumping practices.

Separate from "high-level" categories of wastes, while GAO correctly noted that low-level wastes can be "highly contaminated,"

31/ A. Joseph, United States Atomic Energy Comm'n, United States' Sea Disposal Operations: A Summary to December 1956 (WASH-734) (August 1957) at 4.

32/ September 1981 Hearings, supra note 23, at 389 (testimony of Michael Pogodzinski). The GAO Report does not include the Massachusetts Bay dumpsite in their list of major ocean dumpsites (GAO Report, at 9-10) even though it is listed as a primary dumpsite by the EPA (November 1980 Hearings, supra note 26, at 379). In addition to being by far the shallowest site (92 meters, approximately the length of a football field) and the closest to land (within 20 miles of Boston), this site is located in a fertile marine estuary. Over 4,000 containers of radioactive waste are recorded as being dumped into Massachusetts Bay between 1946 and 1959. The Bay is the subject of a current EPA study. See September 1981 Hearings, supra note 23, at 410; Pogodzinski, M., "Nuclear Waste Dump Sites in Coastal Waters," New England Outdoors, July 1981, at 37-42.

33/ October 1980 Hearings, supra note 20, at 19 (testimony of David Hawkins).

the report fails to consider the importance of that point in its analysis. Instead, GAO summarily equates low-level with low-risk, and in the process ignores intermediate wastes which generally are included in the "low-level" categorization. Some "low-level" radioactive materials can be extremely hot or high-risk, and studies have shown that bioaccumulation and chronic exposure to such wastes can present serious risks to human health and/or the marine environment.34/

Furthermore, the GAO Report refers to the "insignificant amounts of material that have been dumped",35/ while also emphasizing that there is no complete catalogue of the information. The study states that there "is an overwhelming consensus among experts that even if the amounts of radioactive waste dumped in the past are significantly more than reported, they would not represent a hazard to people or to the environment."36/ To imply that it does not matter how much waste was dumped is an indefensible position, especially in this case where the specific type of nuclear material dumped is unknown and available records strongly suggest that some high-level and/or high-risk waste was dumped.

If the volume of waste is irrelevant, then there would appear to be little reason for the GAO to conclude, as they did, that future dumpsites should be [illegible]. [illegible], this GAO

34/ See, e.g., Schell, [illegible], "Radionuclides at the U.S. Radioactive Disposal [illegible] the [illegible], January 198[illegible], cited in November 1980 hearings, supra note 5, at 372-73; Impingement of Man on the Oceans, edited by Donald Hood, Wiley Interscience (1971), Chapter [illegible], pp. [illegible] and [illegible], et al., Radioactive Contamination of the [illegible] Dumping Sites, IAEA-SM-248/111 (1981)

35/ GAO Report, supra note 3 at [illegible].

36/ Id. at 9-11.

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statement is not supported by any quantitative information or any direct citations from experts. Unsupported references to "an overwhelming consensus among experts" as the basis for such an important finding reflects poorly on GAO's traditional attention to detail. In any event, the GAO's leap of faith, coupled with a lack of documentation, does not contribute to a useful analysis of the issues.

III. Determinations of Hazards From Past Dumping Are Inadequate

Has the government done an effective job of assessing possible dangers from past U.S. dumping of radioactive waste? While the Report mentions the efforts of various federal agencies addressing this issue, the GAO reaches an independent conclusion that "EVIDENCE OVERWHELMINGLY SHOWS PAST U.S. OCEAN DUMPING POSES NEITHER AND ENVIRONMENTAL NOR A PUBLIC HEALTH HAZARD."[37/] GAO's analysis and review of studies on this point leaves much to be desired. As shown herein, very little evidence exists that would enable federal officials to provide effective assurances that past dumping poses no undue hazards to public health and the marine environment. Consistent with the recommendations of numerous studies and documents cited below, further monitoring is needed before such assurances can be given.

A. Domestic Concerns

It is difficult to define how much is "enough study" in a case involving nuclear waste disposal. Responsibility for environmental surveys of ocean nuclear dumping was given to EPA under the

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37/ Id. at 11 (emphasis in original).

mandate of the Marine Protection, Research and Sanctuaries Act of 1972 (The Ocean Dumping Act.)[38/] The Ocean Dumping Act created a regulatory/research framework to provide, inter alia, technial information for the development of future regulations through the evaluation of past sites.

Since 1974 the Farallon Island site has been investigated four times: once in 1974 (at the 900-meter depth) and once in 1975 (at 1700m) to see if specific drums could be found, and twice in 1977 (at 900m and 1700m) when samples were taken. The U.S. dumpsites in the Western Atlantic were also surveyed three times during 1974-78 (twice at 2800m, and once at 3800m) and similar experiments were conducted. These surveys were pioneering efforts; not comprehensive examinations of the ocean environment.[39/] Many pictures were taken, but only three drums were actually recovered for direct examination.[40/]

The GAO Report relies upon the findings of "EPA officials" in relation to those surveys as a primary basis for the Report's conclusion that ocean dumping is not hazardous, even though the Report states at one point that those surveys are of "questionable value."[41/] In November of 1980 an EPA official was asked, by Congressman Gerry Studds, if the agency believed that the retrieval of only three

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38/ Supra note 9.

39/ October 1980 Hearings, supra note 20, at 24 (testimony of David Hawkins).

40/ November 1980 Hearings, supra note 6, at 358-79.

41/ GAO Report, supra note [illegible], at 22.

drums out of the thousands that were dumped could constitute proof that the wastes portray no harm. Referring to the entire range of its dumpsite surveys, EPA's response was:

> it has been our technical judgment based on an understanding of what materials were dumped and where they were dumped and how long ago they were dumped and our interpretation of the less than encyclopedic data that we have already collected, that there has been no harm from that past radioactive dumping. 42/

There are two important points in EPA's conclusion that GAO fails to take into account. First is the use of the past tense ("there has been no harm") rather than the more positive statement GAO makes: "DUMPING POSES NEITHER AN ENVIRONMENTAL NOR A PUBLIC HEALTH HAZARD." 43/ However, more significant to the analysis is the premise in the EPA statement that this technical judgment is based on an understanding of the nature, quantity, and age of material dumped, when GAO's first conclusion states that this body of knowledge does not exist.

It is interesting to note that the GAO report claims that although it sought opposing points of view within the scientific community on the question of hazard potential, it was only able to find one university professor (Dr. Davis) to provide counter evidence, and this evidence they question. 44/ While GAO dismisses Dr. Davis' opinions by summarily indicating that the conclusions of his report "were widely questioned by other scientists familiar with the issue," 45/ the Report conveniently ignores the fact that

42/ November 1980 Hearings, supra note 6, at 438 (testimony of Dr. Roger Mattson)

43/ GAO Report, supra note 3, at 11 (emphasis in original).

44/ Id. at 14-15.

45/ Id.

the validity of several of his principal conclusions were expressly acknowledged by EPA at the October 1980 hearings held in San Francisco. 46/

The GAO Report also fails to mention a report compiled from EPA's survey of the Atlantic 3800 meter dumpsite, "Radionuclides at the U.S. Radioactive Waste Disposal Site in the Hudson Canyon," which showed significant levels of Americium-241 in the rattail fish, Coryphaenoides armatus, which the author concludes came from the radioactive wastes. 47/ EPA calls this a speculative conclusion, saying that "[s]tudy of this data is continuing, and it appears that resolution of the open question will have to come from further baseline and dumpsite sampling." 48/ Regardless of EPA's "official" views on this study, at minimum, GAO should have cited that report and concurred with the EPA recommendation that further monitoring is needed.

The GAO Report cites the 1971 National Academy of Sciences study "Radioactivity in the Marine Environment" as the most definitive work on "marine radioecology issues." 49/ While that study is extensive and thorough, it deals primarily with radionuclides from "fallout," "run-off" and "out-falls" from the operation of nuclear power plants; very little attention (two-three pages) is specifically given to the ocean dumping program. 50/ Throughout the

46/ See October 1980 Hearings, supra note 20, at 122-24, 129-32, and in particular, 148-49.

47/ W.R. Schell & A. Nevissi, supra note 34.

48/ November 1980 Hearings, supra note 6, at 373.

49/ GAO Report, supra note 3, at 12.

50/ National Academy of Sciences, Radioactivity in the Marine Environment (1971). Pages 35-36 of that 258-page report focus on packaged radioactive waste disposal.

NAS document a respect is shown for the potential hazards of radioactivity in the oceans. Admittedly, the NAS study generally concludes that "there is no evidence that the past and present policies and practices for radioactive waste disposal in the sea have jeopardized man or any marine species or ecosystems."[51/] While ocean dumping of radioactive wastes is only briefly addressed in the body of the study, that general conclusion was intended to apply to ocean dumping along with other disposal policies and practices. But that conclusion was premised on the statement that the guidelines in place in 1971 "are based on many factors, not all perfectly known, and are subject to change when new and better information becomes available."[52/] Since that study new and better information has become available, including the preliminary findings concerning rattail fish, as well as EPA evidence of a 25 percent implosion rate for cannisters (contrary to the structural integrity presumption referred to in the NAS study).[53/]

Given GAO's reliance on the National Academy of Sciences, it is curious that the Report makes no mention of two earlier NAS studies which were completed in 1959 and 1962 -- at the height

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51/ Id. at 5.

52/ Id. Instead of referencing the general conclusion of the NAS Study, which was qualified as here quoted, the GAO Report paraphrased a more specific conclusion (at 275) that focused on effluent low-level discharges from power plants, distorting that conclusion to include "ocean" discharges. See, GAO Report, supra note 3, at 12.

In the NAS study's limited discussion of ocean dumping, a similar concern with the need for better information is acknowledged in the authors' recommendation that previously used dumpsites will eventually need to be monitored in order "to safeguard users of the sea floor" (at 35).

53/ Id. at 36.

of the U.S. dumping program.[54/] Those earlier studies were based on the most advanced scientific knowledge at the time, provide much more original thought, and were much more focused on ocean dumping of radioactive wastes than the two-to-three pages devoted to that issue in the '71 NAS study. Quoting from each of those studies, the concerns presented reflect insight that is equally valuable today in light of the renewed interest in dumping:

> It has been a practice on the Pacific Coast to dispose of low-level waste by jettisoning containers of it onto the bottom of the sea in designated disposal areas. There is no evidence that this disposal practice has resulted in any inimical effect upon the environment; but neither is there evidence that harmful effects cannot eventually result from it.
>
> The concern here is not with any magnitudes of disposal already undertaken, but rather with understanding the implications of the continuing and increasing use of the oceans as a receptacle for disposal. History is replete with cases in which unrestricted pollution of various kinds, rapidly developing from innocuous beginnings, has subtly damaged or destroyed resources before understanding and controls could be developed. [emphasis added] 55/
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> . . .
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> There must be sufficient monitoring of disposal sites to ensure public health and safety, and to protect marine resources. Such monitoring should not be performed solely by the regulating agency. Records of the quantity and type of radioactive wastes and the areas in which they are disposed of should be maintained in a national center. These records should be available to interested groups, and periodic summaries should be issued.

54/ National Academy of Sciences/National Research Council, Disposal of Low-Level Radioactive Waste into Pacific Coastal Waters (1962) [hereinafter cited as the 1962 NAS Study]; National Academy of Sciences, Biological Effects of Atomic Radiation (1960) [hereinafter cited as the 1959 NAS Study] [both of which are cited in the October 1980 hearings, supra note 20, at 296 and 300, respectively, in testimony presented by the Committee to Bridge the Gap].

55/ Id., 1962 NAS Study at viii.

#695a (Cont)

> An increasing concern about the introduction of radioactive wastes into the sea is apparent at all levels, from local communities to international organizations . . . .The problems involved are complex and can be solved only through the joint efforts of all agencies: local, national, and international. The future will bring new and unanticipated problems, and differing interpretations of incomplete information may lead to controversy. Joint efforts to meet present problems will depend upon available knowledge and its interpretation. A full and free exchange of basic information is necessary. 56/

The GAO Report discusses a 1978 Estes Park workshop that was conducted by the National Oceanic and Atmospheric Administration (NOAA) to investigate the scientific problems of ocean pollution and to suggest programs to solve these problems. GAO reports this workshop as finding that, "[t]o date, no impacts on human health have been documented; no effects harmful to marine organisms are known, even at the sites of large discharges . . . ." 57/ However, it should be pointed out that again this statement is qualified by the words "to date" and "have been documented."

Also significant is the fact that the Estes Park workshop results go into some detail concerning the need for effective monitoring. This is not reported by GAO. From the workshop:

> [E]xisting dumpsites should be watched for leakage of radionuclides to test the validity of present assumptions about the retention of disposed materials in the sediments and to provide a basis for the selection of future disposal areas for low-level radioactive wastes. 58/

Thus, a fuller statement from the NOAA workshop again shows a tone of concern not evidenced in the GAO study.

56/ Id., 1959 NAS Study at 72-73.

57/ National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce, Proceedings of a Workshop on Scientific Problems Relating to Ocean Pollution (March 1979) at 6. [hereinafter cited as the Estes Park Workshop].

58/ Id.

In trying to prove there is no danger from nuclear dumping programs GAO draws on a study done by the Ad Hoc Scientific Committee on Ocean Dumping of Radioactive Wastes organized by the Oceanic Society. However, following the release of the GAO Report the Oceanic Society formally advised the GAO that their position had been misrepresented. First, the GAO Report says that "members of the Ad Hoc Committee have been vigorously opposed to dumping radioactive wastes in the ocean and set out to prove that a problem existed but did not succeed." 59/ Michael Herz, Executive Vice President of the Society responded by stating, "[i]n fact, our committee was formed specifically to evaluate draft reports concerning research on nuclear waste dumping which had recently been released by the Environmental Protection Agency and, in the tradition of the scientific method, started from a position of neutrality on the issue of the effect of radioactive waste on the oceans." 60/

An even more serious misrepresentation occurs when the GAO Report states that "the Committee concluded that there is no evidence of a serious present or future threat to acuatic or human health either at Farallon Island or at the Atlantic sites . . . ." 61/ Again, Dr. Herz responds:

59/ GAO Report, supra note 3, at 16-17.

60/ Letter from Michael Herz to Charles Bowster, Comptroller General of the United States (Dec. 11, 1981) [hereinafter cited as Herz Letter].

61/ GAO Report, supra note 2, at 17.

Although we indicated that most of the existing studies on the Farallon Islands and Atlantic dumpsites contain no convincing evidence of a serious present or future threat to aquatic or human health, we went on to say that "present evidence indicates a relatively small increase in radiation exposure from eating fish at the highest level of radioactivity detected . . . [and] we recommend[ed] that an expanded monitoring program be developed for bony fish, shellfish, and other marine food items. . . [and] that the monitoring program extend along the entire affected coasts." 62/

In addition to misrepresenting the literature referred to above, it is significant to note that the GAO Report does not mention the "Federal Plan for Ocean Pollution Research, Development and Monitoring" which is conducted every two years by an interagency committee to assess the state of ocean pollution and to develop national priorities for five-year time frames. 63/ The plan for 1979-83 establishes radioactive dumpsite monitoring as a high priority, 64/ and the 1981-85 second iteration of the five-year Plan states that

> [e]xisting disposal sites provide an excellent experimental situation to study the physical, chemical, and biological processes that incorporate, transform, and accumulate radioactive elements and cause these toxic substances to migrate from the disposal canister to biological receptors (including humans).
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> * * *
>
> Studies undertaken by EPA and NOAA should employ existing disposal sites to determine release rates of radioactive materials to sediments and water, to

62/ Herz Letter, supra note 60, at 1-2.

63/ These five-year plans are required pursuant to the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978, P.L. 95-273, May 8, 1978, 33 U.S.C. §1701, at §1704.

64/ Interagency Committee on Ocean Pollution Research, Development and Monitoring/Federal Coordinating Council for Science, Engineering and Technology, Federal Plan for Ocean Pollution Research, Development, and Monitoring, Fiscal Years 1979-83, at 130.

> detect uptake by organisms, particularly sedentary species, and to identify bioaccumulation processes. Monitoring programs should be designed to detect any physiological or morphological abnormalities in resident biota and to identify in situ conditions where more subtle physiological processes involving radionuclides might be studied. 65/

B. International Concerns

The GAO Report references international activities concerning dumping at the Northeast Atlantic dumpsite, and recommends that the United States rely upon the international community's research and monitoring in relation to that site as the principal source of scientific understanding for future policy decisions by the United States. While that recommendation is addressed in the following section, it is instructive to note that the London Dumping Convention, the IAEA guidelines adopted thereunder, and other international initiatives, also recognize the need to monitor past dumping for the purpose of assessing potential hazards. 66/

Addressing the issue of monitoring, the IAEA guidelines state that "environmental monitoring combined with research can provide information testing the validity of present assumptions and help to provide a sound scientific basis for the conservation of ocean resources and for future monitoring operations and an

65/ Interagency Committee on Ocean Pollution Research, Development and Monitoring/Federal Coordinating Council for Science, Engineering and Technology, National Marine Pollution Program: Federal Plan 1981-85 (Sept. 1981) at 42.

66/ London Dumping Convention, supra note 13, Arts. VI.1.D, IX, Annex III(B)(4) and C(1)(2), and (3); IAEA Revised Definition, supra note 14, B.2.

#695a (Cont)

improved technical basis for evaluating future practices. These studies should be carried out." (emphasis added).67/

Following the adoption of those guidelines by the United States and other LDC contracting parties in 1978, the IAEA convened an Advisory Group on Low Level Radioactive Waste Dumping in Jamaica.68/ The findings of that meeting confirmed the need for continued validation of present assumptions with respect to past dumping, as shown by the definition of monitoring that was agreed upon:

> Monitoring we have defined as the collection of samples and/or data, and the analysis of samples and/or all the relevant data, required to demonstrate whether an impact of the dumping operations can be seen. It must be emphasized that such data and such interpretation cannot be simply on a yes or no basis, but that the operation must be done in a sufficiently iterative way that trends can be described, and that situations tending toward measurable impacts can be identified and controlled.69/
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> * * *
>
> Monitoring must report where the dumped material in fact is, and how its concentrations, distributions and bio-availability are changing with time. 70/

In April 1981 the Organization for Economic Cooperation and Development's Nuclear Energy Agency (NEA), as part of its

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67/ Id., IAEA Revised Definition, Annex, Para. 2.5.2, at 21; See also, the Oceanographic Basis of the IAEA Revised Definition and Recommendations Concerning High-Level Radioactive Waste Unsuitable for Dumping at Sea, IAEA-210 (1978) at 41-42.

68/ IAEA Advisory Group Meeting on Low Level Radioactive Waste Dumping, Montego Bay, Jamaica, December 11-15, 1978 [hereinafter cited as the IAEA Jamaica Advisory Group].

69/ Id. at 5.

70/ Id. at 23.

responsibilities that it has assumed in conjunction with the requirements of the LDC, approved a "Research and Environmental Surveillance Program Related to Sea Disposal of Radioactive Wastes."71/ This program was established as the result of a meeting of an NEA Group of Experts at which the participants "recommended that the next review of the [Northeast Atlantic] site (scheduled for 1984) should make use of more site-specific information, taking account of the particular features of the North Atlantic basin, and be less dependent on the maximizing assumptions of the generic model."72/ As described in its introduction, one of the two principal focuses of the environmental surveillance program is:

> . . . monitoring for the purpose of radiological surveillance with the objective, in the long term, to assess whether the initial assumptions as to the safety of the site are correct, and to provide realistic radionuclide concentration data to determine if these may be attributable to the dumped waste. 73/

The IAEA guidelines under the LDC, the definition of monitoring that came out of the IAEA Jamaica Advisory Group meeting, and the NEA Environmental Surveillance Program all attest to the importance of site-specific monitoring to test preliminary assumptions and to provide realistic data. While the geographical focus of those findings and recommendations is the Northeast Atlantic

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71/ Nuclear Energy Agency, Organization for Economic Cooperation and Development, Research And Environmental Surveillance Programme Related to Sea Disposal of Radioactive Waste (1981) [hereinafter cited as the NEA Surveillance Program].

72/ Id. at 5.

73/ Id.

dumpsite, which has been used much more recently than the sites off the U.S. coastlines, those concerns are valid and equally applicable to U.S. sites where substantial uncertainty remains as to the existence and status of long-lived and/or high-risk radionuclides.

In response to Senator Roth's concern about the effectiveness of federal efforts to assure that past dumping "poses no undue hazard" to man or the environment,[74/] the existing evidence suggests strongly that GAO's conclusion is invalid. Technical studies, testimony in public hearings, workshop findings and recommendations, international criteria, guidelines and programs support the position that U.S. efforts to date have not provided effective assurances that past dumping poses no hazards to the marine environment or humans. The limited surveys and studies that have been undertaken previously with respect to past U.S. dumping are not sufficiently conclusive to lay such an important concern to rest. Additional targeted research and monitoring, which will test the validity of present preliminary assumptions, is necessary if our government is committed to providing assurances of safety.

IV. Monitoring Is Needed Of Past Dumpsites and "Test" Sites As A Basis for Future Policy Decisions

Most, if not all of the literature cited in the preceding section expressed a dual concern vis-a-vis existing dump sites:

74/ Supra note 2.

they need to be monitored for potential hazards; and they provide "an improved technical basis for evaluating future practices."[75/] Yet, as we formulate responsible policies for the future regarding ocean dumping of radioactive wastes, we need not and should not be limited to sites where dumping has already occurred. Both previously used sites and "test" sites can provide illuminating answers to unresolved concerns.

A. Past Dumpsites

In light of the evidence cited in relation to the need for site-specific monitoring, it is difficult to understand how GAO could have reached its final conclusion that EPA's current approach to ocean dumping could be improved if they "recognized the limited benefits of monitoring prior dumpsites."[76/] It seems their strongest reasoning is that there is a "lack of baseline data on the amounts of natural and fall-out related radioactivity in the oceans . . . ."[77/] However, this does not diminish the fact that much can be learned from prior dumpsites as a basis for more informed decisions concerning proposals to dump radioactive wastes in the future.

At a one-day symposium -- "Nuclear Waste Management: The Ocean Alternative" -- that was convened in Washington, D.C. in February 1980, the need for research and monitoring was a conti-

75/ IAEA Revised Definition, supra, note 11; see also, Estes Park Workshop, supra, note 65.

76/ GAO Report, supra note 3, at 18.

77/ Id. at 19.

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ing theme.[78] One of the principal speakers, Robert Dyer, EPA's Senior Oceanographer with the Office of Radiation Programs, reviewed EPA's ocean dumping surveys that were done under his direction during the 1970's. In his concluding comments, Mr. Dyer noted that:

> [f]rom our initial surveys at the U.S. ocean dumpsites we can conclude that the technology exists or can be improved to properly evaluate the on-site results of deep-sea nuclear waste disposal operations. The formerly-used U.S. ocean dumpsites for nuclear waste can provide key study areas for determining both packaging performance and radionuclide transport processes. 79/

At the November 1980 hearings before the House Oceanographic Subcommittee, the EPA witness advised the committee that "[b]oth NOAA and EPA are committed to developing a monitoring strategy" in relation to ocean dumping of radioactive wastes.[80] While that strategy has not yet been published formally, EPA's 1981 draft version, titled "Program Plan for Monitoring Radioactivity in the Oceans" states that:

> [m]ore detailed information from the old dumpsites is required to improve site selection criteria, to evaluate techniques for waste containment, to develop improved dumpsite monitoring capabilities, and to better understand radiation transport processes in the deep ocean. 81/

78/ <u>Nuclear Waste Management: The Ocean Alternative</u>, edited by Thomas Jackson, Pergamon Press (1981). The symposium was sponsored by the Oceanic Society in cooperation with the Center for Law and Social Policy and Georgetown University.

79/ Id. at 43.

80/ November 1980 Hearings, <u>supra</u> note 6, at 352; <u>see also</u> Estes Park Workshop, <u>supra</u> note 65.

81/ U.S. Environmental Protection Agency, <u>Draft Program Plan for Monitoring Radioactivity in the Oceans</u> (July 20, 1981) at 9.

Hopefully that view will not be erased in response to this Administration's efforts to reduce EPA's research and monitoring budgets, though the GAO correctly notes that EPA monitoring programs have been zero-budgeted for the current fiscal year.[82] (Similar concern with the reduced availability of such funding was voiced in a recent report by the House Committee on Merchant Marine and Fisheries.[83]) Such a shift would be most unfortunate, and inconsistent with all the evidence we have cited which parallels the concern evinced in EPA's draft monitoring plan.

B. "Test" Sites

Concerning the complementary need to monitor "test" sites that are unmodified by prior dumping activities, the GAO Report appears to endorse such monitoring, but recommends reliance on "existing international ocean dumping guidance" as the principal solution to addressing future U.S. policy concerns.[84] Yet GAO's concluding thoughts on this point are difficult to follow, i.e.,

> [m]onitorability of the international [Northeast Atlantic] dumpsite has been questioned . . . . Consequently, in developing its site selection criteria for future dumpsites, EPA should include specific criteria for assuring that site monitoring is possible as well as specific periodic monitoring requirements. 85/

82/ GAO Report, <u>supra</u> note 3, at 22.

83/ H.R. Rep. No. 562, 97th Cong., 2d Sess. 9 (May 17, 1982).

84/ GAO Report, <u>supra</u> note 3, at 22.

85/ <u>Id.</u> at 24.

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How can one determine whether site monitoring is possible (other than depth limitation standards) and what periodic monitoring requirements are appropriate and necessary absent site-specific and basin-specific assessments? Reliance on international guidance alone that is focused on the Northeast Atlantic site certainly won't provide the needed information. At the risk of relying on undocumented assertions, it is widely accepted that the ocean is not a homogenous environment: normal or ambient concentrations of marine radioactivity from natural sources and human activity vary; biological food chains, currents and physical transport mechanisms and other processes vary. Given these and other variations and discontinuities that are peculiar to specific regions of the ocean, it is essential that site-specific monitoring of "test" sites precede any change of existing U.S. policy.

Two additional examples of the value that would result from monitoring "test" sites (as well as past dumpsites) are the development of (1) a complete inventory of all radionuclides deposited in the ocean by human activity; and (2) improvement of the technical adequacy of models, based on empirical data, that will allow radiation exposure to the marine environment and man to be calculated with greater reliability and accuracy. Both of these concerns have been emphasized repeatedly -- both internationally and domestically.

Concerning the need for an inventory of all radionuclides -- which GAO acknowledges without recommending any corrective measures[86/] -- several contracting parties to the LDC, including the United States, have recommended since at least 1978 that IAEA take the lead in preparing such an inventory so that "an estimate of the capacity of the marine environment to accept the radioactive waste from all sources can be developed." (emphasis in original).[87/] At the recently concluded Sixth Consultative Meeting, the IAEA representative advised the contracting parties that no such inventory effort has been initiated; and that IAEA's near-term future work program did not contemplate such work being started unless the Contracting Parties performed those data gathering tasks themselves.[88/] Domestically, the EPA has advised the Congress of the importance of such an inventory, stating at the November 1980 hearing that "[b]aseline monitoring is particularly important to provide information about the normal or ambient concentrations of marine radioactivity against which to measure the impact of any future radioactive waste dumping."[89/]

With respect to the need for improved models, based on empirical data that comes from monitoring, a principal focus of the NEA's Environmental Surveillance Program is "to define a coordinated research and environmental surveillance programme-plar

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86/ Id.

87/ Third Consultative Meeting of Contracting Parties to the LDC, Intergovernmental Maritime Organization (IMO), 9-13 October 1978, LDC III/WP.1 (statement by Canada).

88/ Report of the Sixth Consultative Meeting of the LDC, IMO 5-9 October 1981, Para. 7.6.

89/ November 1980 Hearings, supra note 6, at 351.

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for the Northeast Atlantic dumpsite that will allow the radiation exposure to man to be predicted with a greater degree of reliability and accuracy," i.e., "to enable the development of more realistic models."90/

While that principle is sound, and while the U.S. can benefit from experience gained under the framework of such a program, its structure and implementation serve as a good example of the limited benefits that can come from reliance on "international" activities. As designed, the program underemphasizes the importance of obtaining direct knowledge concerning present conditions at the current Northeast Atlantic dumpsite (such as data on sediments, biota, residence times and up-welling characteristics) and does not give sufficient priority to those activities that will contribute useful information for purposes of the next scheduled Northeast Atlantic site review set for 1984. Annex III of the LDC expresses a concern for the possible effects on amenities, on marine life, and on the sea, yet the program concludes that "there does not seem to be specific need at this time for routine measurements at the dump site."91/ In relation to the next site review schedule for 1984, only nine of the thirty-seven proposed research/monitoring activities that are listed as an attachment to the program are expected to produce results useful to that review.92/

90/ NEA Surveillance Program, supra note 71, at 5.

91/ Id. at 9. But see statement of Robert Dyer at the Symposium on the Ocean Alternative, supra note 78, at 43, where he noted that "the predictive capability for determining the effects is directly related to the technical adequacy for any model which is, in turn, related to the adequacy of the oceanographic information base." (emphasis added).

92/ Id., Annex I, at 12-19.

As a final point on the utility of monitoring as a basis for setting future policy, the GAO reprimands the EPA for not having long ago incorporated international guidelines into EPA's domestic regulatory program.93/ Since United States policy dating back to 1970 has been not to use the ocean as a radioactive waste dumpsite, the GAO's criticism rings hollow. Stated differently, the GAO focus on updating our existing regulations places the proverbial "cart before the horse."94/ In light of all of the above findings, the analysis of information that needs to be obtained from (1) past dumpsite and "test" site monitoring, (2) other U.S.-based ocean research and monitoring, and (3) participation in international programs and activities, including IAEA advisory groups, NEA's Environmental Surveillance Program, and the International Seabed Working Group,95/ collectively must be viewed as a prerequisite to any formal revision of this nation's regulatory program concerning ocean dumping of radioactive wastes.

Conclusion

In conclusion, there are serious problems with the findings and recommendations of the GAO Report. The Report is permeated with inadequate documentation, misrepresentation of evidence, and failures to acknowledge the existence of other pertinent evidence.

93/ GAO Report, supra note 3, at 22-23.

94/ Heywood, John, "Proverbs," (1546), Part II, Ch. 7.

95/ This latter program, chaired by the Department of Energy's Glenn Boyer, is the international complement to DOE's Seabed Disposal Program. See supra, note 14.

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As a result, its principal conclusions are defective. After careful consideration of the GAO Report and other pertinent evidence, we believe that our findings set forth at page 4 are the ones that should have been given in response to Senator Roth's request.

Implicit in our findings, and in the body of this paper, is the conclusion that at present it is premature to reverse the existing U.S. policy of non-ocean dumping of radioactive wastes. Unless and until a more accurate assessment of the hazards of past dumping has been completed, and unless and until past dump sites and "test" sites have been monitored in order to provide empirical data and a sound predictive capability and validation system, no serious consideration should be given to the use of the oceans as a disposal medium for radioactive wastes. Once these concerns are met, it will then be appropriate for all the variables associated with a comprehensive nuclear waste policy (e.g., economic, social, environmental and political considerations) to be addressed in relation to future decisions concerning the disposal of radioactive wastes.

This paper has been endorsed by the following organizations:

Center for Environmental Education
Clean Water Action Project
Committee to Bridge the Gap
Critical Mass Energy Project
Environmental Defense Fund
Friends of the Earth
Greenpeace, U.S.A
Hudson River Sloop Clearwater, Inc.
National Audubon Society
Natural Resources Defense Council
Nuclear Information Resource Service
Oceanic Society
Southwest Research and Information Center
Sierra Club
Union of Concerned Scientists

#695b

THE OCEANIC SOCIETY

EDUCATION • RESEARCH • CONSERVATION

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June 29, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

In response to the Department of the Navy's request for comments on its Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (December 1982), we are enclosing copies of our Oceanic Society Scientific Committee Report on Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants and our Oceanic Society Briefing Report on Ocean Disposal of Obsolete Nuclear Submarines as Proposed by The United States Navy.

These documents were developed by the Society's staff in consultation with members of the scientific community. We hope they will be of use to the Navy in reviewing the Draft Environmental Impact Statement.

Respectfully submitted,

Christopher Roosevelt
President

CR/we

Enclosures

Western Regional Office / OCEANS Editorial Office / Expeditions Office Fort Mason San Francisco Ca 94123 (415) 441-1104

*Issues discussed in this section are side barred in Exhibit 698 (parts 1 and 2).

Oceanic Society Briefing Report

On

Ocean Disposal of Obsolete Nuclear Submarines

as Proposed by

The United States Navy

THE OCEANIC SOCIETY

The Oceanic Society is a non-profit marine conservation organization with 70,000 members across the country. Through research, public policy analysis, conferences, education programs, public participation activities, testimony, and OCEANS magazine, the Society achieves intelligent protection and management of our oceans and coastal seas. The Society's Executive Offices are in the Stamford Marine Center, Magee Avenue, Stamford, CT, 06902; the Western Regional Office is located in Building E, Fort Mason Center, San Francisco, CA, 94123.

Revised December 10, 1982

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Oceanic Society Briefing Report
on
Ocean Disposal of Obsolete Nuclear Submarines
as Proposed by
The United States Navy

On January 14, 1982, the United States Navy officially announced its intention to prepare a "generic" environmental impact statement for disposal of up to 100 defueled, decommissioned nuclear submarines during the next three decades.[1] Radioactivity absorbed in each submarine's nuclear reactor and its supporting structure raises concern regarding safe disposal of these obsolete ships. One option to be considered by the Navy entails removal of the sub's radioactive components and disposal of these materials on land. A second option is ocean disposal of the entire submarine. Sea disposal is expected to be the less expensive course of action.

If the Navy's submarine scuttling proposal is adopted, it will involve unprecedented amounts of radioactivity into the oceans. The disposal of each submarine will equal half of the total radioactivity known to have been disposed of in American waters since ocean dumping began in 1946. Since there is not sufficient information at this time to allow us, or anyone, to confidently predict that there will be no adverse environmental or human health effects of radiation in marine ecosystems, the Navy's submarine scuttling program is cause for great concern.

New Ocean Initiatives

The Navy proposal is only part of growing domestic and international interest in the "ocean alternative" as a solution for nuclear waste disposal problems. Until 1970, radioactive waste was regularly dumped in waters off the Atlantic and Pacific coasts. At that time, the federal government imposed a moratorium on disposal of these wastes

in American waters. Despite this move, European nations like Great Britain have continued to dispose of radioactive wastes in the Atlantic. Now, Japan is considering disposal of low-level wastes in the Pacific. And the United States government is:

* moving to issue regulations permitting ocean disposal of nuclear waste through the Environmental Protection Agency;
* advancing toward sea disposal of defueled, decommissioned nuclear submarines by the U.S. Navy;
* pursuing a Department of Energy study on implacement of high-level nuclear wastes in geological formations of the deep seabed; and
* considering ocean disposal of up to 400,000 tons of Manhattan Project soils contaminated with low levels of radioactivity.

Political resistance to selection of terrestrial waste disposal sites, social pressures, and economic factors have combined to spur consideration of the "ocean alternative." Within this context, the Navy's submarine scuttling proposal will symbolize and reflect public attitude toward use of the oceans for waste disposal. Thus it is critically important for scientists, citizens, elected officials, and conservation groups to thoroughly and thoughtfully evaluate the Navy's argument in support of sea disposal when it is released later this year in a Draft Environmental Impact Statement.

The stakes in this decision are too high to permit quick, irreversible decisions based on political philosophy or personal conviction. This Oceanic Society Briefing Report focuses on scientific and technical questions raised by the Navy's January 1982 announcement. It will be supplemented by additional analysis as the Draft Environmental Impact Statement is reviewed. The Society's objective in this effort is to ensure intelligent and balanced decision-making by enabling citizens and organizations to comment knowledgably on the submarine scuttling plan once the Draft Environmental Impact Statement is released.

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Throughout this report, special attention will be drawn to problem areas where additional scientific information is needed to adequately assess environmental impacts or predict policy implications of nuclear waste disposal at sea. This data may be supplied in the Draft Environmental Impact Statement. Or it may require additional research by independent scientists. This document is designed to serve as an objective introduction to questions posed by the Navy proposal.

Prime Concern: Radioactivity

Radioactive elements -- or radioisotopes -- remaining in the submarine once atomic fuel has been removed from the reactor are the cause of environmental and public health concerns. Radioisotopes have been shown to migrate from old American dumpsites into edible fish.[2] Since the oceans provide protein for much of the world's population, sea disposal of radioactive waste is a global concern. Traditionally, the United States has served as an international leader in conservation concerns. Thus, an American decision to resume radioactive waste disposal in the marine environment could have profound and far reaching policy implications.

It is doubly important, then, for the Navy to adequately demonstrate beyond any reasonable doubt the safety and desirability of any radioactive waste disposal option involving the oceans. Prime questions to be answered by the Navy include:

1. How much radioactivity will be released from the submarines into the marine environment;

2. How, and in what quantities, would this radioactivity move through the web of marine life towards humans; and

3. What are the human health implications of this increased exposure?

The Oceanic Society believes development of policies permitting resumption of nuclear waste disposal in the marine environment should not proceed until these and related questions have been answered with sound scientific research and informed public participation in the policy formation process.

Unknown Release Rate

At this point we cannot confidently predict the rate and amount of radioactivity which would be released to the marine ecosystem by sea disposal of nuclear submarines. While all fuel would be removed from the sub before disposal, each sub would contain radioactivity in its reactor and supporting structures. The amount of radioactivity released to the environment will depend principally on the corrosion rate of stainless steel as affected by interrelated physical, chemical, and geological factors at the disposal site. Despite several Freedom of Information Act requests, the Navy has yet to release all of the background information it has developed to be evaluated in the Draft Environmental Impact Statement (DEIS). Without the data behind the DEIS, it is difficult -- if not impossible -- to estimate the release rate of radioactivity from these submarines.

Containment vs. Dispersion

Past U.S. policy on ocean disposal was based on a faulty assumption. During the period from 1946 to 1970, U.S. policy concerning disposal of radioactive waste was based on an assumption of "disperse and dilute." It was believed that radioactivity released from the dumpsites would diffuse evenly throughout an entire ocean basin.[1] In this manner the radioactivity would be diluted to supposedly harmless concentrations. The problem with this model is that the radioactivity, in fact, does not diffuse evenly throughout the water in an ocean basin. In reality, the limited research conducted to date indicates that the

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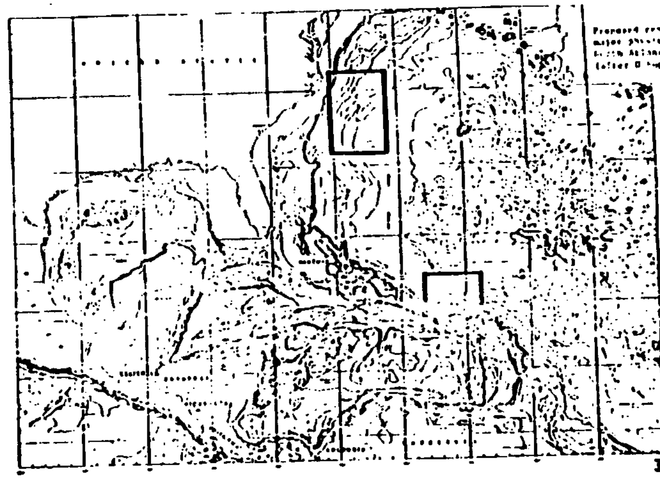
radioactive materials are adsorbed onto the sediments where they remain relatively concentrated, and then can be accumulated in organisms living in the sediments.[4] The importance of this readily accessible source of radioactivity to marine organisms of the abyss will be discussed in a later section.

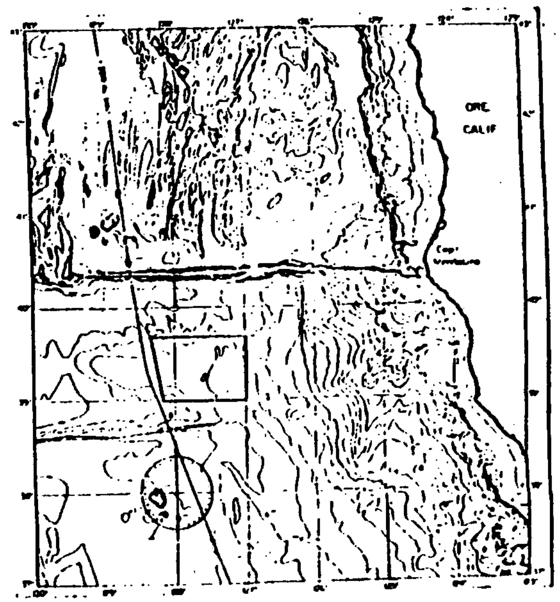
A dumpsite should minimize human exposure to radiation. Today, the main goal of any radioactive waste dumpsite is to minimize and, ideally, eliminate the possibility of future exposure to radioactivity. With this in mind the Navy outline proposes several criteria for ocean disposal sites: "geologic conditions of tranquility and predictability;" minimal levels of biological activity; remoteness from sources of bottom water and strong vertical water column mixing; and distance from areas of present or possible future human activity such as fishing grounds or concentrations of minerals or hydrocarbons. Reportedly, using these criteria, the Navy has selected two "generic" disposal sites on the abyssal plain for study. The Pacific site is located approximately 160 nautical miles southwest of Cape Mendocino, California, just north of the border between the Mendocino and Pioneer Fracture Zones in approximately 4,200 to 4,500 meters of water. The second site lies at 5,000 meters, some 200 nautical miles southeast of Cape Hatteras, North Carolina (see site location charts).

Pathways for Radioactivity

Predictions of how radioactivity could reach humans are shaped by the interaction of physical and biological elements of the food chain in the marine environment. These factors comprise a complex, interrelated network of life which starts with the most basic forms of life and continues on to feed larger forms of life. Chemical and radioactive contamination can move up this food chain to reach humans through the ingestion of fish.



Proposed generic study areas in relation to major physiographic features of the western North Atlantic ... (after ..., 1959)



Proposed west coast generic study areas (black) in relation to major physiographic features of the eastern North Pacific, and to the approximate position of the 200 nautical mile limit (dashed).

Physical/Chemical Elements

Some physical and chemical factors influencing the movement of radioactive materials from submarines into the marine environment are: corrosion of radioactive components of the submarine (the reactor and its cooling system), currents at the disposal site and the nature of the sediments.

How much radioactivity is in the submarine? According to the Navy, each submarine will contain about 50,000 curies* of residual radioactivity at the time of disposal.[5] Although the fuel elements will have been removed and the reactor scrubbed, normal operation of the reactor induces the formation of radioactive activation products in structural components. In the submarine these activation products will be primarily in the pressure vessel walls and as "crud" or corrosive buildup in the primary cooling system.[6]

What elements will be present? Although the Navy has released very few specifics about the reactors in the submarines, it is safe to assume that they are comparable to land-based pressurized water reactors. Thus, at the time of disposal the predominant activation product will be cobalt-60 with a relatively short half-life of 5.26 years. However, recently in connection with land-based reactors, concern has been raised over the presence of niobium-94 and nickel-59 in significant quanitities.[7] Because of their long half-lives of 20,300 and 80,000 years respectively, they would continue to generate substantial doses of radiation.

Corrosion is the primary mechanism for release of radioactivity into the environment. If the submarines arrive at the bottom intact, corrosion will be the initial mechanism of release of radioactivity into the marine environment.[8] The Navy has continually stressed the use of corrosion resistant materials in the fabrication of the submarine and the reactor will contain the radioactivity until it has decayed to "innocuous levels." However, studies conducted at the sites of the USS THRESHER and USS SCORPION in the late 1970's indicated detectable levels of cobalt-60 above normal baseline values in the surrounding sediments.[9] Although the conditions of sinking were different, it appears that corrosion is a sufficient mechanism to release radioactivity from submarines into the environment.

Part of the rationale for choosing sites on the abyssal plain is the belief that the deep ocean bottom is relatively free of current. Current would tend to transport and disperse the radioactive materials from the dumpsite to areas frequented by humans or components of the food chain. Recent evidence has shown substantial bottom currents can be found at the "generic" disposal sites. In addition, corrosion rates can be affected by the temperature and composition of the surrounding water. Thus, better understanding of current patterns is necessary to predict the movement of radioactivity in the marine enviroment.

Reports of oceanographic research at the "generic" sites have not been released by the Navy. Oregon State University and the University of Rhode Island have been conducting oceanographic research for the Navy at the Pacific and Atlantic sites respectively for a number of years. Some of the sub studies have been completed for years[10] and some elements of the research have been discussed at gatherings of academic scientists.[11] But the Navy's refusal to release other components of its research program led to a series of Freedom of Information requests by California and conservation group leaders. Although the Navy refused these requests, a number of sub studies have recently been released and additional information is expected to accompany the Draft Environmental Impact Statement. It is not known whether all of the Navy's research will be made available through this effort.

*The curie is a measurement of the activity of a radioactive material. One curie is equal to 3.7×10^{10} disintegrations/second. By itself the curie is not a measurement of the biolocial effectiveness of radiation.

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The Navy has stated that "relevant" reports will be released with the DEIS. However, it will be difficult to adequately consider this data, essential to corrosion and dispersion calculations, during the brief comment period. Even if data for the Pacific site are made available, much further research will be necessary to form an integrated picture of yet to-be-proposed dumpsites in larger ocean circulation patterns.

Biological Elements

Even if models could be accurately constructed to describe the physical processes governing the release and dispersal of radioactivity, biological models of transport pathways and transfer rates are still very primitive due to a lack of data and the complexity of the marine ecosystem. At present we know very little about the composition, ecology, sensitivity and bioaccumulation of the biota in the deep ocean. Without knowledge of these parameters it is impossible to calculate the potential damage radiation does to the marine environment and humans from future dumping.

Little is known of potential biological "short-circuit" pathways which might allow radioactivity to move quickly from the ocean bottom to commercial fish species. These facts present a compelling need for additional biological survey work.

Knowledge of the composition and ecology of disposal site biota is limited. Accurate predictions about the transfer pathways of radioactivity must rely heavily on data on the composition and ecology of the organisms at the scuttling sites. However, because sampling at such great depths is both expensive and difficult, very little is known about abyssal community structure and distribution.

Infrequent and inaccurate sampling underestimates the importance of large animals. The sparseness of sampling stations and inaccuracies

inherent in the current sampling methods are believed to underestimate the number of mobile organisms such as crustaceans, molluscs and fish. Because some of these species tend to accumulate large amounts of radioactivity in edible parts, they could form a direct link from the food chain to humans in the future.[12]

The abyssal community may be very sensitive. It is generally acknowledged that a large number of different species live in the abyss, although in very low densities. The stable conditions of the abyss may result in populations being sensitive to slight perturbations in their environment. In this respect, the deep ocean has been compared to the fragile environment of the desert.[13] If damage did occur from releases of radioactivity, the slow growth rate of many abyssal species would entail long recovery periods.

Minimal data on the behavior of organisms of the abyss are available. Basic biological data on diets, feeding habits, growth rates, mobility, replacement rates and migration patterns of abyssal species are notably lacking. These data may also vary according to the stage of development of the organism. Some mid water pelagic fish, for example, have eggs which sink and lie on the ocean bottom at great depths during development. Returning to shallow water, juvenile fish may serve as a brief pathway for radioactivity to reach humans. Further, experience with previous radioactive dump sites and with oil rigs indicates that any structure or object on the sea floor serves as an artificial reef, attracting new communities of fish and invertebrates. A serious concern which merits attention is the role this "artificial reef effect" will play in the transfer of radioactivity from waste forms to organisms. Typically, artificial reefs provide breeding and nursery habitats for a complex variety of reef fish. The presence of radioactivity may transform the reef structures into a subtle instrument of long term harm to marine life.

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Radioactive sediments would be at the base of the food chain. Feeding habits are very important in consideration of the Navy proposal because many abyssal species are deposit and detritus feeders. These organisms directly consume the bottom sediment which has been shown to concentrate radioactivity through adsorption.[14] This is possibly a first link between the physical environment and the food chain. Bioturbation, or biological activity in sediments, can also influence the availability and form of radioactivity. Very little research has been done to clarify the interactions between the sediment and its residents.

The amount of radioactive uptake in organisms at the disposal sites is not known. Biological uptake, retention and tissue distribution of radioactive materials is specific to each element and its chemical form as well as the species. Organisms can directly assimilate radioactive elements from the surrounding seawater or they may indirectly assimilate them after they have been concentrated by chemical or physical mechanisms, or through intermediaries in the food chain. To date, the bulk of data measuring these relationships is not directly applicable to the submarine program because of differences in organisms and radioisotopes studied.

Bioaccumulation by deepwater species has not been studied. Most laboratory and field studies on the accumulation of radioactive elements have utilized coastal or shallow water species. It has been assumed that the processes worked in a similar manner in abyssal species although at a slower rate. However, it has not been verified that these data are applicable because behavioral and metabolic differences could account for wide ranges in uptake and retention.

Little research has been conducted on the elements in the submarines. The major portion of existing in situ marine radioecological studies concern the cycling of elements from the fallout of nuclear weapons detonations and some monitoring of former dumpsites.

The radioecology of activation products has been studied to a much lesser extent under true environmental conditions. Laboratory conditions are often far removed from those which might be encountered at the sites. Because the transport and transfer pathways differ greatly with different elements, it is not necessarily valid to extrapolate existing data to the radioactivity in the submarines. It is evident that much more research is needed on the biological pathways of such elements.

There are ambiguities and problems with the definition of uptake and bioaccumulation. The tendency of an element to bioaccumulate is generally expressed in terms of a concentration factor defined as the ratio between the concentration in organisms and the concentration in sea water of radioactivity. There are several problems, however, with this definition and its use in predictive models. Many models consider only the concentration of a radioactive element in seawater, since it was originally thought that radioactivity was diluted in seawater and then diffused throughout the ocean. However, more recent research indicates that some radioactive isotopes are adsorbed onto particles of bottom sediment and are then available for ingestion by bottom dwelling organisms.

Some elements tend to accumulate in specific tissues, affecting doses. The concentration of the radioisotope within the body of an organism may also vary from one tissue to another. Strontium-90, niobium-94 and plutonium tend to accumulate in bone tissue while cesium-137 generally concentrates in soft tissue such as muscle. Because in many cases the entire animal is not eaten, the individual tissue concentrations should be used in calculating the dosages to humans. In addition, some organisms such as polychaete worms and molluscs concentrate radioisotopes as a by-product of their feeding or growth.

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Existing baseline monitoring studies necessary to measure changes in radioactivity levels are inadequate. Studies of baseline concentrations of radioactive water and sediments, as well as the food chain, are a central component of any attempt to model mechanisms of bioaccumulation and cycling. Without data on background levels of radiation due to fallout and natural source, it is impossible to measure changes in levels of radioactivity in any component of the ecosystem. However, very little monitoring has been done, or is planned in the future, to establish a comprehensive database.

The EPA has, in fact, acknowledged this, noting "more data is needed on baseline levels of radionuclides of a geographical area if meaningful estimates are to be made of radical movement of any radioactive materials released from the dumpsite."[15]

Health Effects of Radiation

Background radiation is always present on earth. Humans are constantly exposed to a background level of radiation emanating from terrestrial, cosmic and internal causes. Potassium-40, a radioactive isotope of potassium, for example, occurs naturally and comprises a small percentage of the potassium always present in our bodies. Nuclear fallout also contributes to this background level of radiation. It is estimated that the average person is exposed to a yearly dose of 110 rems,* although this figure may be twice as high at greater elevations because the atmosphere provides less shielding from cosmic rays.[16] In addition, standard medical procedures such as x-rays contribute to normal exposure.

Radiation damage is manifested in various ways. Radiation causes damage by charging the atoms and molecules in its path and transferring its energy to biological tissues. Damage from radiation is manifested in humans in various ways depending on the rate, type of exposure, and the body area involved. A brief list of radiation related effects includes: lens opacities, birth defects, chromosomal damage, and growth and development deficiencies, as well as leukemia and other forms of cancer.[17] Although poorly understood at this time, there are possibly somatic effects which occur long after initial radiation exposure.[18]

*The rem is a measurement of damage to tissue due to radiation exposure. (One mrem equals 1/1000 of one rem). For comparison, a chest x-ray equals a dose of approximately one-tenth (to one-third) of one rem. (See also Gofman, J.W., and Tamplin, A., Radiation and Human Health, San Francisco, Sierra Club Books, 1981).

Low doses of radiation are more damaging than previously believed. Most data on the bioeffects of radiation come from research on large dose exposures such as those resulting from nuclear bomb blasts. Until recently it was believed that the effects of low dose could be extrapolated linearly from these data. However, considerable controversy has arisen, and it now appears that low doses are significantly more harmful than originally projected using this method.[19] Until we have a clearer understanding of what these dose/effect relationships really are, it is not possible to estimate the severity and permanence of damage due to contamination of the food chain.

Unanswered Questions

Predictions of environmental and human health effects of nuclear submarine disposal at sea are based on our limited understanding of radioactivity within the marine environment. This briefing report outlines some of the scientific questions the Navy must address to adequately assess the "ocean alternative." The Navy's initial review of this option is expected to be released in the form of a Draft Environmental Impact Statement (DEIS) in late 1982.

Copies of the DEIS can be requested from:

Captain Edward F. Wagner
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

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If you wish to participate in Navy consideration of this plan, you should request, review, and comment upon the Draft Environmental Impact Statement. The Oceanic Society is working to empanel a special Scientific Advisory Committee to analyze and comment upon the DEIS. We will keep interested persons and organizations informed of the Committee's deliberations and conclusions. For more information on this process, please contact the Society in Stamford, CT at (203) 327-9786 or in San Francisco, CA at (415) 441-1104.

In reviewing the DEIS, you may consider whether adequate, comprehensible answers have been developed to questions on:

* human health effects of exposure to low levels of radiation released into the marine environment over long periods of time;
* whether the cumulative effect of exposure to all sources of radioactivity affecting the marine environment are adequately reflected;
* adequacy of baseline data on levels of radioactivity in sediments, water and marine life at existing as well as proposed marine nuclear waste disposal sites;
* documentation of ocean current patterns throughout the year at existing and proposed nuclear waste disposal sites;
* delineation of interrelationships between circulatory patterns at existing or proposed disposal sites and the oceans;
* quantification of corrosion rates reflecting seasonal variations which will control release of radioactivity from submarines;
* justification of theories designed to forecast release, movement and dispersal of radioactivity in the marine environment;
* description of abyssal fauna composition, ecology and physiology;
* prediction of bioaccumulation and tissue distribution of waste-related isotopes in abyssal and other marine animals;

* whether the transport mechanisms of radioactivity from previous disposal sites to food fish and humans are sufficiently well understood to permit accurate prediction of impacts from submarine disposal on humans; and
* determination of human health impacts based on understanding of the movement of radioactivity in the marine environment and documented through study of old U.S. dumpsites.

Summary Concerns

Only once these questions have been clearly answered with adequate scientific information can we intelligently consider the Navy's disposal proposal. Theoretically, the Navy will address these and related concerns in their DEIS. Comments on the Draft Environmental Impact Statement will reflect the Navy's success in this effort. Until answers based on sound science are at hand, it is premature to declare the "ocean alternative" a viable option for disposal of any nuclear wastes. Instead, radioactive waste should be confined to terrestrial sites where disposal technology is more advanced and mistakes more easily reversed.

This position is consistent with the Oceanic Society's stated policy of opposing disposal of any nuclear waste in the marine environment until:

1. A single, coordinated, comprehensive nuclear waste management program is established by the federal government as the responsibility of one agency.

2. An increased program of scientific study, evaluation and continued monitoring has been obtained. This effort must include monitoring for radioactivity of fish taken for human consumption from both disposal sites and the open sea as well as samples collected from retail markets.

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3. Criteria are established for marine disposal of nuclear waste which include as high priorities provisions for continued monitoring of disposal at new as well as existing sites. Standards for retrieval of these wastes must also be established.

4. Federal regulations mandate the best available technology of packaging, transport and disposal of these wastes.

5. Marine disposal of nuclear wastes is considered only when it can be demonstrated that sea disposal offers less harm to human health and the environment than other practical alternative methods of disposal.

(This paper reflects the research of Clifford Hume, an undergraduate at Carlton College, during a summer internship with the Oceanic Society under Dr. Michael J. Herz, Executive Vice President. Dr. Herz, Thomas C. Jackson and Christopher Roosevelt participated in writing the final paper.)

Revised 12/10/82

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samples from the North East Pacific Ocean, off the coast of California; 9) LLWODP Geotechnical survey: Doppler Penetrometer Data (memo); 10) Data report for current meters on mooring CHMW 1, 1979 to 1980, Pacific Study area W-N (OSU 6); 11) Data report for current meters on mooring CHMW-2 and CHMW-3 1980-81: Pacific study area W-N (OSU-10); 12) Cruise report for R/V Wecoma cruise WA103 A to Pacific study areas W-N, March 1981 (OSU-9); 13) Cruise report for R/V Wecoma cruise - WA109-B to Pacific study area W-N, August through September 1981 (OSU-11); 14) Cruise Report for R/V Thompson cruise TT-141 II: Pacific study area W-N: deployment of current meter moorings CHMW-1 and corrosion experiments OC2-2 and OC2 3: August 1979 (OSU 4); 15) Cruise report, Golden Fleece, October December 1981, area W-N (OSU-12); 16) Pre-cruise analysis: the Hatteras study area (URI-1); 17) Cruise Report, R/V Endeavor cruise EN-053, low level waste program, North Atlantic study areas E-N2 and E-N3, July 26 to August 15, 1980 (URI-2); 18) Final report of 1980 field program (EN-053) (URI-3); 19) Preliminary analysis of northern Hatteras abyssal plain sediments (URI-4); 20) Cruise report, R/V Endeavor cruise EN-069 North Atlantic, June 19-July 4 1981 (URI-5); 21) Cruise report R/V Endeavor Cruise EN-071, North Atlantic August 8-18 1981 (URI-6).

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June 27, 1983
2236 Alameda
San Mateo, Ca. 94403

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
Department of The Navy
Washington, D.C. 20350

Dear Captain Wagner:

I would like to take this opportunity to protest any dumping of radioactive waste in the ocean. The idea of radiation leaking into the ocean should be abhorrent to all of us. How can anyone plan for a future for themselves or their children, with the threat of ocean contamination hanging over them?

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I urge you to extend the Draft Environmental Impact Statement comment period for 90 days. Also, local hearings - especially in the vicinity of Eureka and Fort Bragg would be desirable.

J.15

Sincerely,
Mrs. J. Stassinos

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2236 Alameda
San Mateo, Ca. 94403
June 28, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV - .)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Please extend the comment period on the Draft Environmental Impact Statement for another 90 days. I feel that a lot of the problems have not yet been addressed on the results of dumping submarine reactor plants in the ocean. The radiation from these submarines can certainly be very hazardous to everyone's health as well as a source of contamination to the environment.

Giving local residents a chance to voice their opinions, especially in Eureka and Fort Bragg, would be most desirable. J.15

Sincerely,
Jill Stassinos
Jill Stassinos

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STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

June 28, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington, DC 20350

Dear Mr. Wagner:

N.3, W.1, L.1, J.76 The State of Connecticut, Department of Environmental Protection has reviewed the Draft Environmental Impact Statement on the disposal of decommissioned, defueled naval submarine reactor plants. Our primary concern is that the Navy will select the ocean disposal alternative on the basis of lower cost despite several potential disadvantages of this option. The principal negative factors are the impossibility of retrieving submarines disposed of on the ocean floor, the lack of knowledge about the environment of the ocean abyss and the costs of very long-term monitoring.

The DEIS states that retrievability would not be feasible with current technology. Before such an irrevocable action is taken, all alternatives, even those more costly, which would allow better control of potential radiation releases, should be found to be impracticable.

O.26 Past attempts to dispose of unwanted material by 'throwing it away' in a manner that precluded future management have resulted in serious environmental problems unforeseen at the time of disposal (e.g. wastewater discharges to rivers, uncontrolled burying of chemical waste). A more costly disposal method, which permitted better management with ability to respond to as yet unknown future developments, could be more cost effective in the long term than the cheaper 'dump it in the ocean' plan. Disposal of radioactive waste may be even more serious than the previous examples, given the long life of the material.

U.1, L.55 The limited knowledge of the functioning of the abyss ecosystem should also preclude any rash decision to dispose of wastes there. As stated on page 3-11, "the biology of the deep waters and the sea floor, which are not exploited commercially, is little known at present." For example, there might be as yet undiscovered links between abysmal biota and species utilized by man. In addition, the artificial reef effect, often observed in shallower waters, could occur in this situation, attracting increased numbers of larger, mobile species. These same species are often underestimated using the infrequent and intrusive sampling techniques presently being employed.

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Alternatively, organisms of the abyss may be especially susceptible to radioactive releases, so that the proposed disposal could jeopardize the efficient functioning of the entire ecosystem. In short, given the present lack of knowledge of the abyss ecosystem, any disposal plans which would affect it should be delayed until further research is completed. L.13

The DEIS also appears to be deficient in its discussion of monitoring of future radioactive releases. Because significant radiation releases can be expected whenever the containment is breached, an event expected to occur 100 years after disposal (or when currents flow through reactor at 400 years), monitoring must be carried on throughout this time period and well beyond. The $9 million price assigned to this task appears to be significantly underestimated, given the time period. In addition, institutional impediments to such a long-term project, almost twice the period of this country's existence, have not been explored. J.76 J.79

In summary, because of the risks and the uncertainties of the ocean disposal option, the Connecticut Department of Environmental Protection recommends adoption of the protective storage option until additional studies are completed which would include more definitive baseline data on the biota of the ocean abyss and accurately portray the costs of a very long-term monitoring program. Alternative, land-based disposal options should be thoroughly assessed in a similar manner before a final decision is reached. G.2

Thank you for the opportunity to comment on this project. If you have any questions, please contact me.

Sincerely,

Arthur J. Rocque, Jr.
Director
Planning and Coordination/Coastal Management

AJR/CF/mic

cc Christopher Roosevelt, Oceanic Society

1036

#698

May 16, 1983

Dear Captain Wagner,

I am writing against the proposed nuclear dumping of radioactive wastes off the coast of Mendocino. My husband and our three children have lived outside of Ukiah on a family homestead for 10 years. As county residents and future grandparents we are alarmed about the uncertainty of the radioactive materials leaking into the ocean.

L.20

This uncertainty is admitted in the Navy's Draft Environmental Impact Statement in these words "Since the maintenance of containment integrity is not 100% certain." We cannot know the long term effect of radiation. Let's not as American people of the 20th century condemn future generations to suffering or perhaps extinction. Thank you for reading this.

Sincerely,

Yvonne Kramer
Marvin Kramer

Yvonne and Marv Kramer
9050 Orr Springs Rd
Ukiah Ca. 95486

#699

ENERGY
RESEARCH
FOUNDATION

June 30, 1983

Capt. Edward F. Wagner
United States Navy
Office of the Chief of Naval
Operations (ONAV-22)
Department of Navy
Washington, DC 20350

RE: Comments on the Navy's Draft Environmental Impact Statement of December 22, 1982, concerning the disposal of decommissioned nuclear submarines

Dear Captain Wagner:

L.53 Energy Research Foundation endorses the comments of the Oceanic Society opposing ocean disposal of decommissioned nuclear submarines. We are particularly concerned about the economic viability of South Carolina's Grand Strand beach area centered around Myrtle Beach, whose tourism industry is a major part of our state's economic base.

E.12 Concerning possible land disposal, given the fact that corrosion is the major pathway for radioactive materials from the reactor vessels to enter the environment, and the fact that South Carolina receives a relatively high amount of annual rainfall, Energy Research Foundation further opposes disposal at the Savannah River Plant. Land disposal of the submarine reactor vessels should only occur in an arid or semi-arid environment.

Energy Research Foundation is a privately-funded, non-profit, operating foundation conducting research and educational activities on a wide range of energy, environmental, and economic development issues. Statewide, Energy Research Foundation has over 1,000 contributors of money or time to our efforts.

Sincerely,

John M. Lawson
Executive Director

JML/js

2530 Devine Street
Suite 201
Columbia South Carolina [illegible]
803 256 [illegible]

cc: Mr. Tom Jackson
The Oceanic Society
Stamford Marine Center
Magee Avenue
Stamford, CT 06902

Mr. Fred Brinkman
Director
S.C. Department of Parks, Recreation & Tourism
1205 Pendleton Street, Suite 110
Columbia, SC 29201

Dr. John Stucker
Office of the Governor
P. O. Box 11450
Columbia, SC 29211

Mr. Ashby Ward
Executive Vice President
Myrtle Beach Chamber of Commerce
P. O. Box 2115
Myrtle Beach, SC 29578

#700

COMMONWEALTH of VIRGINIA

Council on the Environment

SHEILA M. PRINDIVILLE
ADMINISTRATOR

[illegible] NINTH STREET OFFICE BUILDING
RICHMOND 23219
[illegible]

June 28, 1983

Captain Edward F. Wagner, USN
Office of the Chief of Naval
Operations (OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

The Commonwealth of Virginia has completed its review of the Draft Environmental Impact Statement on the Disposal of Decommissioned, De-fueled Naval Submarine Reactor Plants. The Council is responsible for coordinating the State's review of federal environmental impact statements and responding to appropriate federal officials on behalf of the Commonwealth. The following agencies took part in this review:

Department of Health
Marine Resources Commission
State Water Control Board
Virginia Institute of Marine Science.

J.9 It is apparent from extensive study of this matter that the Draft EIS does not adequately support a decision to dump in one of the Atlantic Ocean sites proposed in the document. The Lower Continental Rise site (page 3-7, figure 3-5) off Virginia and North Carolina is subject to strong periodic currents that sweep toward the 1000-meter isobath off North Carolina and contains some large migratory fish. Because of the dense layer of suspended particulate matter that characterizes these currents (the Western Boundary Undercurrent), it is entirely possible that radionuclides could be transported away from the disposal site into food webs in this area. Large migratory fish are common here, as well. For these reasons, the Commonwealth strongly recommends that the Lower Continental Rise area be removed from further consideration.

The concept of ocean disposal of nuclear submarine reactors, however, should not be rejected out of hand. Because the deeper water contains much lower populations of benthic organisms, it would be advisable for the Navy to concentrate the Atlantic Ocean portion of its research effort on the Hatteras Abyssal Plain area.

Of particular importance is further work on bottom currents there, particularly in the southeast corner (which seems geologically most acceptable), and a survey of the benthic and benthopelagic nekton. Use of abyssal areas such as the Hatteras Abyssal Plain should be pursued only after adequate studies are made of specific sites in question. Much remains to be done at the Hatteras site discussed in this Draft EIS. (For a more detailed discussion of these concerns, please refer to the attached comments from the Virginia Institute of Marine Science (VIMS).)

Until research such as that suggested by VIMS provides a sound indication of the extent and severity of the ecological consequences of ocean dumping, it would seem unwise to proceed with the ocean disposal alternative since the nuclear reactor compartments, once dumped, will not be retrievable. A premature decision to dump the reactor plants would convert an uncertain but avoidable impact to one which is unavoidable and inevitable, and possibly severe. On the other hand, if the land disposal option is chosen, retrieval would be possible, if necessary. W.1

The enclosed comments provide additional information that the Navy should use in developing the Final EIS and in coming to a decision on this matter.

Thank you for the opportunity to review this document. We look forward to reviewing the Final EIS.

Sincerely,

Sheila M. Prindiville

Sheila M. Prindiville

Enclosures

cc: The Honorable Charles S. Robb, Governor of Virginia
The Honorable Betty J. Diener, Secretary of Commerce and Resources
Mr. Thomas A. Barnard, Jr., Virginia Institute of Marine Science
Mr. Brian D. Harrison, State Water Control Board

#700 (Cont)

COMMONWEALTH of VIRGINIA

Council on the Environment

SHEILA M. PRINDIVILLE
ADMINISTRATOR

NINTH STREET OFFICE BUILDING
RICHMOND 23219
804-786-4500

June 21, 1983

MEMORANDUM

TO: Sheila M. Prindiville

FROM: Charles H. Ellis III

SUBJECT: Navy Draft Environmental Impact Statement (Draft EIS) on the Disposal of De-commissioned, De-fueled Naval Submarine Reactor Plants

I have reviewed this Draft EIS and my comments follow. Page references are to the Draft EIS.

The Navy operates approximately 120 nuclear submarines at present, and anticipates taking as many of 100 of these out of service in the next 20 to 30 years. The Draft EIS indicates that a decision concerning disposal will have to be reached by the end of this decade, when storage space at inactive ship facilities becomes insufficient (page 1-8).

The Navy contemplates preparing submarines for disposal by removing their reactor plants from the centers, removing salvageable ship equipment, and dumping the shells in the ocean. The reactor plants would be disposed of on land or in the ocean. The decision as to which is the subject of the current Draft EIS. Preparations for disposal would take place at a shipyard currently involved in radiological work: there are six such Navy shipyards (four on the East Coast, one of which is at Norfolk), and two such commercial shipyards (both in the East, one at Newport News). The land disposal alternative would use one of two Department of Energy sites at Savannah River Plant, South Carolina or at Hanford, Washington. Ocean disposal study areas are about 160 miles west of Cape Mendocino, California and about 250 miles offshore of Cape Hatteras, North Carolina. In the Atlantic Ocean, the "Lower Continental Rise" area is bifurcated by the 200-mile limit east of Hatteras, while the "Hatteras Abyssal Plain Area" is just beyond the 200-mile line south of the Lower Continental Rise Area. These sites meet disposal criteria of the International Atomic Energy Agency (pages 3-6 through 3-8).

MEMORANDUM
Page 2

The Draft EIS suggests that land and ocean disposal alternatives would have "negligible environmental impacts" and indicates that cost savings, expected to be about $2 million per ship, tend to favor ocean disposal (page 4-26). However, the document concedes that the materials involved would not be retrievable with current technology if dumped in the ocean, and that use restrictions on parts of the ocean floor would be necessary (pages 2-12, 2-13). The nature of the ocean floor and environs in the proposed locations is still being studied; we have reason to believe that the Lower Continental Rise Area in particular is not a good choice of site for disposal (please see the Virginia Institute of Marine Science comments, 6th and 7th pages), and it is not certain that disposal risks are as low as the Draft EIS seems to portray generally. Additional research along the lines suggested by the Virginia Institute of Marine Science might indicate that the reactor plants, which weigh roughly 1,000 tons apiece when separated from their ships (page 2-5), would do harm to the marine environment; a premature decision to dump the reactor plants would convert an uncertain but avoidable impact to one which is unavoidable and inevitable and possibly severe. On the other hand, if the land disposal option is chosen, retrieval would be possible if necessary.

The inability to retrieve reactor plants disposed of in the ocean sites under consideration would also constitute an obstacle to the Navy's procurement of a dumping permit from the Environmental Protection Agency, if one is required, since the Navy would not be able to comply with the requirement that it file a plan to remove or contain the material in the event of a leak in the container (section 104(i)(1)(E) of the Ocean Dumping Act of 1983, PL 97-424).

The Navy recognizes that corrosion of the reactor compartment is the principal mechanism for release of radioactivity into the environment, irrespective of the alternative disposal method under consideration. However, the Draft EIS dismisses the possibility of land disposal options other than the Hanford and Savannah River permanent burial ideas (page 2-16). Corrosion of the reactor compartments would take place much more slowly if the reactors were buried or stored in an area where the soil and air are relatively dry, and it is unclear why there was no consideration of the possibility of government purchase of land in an arid region for use as a disposal site. The Final EIS should discuss this possibility and analyze it from the standpoints of corrosion potential, retrievability, and transportation feasibility. H.3

In conclusion, it would appear that much more work needs to be done by the Navy in regard to understanding the ramifications of this disposal program before any decisions are made or actions taken with respect to nuclear submarine reactor disposal.

#700 (Cont)

CHARTERED 1693
COLLEGE OF WILLIAM AND MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE

June 17, 1983

Gloucester Point, Virginia 23062 Phone (804) 642-2111

Mr. Charles H. Ellis, III
Environmental Impact Statement Coordinator
Council on the Environment
903 Ninth Street Office Building
Richmond, Virginia 23219

RE: DEIS, Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Dear Mr. Ellis:

Please find enclosed the comments of the Virginia Institute of Marine Science for the referenced document. These comments have been prepared by Dr. J. A. Musick and address marine environmental concerns only. We would like to see Dr. Musick's detailed comments incorporated or discussed in the final EIS document.

J.9 In summary, it is our recommendation that the Lower Continental Rise Site be removed from further consideration as a disposal area for the defueled reactor plants. The Lower Continental Rise site off Virginia and North Carolina is subject to strong periodic currents that sweep toward the 1,000 meter isobath. In addition, large migratory fishes are fairly common there. Several mechanisms exist for the transport of radionuclides away from this disposal site and into important marine food webs.

The concept of ocean disposal of nuclear submarine reactors should not be rejected out of hand, however. Because the deeper waters of the Hatteras abyssal plain may contain much lower populations of benthic organisms and be more stable geologically, we recommend that the Navy concentrate its research effort in this area. Before any decision is made regarding ocean disposal in this area, we feel that further research is required particularly on the bottom currents and the benthic and benthopelagic nekton of the site.

If I may answer any questions regarding these comments please do not hesitate to contact me.

Sincerely yours,

Thomas A. Barnard, Jr.

Thomas A. Barnard, Jr.
Associate Marine Scientist

TAB/jh
enclosure

#700 (Cont)

Comments to the United States Department of the Navy on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants.

by

J. A. Musick
Senior Marine Scientist

Virginia Institute of Marine Science
School of Marine Science
The College of William and Mary
Gloucester Point, Virginia 23062

March 1983

Marine Resource Report #83-2

My comments will deal primarily with biological phenomena or with pertinent physical or geological information published in the literature but omitted or ignored in the E.I.S. I am not qualified to evaluate the engineering aspects of this E.I.S. and have assumed that the models presented for corrosion, sinking and impact, etc. approximate real conditions. In addition most of my comments will concern the Atlantic disposal sites which are located in a deep-sea area with which I am reasonably familiar (Musick, 1976, 1979a; Musick, et al, 1975 Musick and Sulak, 1979; Markle and Musick, 1974; Sedberry and Musick, 1978; Wenner and Musick, 1977).

Two Atlantic disposal areas have been proposed: The Lower Continental Rise Area off Virginia and North Carolina (72° 22.5'W-70° 30'W, 34° 45'N 37° 0.7.5'N), and the Hatteras Abyssal Plain Area southeast of Cape Hatteras North Carolina (71°W-75°W, 31°N-36°N). Both of these areas appear to satisfy the generic requirements for selection as radioactive waste dumpsites outlined on page 3-6 of the E.I.S. However, there are several potential problems that have not been addressed or convincingly resolved particularly with regard to the Lower Continental Rise Area. I shall deal with these in order below: J.4

1. The E.I.S. draws heavily on a theoretical model for physical-biological transfer proposed by Robinson and Mullin at a workshop supported by Sandia in 1981 (Mullin and Gomez, 1981). Based on this model the E.I.S. states (page H-3 and elsewhere): "the transport of radionuclides from the ocean bottom to the surface reveals that biological transport is one-thousandth of the physical transport". The E.I.S. fails to note that this model was severely criticized by other working groups at the same workshop.

For instance, the Radioecology group wrote: "... it appears to us that too much emphasis is being placed on large-scale physical oceanography models and not enough on simple submodels of the biological and radioecological aspects of the radionuclides themselves." The Robinson-Mullin model is predicated on nuclides entering the water above a disposal site with the subsequent transport of the nuclides in the water away from the site. The E.I.S. uses the same sort of model (Appendix H) even though it states: "It is anticipated that a large fraction, perhaps as high as 95 percent of the corrosion product particles carrying radionuclides would settle to the ocean floor either through direct deposition or by removal by the detritus particles" (pp H-2, H-3). If this assertion be true, nuclide ocean dispersal models based on simple eddy diffusivity seem to be inappropriate. Rather, bioaccumulation within the benthos and subsequent concentration within benthopelagic predators may provide a more important pathway for dispersal of nuclides like Ni-59 away from abyssal dump sites. U.5

2. The Lower Continental Rise Area is located in a region heavily influenced by the Western Boundary Undercurrent (WBUC); a point mentioned but not stressed in the E.I.S. The WBUC is characterized by a dense layer of suspended particulate matter called a nepheloid layer (Eittreim et al, 1976) which is maintained and transported by the current to the southwest. Cardiner and Sullivan (1981) recently discovered that such nepheloid layers in the deep sea may be subject to frequent and sudden increases in density caused by benthic storms. These density increases may be caused by resuspension of sediments during the passage of severe atmospheric storms. Radionuclides adhering to sediment particles could be resuspended, by benthic storms and carried by the nepheloid layer toward the continental slope to the southwest off North Carolina. The E.I.S. states that the WBUC is deeper than 1800 m. J.4, J.5

This is incorrect. The WBUC sweeps to within the 1100 m isobath off North Carolina (Rowe and Menzies, 1968). Physical transport of radionuclides adhering to sediment particles transported by benthic storms might be orders of magnitude higher than that calculated on the basis of eddy diffusion models in the E.I.S. Models including inputs for transport mitigated by benthic storms directly to the 1000 m isobath off North Carolina should be included in the final E.I.S. J.4, J.5

3. Radionuclides introduced into the nepheloid layer could enter benthopelagic food webs. Such webs are probably very important in the deep sea (Marshall and Merrett, 1977; Sedberry and Musick, 1978) and the biomass of benthopelagic organisms may equal or exceed that of benthic organisms in some deep sea regions. Transport of radionuclides by components of food webs may be important in two ways: U.5

a. The dominant benthopelagic predator/scavenger on the lower continental rise off Virginia and North Carolina is a large rattail fish, Coryphaenoides armatus (Musick and Sedberry, 1979). Although we have studied the fishes in the vicinity of the Lower Continental Rise Area for ten years and have found C. armatus to comprise as much as 90% of the biomass of fishes deeper than 2800 m, we have never captured any individuals with fully ripe gonads, nor have we captured more than a few small individuals (Middleton, 1979). We have suggested that C. armatus may migrate to boreal latitudes to spawn, as one of its congeners is known to do (Musick and Sulak, 1979). Most macrourids including C. armatus lay large numbers of pelagic eggs that probably develop in the upper part of the thermocline. These eggs may provide a means by which radionuclides could be transported from the abyss into epipelagic ecosystems. Also, it is significant that C. armatus has been shown to concentrate Ni (at least in its liver) (Greig et al, 1976) because Ni-59 is the isotope of critical interest in the current E.I.S.

U.5 In summary, C. armatus could concentrate Ni-59 while near the dump-site, then subsequently migrate to boreal latitudes where its nuclide-contaminated eggs could be introduced into epipelagic food webs. The significance of such a transport route is not clear because of lack of information about residence time of individual fishes and nuclide uptake rates. We currently have sufficient data to estimate standing stocks of C. armatus near the Lower Continental Rise Area but not to estimate production or flux through the area.

An effort should be made to collect information on such parameters, and then appropriate models can be tested.

U.5 b. Radionuclides in the nepheloid layer that are carried to near the 1000 m isobath could be incorporated into mesopelagic, benthopelagic, or benthic food webs there. All three food webs can lead to transport upslope and ultimately into resources consumed by man. Most fishes (and many zooplankters) in the mesopelagic zone (100 m - 1000 m) make vertical migrations toward the surface at night, where they are subject to predation by tunas, billfishes and other predators (Marshall, 1979). Some of the dominant benthopelagic fishes such as Nezumia bairdii and Coryphaenoides rupestris make seasonal upslope migrations from below 1000 m to shallower depths (500-1000 m) (Middleton, 1979). While upslope these species are subject to predation by several large epipelagic predators such as blue sharks (Prionace glauca), and more importantly, sword fish (Xiphias gladius). The latter species is subject to a long-line fishery along the continental slope off North Carolina during the cooler months of the year. Among the benthic fauna, the red crab, Gerynn quinquedens, is a dominant from 400 m to ca 1200 m. The juveniles live >1000 m and make an ontogenetic migration upslope as they grow (Haefner and Musick, 1974; Wigley et al, 1975). The species is the object of a developing fishery and is one of the most important underdeveloped resources off the East Coast. Crustaceans tend to concentrate Ni, but in general, Ni is highest in the chitonous exoskeleton and lowest in edible flesh (Eisler, 1981). U.5

4. The information given in the E.I.S. and supporting documents (Talbert, 1982; and Appendices) about the biology of the Atlantic sites is woefully inadequate. Even much of the pertinent biological literature has not been cited.

5. The development of an exposure pathway model in Appendix I (I-2) is based on an equilibrium situation for isotope release. This might be justified if isotopes went into solution and were dispersed according to the eddy diffusion models criticized earlier. However, if (as the E.I.S. asserts) the major isotope released is Ni-59 as corrosion particles which settle in the sediments close to the submarines, will the build up of Ni-59 in the sediments be at a slower rate than the turnover rates of nickle in these sediments, or will Ni-59 become concentrated there? What are the turnover rates of nickle in the sediments at each of the Atlantic sites? U.5

#700 (Cont)

T.14

6. In Appendix J (J22-24), in the calculation of the "worst case dose commitment", a different method was used to compute the hypothetical concentration of isotopes in fish. Whereas in other models based on exposure of fish 250 km away from the dumpsite (after considerable dilution of isotopes) a recognized concentration factor of 5 X 10^2 was incorporated to reflect the tendency of fishes to concentrate Ni from the environment (Table: I-3). In the calculation of "worst case dose commitment" where fish are theoretically exposed to relatively higher concentrations of isotopes in the sediments, no concentration factor was used. Instead concentrations of isotopes in fish were calculated on the basis of average Ni concentration found in fish tissues (from the literature). Such measurements are usually given in µg/kg (Young, 1979). To the contrary, Greig et al (1976) showed that C. armatus, (the dominant large fish at the Lower Slope Area) concentrates Ni (.02 mg/kg) at a level an order of magnitude or more higher than that apparently used in the E.I.S.

J.4

In general, the Lower Continental Rise Area is a very poor choice for a nuclear waste site. The area is subject to strong periodic currents that sweep toward the 1000 m isobath off North Carolina. In addition, large migratory fishes are fairly common there. Conversely, the Hatteras Abyssal Plain Area is relatively tranquil (though subject to rare periodic turbity currents). The physical oceanography of this area (so far as known) would tend to minimize transport of isotopes away from a dump site there. In addition, contrary to that implied (out of ignorance) in the E.I.S., the

J.26

fauna at the Lower Continental Rise Area and at the Hatteras Abyssal Plain Area are not essentially the same. Several workers have shown that the benthic macro-invertebrate fauna changes considerably between 4000 and 5000 m (Menzies et al, 1973; Rex, 1981) with lower biomass and diversity in the deeper area. We have no data on fishes from directly within the Hatteras Abyssal Plain Area, but we have trawled at similar depths in the same water mass to the south and east. The fish fauna there is much lower in biomass than on the continental rise, and more importantly, the large migratory predator-scavengers like C. armatus are rare or absent. J.26

My recommendations are to reject the Continental Rise Site, and to explore further the Hatteras Abyssal Plain Site. Of particular importance is further work on bottom currents there, particularly in the south-east corner (which seems geologically most acceptable), and a survey of the benthic and benthopelagic nekton. The latter objective can most efficiently be achieved by using deep otter trawls, although fish traps would be more appropriate for monitoring fishes immediately adjacent to sunken submarines after disposal. J.4 The concept of disposing of nuclear submarines as proposed by the U. S. Navy in the E.I.S. should not be rejected out of hand (as some environmental lay groups have suggested). The deep ocean, particularly the abyssal areas, may provide relatively remote sites where noxious wastes may be disposed of safely. Indeed, some long-lived xenobiotics such as DDT and PCB's ultimately reside in such deep-sea ecosystems after being transported there by natural, meteorological, oceanographic, and/or biological processes (Musick, 1979b). Faunal impact in abyssal areas would probably be insignificant from a demographic point of view. Even if the fauna were disturbed or destroyed over a 100 mi^2 area, a relatively small number of organisms would be involved because energy availability and density of organisms there is among the lowest of all habitable regions on the earth. In addition, the species that occur there have wide distributions over entire ocean basins, or even circumglobal. (Because of such low population densities such species could never support commercial fisheries.) Use of abyssal waste disposal areas such as the Hatteras Abyssal Plain, should be pursued only after adequate studies are made J.4

at specific sites in question. Much remains to be done at the Hatteras Site proposed in this E.I.S.

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#701

The Last Word

Michael Winks

June 30 is the deadline for people throughout the U.S. to have a say in whether the Navy decides to dump obsolete nuclear submarines in the ocean. The sooner we tell them "No!" the better.

One does not have to live near the coast to understand how serious the concept of ocean disposal of nuclear waste is. But people who live inland are less likely to understand the implications of the action.

L.6 The radioactive waste already
disposed near the Farallon Islands
L.14 has begun to leak. This and future
waste have contaminated and will
contaminate ocean life. This in-
L.36 cludes much of the seafood we
eat.

Once radioactive submarines are
disposed of in this manner, they
W.1 cannot be retrieved. Imagine throwing away something you can't change your mind about. Imagine it sinking 12,000 feet. Imagine fish and organisms which live on the ocean bottom mutating. And it gets worse.

So why does the Navy think it's such a great idea? Well, a lot of waste is already being stored in states such as Utah, Wyoming and Nevada. There's a lot of pressure to find a new home for nuclear waste. So the Navy has released a flawed, incomplete document, noting how ocean disposal is cheap and safe.

What this means is a dangerous L.9.
precedent could be set. If people F.8
see ocean disposal of nuclear waste as an easy, cheap answer, catastrophe could result. Our oceans are right now reasonable unspoiled and provide us with an unlimited food source. The oceans are also a valuable source of recreation for all of us. The creatures of the sea have rights, too.

Also, what gives the U.S. the right to bespoil the ocean? We have no territorial claim to its waters. Other countries deserve a say on such a plan.

We cannot let the Navy bluff us by implying there isn't a better plan. Land disposal sites in arid regions are more favorable and can be monitored. If you agree, write to the Department of the Navy, c/o Captain Edward Wagner, Washington, D.C., 20350. We all have a stake in this.

#702

29 June 1983

Captain Edward F. Wagner, U. S. Navy
Office of the Chief of Naval Operations
Department of the Navy
Washington, DC 20350

Dear Captain Wagner:

We are responding to your letters of March 1983 and to the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (December 1982). We request a further time period to respond more fully to the Draft E I S, and request that a general extension of Sixty (60) days be granted for all respondents.

We find two significant points not addressed thoroughly enough in the Draft E I S :

i) There does not appear to be an accounting of the cost to insure any of the various disposal programs against mishap. O.25
Such an assessment of risk, carried out by a private, independent insurance company would be extremely valuable in determining the "hidden costs" of the operations. (It would also be in good stead with the policies of this Administration!)

ii) Based upon the statistics provided in the Draft E I S for accidents in barge transport, we conclude that, for the disposal of one hundred (100) submarines, there is a five (5) to fifty (50) L.61
percent (%) risk that one submarine will be lost. This risk is highest with the sea disposal option, but seems also unacceptable for other options as well (in light of our "point i)").

We shall provide further analysis of our "point ii)" within sixty (60) days, and recommend on the analysis we have conducted thus far that the Submarine Reactor Plants be stored intact until additional options are considered.

Sincerely,

Robert B. Kusner
Department of Mathematics
University of California
Berkeley, CA 94720

Denise R. Kim
H - Division
Lawrence Livermore National Laboratory
Livermore, CA 94550

#703

June 30, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
OPNAV-22
Department of the Navy
Washington, D.C. 20350

Comments on DEIS on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants Dec. 1982, Dept. of the U.S. Navy

Dear Sir:

The Hanford Site land alternative for disposal of decommissioned, [redacted] defueled Naval Submarine Reactor Plants is the preferred mode.

E.17 The Savannah River Plant in S.C. already has enough problems that need resolution without adding another factor. There are millions of lbs. of mercury contamination, their runoff endangers the drinking water for thousands of resident of that area, not to mention the problems with the L readtor.

W.1 At the present state of the art of nuklear waste disposal, it would seem that retrievable storage is the most prudent. This certainly cannot be done by dumping the reactor plants 2.5 miles into the oceans.

K.4 The DEIS states that the reactor pressure vessel and compartment would be sealed prior to disposal to delay time that any of the radioactive atoms inside would be released to the enviramment. Would this "delay" (reactor compartment bulkhead penetration by corrosion - 200 years; reactor pressure vessel remaining intact for period "probably exceeding several thousand years) be the time for land burial or seabed, where corrosion would be accelerated?

B.2 What is the Navy's definition of "NATURAL BACKGROUND RADIATION"?

L.1 While land storage/disposal of radioactive materials is still developing in nature, even though much more is known about the earth, the oceans are an unexplored area, and even defining the needs for research is now being studied, e.g. the NRC studies to put information about the academic research fleet for oceanography in a "coherent and quantitative form that could be used for projections rather than predictions". In addition, since retrievability is necessary for safe "disposal" of nuclear materials/submarine reactors, even IF the seas were understood, or that part in which the Navy proposes to possibly

sink the decommissioned, defueled naval Submarine Reactor Plants, weather is uncontrollable. On the Atlantic Coast, designated Seabed site, the amount of radioactivity that the reactor plants will release must be added to that which is already in the oceans due to effluent from Savannah River Plant, and other nuclear activities. As for the CALIFORNIA site, again, the aggregate radioactive burden must be considered that is already there, and the dispersion of the warm currents as El Nino. Because so relatively little is known of the oceans, not to mention the seas unpredictability and uncontrollability, the oceans should not be used for radioactive dumpsites. L.7

If those arguments were not enough, Arthur C. Clarke, developer of the first atomic bomb, in his book "The Challenge of the Sea" advocates using NUCLEAR REACTORS to act as furnaces to warm the deep ocean water, start it rising, carrying life-bearing [redacted] fertilizers with it, creating a "hugh fountain on the bottom of the sea, sweeping its riches up to the surface." Any breaches of the decommissioned Naval Submarine reactor plants will act in this same way, while on a smaller scale, creating an attractive life chain, and thereby circulating the radioactive materials that should be isolated from the environment. A.19

Preferred disposal for decommissioned, defueled submaring reactor plants is at Hanford, in retrievable form, where the [redacted] space and expertise is available to assure that they will not [redacted] create a hazard to man or his food chain with no way to remedy the situation in event of a breach of the reactor plants.

A. E. Wasserbach, MRS
Box 2308 W. Saug. Rd.
Saugerties, N.Y. 12477

#704

June 28,

Dear Captain F. Wagner:
U.S. Navy
Washington, D.C.
20350

I am appalled at the dumping of toxic wastes, on land and in the ocean!

I have heard the Navy plans to dump over one-hundred decommissioned nuclear submarines off the coast of California and North Carolina.

This must be stopped now!

I am shocked that the U.S Navy would deliberately dump more radiation in our oceans!

I support Greenpeace in their efforts to stop this suicidal plan of the Naval department.

Sincerely,
Kathy Schmale
448 Tanglewood Ct
Santa Rosa, Calif 95405

1049

1050

#705

JUNE 26th '83

DEAR CAPTAIN WAGNER / DEPT. OF THE NAVY,

WE ARE COMPLETELY AGAINST THE SCUTTLING OF NUCLEAR SUBMARINES OFF THE COAST OF CAPE MENDOCINO. IF YOUR AGENCY IS CONVINCED THAT OCEAN DUMPING IS SAFE, THEN DO IT IN YOUR OWN AREA AND SEE HOW THE RESIDENTS ENJOY THEIR CONTAMINATION. THE LEAKAGE RECORD OF OCEAN DISPOSED WASTES IS NOT GOOD AS SHOWN BY FARRALLONES ISLANDS RADIATION LEVELS.

WE DON'T WANT IT!!

SINCERELY, SUZANNA MULLEN

#706

SAN FRANCISCO BAY CHAPTER

OCEANIC SOCIETY

BLDG 315 FORT MASON · SAN FRANCISCO, CA 94123 · PHONE (415) 441 5970

June 30, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

We have collected the attached signatures opposing ocean disposal of nuclear submarines over the past few months. We are forwarding them to you so that they can be included as communications in the Final Environmental Impact Statement on the Disposal of Decommissionsed, Defueled Naval Submarine Reactor Plants.

The Oceanic Society continues to be opposed to this plan based upon the incomplete and inadequate presentation in the Draft EIS. We hope that the comments forwarded to you under separate cover will assist you in the production of an acceptable Final EIS.

Sincerely,

Joseph C. Marshall
President

JCM/mh

encl.

Petitions signed by 606 individuals were included with Mr. Marshall's letter. One petition page is shown to the right.

DON'T DUMP THE SUBS!

Nuclear Waste Does Not Belong in the Oceans

OCEANIC SOCIETY

We, the undersigned, demand that the United States government not allow ocean disposal of radioactive waste. Our ocean food sources must not be threatened! L.36

1. Signature Richard D. Rogers Print Name Richard D. Rogers ☐ I want to join the Oceanic Society
Address 1281 Brighton Ave
City Albany State CA Zip 94706

2. Signature [illegible] Print Name [illegible] ☐ I want to join the Oceanic Society
Address 1281 Brighton Ave
City Albany State Ca Zip 94706

3. Signature [illegible] Print Name GERALD CLOES ☒ I want to join the Oceanic Society
Address 5830 "E" AYALA
City OAKLAND State CA Zip 94609

4. Signature [illegible] Print Name JOSEPH J. HAUER ☐ I want to join the Oceanic Society
Address P.O. BOX 8306
City FREMONT State CALIF. Zip 94537

5. Signature Susan Eckard Print Name SUSAN ECKARD ☐ I want to join the Oceanic Society
Address 1105 Lincoln Rd
City Yuba City State Ca Zip 95991

6. Signature Renee A Graham Print Name Renee A Graham ☐ I want to join the Oceanic Society
Address 1647 McGinness Ave
City San Jose, CA State CA Zip 95127

7. Signature Claudia Woodward ☒ I want to join the Oceanic Society
Address 4936 Webster St
City Oakland State CA Zip 94609

Circulator's Name ____ Print Name ____ ☐ I want to join the Oceanic Society
Address ____
City ____ State ____ Zip ____

#707

FARALLON FOUNDATION

June 28, 1983

Capt. Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
Dept. of the Navy
Washington, D.C. 20350

Dear Capt. Wagner:

We at the Farallon Foundation realize the problem of nuclear waste disposal is extremely difficult and that the Federal Government needs a place to permanently dispose of such wastes. We wonder, however, if it is also as obvious to you as it is to us that in fact there is no safe place to dispose of these wastes.

H.3 It is unquestionably far safer to consider other options such as burying the submarine reactors in the earth or preferably storing the submarines in specially designed buildings above ground where they could be monitored and maintained until their radioactivity declines to a safe level.

We understand you have been given the task of permanent disposal of these submarines by the Federal Government. After you have retired from your Navy career and the administration has changed completely - it will be our grandchildren and yours who will have inherited a problem which will exponentially increase if you persist in pretending the marine environment is a safe place to dispose of these subs.

Three PHDs with considerable experience in biology, radiation, physics and medicine have raised serious questions about the DEIS. We feel it is imperative that you respond to the specific questions we have raised. We are not criticizing you just for the sake of controversy or opposition. All of this will only have meaning if we sift through the information and arrive at some specific conclusions.

We would appreciate your written response to our evaluation and remain available for further dialogue and consultation on this issue.

Thank you,

[signature]
President

P.O. BOX 9 BOLINAS, CALIFORNIA 94924 415-868-1396

SUB-DUMPING HEARINGS

On Thursday, Feb. 2, 1983, the US Navy held its hearing for public comment concerning the dumping of spent nuclear subs. The public comment was loud and clear - NO!

A Navy spokesman said:

"The plan is to remove the reactor, weld the reactor compartment shut, and haul it to Hanford or Savannah for disposal. The radiation outside the compartments will be below the federal limits (low level waste), so it can be buried with no substantial environmental affects. It will be over 200 years before the metal of the reactor vessel corrodes and releases the radioactivity, and so there will be a slow release of radioactivity, most of which will have become less lethal due to the 200 year containment period."

Lieutenant Governor Leo McCarthy went on record opposing the "potentially deadly nuclear littering."

State Senator Barry Keene, D-Mendocino, urged the Navy to bury the sub hulls on land so they "can be studied, monitored and, if necessary, retrieved."

#707 (Cont)

In special testimony prepared on behalf of the Farallon Foundation and presented at the public comment hearings in Sacramento, three prominent northern Californians spoke out:

" The Navy has suggested that these unprecedented quantities of radioactivity will not harm people because the wastes are bound up in metal walls of the reactor vessel. But let us look forward in time just one century, by which time even the Navy's calculations show that containment will be breached. The Navy says that within a century the radioactivity in each submarine will have decayed to 10,000 Curies, times four submarines equals 40,000 Curies per year. In other words, to proceed with this program is equivalent to dumping 40,000 Curies annually of unpackaged radioactive wastes directly into our grandchildren's laps. This is not a legacy that the people of the United States will willingly leave their grandchildren simply because the U.S. Navy says it is safe."

Dr. Jackson Davis, Ph.D
The Thimann Laboratories
U.C. - Santa Cruz

" I have read the DEIS for the disposal of defueled naval submarine reactors off our Mendocino coast. In summary, I would have to reject this DEIS report for the following reasons:

1- Applying studies of terrestrial freshwater organisms to marine life is not scientifically applicable.

2- There is no study on the accumulative consumption of released radionuclides on marine life.

3- What is the marine life in the Mendocino trench area? Could it be possible that rare marine species be eliminated by the release of these radionuclides."

Dr. Gordon L. Chan, Ph.D
Biology Dept.
College of Marin

The third comment was from Dr. John W. Harris. He has been a radiation biologist for over 20 years and is a physician whose medical specialty is radiation therapy (use of radiation for the treatment of cancer patients). He has an extensive background and knowledge of the biological effects of ionizing radiation and has served, for some years, as the United States representative to the International Atomic Energy Agency working sub-group on Modification of Radiation Therapy in Cancer Patients. Dr. Harris concludes that:

" The report, for all its mathematical beauty, contains little or no hard data regarding the fate of these various isotopes, by themselves or as changed by the marine environment. In my opinion it is tantamount to insanity to believe that we can irretrievable dump 100 nuclear submarines (and one wonders how much more in the future!) with impunity. I think that we are talking about nothing less than potential contamination of the biosphere for future generations and we are considering this based on cost and very limited data! The land option, while admittedly more expensive, would at least permit ongoing monitoring and possible retrieval as needed. Experience with and facilities for this option already exist and should be used.

As a citizen of California, a resident of the Pacific coastline, and a scientist and physician who has worked with and researched the effects of radiation for over two decades, I call upon the California State legislature to take a strong position against this potential insanity and to utilize every means at its command to ensure that nuclear wastes are not disposed of in the marine environment."

The testimony continued until eleven PM that evening. No one testified for the sub dumping. The Farallon Foundation , a public-benefit corporation dedicated to the preservation of the marine environment, has been working for seven years getting information to the public concerning the dangers of nuclear contamination of the seas.

There were many different groups and concerned individuals who spoke out against the Navy's plans. The most poignant testimony was from a group of Mendocino school children:

"Don't dump your subs in my ocean, my ocean, my ocean.
Don't dump your subs in my ocean ... my ocean's clean."

PResident

#707 (Cont)

FARALLON FOUNDATION

Testimony Before the Navy's
Hearings on its Proposed
Nuclear Submarine Scuttling
Program, as prepared by the
following scientists
for the
Farallon Foundation

-Jackson Davis, Ph.D.
-Gordon Chan, Ph.D.
-John Harris, Ph.D.

February 24, 1983 Sacramento, California

P.O. BOX 9 BOLINAS, CALIFORNIA 94924 415-868-1396

Testimony Before Hearings on the Draft Environmental Impact Statement prepared by the U.S. Navy on its Proposed Nuclear Submarine Scuttling Program

prepared by

W. Jackson Davis, Ph.D.
The Thimann Laboratories
University of California
Santa Cruz, CA 95064
(408) 429-2784 (office)
(408) 429-2896 (messages)

on behalf of
THE FARALLON FOUNDATION

Feb. 24, 1983 Sacramento. California

#707 (Cont)

-1-

I am presenting this testimony on behalf of the Farallon Foundation, for whom I have analyzed the Draft Environmental Impact Statement (DEIS) prepared by the U.S. Navy.

<u>Unprecedented Extent of this Proposed Radwaste Dumping Program</u>

I would like to begin by placing the proposed submarine scuttling program into the context of other past and proposed programs of radwaste dumping in the oceans. The Navy says it wants to scuttle 100 submarines between now and the year 2000, each containing 62,500 Curies of residual radioactivity. What the
N.12 Navy has not mentioned is that is is continuing to manufacture nuclear submarines, each of which will also require scuttling when it wears out. In other words we are talking here about an open-ended dumping program which, if allowed to begin, will continue into the indefinite future, for as long as nuclear submarines are manufactured.

According to the DEIS, each submarine will contain 62,500 Curies of residual radioactivity. At four submarines per year, this amounts to dumping 250,000 Curies per year off the California coast every year into the indefinite future. For comparison, the U.S. dumping program carried out at the Farallon Islands and other coastal sites between 1946 and 1971 involved a <u>total</u> of 100,000 Curies. In other words, the proposed Navy dumping operation would entail <u>each year</u> twice as much radioactivity as was dumped during the entire 25 year history of the past U.S. dumping program. The United Kingdom presently dumps about 100,000 Curies per year into the Atlantic, and Japan has proposed a program of similar size for the Pacific. The proposed Navy dumping program would be more than twice as large as either the British or Japanese programs. In other words, what the Navy is here proposing is by far the largest program ever considered of ocean dumping of radwastes.

The Navy has suggested that these unprecedented quantities of radioactivity will not harm people because the wastes are bound up in the metal walls of the reactor vessel. But let us look forward in time just one century, by which time
R.3 even the Navy's calculations show that containment will be breached. The Navy says that within a century the radioactivity in each submarine will have decayed to 10,000 Curies, times four submarines equals 40,000 Curies per year. In other words, to proceed with this program is equivalent to dumping 40,000 Curies annually of unpackaged radioactive wastes directly into our granchildren's laps. This is not a legacy that the people of the United States will willingly leave their grandchildren simply because the U. S. Navy says it is safe.

<u>Questions of Safety</u>

<u>Geological Instability</u>

One of the criteria stated by the Navy in its preliminary scientific evaluations is that "Sites should be away from areas containing active geological phenomena such as volcanoes". But according to the Navy's own studies, the northern California dumpsite lies less than fifty miles from one of the most geologically unstable areas of sea floor known in any ocean on earth, the Mendocino Fracture Zone. J.19 According to the Navy's own data, dozens of major earthquakes -- 3.5 and up on the Richter scale -- have been centered along this zone in the last century. Also according to the Navy, the resulting bottom shears in the dumpsite area, and the effects on scuttled submarines lying on the bottom, are unknown. F.22

<u>Ocean Currents</u>

Another criterion listed by the Navy as important in choosing a dumpsite is "Sites should be away from areas, such as submarine canyons, which have a high rate of exchange of the deep waters with surface layers..." But according to the Navy's own studies, there are powerful near-bottom eddies in the proposed dumpsite that reach velocities of 16 cm/sec and stir the ocean bottom. Current velocities as low as 7 cm/sec are capable of suspending and transporting radio- J.29 active bottom sediments. The Navy also documents a slower, southerly current moving at a rate of 1 km/day. This current could transport suspended radioactivity directly toward the population centers of Marin County and the San Francisco Bay Area, possibly in a matter of ~~weeks~~ months.

<u>Animal Life</u>

The Navy has asserted that animal life in the area is low. But when we examine the actual scientific data presented by the Navy in its preliminary scientific studies, we find a much different picture. These data show that <u>all</u> bottom cores from the study area are "strongly burrow-molted", implying a very active bottom population. Photographs have been made of the ocean floor in the dumpsite area by oceanographers under contract to the Navy. In the scientific studies done in connection with the DEIS we read that all such photographs show evidence of considerable bottom life. As also acknowledged in the DEIS, animals are known to concentrate in dumpsite areas. In short, the dumpsite area contains abundant bottom life which could rapidly return dumped radionuclides to human beings through the ocean food chain.

<u>Human Exposures</u>

The Navy claims that exposures of human beings to radiation dumped at sea would be so small as to be negligible. But it is worth examining closely how

#707 (Cont)

the Navy has arrived at this conclusion. Their assertions of safety are based on the use of extremely hypothetical models to calculate possible human exposures. The Navy has ignored all empirical studies of past and present radioactive dumpsites many of which have produced evidence of much higher radiation in sea food than the Navy suggests. To illustrate, the British discharge 100,000 Curies per year into the Irish Sea, resulting in fish so radioactive that members of critical consuming groups receive literally quadrillions of times more radioactivity (130 mrem/year) than the Navy claims will result from their submarine scuttling program (6×10^{-12} mrem/year). The Navy freely acknowledges the uncertainty inherent in its calculations. Thus on page A-10 of the DEIS we read that calculations of human radiation exposures by different methods yields different values, but "the indicated differences are not considered to be significant; rather, the real difference is overwhelmed by the magnitudes of the uncertainties in the calculations" (emphasis added). In my considered judgment it is inappropriate to base major public health decisions on hypothetical models and unknown and untested safety factors, especially when there are viable alternatives available.

F.12

Legal Status

The Navy has claimed that the proposed submarine dumping program is consistent with both domestic and international law. This claim was of course made prior to the recent domestic legislation placing a 2 year moratorium on ocean dumping of radioactive wastes. With respect to international law, I have just returned from the Seventh Consultative Meeting of the London Dumping Convention where I served as scientific and technical advisor to Pacific Island nations on the issue of radioactive waste dumping at sea. This meeting passed by an overwhelming majority a similar moratorium on radioactive waste dumping at sea pending resolution of scientific questions which I and other scientists have raised. While in London I conferred with the chief legal counsel of the International Maritime Organization, secretariat organization to the London Convention, and learned that in fact there is no legal precedent whatever for dumping used reactor vessels at sea. This counsel advised me that the legality of the Navy's proposed dumping program is not at all established and would be a matter for all the Contracting Parties to the LDC to collectively decide at one of their Consultative Meetings. The Pacific Island nations I represent are presently seeking further legal clarification of this matter.

F.2

F.5

The Land Based Alternative

The Navy's proposal to dump worn out nuclear submarines at sea would be more understandable if there were no alternative. But there is an alternative, one that is safer, fairer, more cost effective and less politically contentious. This alternative is the land based alternative.

Human Exposures

Consider first the issue of exposure of human beings to radiation. The Navy's own calculations, presented in the DEIS, show that human exposures to radiation from sea dumping would be 3-40 times greater than the land alternative. In other words, the land alternative would pose 2.5-33% of the radiation hazard of sea disposal. The Navy claims that these differences are small compared to uncertainties in the calculations. But we may well ask in return, if the uncertainties are so large, are not the inherent risks also large? Knowing as we do that any level of radiation exposure is harmful, it is clear from the Navy's own calculations that the land alternative, although not without risks, is many times safer than sea dumping.

L.47

Monitoring

A second advantage of the land alternative involves monitoring. The Navy has stated that the land burial sites are already monitored on a regular basis, and hence no new monitoring would be required. In contrast, the ocean alternative would require extensive monitoring, before, during and after scuttling operations. The first and obvious question to ask is: Will such monitoring ever take place? Many of us here today recall a Congressional Investigation on the Farallon nuclear dumpsite, held in October of 1980, at which the U.S. Congress asked responsible federal agencies to monitor the Farallon dumpsite off San Francisco. Three years have passed since that order was issued: the Farallon site has still not been monitored; funds to enable such monitoring have still not been allocated; and the people of the Western United States still do not know with certainty whether sea food harvested at the Farallons contains radionuclides from the nuclear dumpsite located there. We are obligated to ask whether monitoring of the scuttled nuclear submarine is any more likely to occur.

J.76, L.6

Relative Costs

The chief argument offered by the Navy for preferring the sea option is costs. Close examination of the economics, however, reveals that the Navy has failed to include several expenses that in total would make sea dumping equally or more expensive than the land alternative. These unaccounted costs include accidents, monitoring, psychological impact, medical expenses, direct economic impact on fisheries and tourism, and the costs of a protracted political struggle which is bound to ensue if the sea dumping program is pursued. I have calculated

L.57, O.26, J.76, L.53, O.34

#707 (Cont)

-5-

these additional costs conservatively as $1.8M/ship, a value which erases any presumed cost advantage of the sea option.

<u>Conclusions</u>

Perhaps the greatest danger of the proposed sea dumping program is the precedent that it would set. Ladies and gentlemen, there are 70 operational commercial power reactors in this country at present, and 70 more in various stages of planning. If this Navy reactor scuttling program is allowed to proceed, a precedent will be set for dumping worn out commercial reactors into our coastal waters. I submit that there are too many uncertainties to justify even a small scale sea dumping program. There are scientific uncertainties. There are public health uncertainties. There are economic and political uncertainties. All of these uncertainties have combined to ignite public opinion against this proposed submarine scuttling program. As just one indication of this opinion, the Board of Supervisors of the County of Santa Cruz has authorized me to deliver to this hearing their unanimous resolution opposing the scuttling of decommissioned nuclear submarines in California coastal waters. As a scientist familiar with the technical issues, and the father of six children, as representative of Pacific Island people whose only natural resource is the sea -- I respectfully request that the U.S. Navy abandon this submarine scuttling program.

L.9, F.8, L.1

n W. Harris Ph.D. M.D.
partment of Radiation Oncology
ng Hospital, Room L75
Francisco, CA 94143
(41) 666-4816

University of California San Francisco A Health Science Campus

UCSF

February 23, 1983

MEMO TO: Farallon Project
California State Legislature

F R O M John W. Harris, Ph.D. (Radiation Biology), M.D.

SUBJECT: Comments on Draft Environmental Impact Statement for Disposal of Nuclear Submarines

As a radiation biologist with over 20 years of research experience on the effects of radiation, and as a physician whose medical specialty is radiation therapy (use of radiation for the treatment of cancer patients), I have an extensive experience with and knowledge of the biological effects of ionizing radiation. I am a member of many scientific and medical societies and have served, for some years, as the United States representative to the International Atomic Energy Agency working subgroup on Modification of Radiation Therapy in Cancer Patients. This background provides me with a unique viewpoint from which to comment on the draft Environmental Impact Statement mentioned above.

This DEIS argues that disposal of 100 nuclear submarines in the ocean environment is a desirable option because it is cheaper, simpler, and requires no new regulations relative to other options. It is a seductive document, replete with mathematical models, formulae, and graphs which obscure and minimize the real issues. (It is pertinent to note, in this connection, that the authorship includes 13 engineers and mathematicians but only two "biologists"-one wildlife biologist Ph.D., and one M.S. in environmental studies with a three year experience). N.11

It is critically important that we remember the old adage that those who fail to learn lessons of history are doomed to repeat them. From the unfortunate results of our A-bomb experience through the many industrial chemical "accidents" whose litigations fill our courts, we should have learned by now that government documents which are replete with reassurances of safety based on complicated and calculated scenarios neglect one central fact: nature does not always understand mathematics and the calculations, no matter how sophisticated, inevitably are based on incomplete data. When such calculations involve trivial matters the consequences are often annoying, at best. However, when a potential crisis of the magnitude involved in miscalculations of the consequences of atomic submarine disposal in the ocean environment are involved, then lack of data may well prove catastrophic. J.20, T.3 J.20

#707 (Cont)

Farallon Project 2 February 21, 1983
California State Legislature

The report concludes that the 6+ million curies of radioactive materials (from 100 submarines) would undergo a significant amount of radioactive decay before its containment shell corrodes. They bolster the argument with very short-term data from 2 sunken submarines and go to great lengths to indicate how secure the calculations can make one feel about the containment, for as long as 200 years. The fact of the matter is that there would still be as much as 5,000 curies of cobalt 60 alone present even 1,000 years from the disposal time. Surely, the mathematicians would not have us believe that the subs will be intact in 1,000 years! It should be apparent that the heart-felt wish that these isotopes will not get into the human environment because they would be insoluble is just that--a wish, not a reality based on any data.

A.7 | L.20 | L.22

The report, for all its mathematical beauty, contains little or no hard data regarding the fate of these various isotopes, by themselves or as changed by the marine environment. In my opinion it is tantamount to insanity to believe that we can irretrievably dump 100 nuclear submarines (and one wonders how much more in the future!) with impunity. I think that we are talking about nothing less than potential contamination of the biosphere for future generations and we are considering this based on cost and very limited data! The land option, while admittedly more expensive, would at least permit ongoing monitoring and possible retrieval as needed. Experience with and facilities for this option already exist and should be used.

J.20

As a citizen of California, a resident of the Pacific coastline, and a scientist and physician who has worked with and researched the effects of radiation for over two decades, I call upon the California State Legislature to take a strong position against this potential insanity and to utilize every means at its command to ensure that nuclear wastes are not disposed of in the marine environment.

[signature] PhD MD
Associate Professor of Radiation Oncology

cv

COLLEGE OF MARIN

February 17, 1983

Mr. Lewis Seiler
President
The Farallon Foundation
P.O. Box 9
Bolinas, CA 94924

Dear Mr. Seiler:

I have read the DES for the disposal of defueled naval submarine reactors off our Mendocino coast. In summary, I would have to reject this DES report for the following reasons:

1. There is no or very little reference of released radionuclides for marine organisms. Applying studies of terrestrial freshwater organisms to the marine biota is not scientifically applicable in my line thinking. | T.13

2. There is no studies on the accumulative consumption of released radionuclides by benthic and pelagic species. What are effects on their reproductive sequences? | L.13, L.43, T.18

3. What is the population of marine biota in the Mendocino trench area? What are the densities of critical marine species that live in the area? Are there any specific marine organism that are few in numbers and might be endemic to this locality? Could it be possible that rare marine species could be eliminated by the release of these nuclides? | J.9, L.1

Until I see such pre-disposal studies, I would not unload such submarine vessels in this marine habitat; and to do so would be a serious mistake in the science of preparatory care of our natural resources

Sincerely,

Gordon L. Chan

Gordon L. Chan, Ph D.
Biology Department

KENTFIELD
CALIFORNIA 94904
TEL (415) 457 8811

#708

JESSE HELMS
NORTH CAROLINA

United States Senate

WASHINGTON, D.C. 20510

June 29, 1983

Captain Edward F. Wagner, USN
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I appreciate the opportunity to review the Draft Environmental Impact Statement on the disposal of decommissioned nuclear submarines. The compilation and presentation of data pertinent to the matter certainly speak well for the dedicated professionals responsible for its contents.

Many North Carolinians have expressed to me their concern about disposing of the subs off the coast of our state. Mention of placing even small amounts of radioactive material in this sensitive marine environment has caused alarm among state legislators, who recently adopted a resolution opposing sea disposal. Perhaps answers to several questions that occurred to me as I studied the Draft EIS will help to allay some of the concern and enable me to better evaluate the sea disposal option.

R.14 Interesting to me were references in the EIS to corrosion of the submarines' structural alloys -- commonly called "crud" -- in the seawater. I am particularly interested in the composition of this crud. Does it contain long-lived radioactive particles that could upset the balance in the underwater ecosystem? Also, is this crud soluable in water and likely to be transported by currents away from the subs?

J.40 I am also interested in experience that might be gained through studying the already sunken U.S.S. Scorpion and U.S.S. Thresher. Might these vessels provide useful information on the impact of even small doses of radioactivity on the marine environment?

Captain Edward F. Wagner, USN
June 29, 1983
Page two

Again, I appreciate the opportunity to review the Draft EIS. I am confident the Department of the Navy will remain sensitive to the legitimate concerns of North Carolinians in this important matter.

Kindest personal regards.

Sincerely,

Jesse Helms

JESSE HELMS:gmb

1060

#709

Julie Kay Norman
14884 [illegible] Road, [illegible], Oregon 97512
Phone (503) 476 0974
Computer Consultant   Whitewater Guide

June 25, 1983

Captain Edward F. Wagner
US Navy
Office of the CNO
Department of the Navy
Washington D.C. 20350

Dear Captain Wagner,

I met you in March at the public hearings in Sacramento, California. I would now like to express in writing my opposition to the dumping of nuclear submarines off the Mendocino coast.

Without making any bones about it, I'd like you to know that your proposal seems totally irresponsible. We are planetary citizens on this earth, you and me and the rest of humanity. How can we radioactivate the OCEANS without acknowledging future generations? You and I will not be alive in 2050...but the decaying isotopes will. Do you hear this argument?????

Now I will go through the ritual of outlining the "facts" which will supposedly deter you from this plan. Although they are relevent, the moral issue seems to make these "rational arguments" pale in comparison.

L.20, L.53 1. Our coastal fishery would be eliminated if the radioactive waste entered the food chain. You have not truthfully explored the chance of there being leaks from the dumped subs.

W.1 2. The subs would be irretrievable once dumped. We would not have a second chance.

J.12, J.28, F.19 3. The EIS is inadequate in its estimations of the current fishery and the subsurface actions of currents. The subs would certainly not "spiral" peacefully to the ocean floor, coming gently to rest in the mountainous terrain off the Mendocino coast.

4. Dumping these submarines would further delay our larger problem of nuclear waste disposal. We should regard these submarines as an opportunity to develop a sane waste disposal program.

L.9, F.8 5. We have a responsibility to the world not to contaminate the oceans or set such a precedent. Nuclear waste is a planetary problem. There has been so much destruction already. Let's stop that now.

Captain Wagner, I wish you the best of luck in dealing with this critical problem. I beg you to encourage your superiors to explore the alternatives. We will not let our dear Pacific ocean suffer under the shortsighted abuse of the military. Please help us preserve the planet for the future of mankind.

Regards,

Julie Kay Norman

#710

ANTONIO B. WON PAT, M.C.
Territory of Guam

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CHAIRMAN, INSULAR AFFAIRS
PUBLIC LANDS AND NATIONAL PARKS

June 22, 1983

Captain Edward F. Wagner
Office of the Chief of Naval Operations
U.S. Department of Navy
Washington, D. C. 20350

Dear Captain Wagner:

This is to inform the Department of my strong opposition to the findings of the Navy Draft Environmental Report on the disposal of 100 obsolete nuclear submarines.

As the Delegate from the U.S. Territory of Guam, I can state without equivocation that my people and those who live on other Pacific islands do not, under any circumstances, want <u>any</u> form of nuclear wastes to be dumped in our ocean. We have been fighting for several years a proposal by the Government of Japan to dump low-level radioactive wastes in the Pacific. We shall oppose with equal vigor the plan under consideration by the Department of Navy.

I further remind the Navy that Congress has mandated that all dumping of wastes at sea will require its approval. I can assure you that I will never vote for such action by the United States. Nuclear wastes are too hazardous to be disposed of in a sea environment. The danger to our fish supplies and related life is, in my mind, too great to permit such a reckless act in the name of economy.

Nuclear wastes belong in a safe vault in a land disposal site. They do not belong at the bottom of the sea away from our observation and out of reach of our scientists. It is the proposal which should be dumped at sea, not 100 nuclear submarines or any other form of radioactive wastes.

Sincerely yours,

ANTONIO B. WON PAT
Member of Congress

JUL 6 1983

#711

MEMORANDUM

SUBJECT: Response to U.S. Navy draft E.I.S. regarding proposed sea disposal of decommissioned nuclear submarines

ADRESSED TO: Captain Edward F. Wagner, USN
Office of the Chief of Naval Operations
Department of the Navy
Washington, D.C. 20350

FROM: Robert A. Hooper, J.D., M.F.A. RAH
P.O. Box 2175
Del Mar, CA 92014

DATE: June 28, 1983

> I believe it is the duty of each of us to act as if the fate of the world depended upon him... It is with this conviction that we squarely confront our duty to posterity.
>
> Admiral H.G. Rickover, USN
> April 9, 1983

The concept, design, deployment, operations and maintenance of todays commissioned nuclear powered naval vessals boast an unparalleled record of safety and design integrity. In marked contrast to the (well publicized) deficiencies of the civilian nuclear power industry, the U.S. Navy has earned an enviable safety record (and in so doing has merited the public trust) in the operation of hundreds of reactors both aboard ship and on land. This achievement remains a major factor in the extensive public support enjoyed by the Navy in regard to current fleet operations, as well as for the ambitious building program now underway. The Navy cannot (must not) jeopordize this exemplary record.

As the first generation of nuclear powered wessals become obsolete and are decommissioned, continuing support for the funding and construction of a new generation of vessals vital to the nation's defense could become partially contingent upon public perception of the safe disposal of vessals decommissioned today. It is this issue of public perception and confidence -- a

situation exacerbated by an apalling record of questionable radioactive waste disposal practices at sea between 1946 and 1970 -- that has not been adequately addressed in the Navy's draft E.I.S. Nor has it been addressed in the Sandia Reoprt (SAND 82 - 1005/I) in support of the D.E.I.S. This single issue will attain an overriding significance in the years ahead.

PAST OCEAN DISPOSAL PRACTICES

Whether or not one concludes (from the limited data now available) that past disposal practices endanger public health, it cannot be denied that these operations present a record of widespread mismanagement, obsolete or erronious scientific assumptions regarding ocean currents and vertical transport of radionuclides by organisms along the vertical water column, gross negligence in package transport and dumping operations, and an almost total disregard for proper site selection criteria, accountability, identification of package contents, and anticipated impacts on marine ecosystems. Accordingly, we are faced with upwards of 89,500 drums of radioactive wastes situated not only at designated sites, but strewn haphazardly about the ocean floor in depths ranging from less than 10 meters (Massachusetts Bay) to in excess of 5000 meters (Atlantic sites). It is this dismal record which, ipso facto, impeaches the credibility of all future sea disposal operations -- whether they be containerized low level wastes, decommissioned submarine reactors, or the seabed implacement of high level wastes.

Surveys of waste disposal areas conducted by the Environmental Protection Agency (EPA) between 1974 and 1979 do not support the conclusion that ocean dumping of radioactive waste poses no public health nor environmental hazard. And despite a recent GAO report to the contrary (October, 1981) to the contrary, there exists no consensus of scientific opinion that past ocean dumping has proven harmless. On the contrary, many of EPA's own consultants and contractors -- Dr. Holger Janisch, Dr. Gil Rowe, Dr. W.R. Schell, and others -- have raised disturbing questions regarding vertical transport of radionuclides by marine organisms, and dispersal of these materials by currents. The issue of the biological "short circuit" -- mechanisms by which a direct link is established between ocean bottom dump sites and commercial surface fisheries -- was raised recently by Woods Hole's Dr. Charles D. Hollister in hearings before the Committee on Merchant Marine and Fisheries, U.S. House of Representatives (Serial No. 97-47, October 19, 1982). Dr Hollister concludes (at p. 62):

#711 (Cont)

I think that the biological short circuit is the big unknown. I think we may be able to say, with high probability, that there is no biological short circuit, but I think that is the biggest technical issue.

History is replete with examples of scientific discoveries shedding light on past (often irrevocable) mistakes. Issues like the biological short circuit must be researched, investigated at sea, analysed and successfully resolved before an enlightened public will support the option of sea disposal of decommissioned nuclear submarines with their reactors left on board.

In summary, EPA's surveys were but a first step in understanding the complex interactions of radioactive substances on deep-sea ecosystems. These surveys, ably conducted by EPA's chief oceanographic scientist, Robert S. Dyer, raised questions which must be answered before significant quantities of radioactive materials are again permitted to enter the marine environment.

PUBLIC AWARENESS, ECONOMICS, AND THE MEDIA

A public rudely awakened by Love Canal, Three Mile Island and similar problems will cast a very critical eye at any sea disposal option which includes the reactors left on board the vessals. Regarding the Cape Mendocino sites on the West Coast, the California Department of Fish and Game has informed me (personal communication, April 13, 1983) that significant portions
J.12 of California's $47 million albacore fisheries lie proximate to the site coordinates suggested by the draft E.I.S. Given the remotest possibility of the existence
0.34 of a biological short circuit and similar food cahin transport mechanisms, the seafood consuming public will react by purchasing significantly less albacore. Worse, this negative public reaction could extend to California's $140 million commercial tuna industry, and subsequently to the sable fisheries industry. Such "guilt by association" consumer response could have unforseen consequences. The economic impact of even a 10% loss to these industries is significant in terms of revenues and employment. A greater loss could cripple these industries, causing dislocations which must be address in future drafts of the Navy's E.I.S.

Should anyone doubt the economic impacts of adverse public

reaction to the ocean disposal of radioactive waste, it would be illuminating to pose the issue to one's children, neighbors, friends -- even strangers encountered in the supermarket. The response you receive will be surprising as well as enlightening. Even the most remote possibility of contamination by radioactivity causes an immediate and passionate response, and it is this reaction which alarms the seafood industry. When viewed in light of the cost differential between sea disposal of a vessal with nuclear reactor intact ($5.2 million) versus land burial of the reactor and sea disposal of the hull ($7.2 million), multiple years of economic loss to the fishing industries could dwarf modest savings to the Navy gained by the sea disposal option. This issue must be addressed by the Navy in a subsequent E.I.S.

SUMMARY

EPA's ocean surveys of past radioactive waste sites have raised disturbing questions which must be addressed before the ocean disposal of submarines with reactors on board can be seriously considered. The Navy must not jeopordize its exemplary safety record and positive public image by an ocean dumping program fraught with controversy, scientific questions, and potential economic impact. The savings of a few millions of dollars does not justify the tarnishing of the Navy's public image and the loss of public support for fleet operations and shipbuilding programs. Finally, economic impacts on major California fisheries must be assessed in light of potentially adverse reactions by the seafood consuming public.

#712

243 Dean St.
Arcata, Ca. 95521

June 4, 1983

Capt Edward T. Wagner
U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Dept of Navy
Washington, D.C. 20350

Dear Captain,

I am among those who feel it would be unsafe to scuttle decommissioned nuclear submarines off the Coast of Cape Mendocino. While I feel that there is probably no really safe place to dispose of these submarines, the ocean, I believe, is many more times more dangerous than on land because if a problem of nuclear contamination occurs it would be much more difficult to deal with in the ocean than on land. I hope you will decide to lay aside your plans to bury the subs in the ocean.

Yours sincerely,

Nancy Ihara

1064

#713

THE FARALLON PROJECT

RADIOACTIVE WASTE MANAGEMENT

POB 412 BOLINAS CALIFORNIA 94924 (415)868-2112
868-1057

30 June 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations (OPNAV-22)
Department of the Navy, Washington D.C., 20350
Telephone: (202) 697-1961

Dear Sir:

Enclosed is my written commentary to the December 1982 issue of the "Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants".

As indicated in a previous correspondence to your office of March 1982, the purpose of The Farallon Project with respect to the disposition of the Navy's decommissioned nuclear submarines, is to propose the "Seacrete" system as an environmentally safe, politically acceptable, and cost-effective solution to the problem.

H.6 Although this presentation includes criticisms of the three proposed approaches discussed in the DEIS, its primary objection is that the alternative of permanent land storage is not addressed. Therefore, the Seacrete system is a proposed solution that would utilize permanent land storage as a fourth alternative.

It is hereby formally requested that such a fourth alternative be fully considered and presented in the Final Environmental Impact Statement, with Seacrete and other potential containment methods included in the analysis. Although this will entail the expenditure of additional time and effort, the critical nature of such an important and difficult decision warrants the most careful and complete study that is possible.

Thankyou for your continued attention to these efforts to achieve a mutually acceptable solution to a significant portion of the unsolved radioactive waste management problem.

Sincerely,

Conrad F. Golich

Conrad F. Golich
Consultant
The Farallon Project

(The Farallon Project-1)

1 SUMMARY

1.1 Contents

The introduction to this presentation (section 2) includes a general discussion about radioactive waste, the previous involvement of The Farallon Project in this subject, and criteria for a successful systems approach to solve the problem. The next section (3 Criticism) contains specific points of disagreement with designated parts of the existing DEIS. Section 4, Proposal, outlines a permanent land storage system utilizing a patented technique called Seacrete. Only general environmental impact considerations of Seacrete are discussed, since additional study would have to be made prior to a Final Environmental Impact Statement. Section 5, is an appendix of publicity about the Farallons.

1.2 Abstract

There is currently no agreed upon approved method of safely dealing with radioactive waste materials. Past practices involved dumping on land or into the ocean, some of which have resulted in accidental contamination of soils or marine life. A correct solution to the problem should involve the criteria of safety, containment, monitorability, and retrievability. The ocean disposal of part or all of decommissioned nuclear submarines is rejected. The permanent storage on land is proposed, using a mothballing system called Seacrete.

2 INTRODUCTION

2.1 Radiation Hazard

Attendant to the many promised benefits of the Atomic Age is a single most significant problem of what to do with the radioactive waste materials created by nuclear fission. Unlike all other technological processes developed by man, there is no existing antidote to radioactive contamination--no practical method of neutralizing radiation, except by transmutation in the laboratory, or by waiting hundreds or thousands of years for natural radioactive decay to occur. As more data accumulates about a technology that is quite new compared to 10,000 years of recorded history, we have resorted to the concept of permissable exposure amounts. However, we really don't know for sure what its long-term effects will be on the Earth or on any of its living creatures, including ourselves. Information from Hiroshima and Nagasaki is still being accumulated, and new conclusions are still being formed.
Added to this basic uncertainty, is the problem of radiation being a health hazard that is imperceptible to our five senses. This lends it an aura of vagueness and unrealness that manifests in many ways. And not the least of these, is the current scientific dispute of how much (if any) radiation exposure can safely be tolerated by humans without significant short or long term danger. That it can cause the dreaded cancer is not disputed, but how much is causitive is debated.

2.2 Radioactive Waste

In actuality, anything that has ever been exposed to radiation will become radioactive waste, because whenever its practical use by man has ceased, it must be "disposed of", since its continued presence poses a potential health hazard to humans. Thus we have created contaminated

(The Farallon Project-2)

mountains of uranium mining tailings, millions of gallons of liquids from nuclear bomb and power plant manufacture, tons of solidified radioactive chemical salts, and carloads of materials such as hand tools, protective garments, and medical equipment.

And now we are faced with the question of what to do about the obsoleted radioactive machines that produced the above mentioned waste products. Indeed, what can be done about 100 poisoned worn out nuclear power plants the size of multi-storied office buildings, or in the specific case at hand, 100 contaminated and soon-to-be decommissioned nuclear submarines? Furthermore, what about the disposition of 20,000 atomic missiles that both superpowers claim they don't want to use? The problem is a classic "catch-22" of doomed if we do, and damned if we don't. Sooner or later, old unused weapons will have to be dealt with, and our past experiences with radioactive waste are not exactly reassuring.

The disposition of forty years of this atomic garbage is well documented in a book entitled "Radwaste, A Growing Nuclear Menace", by Robert Sheer and published by Random House. The radwaste from the original Manhattan Project, that inaugurated the Atomic Age, still lies buried under a few feet of dirt in a park just south of Chicago. Local well show elevated levels of radioactive contamination. Thousands of barrels of radwaste from experiments at California's Lawrence Radiation Labs, (the nation's primary nuclear weapons design facility), were simply dumped into the ocean some twenty miles offshore from San Francisco. Recently, about fifty more such ocean dump sites have been identified all along the Pacific, Gulf, and Atlantic coastlines of this country--and even off Canada and Mexico, the latter without their knowledge.

At three of this country's main land storage sites, accidents have resulted in contamination of soils, streams, and underground aquifers. A Soviet radwaste dump apparently blew up, with unknown loss of life and contamination of a large area. The Three Mile Island accident grabbed headlines several years ago, although the less newsworthy, but equally serious problem of cleanup and decontamination continues. What is to be done with millions of gallons of radioactive water? Some of it was dumped into the local river. And how many years later will the vented gasses and dumped water create a radioactive Love Canal problem at Harrisburg, Pennsylvania?

2.3 Radwaste Dumping

The management of radwaste has followed a basic principle which is used by virtually every kind of waste management system, and is characterized by oneword, namely, dumping. Despite occasional use of more attractive terminology such as "sanitary land fill", the trash of our modern living, toxic and otherwise, has generally been dumped onto the land, or into streams, lakes, and oceans. Occasionally, there have been crude containments of earthen overfill, or concrete or metal barriers in the case of toxics, but many of them eventually leak back into the ground or local water.

Even on the international level, the management of radwaste equates to nothing more than observation and recording of so-called allowable quantities of dumping into the ocean. The British still dump low-level radwaste directly into the North Atlantic from an outfall pipe. And the agency that oversees these activities is called appropriately, the London Dumping Convention.

At the major U.S. radwaste storage site, Hanford, Washington, new steel tanks are being constructed to replace leaking old ones until a permanent solution is decided upon. And despite the increasing number

(The Farallon Project-3)

of toxic dump stories about the hazardous contamination of entire towns, the essential thrust of all federal efforts in the past five years is to find an "acceptable" place to dispose of (i.e., dump) our growing inventory of radwaste. And even though elaborate scientific studies have been made of salt mines, glaciers, seabeds, and so on, no geologic medium has been certified as capable of safely containing radwaste for as long as thousands of years.

In addition to the technical uncertainties, there is the political problem posed by the numerous local, county, and state governments that have passed ordinances prohibiting or restricting the transport of radwaste through their jurisdictions, fearing possible lethal accidents. And as for locating a new radwaste dump site to receive materials from other areas, no state government wants to have it located "in our back yard". Nobody wants the Atomic Tarbaby.

There has been much discussion recently about the EPA's handling of Superfund money to clean up our worst toxic dump sites. None of that has been earmarked (yet) for radwaste toxic dumps. In any event, when an old toxic dump is discovered to be a problem, or when a toxic spill or accident occurs, plans are made to "clean up" the site. Now in the case of radwaste, the approach of cleaning up is virtually a hoax, since if they are cleaned up from one location, they must be brought back down to somewhere else. This creates a newly contaminated site, and of course contaminates more workers and equipment in the process. This nuclear shell game is only just beginning, and will continue until a safe and proven containment system is devised. There is at the present time no such method, since radiation has the ability to permeate any known material in time--and radioactivity stays active thousands of years.

2.4 Ocean Dumping

It is quite obvious that there is no assuredly safe place to dump any toxic materials on the land, in the waters, or into space. Yet elaborate plans, costing millions of dollars, continue to determine how to "safely dispose" of our self-generated poisons, including "Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants". And since launching into space is currently not practical (although the space shuttle program may eventually get to it), and land disposal is being met with stiff political opposition, waste managers (dumpers) in industry and in government are looking to the oceans as an easy escape from their dilemma. Ocean dumping has, from their point of view, several obvious benefits of "out of sight, out of mind", few if any voters, and almost no laws--especially with the sandbagging of the International Law of the Sea Conference in 1982 by this country and its fellow dumping nations such as Japan, England, and Germany.

It is especially interesting that the U.S. Environmental Protection Agency has also, by "coincidence" in 1982, proposed changes in policy to allow a resumption of ocean dumping of radwaste--the same year of this DEIS. And we are supposed to believe that it is only a coincidence that the Navy's head of its reactor program was transferred last spring to, where else, the EPA's radiological safety program. Add to these interesting connections the multi-million dollar, eight-year program at Sandia Labs to develop a Subseabed disposal plan for radwaste, and it becomes clear that the oceans are the final solution that our very respected scientific community (in the military-industrial complex) has in mind.

2.5 The Farallon Project

The question of impingement on the health of the Earth's ecosystems

#713 (Cont)

(The Farallon Project-4)

and its included human population from radwaste dumping into the oceans is a long and elaborate discussion. It is more appropriately addressed by those better qualified in this field, including marine biologists and organizations such as the Oceanic Society. However, some experience in these matters has been aquired by those associated with The Farallon Project since 1976. Reprints of some of the publicity concerned with the Farallon Island Radioactive Waste Dump Site are included in the appendix (Section 5). The situation has been the subject of several Congressional hearings, including extensive testimony by this author on the inherent dangers of radwaste dumping into the ocean.

In summation, seven years of research into the question has made it irrefutably clear that continued use of the oceans as a convenient sewer for mankind's technological trash is risking virtual specicide. In the case of radwaste, it smacks of "atomic koolaid", especially in view of the recent discovery that Rattail fish off the Atlantic are contaminated with Americium, which is a radioactive decay product of Plutonium which was dumped off the Atlantic coast in the nineteen-fifties.

And continual stonewalling and refusal to publish reports by the EPA over the years since the Farallon situation was first brought to public attention, particularly with the recent scandals concerning EPA's misshandling of toxic waste management, has not increased the credibility of any plans for additional ocean dumping of anything that is radioactive. Perhaps the common sense of a fisherman from the coast of Mendocino County, California (th location of one possible ocean dumping site for obsolete nuclear submarines) is most succint in the matter. Interviewed on a nationwide broadcast of ABC's 20-20 program, he said "These same people want to put the nuclear waste down there, but these people will not crap in their own plate and then eat dinner out of it--but round about, that's what you're doing."

I also remember the words of a grade-school girl from Mendocino who testified at the public hearings in Sacramento on this DEIS. She said that the Navy should have thought about what they were going to do with the submarines before they built them. While it may be too late for that, it is not too late to decide what to do with these Polaris subs before we create any more radioactive Trident reactor plants.

2.6 Management Criteria

Toxic waste management must evolve beyond the dumping concept into the approach of recycling which is now being advanced in the areas of municipal refuse, cogeneration of waste heat from industrial production, metals reclamation, and composting of organic wastes into usable fertilizer. In the case of radwaste, the thermal value alone is worth investigation for recycled heat value. Beyond that, no less an eminent authority than Dr. Edward Teller has said that it does not make sense to bury radwaste, since we will only end up mining it years from now for its energy value.

In an interview during the last presidential campaign, Vice President Bush indicated that an acceptable solution to the radwaste problem would be an interim safe retrievable system that would buy us the time to achieve a truly acceptable scientific answer. Hasty ocean dumping of servicable Polaris submarines to make way for a new batch of Tridents--which will also have to be dealt with thirty years from now--will only preempt the development of a reliable solution.

From a systems engineering approach, an acceptable radwaste management method would include the characteristics of safe containment, moniterability, and retrievability. It would also lend itself to the

(The Farallon Project-5)

development of a recycle system that would make use of the material. It should also investigate the creation of a method of neutralizing radwaste by creating a forshortening of the naturally occuring decay process. This would achieve two benefits, inert and safe end-products, and a large energy release in a short period of time. Since transmutation is now possible in cyclatrons, the physics needs to be made practical. This general approach was suggested by former ambassador to the Soviet Union, George Kennan, in accepting the Einstein Peace Prize. He said about the problem of dismantled nuclear warheads: "...serious problems might be presented by the task of removing and disposing safely of, the radioactive contents of many thousands of warheads that would have to be dismantled." He proposed that "there be extablished a joint Soviet-American scientific committee under the chairmanship of a distinguished neutral figure, to study jointly and in all humility the problem not only of the safe disposal of these wastes, but also the question of how they could be utilized in such a way as to make a positive contribution to human life... In such a joint venture, we might both atone for our past follies, and lay the foundation for more constructive relationship.

3 DEIS CRITICISM

3.1 General Considerations

The DEIS addresses itself to two basic options of disposition on land or in the ocean, with a third, space, obviously ruled out because of current inpracticability. Since the essence of this commentary is relevant to a land storage option, negative comments are directed only towards considerations of ocean dumping.

The first general observation has already been addressed in this introduction, having to do with the questionable relationship between the EPA and the Navy Department. It is no secret that commercial generation of electricity by nuclear power faces multi-million dollar losses in the absence of a solution to the radwaste problem. A recent U.S. Supreme Court decision has upheld the California prohibition of more nuclear power plant construction in the meantime. Therefore, in the vernacular of the racetrack, a three-horse parlay would be achieved if the public could be convinced that ocean dumping of radwaste is a safe solution to the problem. The Navy's submarine disposition needs are fulfilled first of all, invoking if necessary national security needs relevant to deployment of the new Trident subs and Salt I treaty requirements. Second, the EPA looks very good, having come up with a "safe" solution to the radwaste dumping question. And last but certainly not least, the dead nuclear nightmare of fission-generated electrical power is resurrected, despite the financial warnings of the ultra-conservative Wall Street Journal and other economists' advice to pull the plug.

The second general objection concerns what I have referred to in other dissertations on this subject as spurious anologies and scientific guestimates. It is an insult to my intelligence and to anyone else with common sense to expect us to accept assurances that radioactive garbage dumping into a major fishing ground is analegous to a trans-continental airplane flight. And the same goes for the contention that dumping 100 radioactive submarines in the same area is a thousand times safer than watching television for two hours a day for a year. This kind of utter nonsense has no place in a document produced by a department of the United States Government, especially the Navy which is supposed to be charaterized by the ability to run a tight ship. Whichever consultants advised using those anologies ought to be dismissed from further service.

#713 (Cont)

(The Farallon Project-6)

The scientific "guestimates" referred to are the pages of differential equations which attempt to prove mathematically that there will be no delliterious effects from more radioactive garbage dumping into the ocean. While those elaborate mathematical gymnastics may prove to be an effective "snow job" on the scientifically uneducated general public, their
L.14 anological qualities do not make up for the DEIS's lack of biological data relevant to the potential effects on marine organisms. For specifics on these matters, reference should be made to the uncertainties expressed in the Oceanus magazine published by Woods Hole Oceanographic Institute: High Level Nuclear Waste In The Seabed?" (Winter 1977).

Among many very interesting comments regarding ocean floor usage for radwaste, the above magazine says:"The fauna"(involving the bottom) "is likely to be sensitive to minor environmental perturbations, and would require a very long time to recover. Nor is its isolation so complete as to preclude the possibility of biological transfer of harmful substances if radionuclide leakage were to accidentally occur. ...The amount of available data on the deep-sea community is very small, much too small to form a sufficient base for such an important conclusion. ... Todate, nothing is known about the ways in which deep-sea organisms will respond to exposure to radionuclides."

One would have hoped that with the impressive list of qualifications listed with the PHd contributors to this DEIS, they could have gotten involved in an objective discussion about these matters. They seem to have preferred cerebral prognostications instead. Of course, the bottom line is that long after these predictors are dead in their graves, if their guesses were wrong, their great-grand children may discover that the oceans have been terminally polluted by their forbearers. In that case, the Biblical admonition would obtain that the sins of the fathers are visited upon the children, even unto the third generation. In any event, if would be foolhardy for Americans to depend on the reliability of scientific consultants who assure four billion humans that radioactive fouling of our own nest is a wise decision.

3.2 Specific Criticisms

(S-4 & S-7) The basic premise of this commentary is that permanent protective storage is the preferred alternative. Although the potential effects of ocean disposal are hardly comparable to previous atomic testing in the oceans and in the atmosphere, they cannot really be proven to be safe--elaborate mathematical modeling nonwithstanding.
L.9 Furthermore, allowing ocean dumping of the submarines would open the door to resumption of first low-level dumping of commercial radwaste, and pave theway to eventual dumping of high-level materials onto the or into the seabed. Instead, we must accept the responsibility of dealing with our own garbage, rather than always assuming that there will be another available dumping location. The U.S. Navy should not be made the pawn of irresponsible commercial interests,who wish to get the nuclear power industry off the hook by approving ocean dumping of deadly toxic radioactive waste products.
(S-10) If only 100 years of radioactive decay would truly "eliminate external exposure to radiation", then it does not seem overly difficult to consider protective storage on land for that period of time. This seems to be supported by the additional statement that "There is little risk of radiation exposure to anyone in the general public during movement to the burial ground, actual burial, or after burial".
L.20 (S-13) The contention is made that "the containment provided by the hull, etc. While this is most probably true on land, and certainly verifiable there, it cannot be proven true if in the ocean, and certainly cannot be

(The Farallon Project-7)

verified if it is sunk into the deep ocean. Furthermore, reclamation of the metal may prove to be possible a number of years from now when radiation technology has had more timeto develop new answers to current problems.
(S-14 & E30, E31) It is a commonly known fact that sea life is attracted to sunken hulls. Yet in discussing bottom-dwelling life, the DEIS L.55
suggests that the Mendocino area "will never attract such fisheries". It is just this kind of attraction that presents the phenomena of eventual absorption into the food chain of radioactive corrosion particles consumed by fish and then by humans. EPA photographs from the L.36
Farallon Island radwaste dump show just that occurence, and is a primary reason for concern about the proposal to dump radioactive submarines adjacent to a prime fishing area off the Mendocino coast of California.
(S-16) Table 3 should be ammended to include the cost of permanent protective storage on land. Furthermore, if the mothballing system were effective enough, the cost of cutting out the reactor compartment could be eliminated. The total dollar cost would then be comparable to sea disposal of the entire submarine.
(1-7 & 1-8) In view of the facts that the U.S. government has passed a law for a two-year moratorium on any more ocean dumping of radwaste, and the London Dumping Conference has voted to call for a world-wide moratorium, it seems likely that the submarine disposition decision will not have to be made "in the near future". It does not seem unreasonable to spend $3 million for protective storage to buy us the time to make the environmentally, politically, and financially correct decision.
(2-1) The entire first paragraph is dependent on assumptions, such as the need for permanent "disposal"--ignoring the possibility of recycling. It assumes that a future generation would prefer ocean dumping now to a more educated decision later on. To paraphrase the saying about a sudden marriage, the DEIS suggests that we dump in haste, and repent in leisure. Or as an editorial in Oceanus (previously mentioned) puts it, "the Faustian nature of the disposal bargain--present advantage in return for liability stretching millenia into the future".

A further assumption is made by contending that"no significant exposure to the public would occur in either case". Unfortunately, this has already been negated by evidence that previous ocean dumped radwaste hns entered the food chain via fish caught near the Farallon Islands. L.6
After being threatened with a Congressional suppena, the EPA finally did release data showing Cesium 137 in the skin of Rock Cod from near the dumping area. Some people eat the skin, of course.
(2-14 & 2-15) Again, the writer makes unsupported assumptions that "other options as yet unidentified" (such as Seacrete?) "could not be significantly more advantageous in terms of environmental impact than immediate land or sea disposal, and are unlikely to be more advantageous in terms of cost or occupational exposure". Just what makes the author so sure that future developments could not be more attractive than immediate disposal? Frankly, I suspect that there is an overeagerness to substanciate a predisposition to initiate more ocean dumping as soon as possible. This kind of fallacious reasoning should not be forthcoming from the kinds of impressive experiences listed in the resumes of the authors at the back of the DEIS.
(3-6) The IAEA requirements cited should place the Mendocino area in question, since it is a "known area of natural phenomena", i.e. the earthquakes on the Pacific rim of fire. It is also adjacent to potential seabed resources such as minerals, oil, and a major fishing area. J.19, F.22

#713 (Cont)

(The Farallon Project-8)

(3-9) References 6, 8, & 9 present the same observations as made about 3-6 above, with special relationship of 6 "Effects of other dumpins which may have been made in the area". The Farallon Island dump site just below Mendocino has never been adequately studied by the EPA, despite numerous Congressional directives to do so. The excuse has always been lack of time and or money, both during this and the previous presidential administrations. Personally, I have always suspected that the real reason has been to avoid shedding any bad light on the plans to renew ocean dumping of radwaste in the Pacific. The suspicions came, in part, from personally observing the cosy three-way conversations, at a House hearing in Washington D.C., between the respective representatives of the EPA, DOE, and Lawrence Livermore Labs, who were all testifying about the ocean dumping issue including the Farallons and the Subseabed idea.

F.22 (3-11) Again, the author expresses an assumption which borders on an absurdity, that "the likelyhood of future earthquakes is small". And then the error is compounded by an apparent attempt to support the contention by stating that "The general area is at least 40 miles south of the seismically active Mendocino Fracture Zone". Anyone who lives on the California coast knows that forty miles is no safe distance in a major quake, and also knows that the likelihood of future quakes is <u>large</u>.

(A-11) As has been pointed out by several other scientists in addition to my comments above, there is no biological assesment of the potential effects on marine life included under costs. This is a major ommission, and it must be corrected for the EIS to have any validity at all.

(D-A16) The presence of Cesium 137 is attributed to fallout from weapons testing. This same evasive contention is made by the EPA about the source of Cesium 137 in Rock Cod caught off the Farallon Island dumpsite. The Farallon Project has evidence that it came from 100 dumped glove boxes from Lawrence Radiation Laboratories, and not from the sky. The effects of Cs 137 are particularly destructive in the human body--it lodges in the bone marrow, causing leukemia, and in the gonads wher it attacks the reproductive system, causing sterility and posses a threat of genetic damage that may be transmitted to future generations. Frankly, I don't buy that the Cesium fell from the sky. Cesium is produced in power reactors, and it probably came from the submarines in question. This appears as yet another attempt to minimise the potential danger to humans from dumping radioactive fission products into the ocean.

(PI-25) The corrosion discussion does not address itself to the real importance of how radioactive corrosion products might get back to humans. This question is currently being investigated by The Farallon Project, because of some sunken ships from atomic bomb tests that are in the water off the coast near San Francisco. There have been reports of extensive metalic deposition on the beaches north of the Golden Gate, and the concern is that it might be radioactive, originating from the ships. Perhaps the corrosion of these ships might be investigated with respect to potential submarine corrosion rates.

(G-3) Since the reactor compartment would possible be breached in 100 to 400 years, there is obviously concern that radiation would enter the local seafloor area at some point in time, and possibly sooner than the calculations predict.

L.1 (H-3) The assurances of the Sandia references are not corroborated by the above mentioned Woods Hole discussion, which contends that we do not know enough about the deep ocean sediments and their lifeforms.

(I-10 & 13) The radioactive retention of seaweed is of general concern because of its ability to bioconcentrate minerals, and seaweed is eaten by many people, and used for fertilizer by others.

(The Farallon Project-9)

4 PROPOSAL

4.1 Solution Requirements

An acceptable solution to the problem of disposition of decommissioned nuclear submarines should be technicaly viable, environmentaly safe, politicaly agreeable, and financialy reasonable. Although the subject is not evaluated in the DEIS, the solution must also be militarily secure. We believe that the Seacrete system, if given sufficient research and development attention and funding, could satisfy these criteria.

4.2 System Description

Seacrete is the trade name for a patented method of elecrodeposition of certain minerals, naturally occuring in seawater, onto metalic structures. Direct current electricity is applied to wire mesh, causing the depositing onto the metal, and creating a material which is similar to the shells formed by various mollusks such as clams and oysters.

The material thus formed has many interesting characteristics that are particularly of use involving substances that are in sea water or that might wish to be constructed in the sea. It is impervious to sea water and will not deteriorate therein, in contrast to concrete, metal, and other land-originated materials. It is stronger than concrete in compressive strength, and less expensive to create. It "grows" at about one inch of thickness per month, and structures of virtually any size or shape can be formed underwater. Its electrical requirements are relatively low--in the neighborhood of the output of an automotive storage battery, and could be produced by any of several solar generation methods. It has been developed for about ten years, and is now being used by a number of contracted applications, including: the State of Louisiana, the United States Coast Guard, a state navigation district, and several private pier restoration projects. There is an extensive file of information about previous tests and applications available from the corporation which is developing the patent rights (see appendix).

4.3 Submarine Application

The approach suggested is to mothball each ship completely, with the reactor retained inside, with a complete cocoon of Seacrete. While an entire vessel of this size has not yet been Seacreted, we feel that accomplishing of this capability could easily be demonstrated. In fact, a steel hull restoration project in Sausalito, California is now being explored, and if successful, would yield test results of interest. In view of the many millions of dollars being quoted to simply dump the subs in the ocean, it does not seem unreasonable to expend a hundred thousand or so to explore an effective mothballing system.

The submarines would either be cocooned in dock space now available, or additional docking structures can be created out of the Seacrete material itself. Or, and this would seem to be the preferred method if if could be accomplished economicaly, artificial lagoons could be dredged out on land adjacent to seawater. The bottoms and sides would be lined with wire mesh which would then be Seacreted to any desired thickness. Radiation detection sensors would be imbedded into the surface for any possible future leak detection. Then the submarines would be placed on pedestals in the lagoon, and they also would be completely covered with Seacrete material--either directly onto the hull, or onto a wire mesh covering the entire ship. Again, radiation detection sensors would be mounted on the exterior surface of the Seacrete coating, to immediately warn an automatically monitoring system if any radiation had penetrated through the existing Seacrete covering.

Now one of the advantages of using this system,is that if any such radiation penetration did occur, it would be possible to immediately start adding another layer of coating by simply restarting the electrical current in the wire mesh coating. This would grow an additionl layer to once again establish a protective barrier between the radiation and the human environment. In the industry, this quality is known as a multiple-barrier system, and in this case, can be produced in-situ without having to drain the enclosing seawater, or further exposing any workers, or removing any previous containment.

4.4 Advantages/Disadvantages

Considering the criteria defined in 4.1 above, the Seacrete system proposed has some advantages and disadvantages. Technicaly, it does work and is a patented invention. Some testing of its radioactive retainability has been made at the New York State University (Stonybrook) by Professor Herbert Herman. Those results are still under analysis. The fact that applications of Seacrete are still in the R&D phase is a disadvantage as far as immediate usage on the submarines. On the other hand, the time scale for need stretches out to the year 2000 in the DEIS. And, of course, radioactivity lasts for thousands of years, so a little research time now should be no insurmountable barrier to eventual use. And it should be kept in mind that no claim is being made that we can guarentee that the Seacrete system will prove adequate, only that its potential is so good, that it warrants further investigation by the Navy.

Environmentaly, the system seems to have a clear advantage over just dumping the submarines into the ocean. We would have a definable and monitorable containment system that could contain radioactivity for a virtually indefinate period of time. This could at least aquire enough time to allow for breakthroughs in research in radiation containment and or attenuation and neutralization. The system would not rely on mere calculations of what is happening in a remote part of the sea; we would have a positive, immediately controllable, provable containment. There are some potential environmental disadvantages which would require further investigation: some release of chlorine gas, changes in ph levels in confined sea basins, and other unknowns associated with a process still in a partial research stage. These will take time and money to determine.

Politically, the ability to locate a storage system in a remote land area adjacent to seawater would avoid objections from citizens concerned about impingement on fishing areas, or proximity to residential areas. Interestingly enough, I have run into opposition from environmental organizations who object to our offering a possible solution to the military or to industry. Their position is that we should not let them off the hook of an unsolved radwaste problem that can prevent any more production of nuclear weapons or power plants. While one can appreciate this attitude as an advantageous tactic to environmentalists' adversarial role versus the government or industry, The Farallon Project rejects such self-serving behavior as merely obstructionist. We are concerned with solving a problem that threatens the health and safety of all humans, regardless of their political or organizational or occupational status.

With regards to costs, I might point out the obvious advantage of avoiding a protracted "warfare" with the opponents of ocean dumping. The financial, legal, and psycological price to pay for divisive fighting between the military and the citizenry on this issue is prohibitive, even if forced down the throats under the threat of martial law. It is time to find co-operative solutions that save time and money and anger.

With respect to the potential costs to all of humanity, what is the reasonable price to pay to avoid the terminal radioactive poisoning of the sea upon which all life depends? If Seacrete can successfully contain radioactive waste, we will have possibly prevented millions of deaths from radiation-induced cancer. We may be able to prevent genetic damage to future generations of unborn children. What is the current cost of trying to cure cancer? The answer to cancer is prevention, not cure. There is no mystery virus that we need to discover and kill. As Pogo said it so well, "We have met the enemy, and it is us". We must not dump any more of our self-produced carcinogenic toxic wastes into the land, or the rivers, or the lakes, and certainly not into the ocean. The ultimate cost is the final price of survival or extinction.

As far as dollar costs for a Seacrete containment system, it would be presumptous to assert any reliable figures because of the newness of the existing technology. However, the aforementioned avoidance of cutting out the reactor compartment would save several millions. And sea water is, to make an understatement, relatively cheap. The same goes for direct current electricity which is exceptionally easy to produce with solar energy. Wire mesh is somewhat less than titanium valves. Lets put it this way, it seems reasonable to predict that the price per ship would be somewhat less than any figure quoted in the DEIS for any of the other alternatives discussed there. In any event, we are not suggesting that the Navy should award a half-billion dollar contract to the Marine Resources Corporation which owns the Seacrete patent. We do suggest that some R&D funds should be made available, now, to see if there is a viable basis for further consideration of a new mothballing technique, which may also have many other potential applications for use by the Department of the Navy.

4.5 Other Applications

In addition to the possible use for decommissioned submarines, the Seacrete system may prove applicable to other radwaste problems. In the case of a decommissioned nuclear power plant, for instance, the option of entombment could be accomplished with Seacrete. It would certainly make more sense that cutting them up and trucking them all over our nation's highways in trucks. If disarmament talks ever get past the word stage, Seacrete could be used to safely contain the radioactive portions of the dismantled weapons. Fuel rods at power plants could be safely contained, instead of moved around the country. The transportation of radwaste is another potential nuclear nightmare, and is addressed in a book recently published. It would be easier to transport salt brine than bomb-grade plutonium, and safer if the truck has an accident. And is important to remember that the atomic tarbaby is just that--the more its contacted, the more contaminated one gets. There are also a multitude of applications of Seacrete other than for radwaste, such as mining towns on the seafloor, but they are too many and too elaborate to discuss in this commentary. The following references give sources of additional information of the Seacrete process.

4.6 References

Inventor: Wolf H. Hilbertz, President, The Marine Resources Company, 819 Ball Avenue, Galveston Texas, 77550, (713) 763-0777

Invention: Mineral Accretion of Large Surface Structures, Building Components, and Elements. U.S. Patent #4,246,075, Jan 20, 1981

Publications: IEEE Journal of Oceanic Engineering, July 1979. NEXT magazine, March 1980; Hearings, Merchant Marine & Fisheries, Nov 20,1980, Subcommittee On Oceanography, Serial #96-53, pages 492-507, U.S. House Rep.

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#713 (Cont)

(The Farallon Project-12)

5 APPENDIX

1 Independent Journal reprints (2)
2 EPA Fish photo
3 EPA Watchdog cartoon
4 Waste disposal cartoon
5 Seacrete Solution, Pacific Sun
6 Testing The Eaters, Pacific Sun
7 N-Wastes in Bay, S.F. Chronicle
8 Solo Crusade, I.J.
9 EPA Pledge, S.F. Chronicle
10 Perlman, S.F. Chronicle
11 Plutonium Fish, I.J.
12 Golich, Pacific Sun
13 Plutonim Mess, Pacific Sun
14 Radiation Fears, Pt. Reyes Light
15 Congressional Directives, Resume Golich

#714

Elsie Allbright

MISS ELSIE ALLBRIGHT
15312 S. Normandie, Apt. 204
Gardena, Calif. 90247

July 5, 1983

Captain Edward F. Wagner, U.S. Navy
Office of the Chief of Naval Operations
(OPNAV-22)
Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

I am writing you to voice my objection to the ocean method of disposal of radioactive wastes as outlined in the U.S. Navy Draft Environmental Impact Statement (EIS).

Are you aware there is a method of NEUTRALIZING ATOMIC WASTE AND NUCLEAR WEAPONS? Someone in your department certainly should know about this method, for doubtless, the Russians know of it through
H.13 their experiments with Nikola Tesla's ideas. The method I refer to disposes of radioactive waste without harming anyone or anything and is much less costly than are any of the present methods.

If you wish to look into this method, get THE JOURNAL OF BORDERLAND RESEARCH for May-June, 1983 at $2.50 and on pages 9 to 11 you will learn of it. Obtainable from BSRA, P.O. Box 549, Vista, CA 92083-0190.

I would appreciate hearing from you your views of the feasibility of this method.

Sincerely yours,

Elsie Allbright

1072

#715

Resources Building
1416 Ninth Street
95814

(916) 445 5656

Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Boating and Waterways
Department of Parks and Recreation
Department of Water Resources

GEORGE DEUKMEJIAN
GOVERNOR OF
CALIFORNIA

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

Air Resources Board
California Coastal Commission
California Conservation Corps
Colorado River Board
Energy Resources Conservation and Development Commission
Regional Water Quality Control Boards
San Francisco Bay Conservation and Development Commission
Solid Waste Management Board
State Coastal Conservancy
State Lands Commission
State Reclamation Board
State Water Resources Control Board

JUL 08 1983

Captain Edward F. Wagner
OPNAV-22 Department of the Navy
Washington, D.C. 20350

Dear Captain Wagner:

Attached are copies of comments developed by the Department of Fish and Game, which is a unit of the California Resources Agency, concerning the draft environmental impact statement prepared by the U. S. Navy concerning the disposal of decommissioned, defueled naval submarine reactor plants.

Sincerely,

T. Egan
Gordon K. Van Vleck
for Secretary for Resources

Attachments

State of California THE RESOURCES AGENCY

Memorandum

To : Resources Agency

Date : [illegible]

From : STATE WATER RESOURCES CONTROL BOARD

Subject: COMMENTS ON DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS - SCHEDULE #83030902

Costs appear to be biased toward the option of total ship disposal at sea, as opposed to the other alternatives considered for disposal of the reactor compartments. Salvage is estimated to cost more than sea disposal of the entire hull (dismantling center section with reactor container, reassembly and welding of bow and stern, transportation). A breakdown of costs and potential income involved in salvage is not provided; such an operation should be cost effective, unless some factor not mentioned in the EIR is to be considered (for example, if the hull is contaminated). O.2

A controlled scuttled disposal was not demonstrated, since the ship in the demonstration broke up. A prediction of the impact area cannot thus be made with certainty (nor area of dispersal if ship breaks up). A demonstration was conducted with a conventional submarine; instrumented, but not specially prepared for sinking (not totally flooded, no air escape holes cut in hull). There apparently has been no demonstration representative of the expected conditions. This is recognized in the document by the following: F.19

Appendix D, VIII

> *"If and when sea disposal of the first decommissioned submarine is performed, monitoring during and after the sinking operation either will confirm that containment has remained intact, or it will reveal that some problem was not anticipated and containment integrity was lost or diminished. ... Since the maintenance of containment integrity is not a 100 percent certainty, the environmental effects of sea disposal have been conservatively estimated with the assumption that a sea disposal action could produce a "worst case" type of radioactivity release associated with complete loss of containment."*

The Savannah River Plant site has perched ground water at or near the surface, with rainfall at 47 inches/year. Trenches at the surface would not appear to prevent water movement and leaching to ground water,

#715 (Cont)

E.11 as well as direct surface drainage to the Savannah River. This would not appear to meet the technical standards requiring that solid radioactive waste be stored with at least ten feet of undisturbed soil between the permanent ground water table and the stored waste. With the level of detail contained in the EIS, there is no basis to assume that the trenches would lower the perched ground water tables in the burial area, or prevent this surface drainage from reaching the local streams and Savannah River.

C.1 Contaminants other than nuclear fuel and associated radiation are not addressed in the EIR. These would include such potential hazards as PCBs in transformers, electrical components, on board hydraulics system fluids, residual fuel oils, and battery fluids.

Walt Pettit

Walter G. Pettit, Chief
Division of Technical Services

State of California

THE RESOURCES AGENCY OF CALIFORNIA

Memorandum

To: Harold Waraas
Assistant Deputy Secretary
for Resources
The Resources Agency

Date: March 22, 1983

Subject: SCH 83030902
Disposal of Nuclear Submarines

From: Department of Conservation--Office of the Director

The Division of Oil and Gas (CDOG) of the Department of Conservation has reviewed the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants. The following comments are offered for your consideration:

The area studied on the West Coast for the ocean disposal of the submarines is located approximately 200 nautical miles off Cape Mendocino. Water depth in the study area is approximately 14,000 feet. Submarine disposal in this area will not affect any future oil or gas exploration activities because of the extreme water depth and shallow depth below the mud line to the basement basaltic rock.

If you have any questions, please contact Bob Reid at the CDOG office in Sacramento. The address is Room 1310, Resources Building; telephone 3-1781.

Esther Maser

Esther Maser
Environmental Program Coordinator

cc: Bob Reid

#715 (Cont)

State of California — The Resources Agency

Memorandum

To : Secretary for Resources
1416 Ninth Street
Sacramento, California 95814

Date : April 15, 1983

From : Department of Fish and Game

Subject: DEIS - Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (SCH 83030902)

This document, prepared by the U.S. Navy, seeks to explore alternatives for permanent disposal of about 100 nuclear submarines which are obsolete or will become obsolete over the next thirty years. Of the two options explored in depth (Land Disposal and Ocean Disposal), we are more concerned with the Ocean Disposal alternative because one of the proposed sites lies off the coast of Cape Mendocino and, if selected, disposal could affect fisheries and other natural resources of California. Our interest in this matter stems from our responsibility to protect, maintain and enhance California's fish and wildlife resources and to hold them in trust for present and future generations. In addition, we have a statutory obligation to assure living marine resources are managed so that their aesthetic, sport, commercial, scientific and educational values can be enjoyed by all.

General Comments and Conclusions

After reviewing the DEIS and other information not included in the document, we believe that the Land Disposal or No Action alternatives are preferable to the Ocean Disposal alternative. Our reasons can be generally summarized as follows:

1. Land Disposal or the No Action alternatives provide for maximum control of the radioactive materials so that other alternatives (such as salvage) can be implemented at a later time should they become desirable or technologically feasible. In contrast, Ocean Disposal is an irrevocable method. If later insights indicate that the practice is ill-advised, it would be impossible to correct the error. W.1

2. Both Land Disposal and No Action alternatives allow for environmental monitoring before and after disposal takes place; monitoring for the Ocean Disposal alternative will be expensive and technologically difficult to accomplish. We think this is a major disadvantage to the Ocean Disposal alternative. J.76

3. The document admits in several places that little or no information exists about the biology of deep ocean waters. The No Action alternative would keep both the Land Disposal and the Ocean Disposal alternatives L.1 G.2

open until missing marine biology data can be obtained so that the two options can be more meaningfully compared.

4. The major difference between the Land Disposal and Sea Disposal alternatives is apparently a difference in the cost (page S-16). The document states that Land Disposal could cost as much as 200 million dollars more than ocean disposal over the thirty-year life of the project. Census figures indicate that the nation's population is about 200 million people. Therefore, a 30-year Land Disposal program will have an extra cost of about one dollar per person or about 3 cents per person per year (in 1981 dollars). Given the acknowledged uncertainties of Ocean Disposal and the controls possible with Land Disposal, the extra cost seems minimal and worthwhile.

5. Several unknowns about Ocean Disposal remain:

- the rate of exchange between bottom and surface waters. U.7
- vertical migration patterns of squid and crustaceans. U.4
- food web ecology and exchanges across the boundaries of deep-water, mid-water and surface-water masses. U.8
- ecology of deep-ocean habitats at or near the bottom. T.21

Until these factors are well-understood, the Ocean Disposal alternative seems undesirable.

Specific Comments

1. Overview. Our specific comments will be mostly confined to the biological consequences of the Ocean Disposal alternative and will mainly focus on the Pacific Study Area. In an attempt at clarity, we will make comments on the basis of issues because the document's structure makes it difficult to give coherent page-by-page critique.

2. Selection Criteria. The document states that one criterion for selecting Ocean Disposal sites was "...to avoid areas which have the potential for future use..." (p.S-11) and to avoid areas that "...have the potential to be exploited either directly by mining or the harvest of marine products, or indirectly (e.g. spawning) as feeding grounds for marine organisms important to man" (p.3-6). The document then portrays only the present commercial fishery for albacore (*Thunnus alalunga*), and only in terms of catch per unit effort at the site. J.13

However, the document ignores the fact that California has a growing fishery for sablefish (*Anoplopoma fimbria*) and that a fishery for grenadiers (family Macrouridae), which are fished commercially in other countries, could develop off the Mendocino Coast. Both sable fish and grenadiers are deep water fish. Grenadiers may be found at the disposal site (p.E 30) and sablefish may migrate considerable distances between depths as deep as the disposal site and shallower; exploitable depths near shore (Jim Hardwick, DFG, personal commun.; Cailliet, Moss Landing Marine Laboratory, personal commun.; Cailliet, Osada and Moser [1]). These fisheries have grown J.14, T.19, J.9

[1] Cailliet, G. M., E. K. Osada, and M. Moser. In press. Ecological studies of sablefish in Monterey Bay.

#715 (Cont)

J.14

because techniques for fishing deeper and deeper waters have evolved as competition for fisheries stocks has increased, and it seems reasonable to assume that this trend will continue as market demand and new gear developments continue to increase.

J.12, J.14, J.9

The document should be revised to reflect the potential for the growth of these fisheries and the site should be reconsidered in the light of the possible migration of fish stocks from the disposal-site depths to exploitable depths.

O.34

3. Commercial Fisheries. The document is inadequate in its discussion of commercial fisheries because (as noted earlier) it omits discussion of some fisheries, because it poorly portrays others such as the albacore fishery, because it lacks a portrayal of the economic value of these fisheries to the State's economy and because it does not portray adverse consumer reaction to a fishery product that may be contaminated. The document should be revised to include at least the following discussion.

J.14

a. Sablefish. According to data gathered by DFG, in 1981 the value of sablefish at dockside was over $2.7 million. About half of the fish were landed at Eureka, the closest fishing port to Cape Mendocino and the proposed Pacific Disposal Site. The fish are sold either as smoked fish (Alaskan cod) or as fresh and frozen fillets (butterfish). In recent years California has produced nearly 75% of the landings along the U.S. Pacific Coast.

J.9

b. Albacore and Other Tuna. The document states that the catch-per-unit-effort for albacore at the Pacific Disposal Site is low (p.E-30). However, the discussion fails to note that albacore, like all tunas migrate over long distances. Therefore, it is possible that fish could feed at or near the Pacific Disposal Site, and be caught elsewhere after long migration. In 1981, landings for albacore at dockside in Eureka were valued at about $4.2 million; the State-wide landings were valued at about $17.2 million.

L.53, O.34

California also has a significant tuna cannery industry, which packs and ships not only fish caught in California, but fish imported from elsewhere. In 1981, the canneries shipped almost $41 million worth of albacore; they also packed and shipped other species of tuna as well. The total value of all tuna packed and shipped by California canners was $136,696,350. Origins of canned fish are not proclaimed except that the cans show it was packed in California.

c. Adverse Consumer Reaction. The document contains considerable discussion about radiological hazards to marine life and mankind which may result from disposal practices. However, it lacks a discussion and assessment of the consequences for the State's fishermen and canneries, if the public, concerned about radiological hazards, suspects that albacore from California were radioactively contaminated. Such adverse effects could be even more severe if, as is possible, people make no distinction between albacore and other tunas. Adverse consumer reaction could

affect the sablefish fishery and the development of new fisheries at or near the project site. We, therefore, recommend the DEIS be revised to include a discussion and assessment of these potential impacts not only for existing fisheries, but also for potential fisheries that could develop in the project area. L.53, O.34

4. Bottom-to-Surface Transport of Radioactive Materials.

a. Physical Pathways. Although Appendix H contains lengthy discussion of currents and eddy movements, it lacks a clear portrayal of how soon bottom waters from the Pacific Ocean Disposal Site will reach the surface and how soon bottom waters will reach a depth of known biological activity. The document also lacks a discussion of whether water moving upward will carry radioactive particulate material into the food web, and the biological effects of such an occurrence. U.7, J.31

b. Biological Pathways. The document claims that physical mechanisms are more important than biological mechanisms for moving radionuclides from the bottom to the surface (p.J-17) and gives a reference citation instead of a discussion of this claim. However, without at least a summary from the cited reference, we think this claim is poorly supported. The document should elaborate on this point, and include a discussion of vertically migrating species such as squid and crustaceans that may move considerable distances through the water column and which could transport radionuclides through the food web. U.4 U.8

5. Portrayal of the Pacific Disposal Site-Sampling Techniques. The document discusses studies that were performed at ocean disposal sites including photographic portrayals of the bottom (Appendix E). Although the document states that bottom samples were taken (p.E-29) it fails to specify the method of collection. J.73

The photographs are also offered as evidence of sparse fish populations. However, we think this portrayal is inadequate. Instead we believe a baited camera with time-lapse photography should be used to portray the numbers and kinds of fishes present at the site. Nevertheless, a fish does appear in one of the photographs (p.E-22), which the document claims is a "bathysaurus fish" (p.E-20). Based on a rudimentary morphometric analysis, we believe the fish could be a sablefish. If so, the occurrence of sablefish at the site could mean the fishery for this species may be adversely affected if Sea Disposal was implemented at the Pacific Ocean Disposal Site. Therefore, the document should clearly state whether the fish belongs to the genus *Bathysaurus*, or if it is a sablefish and should reflect how this conclusion was reached. J.9, J.74

In addition, it appears from statements on pages E-20 (second paragraph) and E-29 (last paragraph) that data analysis is incomplete. For this reason, we further believe the discussion of the Pacific Ocean Site is inadequate in its present form. J.9

#715 (Cont)

J.76 6. Monitoring. The monitoring program outlined on pages K-1 to K-3 does not specify sampling techniques, sampling frequency, or numbers of samples. Until a detailed program is presented and discussed, we believe this section is inadequate.

O.2 Costs for site selection ($6 million) and monitoring ($9 million) are projected to cost about $0.1 million per submarine for the Ocean Disposal alternative (p.K-3). Because cost is a primary factor in selecting the disposal alternative, the figures used to arrive at the estimated cost should be given in the document.

J.76 We are concerned that monitoring may be significantly more expensive than originally estimated and this development may cause the monitoring program to be curtailed or eliminated. In addition, because sampling at great depths is difficult at best, an adequate monitoring program may be technically impossible, despite best intentions.

L.45 L.13 7. Ingested Radionuclides (Biological Consequences). Although the document states that radioactive materials will pose little threat to living organisms unless ingested or inhaled (p.1-2) and although there is extensive discussion concerning the distribution of radionuclides once they enter the organism (Appendices I and J), there is no portrayal of what the dose committments mean to an individual organism.

The dose committments portrayed in Appendix J are apparently not acutely lethal. However, the document should portray the consequences (to an organism and to a population) of long-term, low-level exposure. Consequences to marine biota should be discussed in addition to human health aspects.

L.55 8. Submarines as Reefs. The document emphasizes that only 3 of 180 photographs show fish at the disposal site (p.E-20) and states that the expected "large animals" will be holothurians (sea cucumbers) and brittle stars. However, obsolete Liberty Ships have been sunk off California's Coast to make artificial reefs. Subsequent studies have shown that in locations with sandy bottoms (i.e. no relief) artificial reef structures attract an abundance of fishes and other marine life. In light of past experience, it would seem logical that if the Ocean Disposal alternative were selected submarines will function as an artificial reef. The document should discuss this possibility and discuss how biological transport mechanisms may be accelerated if marine life is attracted to submarine hulls.

This concludes our review. If you have questions about these remarks, please contact Mr. Rolf Hall, Environmental Services Supervisor in our Marine Resources Region at 245 West Broadway, Long Beach, California 90802; telephone (ATSS) 635-5155 or (213) 590- 5155. Thank you for this opportunity to comment.

E C Fullerton
Director

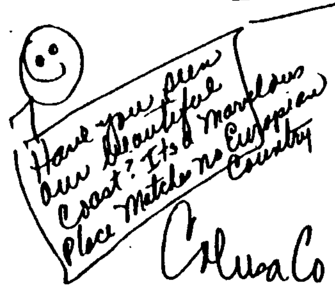
#716

Captain Wagner: Where does the "Buck stop"?

You Must

Please! Stop. Dumping!

Stop this terrible  "Waste" of our beautiful World - I am 44 and want my Children & grand Children to enjoy the Coast and the world - Dont you?



Lorraine Davis
Rt 1 Box 215
Colusa Co. Arbuckle Calif 95912

#717

Marianne Brettell
c/o General Delivery
Encinitas, CA
92024

SAN DIEGO, CA PM 1 JUL 1983

July 15th

Greetings!!!!!

Please stop ocean dumping! Listen to the truth within you. Truth is what does the most good for the most people (and all of creation). Let this be your good on what is right.

Thankyou

Sincerely,
Marianne Brettell

1078

#718

SEVENTEENTH GUAM LEGISLATURE
1983 (FIRST) Regular Session

Committee on Rules
Resolution No. 69

Introduced by: M. D. A. Manibusan, J. F. Quan, J. F. Ada
A. C. Lamorena III
T. V. C. Tanaka
J. H. Underwood
A. R. Unpingco

Relative to supporting the efforts of Congressman Antonio B. Won Pat in opposing the Navy's plan to dump 100 nuclear submarines in the ocean.

BE IT RESOLVED BY THE COMMITTEE ON RULES OF THE SEVENTEENTH GUAM LEGISLATURE:

WHEREAS, the U.S. Navy has proposed to endanger the marine environment by dumping 100 obsolete nuclear submarines in ocean waters containing 6,000,000 curies of radioactivity; and

WHEREAS, among the sites under consideration by the Navy is a location in the Pacific Ocean near Cape Mendocino, California; and

WHEREAS, the Pentagon officials are now in the process of reviewing an environmental impact statement on the proposal; and

WHEREAS, Congressman Antonio B. Won Pat of Guam has urged the Navy to abandon its plan to dump these submarines in the Pacific and Atlantic Oceans; and

WHEREAS, the people of Guam oppose the dumping of nuclear waste in any form in the oceans; now, therefore, be it

RESOLVED, that the Committee on Rules of the Seventeenth Guam Legislature join with Congressman Won Pat in opposing any plan by the Navy to dump nuclear waste in the ocean; and be it further

RESOLVED, that the Committee on Rules of the Seventeenth Guam Legislature does hereby make it known to the United States Department of the Navy, that it does not support any proposal to endanger the lives of the people of Guam and the Pacific by dumping any form of nuclear waste in our ocean; and be it further

RESOLVED, that the Navy is requested to provide the Committee on Rules of the Seventeenth Guam Legislature with a final copy of the environmental impact statement; and be it further.

RESOLVED, that the Speaker and the Chairperson of the Committee on Rules certify to and the Legislative Secretary attest the adoption hereof and that copies of the same be thereafter transmitted to Congressman Antonio B. Won Pat; to the President of the United States; to the Secretary of the Navy; to the Secretary of the Department of Defense; to the Commander, Naval Forces Marianas; and to the Governor of Guam.

DULY AND REGULARLY ADOPTED BY THE COMMITTEE ON RULES ON THE 30TH DAY OF JUNE 1983.

ELIZABETH P. ARRIOLA
Senator and
Legislative Secretary

JOHN F. QUAN
Acting Chairperson,
Committee on Rules

CARL T. C. GUTIERREZ
Speaker

#719

STATE OF NORTH CAROLINA

Department of The Secretary of State

I, THAD EURE, Secretary of State of the State of North Carolina, do hereby certify the following and hereto attached THREE (3) sheets to be a true copy of RESOLUTION 30 , 19 83 Sessions Laws entitled

A JOINT RESOLUTION URGING THE UNITED STATES GOVERNMENT TO REFRAIN FROM OCEAN DISPOSAL OF DECOMMISSIONED NUCLEAR SUBMARINES OFF THE NORTH CAROLINA COAST.

ratified on the 17th day of June , 19 83 , by

The General Assembly of North Carolina

the original of which is now on file and a matter of record in this office.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal.

DONE IN OFFICE at Raleigh, this the 21st day of June , 19 83

Secretary of State

3U0252690

GENERAL ASSEMBLY OF NORTH CAROLINA

SESSION 1983

RATIFIED BILL

RESOLUTION 30

SENATE JOINT RESOLUTION 211

A JOINT RESOLUTION URGING THE UNITED STATES GOVERNMENT TO REFRAIN FROM OCEAN DISPOSAL OF DECOMMISSIONED NUCLEAR SUBMARINES OFF THE NORTH CAROLINA COAST.

Whereas, the Navy is searching for a safe disposal of approximately 100 defueled nuclear submarines; and

Whereas, one of the proposals that the Navy is most seriously considering is dumping these radioactive submarines in the Atlantic Ocean about 200 miles off the North Carolina coast; and

Whereas, scientific evidence now shows that species of marine life have been contaminated by radioactive materials dumped at sea and these species of marine life enter into the food chain and will be consumed by humans; and | L.36

Whereas, North Carolina's coastal economy is dependent upon clean and unpolluted water and beaches for commercial and sports fishing and tourism and recreational opportunities; and | L.53

Whereas, the State is vitally concerned about the health of its citizens; and

Whereas, the citizens of North Carolina have themselves placed a high priority on a clean and healthy environment as shown through a 1982 citizens' survey conducted by the Commission on the Future of North Carolina; and

Whereas, the radioactivity may have adverse health and environmental effects; and | L.36

Whereas, the dumping will almost surely have adverse psychological effects because our citizens have not been assured of the complete safety of the proposal and have a general fear and lack of understanding of radioactivity; and | O.34

Whereas, the Outer Banks Chamber of Commerce and many other groups, organizations and private citizens have joined in expressing great concern or opposition to the proposed dumping; and

Whereas, Jane Patterson, North Carolina Secretary of Administration, has stated that "it is the policy of the State of North Carolina to oppose the ocean dumping of nuclear submarines until a national ocean use policy has been developed with a consistent and complete regulatory system"; and

Whereas, Secretary Patterson has raised concerns about lack of adequate scientific data, lack of sufficient monitoring, and other inadequacies in the Navy's Environmental Impact Statement on the proposal; and | L.1, J.76

Whereas, because of safety considerations, the United States has not dumped radioactive wastes in the ocean since 1970; and

Whereas, Congress has banned ocean dumping of radioactive wastes until 1985; and | F.8

Whereas, these defueled submarines will continue to emit radioactivity into the ocean's waters for 30,000 years; and

1079

1080

#719 (Cont)

Whereas, burying the submarines in the earth would permit better monitoring and easier retrieval if problems arose; and

Whereas, the General Assembly has great concern at this time about the Navy's plans to move forward with its proposal to dump these radioactive submarines in the Atlantic Ocean off the North Carolina coast;

Now, therefore, be it resolved by the Senate, the House of Representatives concurring:

Section 1. The General Assembly of North Carolina respectfully urges the Congress of the United States to direct the Secretary of the Navy to immediately halt all plans for the sinking of decommissioned nuclear submarines in the Atlantic Ocean off the coast of North Carolina.

Sec. 2. The General Assembly further urges Congress to insure that the United States Environmental Protection Agency, the United States Navy, and all other involved parties have the necessary, correct, and detailed information that is needed to reach a decision that will protect the health, safety, and welfare of all citizens of North Carolina and other coastal states that may be affected.

Sec. 3. The General Assembly of North Carolina respectfully urges the Secretary of the Navy to research fully the possibility of completely dismantling these submarines and utilizing land disposal areas for radioactive parts because land disposal would appear to provide a safer and more controlled and controllable disposal method with less chance of causing environmental damage, pollution problems, or adverse economic effects.

Sec. 4. The General Assembly urges Congress at the very least to consider immediately a comprehensive national ocean use policy with a complete regulatory system. Without such a policy, haphazard ocean dumpings may prove dangerous to persons and property.

F.2 Sec. 5. The General Assembly urges Congress to delay the further consideration of any ocean dumpings. Recent amendments to the Ocean Dumping Act ban dumping of low-level radioactive wastes in the oceans until 1985, so the proposed dumping cannot occur until then, but the General Assembly urges Congress to consider a permanent ban if health, safety, and economic considerations make such a ban wise.

Sec. 6. The Secretary of State shall send a certified copy of this resolution to every member of the congressional delegation from North Carolina, the Secretary of the United States Navy, the Administrator of the Environmental Protection Agency, the Governor of North Carolina, and the North Carolina Secretary of Administration.

Sec. 7. This resolution is effective upon ratification.

In the General Assembly read three times and ratified, this the 17th day of June, 1983.

JAMES C. GREEN
James C. Green
President of the Senate

LISTON B RAMSEY
Liston B. Ramsey
Speaker of the House of Representatives

#720

JOHN R. SWANSON
P. O. Box 922
Berkeley, Calif 94701

July 26, 1983

Captain Edward J. Wagner
Office of the Chief of Naval Operations
(OP NAV - 22)
Department of the Navy
Washington, D.C. 20350

Dear Sir,

Please accept my comments, as follows, concerning:
- Draft Environmental Impact Statement Sub-sinking Proposal -.

I wish to advise that I Oppose any and all forms of dumping into the oceans. And such opposition includes the current proposal to sink submarines in the Pacific Ocean.

L.20 In addition to the varied problems of radioactive materials that will integrate into the oceans' system, such sinkings appear to be a substantial waste of varied materials.

And presume that the Navy continues to consider the oceans as, primarily, a massive toilet.

O.10 Such submarines and other items could easily be sold for scrap, thus, saving the materials involved, assisting in saving the environment and making a profit.

Let us, then, as national citizens save rather than destroy our World's environment.

Sincerely,

John R. Swanson

1082

#721

GEORGE DEUKMEJIAN, Governor

STATE OF CALIFORNIA

HEALTH and WELFARE AGENCY
OFFICE OF THE SECRETARY
1600 NINTH STREET, ROOM 460
Sacramento, California 95814
(916) 445-6951

July 11, 1983

Captain Edward F. Wagner
U.S. Navy
Office of the Chief of
Naval Operations
Washington, D.C. 20350

Dear Captain Wagner:

RE: Ocean Disposal of Nuclear Submarines

This is in response to the Navy's request for comments on the disposal of decommissioned nuclear submarines. In the Navy's Draft Environmental Impact Statement (EIS), several disposal options were presented, including ocean disposal of the defueled submarines.

We have concluded from our reviews of the EIS that there would be no adverse health effects associated with ocean disposal; however, it is very apparent that the public, fisheries industry, environmental groups, legislators, local government representatives, and others perceive this to be a threat of unknown dimensions to the ocean resources and, ultimately, human health, as well as being a precedent-setting, irreversible action. These fears have been expressed clearly at the hearing held by the Navy in Sacramento and in the many letters which we have responded to on behalf of the Governor. Even a perceived threat can have a damaging effect on northern California's fisheries industry and the economy of the area.

0.34

W.1

The irreversibility of the ocean disposal action is a particular public concern in that any unconsidered or miscalculated effect could not be rectified and the Navy is not looked upon as being infallible or as having considered every possible contingency.

Although "peace of mind" cannot be factored into an EIS, these very real public concerns and uncertainties and the

Captain Edward F. Wagner
July 11, 1983
Page Two

effect they may have could support a position in opposition to the ocean disposal of the defueled submarines. In our opinion, however, the proposal cannot be opposed on the basis of adverse health effects.

Sincerely,

DAVID B. SWOAP
Secretary

DBS/MJ:cy

#722

LEMBO PRODUCTIONS
BOX 1853
CARMEL, CA. 93921

Captain Edward Wagner
U.S. Navy
Office of the chief of Naval Oper.
OPNAV-22
Dept. of the Navy
Washington D.C. 20350

No dumping of decommissioned nuclear submarines in the ocean!!

No nukes is good nukes!

Thanks.
Joanne

JL
JOANNE LEMBO
625-2080

CALIF. INTL. ... NAVY BLUE ... OCT. 16. 1 ... SALINAS

1083

1084

#723

WESTERN GOVERNORS' CONFERENCE
THE COUNCIL OF STATE GOVERNMENTS

720 SACRAMENTO STREET, 3rd FLOOR SAN FRANCISCO, CALIFORNIA 94108 (415) 986-3760

APPROVED RESOLUTION NO. 83-18

OCEAN DUMPING OF NUCLEAR WASTE

(Introduced by Governor Ricardo Bordallo, Guam)

WHEREAS, Japan continues to explore and test an area 600 miles (900 kilometers) north of the Marianas archipelago in the Pacific Ocean for the dumping of low-level radioactive waste, despite an announced delay in the project; and

WHEREAS, the U.S. Navy is continuing its efforts to dispose of 100 obsolete nuclear submarines in the Pacific and Atlantic Oceans over the next three decades; and

L.39 WHEREAS, it has been shown that such disposal of radioactive waste in an ocean environment has unpredictable consequences for the marine ecosystem of the entire Pacific basin; and

L.53 WHEREAS, fishing and tourism are recognized as being significant contributors to the economies of the Pacific Rim States and the U.S. Flag Territories of the Pacific, and these industries are absolutely dependent on a pollution-free environment; and

WHEREAS, a 1981 scientific analysis of the proposed Japanese oceanic nuclear waste disposal program commissioned by leaders of the Commonwealth of the Northern Mariana Islands found serious flaws in the planned program and concluded "The lesson of past oceanic radioactive waste disposal operations is clear: What we put into the sea eventually returns to us in our food;" and

WHEREAS, the Seventh Consultative Meeting of the London Dumping Convention, held February 14-18, 1983, voted by a 75 percent margin in favor of a two-year moratorium on all nuclear waste dumping at sea; and

WHEREAS, the United States and Japan were among the minority nations casting dissenting votes on the two-year moratorium and declared their intent to ignore it; and

WHEREAS, the Pacific Basin Development Council Board of Directors, composed of the Governors of Hawaii, American Samoa, the Commonwealth of the Northern Mariana Islands and Guam, adopted a statement of principal on October 3, 1980, totally opposing the dumping of radioactive nuclear wastes in any part of the Pacific Ocean; and

WHEREAS, the Peoples of the U.S. insular areas in the Pacific have continued to exhibit vocal and vehement opposition to the ocean dumping of any radioactive waste through both popular demonstration and resolutions adopted by their elected leaders in local legislatures and regional forums;

NOW, THEREFORE, BE IT RESOLVED that the Western Governors' Conference denounces ocean dumping of nuclear waste, no matter what the level of radioactivity, and urges the governments of Japan and the United States to vigorously pursue alternative methods for the disposal of such toxic waste.

(APPROVED BY THE WESTERN GOVERNORS' CONFERENCE ON JUNE 29, 1983 IN KALISPELL, MONTANA)

WGC14R8318

#724

G. Oetcamp
Box 1914
Kings Beach, CA.
95719

Aug 30, 1983
Kings Beach, CA.

Mr. Secretary,

I am writing to urge you to abandon your plans to dispose of nuclear submarines in the oceans. The pentagon has never hesitated to spend taxpayers money on weapons systems, so now you should not hesitate to spend money to safely dispose of them. How can we expect our citizens and our children to act responsibly if our government does not?

When we develope a weapons system we are responsible for its use and its safe disposal when obsolete. Hopefully the Navy would not dispose of live ammunition in a city park? Don't dispose of nuclear waste in the ocean!

Sincerely,
[illegible signature]

#68a*

Testimony on Behalf of
the California Coastal Commission
at the
Public Hearing
on the
Draft Environmental Impact Statement
on the
Disposal of Decommissioned Nuclear Submarines
Sacramento
February 24, 1983

The California Coastal Commission is responsible for implementing the California Coastal Act of 1976. That statute is the main component of the California Coastal Management Program (CCMP), which has been approved by the federal government for carrying out national coastal policies in California.

Under federal law (the Coastal Zone Management Act) the federal government may not conduct activities which directly affect California's coastal zone unless the federal agency determines that the activities would be consistent with the CCMP to the maximum extent practicable and the Coastal Commission concurs in that determination. If the Commission disagrees, the activity may not take place unless the federal agency is prohibited by some other law from complying with the CCMP. In reviewing these federal projects, the Commission must consider national, as well as state and local interests.

The dumping of radioactive wastes in the ocean waters offshore California would raise serious questions before the California Coastal Commission. A consistency determination would be required for any dumping by federal agencies within the state waters (3 miles offshore) as well as any dumping in federal waters which would directly affect the coastal zone. Any dumping by a non-federal entity in state waters would require a permit from the Commission. F.11*

*Other issues discussed by Mr. Douglas of the California Coastal Commission are side barred in Exhibit 68.

#68a (Cont)

The Coastal Act calls for the maintenance, enhancement, and restoration of marine resources. Section 30230 of the Act requires that "uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes." The effects of any ocean dumping of radioactive wastes would have to be measured against these and other Coastal Act provisions. Based on preliminary information, the Commission staff believes that any radioactive dumping in U.S. waters off the California coast has the strong potential of impacting the state's coastal zone through at least the following ways:

L.37 o bio-accumulation of radionuclides through the marine food chain;

L.10 o adverse synergistic effects caused by the combination of radionuclides with biological and chemical constituents of ocean waters;

T.18 o radiation in marine waters can affect the fecundity of fish, most especially currently over-exploited fish species;

L.53 O.34 o serious impacts on the coastal fisheries...these impacts would result, in part, from either actual or publicly perceived radiation damage or contamination to marine food species. If the consumer knows or feels that fish and shellfish are coming from coastal waters where radioactive wastes have been recently dumped, the purchaser is quite likely to avoid a fisheries product. Consumer avoidance or rejection of fisheries products due to potential radiation damage would devastate coastal fisheries.

L.7 The cumulative effects of a disposal of radioactive wastes in the Pacific Ocean must be carefully assessed. Nuclear wastes have been dumped at several locations off the California coast and at numerous other places in the Pacific. Accurate records of the amounts and locations of all such dumpings were not kept.

While some monitoring of existing dump sites has been done, these studies were often quite cursory. Little definitive information has been generated about the fate and effects in the ocean of the various specific types of radionuclides. There is still a significant gap in knowledge, and until that gap is filled by sound scientific evidence, no consideration should be given by E.P.A. to lift the de-facto moratorium on ocean radioactive waste dumping. L.6

The U.S. Navy's consideration of scuttling nuclear subs off the Mendocino coast is the most immediate and alarming proposal to re-establish the use of California's ocean waters offshore California as a radioactive waste receptacle. The proposed dumping of these radioactive submarines 160 miles offshore and in 13,500 feet - 14,800 feet of water must be considered a final, irreversible action. If serious problems are discovered after the marine disposal of the radioactive wastes, it would be nearly impossible to take corrective actions. W.1 Because the U.S. has not yet developed a sound national policy on ocean dumping of radioactive wastes, extreme caution should be exercised in consideration of the proposed irreversible dumping of nuclear submarines off the Pacific coast.

In reviewing a future federal consistency determination to scuttle nuclear submarines off the California coast, the Coastal Commission would address all questions relevant to coastal zone impacts, and would require the Navy to provide detailed technical information to fully illucidate all significant effects on the coastal zone. While the Draft Environmental Impact Statement does touch on some of the salient topics, the impact issues are far from being resolved. J.9 J.20 The Commission's staff is currently reviewing the Draft Environmental Impact Statement and will submit sunstantive comments by the March 31 deadline. These comments will focus on the following general questions and concerns that must be addressed in the Final Environmental Impact Statement and in the Navy's federal consistency determinations:

#68a (Cont)

J.28 o Ocean Currents: A detailed assessment of current conditions and a model projecting the maximum movement of radionuclides dumped is essential.

J.19 F.22 R.1 o Geology: What is the seismic history of the area? What is the likelihood of major seismic activity? What effect would an earthquake have on the dumped material? Are the radionuclides likely to be trapped in sediments?

J.9 o Living Marine Resources: A detailed survey of the plants and animals which inhabit or pass through the dump site is needed. An accurate mapping of all fish breeding and spawning areas is also necessary. This data must be carefully correlated with water movement data to determine
L.10 L.37 potential effects on fishery stocks. How do these particular radionuclides react in seawater? What are the potential synergistic effects? The question of bioaccumulation must be addressed in detail.

L.53 o Fisheries: The dumping of nuclear wastes in California's ocean waters would certainly affect the public's acceptance of fisheries products.
O.34 The fishery industry is an vital part of the economy of the Northern California Coast. This issue must be addressed.

L.6 o Precedent & Cumulative Impact: The potential dumping of nuclear subs off the California coast cannot be viewed as an isolated incident. The past
F.8 dumping or other sources of radiation in the area must be a part of this consideration. Since the Commission will also consider the precedent the
L.9 dumping would set and assess the cumulative impace on marine resources, an
L.7 assessment of the overall effects of the disposal of radioactive wastes offshore California must be provided.

In summation, the California Coastal Commission has serious concerns over the potential ocean dumping of nuclear submarines off California. Based on

present information, the Commission believes that the dumping of nuclear submarines off Cape Mendocino would affect the California Coastal Zone and would; therefore, have to be reviewed by the Commission for consistency with the approved California Coastal Management Program.

In conclusion, the California coastline is the gateway to the Pacific Ocean for millions of visitors from throughout the world. The Pacific is a rich source of food for mankind and an important element in the California and national economy. It is critical to the well-being of California, the nation and the world that the biological health and productivity of the ocean waters along the coast be vigorously protected and preserved. The vitality of this rich environment should not be jeopardized by a quick fix solution to the long-term problem of nuclear waste disposal..

1088

#160a

Please return to attendant when completed.

NAME Elizabeth Ann Hathcock DATE 2-24-83

MAILING ADDRESS Star Route

CITY Redway, Ca. STATE Ca ZIP 95560

SPEAKING AS: (Check one)

- [x] Individual
- [ ] Representing a Non-Government Organization
- [ ] Representing a Local Government Organization
- [ ] Representing a State Government Organization
- [ ] Representing a Federal Agency or Organization

NAME OF ORGANIZATION OR AGENCY ____________

MAILING ADDRESS ____________

CITY ____________ STATE ____________ ZIP ____________

Written comments may be provided on the other side.

I object to any nuclear waste - submarine or otherwise, being dumped in the oceans of the earth!

*Other issues discussed by Dr. Weiner are side barred in Exhibit 39.

#39a

SIERRA CLUB
Cascade Chapter
6837 51st Ave NE, Seattle, Wa. 98115

STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

Ruth F. Weiner, Ph.D.
February 22, 1983

I am here representing the Washington Environmental Council and the Cascade Chapter of Sierra Club; I am chair of the Cascade Chapter. I general, we support the position of the Oceanic Society of America I would only like to add a few persepctives to the statement of the Society's Scientific Advisory Committee.

The Navy has considered three options for disposal of the decommissioned reactor plants: deep ocean disposal at 4000 meters or thereabouts, land burial on the LLW site at Hanford or Savannah River, and leaving the subs moored where they are. The nuclides of major concern in this disposal venture are (Table1.1, DEIS):

Nuclide	Half-life	Initial activity/sub
Co-60	5.26 years	22000 Curies
Ni-63	92 years	18000 Curies
Fe-55	2.60 years	17000 Curies
Ni-59	80000 years	120 Curies
C-14	5730 years	1 Curie

The first three of these have both long half-lives and very high abundance; Ni-59 has an exceedingly long half-life, and C-14 both has a long half-life and is very readily incorporated into the food chain.

In suggesting ocean disposal, the Navy is taking a calculated gamble: that the nuclides will have decayed sufficiently by the time that the material of the compartment has corroded and dispersed that contact with the food chain would prove harmless. L.20*
Fir the nuclides listed above, particularly C-14, the gamble is that the material will never reach the food chain at all. As the Oceanic Society has pointed out, the combined uncertainties in corrosion rates and dispersion rates make this gamble something less than an educated guess. L.36 S.25
Ionizing radiation is known to damage crystal and glass structures and could well enhance corrosion. Q.13
Moreover, the accumulated CRUD in the reactor plants is just about ignored on the DEIS; this material is far more labile in the environment than the metal of the plant itself. A.12

The Oceanic Society statement points out the uncertainties in the THRESHER and SCORPION data. It is also unclear why data from the GLOMAR EXPLORER attempt to raise the Russian submarine was not included. J.34
This last provided a real case of radioactive material in a submarine in the marine environment. It differs from the THRESHER and SCORPION data in that we know where the J.64

#39a (Cont)

Russian submarine is!

L.20 W.1 J.76 L.7 L.29

In sum: the marine environment is, of course, exceedingly corrosive. Eventual corrosion and dispersion is a certainty, and will, in some fashion, contribute to the radioactive loading of the oceans. Disposal in the ocean is the alternative with the ,ost uncertain future. Moreover, retrievability is out of the question and monitoring poses enormous problems. The DEIS fails to consider the cumulative effect of old ocean dumps, the FUSRAP program, and ocean dumping now done or contemplated by other nations. It can be argued that the volumes of both the Atlantic and Pacific oceans are enormous, but it can also be argues that we are talking bout hundreds or even thousands of years. The comparisons which the DEIS does make to other processes which put radioactive material into the environment are often spurious. For example, Table 4-7of the DEIS compares activity from the reactor plants with activity naturally washed by rivers into the ocean (how "natural" that process is considering current uranium and coal mining activity is anybody's guess). This is an "apples and oranges" comparison: U-234, U-238 and Th-232 are compared in the table with Ni-63, Ni-59 and C-14, although the chemical and biochemical behavior of the latter three nuclides is completely different from that of the former. This is just another of those spurious comparisons designed to convince the public that "it's no more radioactivity than you are exposed to naturally".

O.2 I.4

There is not an adequate data base for the costs presented. The Oceanic Society has commented on the costs of marine disposal. I question the cost estimates as well as other features of the discussion of the land burial option - in particular the discussion of the Hanford site. The Navy's assessment of that site is based on a 1975 environmental study. At that time, the commercial LLW site adjacent to the DOE site discussed was receiving 1000 m^3/year. In 1976, the rate of burial began to increase exponentially, and today the rate of burial at the commercial site is about 50,000 m^3/ year. Moreover, the basalt which underlies Hanford is a strong candidate for a HLW repository. Environmental conditions have changed since 1975, and state legislation is now being considered which would require an updated environmental study of that part of Haford leased to the state, including the commercial LLw site.

E.18 L.57 A.12

The burial site proposed by the Navy apparently adjoins the commercial site, although this is not clear. The estimated costs of land burial are so vaguely addressed that it is impossible to judge whether more recent activities have been taken into account or not. Transportation accidents are also not adequately addressed. The Columbia River Bar at Astoria is a notorious navigational hazard, and an accident in the Columbia could bring radioactive material, at least from the CRUD, into the food chain immediately.

E.28 E.29

Section 3, page B-4, is particularly vague and sloppy; land burial sites other than Hanford and Savannah River are barely metioned, and receive no serious consideration at all. Hanford and Savannah River, as usual, are considered because they are already being used as LLW sites, not because they are particularly suited for that use.

The Navy has failed to consider an obvious and quite sensible alternative: disposal above ground in a desert. The Federal government owns plenty of such land besides Hanford in military reservations: China Lake, for one. The Nevada Test site and Alamogordo are two other possibilities. Aboveground disposal, possibly covering the plants with the plastic sheets that we worry are going to last hundreds of years anyway, in a region of less than eight inches of rainfall a year would minimize corrosion. In this particular instance, corrosion, rather than random dispersal, is the primary force in releasing radioactive material into the environment. Aboveground storage poses the best situation for both monitoring and retrieval. We are not making an argument for this option at this time, but it must be considered as an alternative in the EIS. Savannah River is not suitable for such storage, and sites in addition to Hanfordmust also be considered. H.3

It is easy for environmental groups in other coastal states to make a strong argument against the ocean disposal option and not address land burial. That is not easy, or even possible, for residents of Washington or Sout Carolina. The Navy is telling us in Washington that if the reactor plants don't go into the ocean they will go to Hanford, thus leaving us with a Hobson's choice. However, we recognize that the reactor plants must be dealt with, and our recommendation on the EIS is two-fold:

1. Revise, update, improve and expand the section of the EIS dealing with land burial, and correct the inadequacies in the current DEIS. O.2, E.28 E.29, I.4

2. Add a thorough discussion and investigation of the above-ground disposal option. H.3

Again, we support the Oceanic Society's position. We also would like the Navy to consider its future submarine construction program in the light of the difficulty of disposing of the decommisioned plants. N.12

#37c

THE OCEANIC SOCIETY

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TESTIMONY OF THE OCEANIC SOCIETY
before the
U. S. NAVY PUBLIC HEARINGS
on the
DRAFT ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

Olympia, Washington

February 22, 1983

I am Dr. Michael J. Herz, Executive Vice President of the Oceanic Society, a 60,000 member, non-profit organization devoted to protection of the marine environment. The Society has headquarters in San Francisco and Stamford, CT, and active chapters along both coasts.

The Oceanic Society has, since it began, been concerned with the issue of ocean disposal of nuclear waste. Although we view with alarm the possibility of the Navy disposing of 100 nuclear submarines in the oceans, it is as much because of the precedent setting nature of this action as it is because of our concern over the potential impact of the 6.2 million curies of radioactivity that would be added to the seas by the subs. It should be noted that in addition to the Navy's reactor disposal program, the Department of Energy has spent over $20 million since 1976 to investigate the use of the seabed off Hawaii as a disposal site for high level nuclear waste - fuel rods from nuclear power plants. In addition, DOE is also considering the ocean alternative for the disposal of nuclear waste from the Manhattan Project that produced the first atomic bomb. L.9*

The Oceanic Society's role in evaluating the potential impact of proposed activities on the marine environment is to assess the science and technology present in support of such a proposal. In early February, we convened a Scientific Committee, made up of experts from a variety of disciplines, to review the adequacy of the Navy's DEIS and supporting Oceanographic Studies. The points raised in the testimony that follows are based upon the conclusions of this Committee.

1. <u>POOR DOCUMENT</u>: The Navy's DEIS is one of the poorest environmental documents that any of the Scientific Committee members have ever reviewed. It is filled with signficant information gaps and technical deficiencies and raises a great many issues requiring

EXECUTIVE OFFICES Magee Avenue [illegible]

***Other issues discussed by Dr. Herz are side barred in Exhibits 37, 37a, and 37b.**

#37c (Cont)

much additional information. (These will be considered and discussed below). By in large, the document reflects poor scholarship as demonstrated by its authors' failure to consider large bodies of pertinent information regarding a number of issues, and by the use of old information when significant new data are readily available.

J.21 2. <u>INTERNAL INCONSISTENCIES</u>: Review of the DEIS and the supporting Oceanographic Studies (Vols. I and II) reveals numerous internal inconsistencies, e.g., DEIS Summary misrepresents data presented in the body of the DEIS, and the DEIS and Oceanographic Studies Summary (Vol. I) misrepresent information from the Oceanographic Studies (Vol. II).

3. <u>AVAILABILITY OF RADIOACTIVITY</u>: The most serious deficiencies in the DEIS consideration of the ocean disposal alternative concern the availability of radioactivity and the possible pathways through which available contamination might reach humans. Issues not addressed or inadequately considered include:

A.12 A.11 a. Additional information is required to fully assess the significance of the radioactivity contained in "crud" deposits in reactor cooling systems. Data from "crud" collected at land-based reactors suggest that this may be one of the most serious sources of radioactivity which can easily become available to the marine environment. Further data on alpha emitters and "crud" from wrecked and decommissioned nuclear subs is needed.

J.64 Missing details on sampling sites relative to the location of reactors from the Thresher and Scorpion accidents make it impossible to evaluate the Navy's claim that such subs pose no threats to the marine environment or to humans.

J.34 Sediment, water and organism samples should also be collected from the site of the Soviet sub which the U.S. government attempted to raise with the <u>Glomar Explorer</u>.

b. Projections fail to take into consideration galvanic effects, manner and rate of corrosion at external weld locations, and the manner in which the lattice breakdown in radiated stainless steel will affect corrosion. Q.13

4. <u>PATHWAYS TO HUMANS</u>: Of greatest concern with any disposal alternative are the potential pathways through which radioactivity might reach humans. There exists a significant body of literature concerning the migration of radionuclides from waste forms to the water column, sediments and to organisms that appears to have been ignored in the preparation of the DEIS. L.36 Pathway issues not addressed or inadequately considered include:

a. Studies conducted by EPA and others demonstrate possible pathways such as benthic organisms to rattail fish which should serve as a warning that other potential pathways exist and that further investigations are warranted. U.9 U.5 L.35

b. The "artificial reef" effect has not been investigated in the deep ocean, but settling by marine organisms on the subs appears likely and should be investigated, particularly in terms of how it might serve as a pathway in an accident scenario, both at a disposal site and on the continental shelf. L.55

c. Failure to consider the possible role of bacteria in the mobilization of radionuclides. Q.12

d. The potential effects of accidents have not been adequately addressed. The Navy estimates 0.1 accidents per 100 subs scuttled at sea. L.57 Because this is a "reasonable probability", the potential impact of such an accident on the Continental Shelf (from both an intact sub and from an exposed reactor compartment) should be dis- L.61

#37c (Cont)

cussed in detail, especially in terms of possible exposure levels of 3 rems to a population of 30,000. Determination whether this is an acceptable exposure rate should be provided in the DEIS.

U.21 U.19 e. "Worst case" calculations are confused and appear to be off by 9 orders of magnitude. Further, the use of the EPA standard for drinking water is misleading and inappropriate, especially since correct calculations using the Navy's data come to within 0.1 of that standard.

J.12 f. Data presented in the DEIS on albacore catches in the vicinity of the Mendocino site are based on 13-23 year old information while more current available data suggest a more significant fishery in the area.

J.9 In addition, there is no information presented on catches at the east coast sites.

R.24 5. There is a lack of consistency throughout the DEIS in terms of the use of worst and average case scenarios. In order to make discussions of exposure doses resulting from accidents, a uniform approach to terminology and calculations should be adopted in order make presentations meaningful.

S.25 6. A serious deficiency throughout the DEIS is the fact that none of the measurements presented are accompanied by error terms, making it impossible to determine the level of precision or the range or variability of the data reported.

J.9 7. Although the DEIS states that locations for possible ocean disposal have not been selected, the stated site selection standards suggest that at least the Lower Continental Rise Area, and possibly the Hatteras Abyssal Plain Area as well, might be eliminated based on data presented in the Oceanographic Studies

(Vol.II). In additon, it appears unlikely that locations other than the Cape Mendocino Area could be found on the west coast that meet the required selection criteria. J.2

Obviously, more site-specific data will be required before evaluation of impacts on delineated disposal locations can be made. J.9

8. As presented in the DEIS, the monitoring plans for either land or ocean alternatives are inadequate. With the land alternative, the assumption is made that monitoring will be conducted as part of current and continuing programs at Hanford or Savannah River sites. However, the cost of monitoring is not reflected in estimates presented. I.13

The sea disposal monitoring presentation is also clearly inadequate. Based on the inadequate record keeping and the failure of the U.S. government to conduct any but the most rudimentary monitoring or research at any of the ocean sites used for disposal of nearly 100,000 curies of waste during 1946-70, the program and site documentation as part of the DEIS. Although the document contains no cost breakdown, the total amount listed for monitoring appears to be inadequate. WITHOUT AN ADEQUATE MONITORING PROGRAM, THE COMMITTEE UNANIMOUSLY DECIDED THAT THE SEA DISPOSAL OPTION SHOULD NOT RECEIVE FURTHER CONSIDERATION. J.76

9. By far the most serious problem with the sea disposal alternative as presented in the DEIS is that once scuttled, the submarines are, by the Navy's admission, irretrievable. Indeed, the Anderson Amendment, recently signed into law by the President, requires that radioactive waste disposed of in the ocean MUST BE RETRIEVABLE. W.1 F.2

10. Because there are significantly more gaps, deficiencies, unanswered questions and uncertainties regarding the sea disposal alternative, the Committee concluded, based on the existing

#37c (Cont)

information, that A LAND DISPOSAL OPTION IS FAR PREFERABLE. Land disposal would minimize corrosion, the principal mechanism producing available radioactivity, and would greatly simplify the monitoring process.

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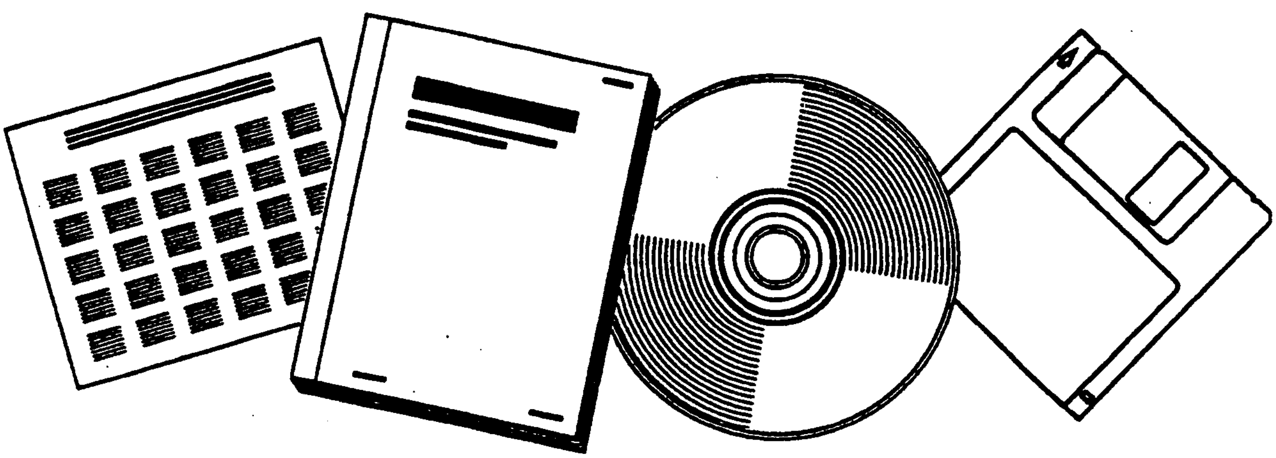
FINAL ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS. VOLUME 3. RESPONSES TO ISSUES FROM PUBLIC REVIEW

DEPARTMENT OF THE NAVY
WASHINGTON, DC

MAY 1984



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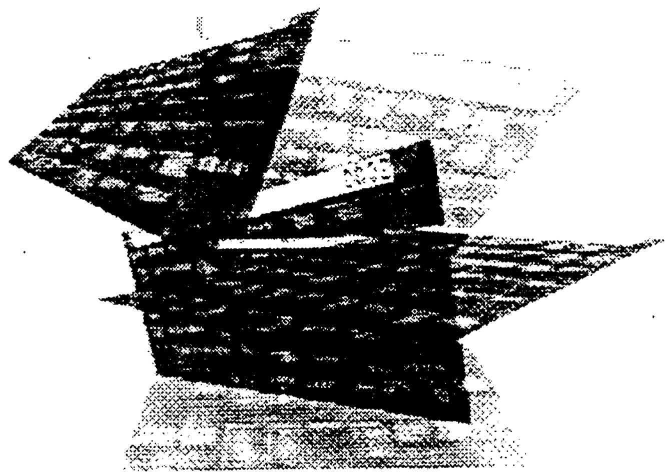

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FINAL ENVIRONMENTAL IMPACT STATEMENT

ON THE

DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL SUBMARINE REACTOR PLANTS

VOLUME 3 OF 3

RESPONSES TO ISSUES FROM PUBLIC REVIEW

MAY 1984

United States
Department of the Navy

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INTRODUCTION

Volume 3 presents responses to 517 issues identified during the public review period for the Draft Environmental Impact Statement. These issues were received in letters and in statements made at the public meetings, as recorded in Volume 2. The issues are identified where they appear in Volume 2 by vertical lines in the margin and are given a serial number consisting of a Section letter and number, such as A.5 or D.3, which relates the issue to the section in this Volume 3 where the response is provided.

In this volume, the issues and their responses are organized into sections which correspond to the major sections in the four chapters of the EIS and to selected appendices, based on the subject of each issue. Within these sections, the individual issues are listed in order as shown in the Table of Contents: first, Issues A.1 through A.20, followed by B.1 through B.9 and so on. The Table of Contents identifies the page number corresponding to the beginning of each Section.

As presented in this Volume, each issue is stated, followed by a list of the respondents who identified the issue, with their identification numbers from Volume 2, and the Navy's response to the issue. In some cases the issue has been summarized or paraphrased to include the comments of several individuals who worded the issue differently.

SECTION A

This Section (A.1—A.20) contains issues related to the Summary and Chapter 1, Section I of the Environmental Impact Statement.

A.1—Summary of Issue

The EIS should describe the number of submarines and the period of time involved in disposal.

Those Identifying Issue	Identification Number
Ms. Ivana Noell	645
Mr. John Runkle	18 or 468
Atty. Gen. John K. Van DeKamp	446
Mr. James Widmeyer	678

Response

The information on this issue was provided in Chapter 1, Sections I.A and IV of the DEIS.

A.2—Summary of Issue

A clear statement is needed in the Summary pertaining to the expected levels of radioactivity at the time of disposal.

Those Identifying Issue	Identification Number
EPA	694

Response

This information was provided in Chapter 1 of the DEIS and there is no need to duplicate it in the Summary.

A.3—Summary of Issue

"The degree and quantity of radioactivity in a spent reactor casing will not, under any circumstances, 'decay away'."

Those Identifying Issue	Identification Number
Mr. Walbridge J. Powell	448

Response

Mr. Powell's statement is incorrect. Each radioactive species listed in Table 1-1 of Chapter 1 is characterized by its half-life, which is the time required for one-half of the radioactive atoms to change into non-radioactive atoms. As shown in Table 1-1, some half-lives are short, some are long; but most of the radionuclides present in the defueled submarine have half-lives of several years or shorter. For example, the principal gamma-emitting radionuclide, Cobalt-60, has a half-life of 5.27 years. Figure 1-2 shows that the total amount of radioactivity decays quite rapidly with time, decreasing by a factor of about 7 in the first 100 years.

A.4—Summary of Issue

"The presentation . . . in Table 1-1 and . . . in Figure 1-2 might be enhanced by some additional information . . . to show that the principal component is Cobalt-60, a gamma emitter with a half-life of 5.26 years, as contrasted to the next significant component, Nickel-63 which is a beta emitter . . . by giving their remaining radioactivity after some time period (i.e., 100 years)."

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy agrees with the comment. Table 1-1 was modified to include the inventory of each nuclide after 100 years. The text of Chapter 1, Section I.A was modified to emphasize the rapid decay of the principal gamma emitter, Cobalt-60.

A.5—Summary of Issue

"Results could be accepted with greater confidence if the text contained a brief outline of the procedures used in the calculations, and if a listing were given of the names of computer codes employed (or of equivalent or similar generally available computer codes in common use for such calculations)."

Those Identifying Issue	Identification Number
EPA	694

Response

The calculations to determine the amount of each nuclide present were performed using large, high speed computers with detailed information on reactor design and operating history and programs typical of those commonly available for describing detailed, multi-dimensional neutron movement and reactions in nuclear reactors. The entire reactor compartment, including the reactor core and all the reactor plant components, was modeled using a discrete ordinate neutron transport theory computer program to calculate the axial (vertical) and radial (horizontal) variation in neutron density. Macroscopic few-group neutron reaction cross sections used in the discrete ordinate program were obtained for each reactor plant material by averaging cross sections over an infinite medium multigroup spectrum. Neutron fluxes in each of eleven energy groups were calculated, giving a radial and an axial distribution in the compartment. The volume-integrated neutron fluxes in each component were used with the appropriate atom concentration, cross section and conservative operating history to calculate the number of curies present for each nuclide, as listed in Table 1-1.

A.6—Summary of Issue

It seems unrealistic to present in Table 1-1 as radioactivity in a "typical" reactor plant the "maximum activity (worst case) for the most representative reactor plant" which is undefined. It is not clear what ranges of uncertainty or conservatism are involved. Data on the absolute maximum amount and the average amount [of radioactivity] in the inventory would be helpful. Also, the EIS does not state the source of the data on radioactivity inventory.

Those Identifying Issue	Identification Number
Ms. Jane O. Ballus	19
Ms. Janet P. Brooks	693
EPA	694, 694a
Ms. Rebecca Matthews	693
Atty. Gen. John K. Van DeKamp	446

Response

Chapter 1, Section I.A, states that "(t)he plant selected is used in a large majority of the submarines, and its operating lifetime and average power level have been chosen to give a maximum radioactivity inventory for the type of reactor installed."

Submarine missions vary widely causing each submarine to operate its reactor at power levels and for time periods which differ from those for reactors of the same type in other submarines. Because it would be confusing to present the activities for each submarine, the procedure used to calculate the values in this EIS was designed to lead to results which would not be exceeded by any plant of the type. For example, the calculation of the number of curies of radioactivity in the reactor components is a multiple-step process in which the chemical composition of the corrosion resistant alloys enters in at several steps. Because the composition of the alloy may vary within certain limits (e.g., the amount of nickel in 304 stainless steel may range from 8 to 12 percent) it is customary to choose an average value to use throughout the calculation. Instead, the Navy used the lowest concentration in some steps and the highest in other steps, always choosing that value which would lead to the highest estimate of radioactivity in the final step.

Further, the operating lifetime and average power level chosen produced the maximum concentrations of Cobalt-60, Iron-55, and all shorter-lived nuclides. The activities of the long-lived constituents are little affected by this choice because these concentrations are determined by the total number of neutrons produced by the reactor rather than the variation in the number of neutrons with time. Because the calculational procedure was intended to be highly conservative for the submarine reactor plant with the longest operation, the results in some instances may be more than two times the actual activity present in a particular submarine which had been operated for a shorter time or with other variations from the case used.

Thus, when multiplied by 100 the total activity tabulated for one submarine is conservative for 100 actual submarines, and no individual submarine would exceed this amount by more than about 5 percent.

A.7 — Summary of Issue

There would still be as much as 5000 curies of Cobalt-60 alone present even 1000 years from the disposal time.

Those Identifying Issue	Identification Number
Dr. John W. Harris	85
Mr. Lewis Seiler	707

(Continued on next page)

Response

Dr. Harris' calculation is incorrect. With a half-life of 5.27 years, the 22,000 curies of Cobalt-60 in one submarine would have decayed to 5000 curies in 11.2 years. With 100 submarines (each having 22,000 curies at time of disposal) disposed at the rate of 3 per year for 33 years, the total Cobalt-60 would have decayed to less than 5000 curies in less than 36 years after the last submarine was disposed of, and would be less than 1 curie in an additional 65 years. In fact, radioactive decay calculations indicate that after 431 years, only a single atom of Cobalt-60 would remain.

A.8 — Summary of Issue

"Reference 1.1 for Chapter 1, Lederer et al, *Table of Isotopes*, 6th Edition 1967 is somewhat out of date. The Navy should use the more recent version Lederer, C. M. & V. S. Shirley, editors, *Table of Isotopes*, 7th Edition, . . . 1978. Several of the half-lives listed in Table 1-1 have been revised; however, the revisions do not significantly affect the conclusions in other parts of the DEIS which depend on Table 1-1."

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy agrees with the comment, and with the EPA's evaluation that the conclusions in other parts of the DEIS are not significantly affected.

Reference 1-1 has been changed to *Table of Isotopes*, 7th Edition, and newer values of half-life, where appropriate, have been used in Table 1-1. No changes were made in the remainder of the DEIS because the small changes of half-life made in Table 1-1 did not affect the results of calculations.

A.9 — Summary of Issue

"The listing for Cobalt-60 in Table 1-1 is misleading since the gamma energy is given as 2.82 MeV, when usual emissions are 1.33 and 1.17 MeV. Using the data in Table 1-1 could create errors in dose calculations. Gamma emitters are usually characterized by predominant photopeak energies."

Those Identifying Issue	Identification Number
EPA	694

Response

Careful reading shows that the fourth line in Table 1-1, which contained the value of 2.82 MeV for Cobalt-60, was labeled "Maximum Energy per Disintegration", not gamma energy. Furthermore, values were listed in this line for pure beta-emitters such as Nickel-63, Carbon-14 and Sulfur-35, so this line obviously does not refer to gamma energy alone. Persons making dose calculations need to refer to other sources, such as Reference 1-1, for additional information. However, the Navy agrees that Table 1-1 could be improved by adding the energies of the prominent photopeaks to the gamma emitters.

Table 1-1 has been modified by adding the energies of the prominent photopeaks to the gamma emitters.

A.10—Summary of Issue

The amount of Cobalt-60 is underestimated by a factor of 6 and that of Niobium-94 by a factor of 100.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. Marvin Resnikoff	13b	Mr. Thomas C. Jackson	37b
Others, quoting Resnikoff:		Ms. Rebecca Matthews	693
Ms. Janet P. Brooks	693	Ms. Cathy Ryan	99
Mr. Clifton E. Curtis	695	Mr. David Schromer	48
Mr. Cricket Feringer	42	Mr. James Widmeyer	678
Mr. James Arthur Ferrara	665	Mr. Christopher D. Roosevelt	695
Dr. Michael J. Herz	37b		

Response

Dr. Resnikoff arrived at his conclusion that the DEIS underestimated Cobalt-60 by a factor of 6 and Niobium-94 by a factor of 100 based on scaling down calculations performed for a commercial nuclear power plant. The assumption that Naval ship power level, operating history, and materials can be directly scaled from commercial plants is erroneous.

Because of the concern expressed about the amount of Niobium-94 and Cobalt-60 present in the submarine reactor plants, the Navy has reviewed all of its radioactivity calculations. In the FEIS, the Niobium-94 has been increased from 0.0063 curie to 0.082 curie to reflect more conservative calculational techniques. The values previously calculated for Cobalt-60 and for all other radioactivities were confirmed and required no revision.

The change in the amount of Niobium-94 did not affect any of the conclusions of the Draft EIS since this nuclide is important only in the estimation of the possible exposure to an "agricultural intruder" several thousand years after land disposal, as discussed in Appendix C, Section VII.A. The waste classification under the rules of 10CFR61 was also unaffected by this change since the revised Niobium-94 concentration is still a factor of 100 lower than the limit allowed for Class B waste.

A.11—Summary of Issue

Further data on transuranic alpha emitters, particularly plutonium, is needed.

Those Identifying Issue	Identification Number
Dr. Michael J. Herz	37, 37a, 37b, 37c
Mr. Thomas C. Jackson	37b
Mr. Ken Kelley	612
Mr. Charles B. Williams	688

Response

Table 1-1 lists all radioactive nuclides present in submarines in quantities greater than 0.001 curie. The uranium fuel and the transuranic and fission product radionuclides created in the nuclear fuel during operation of the reactor are completely retained within the fuel elements and

(Continued on next page)

therefore are removed when the reactor is defueled. The only fission products and alpha emitters remaining in the reactor plant are those from the trace amount of natural uranium which is found in all metals. No significant amount of transuranics is present in the submarine plant after defueling. Therefore, no transuranics are listed in Table 1-1.

A.12—Summary of Issue

Radioactivity in crud (high temperature corrosion products) deposited on internal surfaces of the reactor plant is ignored or understated in the Environmental Impact Statement, and there is concern whether the crud contains significant quantities of uranium, transuranics, or fission products.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693	Mr. Thomas C. Jackson	37b
Mr. Bruce R. Campbell	421	Mr. William A. Lochstet	443
Mr. Clifton E. Curtis	695	Ms. Rebecca Matthews	693
Honorable Ronald V. Dellums	447	Mr. Scott McCreary	86
EPA	694	Mr. Christopher D. Roosevelt	695
Mr. Ron Guenther	105a	Dr. Ruth F. Weiner	39a
Dr. Michael J. Herz	37b, 37c	Mr. James Widmeyer	678

Response

The Navy does not agree that radioactivity in crud was either ignored or understated in the EIS. Based on actual data from operating ships, crud radioactivity, as stated on page 1-2 of the EIS, amounts to 0.1 percent of the total plant radioactivity inventory, and has been included in the radioactivity tabulated in Table 1-1. Table 1-1 lists all radioactive nuclides present in submarines in quantities greater than 0.001 curie.

Refer to Issue A.11 for a discussion of uranium, transuranics, and fission products.

A.13—Summary of Issue

There is concern over the weight of radioactive corrosion products (crud) deposited on system surfaces and the area of the surfaces, and whether crud may be preferentially solubilized by bacteria.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Michael J. Herz	37a, 37b
Mr. Thomas C. Jackson	37b
Mr. Christopher Roosevelt	695

Response

The area of reactor system surfaces that contains crud, and the total weight of crud deposited thereon, are not pertinent to the evaluation. The pertinent information is the amount and type of radioactivity present in the crud, which is 0.1 percent of the total activity (Chapter 1, page 1-2).

The rate of solubilization of the crud is also immaterial, because the evaluation conservatively treats the crud as being completely transportable, and in the use of concentration factors to estimate the radionuclide content of plant and animal life from the concentration present in the water no distinction is made between insoluble and soluble activity in the water; i.e., the evaluation conservatively treats all the transported activity as soluble when considering its uptake into the food chain. Thus, activity in the crud has been conservatively treated in the evaluation. Even with this conservative treatment, the estimated radiation exposure to humans is very, very small compared to variations in normal background radiation exposure.

A.14—Summary of Issue

"Data on the breakdown of the radionuclides in this material [crud] would be of interest."

Those Identifying Issue	Identification Number
EPA	694, 694a

Response

The radionuclide composition of the crud is similar to that of the total radioactive inventory shown in Table 1-1 of Chapter 1 except that Nickel-63 is relatively less abundant and Iron-55 relatively more abundant in the crud, and that all of the Hafnium-181 and Zirconium-95/Niobium-95 activity listed in Table 1-1 is in the crud.

A.15—Summary of Issue

DEIS Page S-4—The statement that ". . . defueling removes most of the radioactivity from the ship" has no meaning.

Those Identifying Issue	Identification Number
EPA	694

Response

This statement is clear. Spent fuel contains much more radioactivity than the defueled reactor plant.

A.16—Summary of Issue

High level radioactive materials would remain inside the reactor plant at the time of disposal.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Brian N. Baird	55a	Mr. Ken Kelley	612
Mr. Bill Barlow	17	Mr. Jim LeCuyer	84
Mr. Thomas D. Brown	178	Mr. Michael Lowery	377
Mr. John Hylinger	45	Dr. B. D. Wapen	590

Response

Before a submarine would be taken out of service, the nuclear fuel would be removed from the reactor pressure vessel in a process called defueling. (See Figure S in the Summary.) This defueling removes most of the radioactivity, all of the uranium, and all of the fission products from the

(Continued on next page)

submarine. No high level radioactive material would remain inside the reactor plant at the time of disposal. For more detailed information on this matter, see Chapter 1, Section I.A and Chapter 2, Section II.H.

A.17—Summary of Issue

The Environmental Impact Statement should include the disposal of the fuel from nuclear submarine reactors.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Mr. B. Donoghue	506
Owlswan Free-Eagle	151
Ms. Marcia Kay	598

Response

The disposal of fuel from nuclear submarine reactors was not included in the Draft Environmental Impact Statement because all the radioactive nuclear fuel would be removed before any disposal option would be implemented. (See Chapter 1, Section I.A.) The removed fuel would then be handled under a currently existing Department of Energy program for this material. The environmental effects of fuel removal and disposal are not germane to this evaluation of the disposal of defueled, decommissioned submarine reactor plants.

A.18—Summary of Issue

Is the amount of heat generated sufficient to cause expansion of the water in the reactor compartment causing the valve to rupture?

Those Identifying Issue	Identification Number
EPA	694a

Response

In Chapter 1, Section I.B of the DEIS the heat generation rate due to the activation of structural components was stated to be 800 watts or less, distributed over many tons of metal. For sea disposal this small amount of heat would also be distributed over many tons of water. For either disposal method, but particularly for sea disposal, the heat would be transferred rapidly to the submarine's surroundings and result in no significant rise in the temperature of the reactor compartment. Therefore, in the sea disposal option there would be no expansion of the water in the reactor compartment.

A.19—Summary of Issue

Fish will be attracted to the site as radiation activity heats the water.

Those Identifying Issue	Identification Number
Ms. Judith Evered	71
Mrs. Lillie Kocher	639
Ms. Teresa Matta	382
Mrs. A.E. Wasserbach	703

Response

Section I.B of Chapter 1 discusses the heat generation for each reactor compartment and concludes that the amount of heat is too small to produce significant warming of the metal, let alone the ocean water.

A.20 — Summary of Issue

There is no discussion of decontamination procedures for the reactor vessel after defueling.

Those Identifying Issue	Identification Number
EPA	694

Response

The reactor vessel will not be decontaminated before disposal. A brief discussion of the operation to be performed is given in Appendix B, Section III for land disposal and Appendix D, Section III for sea disposal. There is no need to decontaminate the reactor vessel and no decontamination is planned.

SECTION B

This Section (B.1—B.9) contains issues related to the Summary and Chapter 1, Section II of the Environmental Impact Statement.

B.1—Summary of Issue

The EIS should tabulate the total number of cancers from the total dose to the population over all time.

Those Identifying Issue	Identification Number
Mr. Wm. A. Lochstet	443
Dr. Marvin Resnikoff	13b

Response

The EIS provides estimates of the possible additional cancer cases for each hypothetical population for the maximum yearly exposure from either disposal option. Exposures over all time are not included in the EIS because they would not be meaningful. However, one can make a conservative estimate of the upper limit on exposure over all time for any one population group by multiplying the maximum annual rate by 70 years. Thus for the sea disposal option the population exposure over the 70 years of highest exposure would be less than 420 man-rem, while for the land disposal option the corresponding population exposure over the 70 years of highest exposure would be less than 147 man-rem. (see Chapter 4, Table 4-11). Based on a rate of 0.00045 additional cancers per man-rem from Chapter 4, Section II.A.3(d)(4) of the EIS, the resulting estimate of cancers to a population over its entire lifetime would be 0.19, for sea disposal, and 0.07 for land disposal. These highly conservative figures imply that there would be a low probability that one person would experience a cancer as a result of submarine disposal during any single population's life span, over all time.

B.2—Summary of Issue

The DEIS should define "natural background radiation."

Those Identifying Issue	Identification Number
Mrs. A. E. Wasserback	703

Response

Background radiation was defined in the Glossary.

B.3—Summary of Issue

Additional study and documentation are necessary regarding the potential risk from occupational exposure to radiation.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Ms. Rebecca Matthews	693

Response

This issue is considered beyond the scope of matters covered by the EIS. Estimates of health effects due to radiation exposure provided in the EIS were based on authoritative sources (Reference 4.15).

B.4 — Summary of Issue

Shipyard workers at Portsmouth Naval Shipyard, New Hampshire, had a leukemia rate 450 percent above the national average.

Those Identifying Issue	Identification Number
Mr. Yorgos Savides	83

Response

This issue is considered beyond the scope of matters covered by the EIS. Estimates of health effects due to radiation exposure provided in the EIS were based on authoritative sources (Reference 4.15).

Because of public interest, Congressional hearings and extensive media coverage, Congress directed the National Institute for Occupational Safety and Health (NIOSH), an independent organization, to conduct a review of the shipyard workers at Portsmouth to investigate claims that allege higher rates of cancer occurring at the Portsmouth Naval Shipyard. NIOSH completed their study and published a report entitled "Epidemiologic Study of Civilian Employees at the Portsmouth Naval Shipyard," December 1980, which concluded: "No relationship between exposure to radiation and mortality from any cause was observed among the PNS (Portsmouth Naval Shipyard) population, when compared to the United States white male population. Furthermore, no excess in leukemia mortality was observed in the radiation exposed population when compared to the non-radiation exposed employes of PNS." Thus the earlier reports of excess cancer and leukemia death rates among Portsmouth workers exposed to low level radiation were not substantiated by NIOSH.

The evaluation of possible health effects (cancers) for disposal of submarines included use of the sensitivity to low level radiation advocated by John W. Gofman (see Chapter 4, Section II.A.3.(d)). The predicted effects are so small that it makes little difference whether Dr. Gofman's recommended sensitivity is used or the more widely accepted sensitivity values are used.

B.5 — Summary of Issue

The comparison in Table 1 of the Summary between radiation exposure due to an airline flight and that due to submarine disposal is not valid because the submarine disposal exposure is calculated much more conservatively than the airline flight exposure.

(Continued on next page)

Those Identifying Issue	Identification Number
EPA	694

Response

Table 1 provides a comparison that shows the conservative estimates from submarine disposal (less than 0.006 millirem) to be significantly less than the radiation exposure from a round trip air flight from Los Angeles to New York (1.9 millirem). EPA is correct, the potential exposures from submarine disposal are very conservative (i.e., an overestimate) and the air flight exposure is real and not an overestimate. However, the purpose of Table 1 is to provide an appreciation of the environmental impact of submarine disposal that is easily understood. Table 1 accomplishes this objective even when the conservative estimates of submarine disposal are compared to real radiation exposure of air travel. The table has been altered to clarify this point.

B.6—**Summary of Issue**

No radiation exposure rate is given for the exterior surface of the reactor hull after removal of fuel. This parameter is needed to estimate external exposure [during transportation].

Those Identifying Issue	Identification Number
EPA	694

Response

The exposure rate in air outside the reactor compartment, six feet from any surface, would not exceed 10 mrem per hour, as described in Section IX of Appendix C, which includes an evaluation of possible external exposure during shipment to a land disposal site. This maximum rate would not exceed the requirement of 49CFR 173.393. This information is adequate to assess possible external exposure during transportation. See also Issue K.13.

B.7—**Summary of Issue**

The estimates of radiation levels within the reactor compartment are incorrect.

Those Identifying Issue	Identification Number
Dr. Marvin Resnikoff	13b

Response

In support of his claim, the respondent has tabulated "projected submarine exposure rates" of 41,500 r/hr for "shroud" and 40 r/hr for "inner wall," stating that these were "obtained from NUREG/CR-0130, scaled down to size of submarine reactor." The respondent stated that "The DEIS claims that the radiation level will decline to 0.1 mr/hr after 53 years (p. 1-6) are based more on wishful thinking than the laws of physics."

NUREG/CR-0130 (Reference 1, page C-23) states that the tabulated "Radiation Dose rates (are) computed at a distance of one centimeter from the surface of the activated material." They therefore refer to the dose rates inside the reactor pressure vessel of a large commercial reactor, in close contact with the components. The DEIS, on the other hand, discussed "the exposure rates within the reactor compartment" on Page 1-6, that is, in the area around the piping and steam generator and reactor vessel, where a person would stand, or, if sea disposal were employed, where fish could swim in later years after the reactor compartment bulkhead had corroded away. The submarine's irradiated components are not accessible to people or fish, because they are isolated within the heavy walled reactor pressure vessel, which is bolted and welded shut.

Reference

1. NUREG/CR-0130, Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station, U. S. Nuclear Regulatory Commission, June 1978.

B.8—Summary of Issue

"The DEIS (page S-10) is wrong in stating under LAND DISPOSAL in the Summary that after about 100 years ... decay would essentially eliminate external exposure to radiation even if someone were to enter the compartment. The radiation hazard would exist for many thousands of years, and radiation damage is no more 'external' than x-rays stop at the surface of your skin."

Those Identifying Issue	Identification Number
Mr. James Widmeyer	678

Response

The DEIS stated in Chapter 4, Section II.A.3(a) that "the radiation levels inside the reactor compartment would be less than 100 mrem per hour" prior to disposal. This measured dose rate is due almost completely to Cobalt-60 which has a half-life of 5.27 years, the remainder coming primarily from shorter-lived nuclides like Cobalt-58 and Manganese-54. It is therefore realistic to consider that the dose rate will decrease with the half-life of Cobalt-60. In 100 years, or 19 half-lives of Cobalt-60 the exposure would decrease by a factor of 2^{19}, or more than 500,000, to less than 0.001 mrem per hour. Therefore, it is correct to state, as the DEIS does, that "decay would essentially eliminate external exposure to radiation."

Regarding the respondent's last point, it is customary to distinguish between two possible sources of radiation exposure. Radiation exposure which comes from radioisotopes within the body (such as from the Potassium-40 which is a naturally-occurring long-lived radioactive isotope that is found in every potassium-containing food we eat) is termed "internal exposure," while that coming from sources outside the body (such as from cosmic rays, or a reactor plant) is termed "external exposure." There is no implication that gamma rays stop at the skin.

B.9—Summary of Issue

"On pages 2-5 and 2-12, there appears to be some inconsistency in the use of rems units. In one instance rems per year is used, at other times rems are reported in total exposure units. Over what time period does total exposure refer to?"

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

There is no inconsistency in units in the referenced discussion. The estimated total occupational radiation exposure of 17 rem for preparing an active ship for disposal is just as stated: It is the total radiation exposure incurred for the task, independent of whether it is incurred in a single year or spread over several years. Similarly, the estimated 20 rem exposure for preparing an inactive ship for disposal includes the above 17 rem plus an additional 3 rem incurred while performing preventive maintenance and routine radiological monitoring during the years of protective storage.

The comparison to the 1000 rem per year occupational exposure limit for a shipyard work force of 200 persons was included to show that the estimated 51 to 60 rem radiation exposure incurred associated with disposing of an average of three submarines a year would not be a major fraction of the exposure limit for a shipyard even if all disposal work were to be done in a single shipyard.

SECTION C

This Section (C.1) contains an issue related to the Summary and Chapter 1, Section III of the Environmental Impact Statement.

C.1 — Summary of Issue

Contaminants other than nuclear fuel and associated radiation are not addressed in the DEIS. PCBs, hydraulics system fluids, fuel oils, and battery fluids should be included.

Those Identifying Issue	Identification Number
Mr. Gordon K. Van Vleck	715

Response

The DEIS described materials other than radioactive materials in Chapter 1, Section III, and in Chapter 4, Sections I.A.3(c) and II.A.4(b)(1).

SECTION D

This Section (D.1—D.8) contains issues related to the Summary and Chapter 1, Section IV of the Environmental Impact Statement.

D.1—Summary of Issue

It is very uncertain as to whether there is any need to make a decision at this time.

Those Identifying Issue	Identification Number
EPA	694

Response

Although the Navy has no immediate need to permanently dispose of any nuclear powered ships, it is clear that disposal will be needed some time in the future. The Council on Environmental Quality directs that agencies shall integrate the National Environmental Policy Act (NEPA) process with other planning at the earliest possible time to ensure that planning and decision reflect environmental values, and to head off potential conflicts (40CFR 1501.2 and 1502.5). The Navy has initiated the process at this time to provide time to resolve the question of the method for nuclear submarine disposal in an open, deliberate, and technically well-founded manner.

If land disposal is selected at the end of this process, it could proceed without additional action since the practical and institutional structure for this method is in place and is being used for other types of low level radioactive waste. If the Navy decided to pursue ocean disposal, the completion of this Environmental Impact Statement process would not lead to immediate implementation of this option, since additional administrative actions would be required. An extensive process would remain to be carried out if the Navy decided to pursue ocean disposal. This process would take a minimum of two to three years to complete.

D.2—Summary of Issue

The DEIS fails to meet the requirements of the Council on Environmental Quality, and case law, to reveal lack of information or existing scientific uncertainty surrounding the ocean disposal option and stemming from (1) lack of scientific data, (2) responsible conflicting scientific opinion, and (3) the underlying randomness of nature and the ability of future technology to cope with this randomness.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher D. Roosevelt	695

Response

The respondents relate the cited lack of information or existence of scientific uncertainty surrounding the ocean disposal option to the question of precisely what the environmental effects might be. The DEIS discusses the fact that uncertainty exists in the prediction of environmental impacts associated with ocean disposal. This is emphasized by the presentation of estimates of radiological exposure to humans calculated for several different approaches, including an estimate prepared using current ideas of the magnitude of ocean processes, another using more pessimistic assumptions concerning these processes, and yet another assuming a direct "short-circuit" pathway from the ocean floor to man. The range of variation in these various estimates provides a very clear illustration of possible uncertainties.

The DEIS clearly did include identification and discussion of uncertainties and the randomness of nature and the analyses performed were designed so that the conclusions would be as independent of these factors as possible. No new technology was relied upon to prevent or mitigate environmental impacts so the capability of such technology is not a concern.

D.3—Summary of Issue

It is a weakness in the status of the DEIS that avenues for public awareness and input early in the process were not utilized.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692

Response

In accordance with the guidelines of the Council on Environmental Quality, on January 14, 1982, the Navy published an announcement in the Federal Register of its intent to prepare a Draft Environmental Impact Statement on the permanent disposal of decommissioned, defueled naval submarine reactor plants. The notice described the two basic disposal options and the alternative of temporary protective storage. The notice also described the impacts that were to be assessed, offered an annotated outline on request, and solicited comments or suggestions from interested agencies, organizations, and the general public for consideration in connection with the preparation and scoping of the Draft EIS. Copies of the Federal Register Notice were mailed by the Navy directly to over 150 federal and state legislators and agencies, environmental and consumer groups, trade or industrial associations, private companies and individuals. Included with the notice was a letter that invited suggestions on the alternatives or on matters to be considered in the Draft EIS.

Approximately 70 letters were received from individuals and organizations, either requesting a copy of the annotated outline, asking questions, or raising issues related to the necessity for disposal and the disposal alternatives. Each of these letters was answered by the Navy, with information provided as requested.

On December 22, 1982 a Federal Register Notice was published to announce the availability of the Draft EIS. Single copies at no charge were offered upon request, and a list of over 75 public libraries where the DEIS was available for review was provided. At that time approximately 600 copies of the DEIS were delivered to all who had requested it, and to all state and federal agencies, organizations, and individuals who were believed likely to be interested in the subject. Another 1000 copies have been distributed since then.

Public comment was solicited and written comments were received through the end of June 1983. Public hearings were advertised in over 30 newspapers and were held on February 14, 17, 22, and 24 respectively, at Raleigh, North Carolina, Columbia, South Carolina, Olympia, Washington, and Sacramento, California. Comments were received at these hearings in the form of oral statements which were fully recorded verbatim.

The Navy conscientiously and thoroughly fulfilled its responsibilities to use avenues for public awareness and public input at all stages.

D.4—Summary of Issue

If, in fact however, the submarines are already so contaminated that they cannot be safely operated, then certainly they should not be dumped in the ocean but should be buried ashore.

Those Identifying Issue	Identification Number
Mr. Nathaniel S. Bingham	78a
Mr. Greg Wellish	103

Response

Section I.A of Chapter 1 states that the aging submarines would be declared excess because the costs of maintenance and operation would no longer be justified by their military capability. These submarines are not unsafe to operate because of radiation or contamination.

D.5—Summary of Issue

I assume that these subs must be dangerous and that you need some way to put them out of commission.

Those Identifying Issue	Identification Number
Ms. Bonnie Blackberry	79
Ms. Deborah DaPron	223

Response

Nuclear submarines eventually reach the end of their service life when the cost of continued operation is no longer justified by the ship's military capability. These submarines are not unsafe to operate because of radiation. See Section I.A of Chapter 1.

D.6—Summary of Issue

"Why was this [Farallon Islands] dumping kept secret from the public for so long? Please be specific in your answer."

Those Identifying Issue	Identification Number
Kelly Townsend	503

Response

This issue is beyond the scope of this Environmental Impact Statement since it is not in any way related to the future disposal of defueled, decommissioned submarines.

However, for information, the sea disposal of solid, packaged waste was performed at designated locations in the Atlantic and Pacific Oceans, beginning in 1946 and continuing until the practice was suspended in 1970. This sea disposal was not kept secret from the public; for instance, nearly twenty years ago at the Third International Conference on the Peaceful Uses of Atomic Energy in

Geneva, Switzerland, the U.S. Atomic Energy Commission presented a paper entitled, "U.S. operational experience in radioactive waste management (1958-1963)," which discussed ocean disposal in the Atlantic and Pacific Oceans among other topics. Sea disposal was also reported in the 1971 publication of the National Academy of Sciences, "Radioactivity in the Marine Environment."

D.7—Summary of Issue

The Environmental Impact Statement should describe how the 1972 SALT I Agreement affects plans for submarine deactivation and disposal.

Those Identifying Issue	Identification Number
Mr. William H. R. Clark	271
Dr. Michael Herz	37a

Response

This issue is not within the scope of the matters covered by this Environmental Impact Statement because the 1972 SALT I Agreement has no effect on disposal methods discussed in the Environmental Impact Statement.

D.8—Summary of Issue

The EIS should discuss the location of the reactor from the NS SAVANNAH.

Those Identifying Issue	Identification Number
Mr. John Maloney	139

Response

The NS SAVANNAH is not a submarine or even a U.S. Navy ship, and, therefore, is beyond the scope of this Environmental Impact Statement which identifies and evaluates alternative disposal methods for defueled and decommissioned nuclear powered submarines. However, for information, the SAVANNAH is currently on display in Charleston, S.C. in a condition similar to the floating storage described in the EIS.

SECTION E

This Section (E.1—E.35) contains issues related to Chapter 2, Section I and Appendix B of the Environmental Impact Statement.

E.1—Summary of Issue

The DEIS should discuss what would actually be implemented for any option; that is, it should distinguish between what can be done and what would actually be done.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Mr. Martin F. Golden	634

Response

In describing any option, the DEIS did state what would actually be done. Sections I.A and II.A of Chapter 2 contained explicit descriptions of actions that would be implemented if a particular option were selected. The descriptions were written in the subjunctive mood because the option for disposal has not been decided.

E.2—Summary of Issue

The DEIS has no proposed action among its alternatives, and therefore does not satisfy the requirements of the Council on Environmental Quality.

Those Identifying Issue	Identification Number
Mr. Nathaniel S. Bingham	78a
Mr. Clifton E. Curtis	695
EPA	694
Mr. Christopher D. Roosevelt	695

Response

At the time the DEIS was issued, the Navy did not have a preferred alternative for disposal of submarine reactor plants and therefore did not propose a specific disposal method. However, this is acceptable since the Code of Federal Regulations, Title 40, Part 1502.14(e) requires identification of a preferred alternative in a draft environmental impact statement only if a preferred alternative exists.

E.3—Summary of Issue

The DEIS should clarify the terms: "reactor vessel" and "reactor plant". Do they mean the same thing?

Those Identifying Issue	Identification Number
EPA	694

Response

Figures 2-2 and 2-3 show the reactor power plant or nuclear propulsion plant, and the reactor vessel, respectively. Further, the reactor vessel was described in the Glossary. As shown in Figure 2-2, the reactor plant is the entire complex of components that produce and utilize the heat of nuclear fission, including the reactor vessel, the steam generator, pipes, pumping, and valves.

E.4—Summary of Issue

"Discussion of potential adverse effects from land disposal on groundwater should be included."

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
EPA	694
Ms. Rebecca Matthews	693

Response

The potential effect of land burial on groundwater has been evaluated and discussed in Appendix C, Sections I through VII. The evaluation conservatively assumed that all radioactivity released would be transported immediately to either a nearby river or to a small stream or well supplying water to people. The resultant radiation exposures were calculated to be negligible.

E.5—Summary of Issue

Land disposal should be the only option, but the compartments should be sealed better and the material processed down (presumably reduced in volume).

Those Identifying Issue	Identification Number
Mr. Scott Elliott	56

Response

The reactor compartments would be completely sealed by welding shut any openings in the bulkheads or pressure hull. The sealed reactor compartment has been analyzed as a shipping container for the radioactivity contained within it and meets all the requirements of Federal law as specified in Title 10, Code of Federal Regulations, Part 71 (10CFR71). A submarine reactor compartment is a very compact package for a complete nuclear reactor plant; it is designed to fit in a small space. Since the package complies with all the requirements of 10CFR61, no processing of the material is needed.

E.6—Summary of Issue

The discussion of burial site operations should be expanded to include detailed specifics on the methods to be used in burying reactors.

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

Burial of radioactive waste in trenches is not a new or unusual practice and is adequately described in References B.1, B.2, and B.3. Repetition of these details in this EIS would not be useful. 40CFR1500 requires Environmental Impact Statements to be concise and encourages the incorporation of previously published information by reference.

E.7—Summary of Issue

The uncontaminated portions of the submarine should be transported to the burial site and disposed of, using either the same land transport system used for the reactor compartments, or using air transport.

Those Identifying Issue	Identification Number
Mr. Tom Willis	152

Response

Ocean disposal of non-radioactive naval ships is permitted by law under a general permit issued by the Environmental Protection Agency in accord with Title 40, Code of Federal Regulations, Part 229.2. Transporting the approximately 5000 tons of uncontaminated submarine parts to an inland burial site is unnecessary because there is no reason or requirement for such action. This would not only be needlessly costly, but would defeat the purpose of the radioactive waste burial grounds by needlessly filling them with uncontaminated material.

E.8—Summary of Issue

Salvaging the metal components from a shallow land burial location after 600 years or 20 half-lives should be considered.

Those Identifying Issue	Identification Number
Mr. Dennis L. Lundblad	372

Response

After 600 years, there would be approximately 400 curies remaining from the original inventory of 62,000 curies in each reactor plant. It would consist mostly of Nickel-63 (280 Curies) and Nickel-59 (120 Curies), and the remaining radionuclides would each be less than one curie. This material would still be slightly radioactive and therefore not suitable for unrestricted salvage. Further, normal corrosion during the 600-year period would have ruined much of the useful metal in the components.

E.9—Summary of Issue

Disposal of submarine reactors at a land burial site should not be justified on the basis that the amount of radioactive material involved is only a small fraction of the amount already there.

Those Identifying Issue	Identification Number
Mr. Heyward G. Shealy	236

Response

The environmental assessment of the land disposal option does not intend to justify this option on the basis that the amount of radioactive material involved is only a small fraction of the amount already there and, indeed, no such argument appears in the statement.

The DEIS did state that the estimated amount of land area that would be needed for this use would be a small fraction of the land area of the two sites considered to be suitable (Chapter 4, Section I.A.1 and Appendix A, Section III.D.3), and that the magnitude of the radioactive inventories being assessed would be similar to those already being disposed of by land burial (Chapter 2, Section I). These statements were provided to indicate that the impact of this option on these sites would not be large in either the amount of land needed or in the amount of radioactive material being disposed of.

E.10—Summary of Issue

Dredging of a swamp at the Savannah River Plant to build a barge slip would disturb cesium deposited in the swamp during past, current, or future operations. This matter is not addressed in the DEIS.

Those Identifying Issue	Identification Number
Dr. Marvin Resnikoff	13b

Response

The DEIS discussed the need to prepare barge unloading facilities at the Savannah River Plant (SRP) if land disposal at that location were selected (Chapter 4, Section I.A.3(1) and Appendix B, Sections III.D.4b and III.D.5). Since the unloading facilities would be constructed at a location along the river bank which is not a part of the swamp (see Appendix B, Section III.D.4b and Appendix L), no dredging would occur in the swamp. No cesium or other radioactive material has been deposited from SRP operations at the proposed barge unloading site, and no Savannah River Plant operation which might deposit radioactive material is planned at the locations considered.

E.11 — Summary of Issue

At the Savannah River Plant site, the amount of rainfall, the existence of perched groundwater [groundwater occurring in a saturated zone separated from the main body of groundwater by unsaturated rock], and the location of the groundwater table indicate that the reactor compartment could be within 5 to 10 feet of ground water (Appendix B, Sections III.B.2 and III.E.1).

Those Identifying Issue	Identification Number
EPA	694
Mr. Gordon K. Van Vleck	715

Response

Surface drainage ditches channel the runoff of rainwater away from the burial area. This prevents the accumulation of perched groundwater in the burial area and supplements the effective erosion control provided by the relatively level terrain and the specially selected grass cover. The bottom of the burial trench would be limited to a depth of at least 10 feet from the groundwater table in compliance with the requirement of the burial site operator.

E.12 — Summary of Issue

The Savannah River Plant should be considered inappropriate as a disposal site because the amount of rainfall precludes the area from being an arid or semi-arid site.

Those Identifying Issue	Identification Number
Mr. Thomas C. Jackson	15a
Mr. John M. Lawson	699
Mr. Michael F. Lowe	29
Ms. Joyce Rosenthal	13a

Response

There is no requirement that the site be arid or semi-arid. Solid radioactive wastes similar in form and isotopic content to those considered in the DEIS are currently being buried at the Savannah River burial ground. The National Research Council has concluded that no measurable harm has resulted from past and present practices in disposal operations (See Reference 3.2 for detailed information).

E.13 — Summary of Issue

The location of the Savannah River Plant over the Tuscaloosa aquifer in the southeast is disadvantageous.

Those Identifying Issue	Identification Number
Mr. Michael F. Lowe	29

Response

The surface and ground water hydrology in the vicinity of the Savannah River Plant (SRP) is described and analyzed in detail in pages II-138 through II-152 of ERDA-1537, the Final Environmental Impact Statement on Waste Management Operations at the Savannah River Plant (Reference 3.4). This analysis and recent groundwater analyses show that water from the surface at the center of the SRP site near the burial ground is unlikely to percolate down to the Tuscaloosa aquifer because several layers of low permeability clays and a hydrostatic head difference exist between the surface and the aquifer in this portion of the SRP site. Both the recharge and discharge regions of the Tuscaloosa aquifer are principally northwest of the burial ground, and indications are that the Tuscaloosa is not recharged below the burial ground.

This Environmental Impact Statement recognizes the Savannah River Plant hydrology and incorporates the information by reference. No change to the evaluation of possible environmental impacts has been identified.

E.14—Summary of Issue

On page 2-5, the Final EIS should more specifically discuss the area within the [Savannah River] site that is being considered for land disposal and its hydrogeological characteristics.

Those Identifying Issue	Identification Number
EPA	694

Response

A more complete discussion of the site and its hydrogeological characteristics was included in Appendix B, Section III.B.2 of the DEIS. Additional data are found in ERDA-1537, Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, and in the 1976 report by the National Research Council, The Shallow Land Burial of Low-Level Radioactively-Contaminated Solid Waste, incorporated into the EIS by reference (References B-3 and B-2, respectively). Appendix L, Floodplain/Wetlands Assessment, provides further hydrology information in Appendix L, Section III.B and Figures L-2 through L-5.

E.15—Summary of Issue

Factors favoring land disposal relative to sea disposal is that only 10 acres of land would be utilized *vs* 100 square miles of ocean bottom for disposal at sea and supervision and control would be possible throughout the total operation for land disposal.

Those Identifying Issue	Identification Number
Mr. Keith Houck	301
Ms. Lynne Penney Janbergs	364
Ms. Mary Sue Noe	2

Response

The differences in area required for land and sea disposal identified in this issue have been recognized and clearly stated in the DEIS. See Section I.I of Chapter 2 and COMPARISON OF DISPOSAL METHODS in the Summary.

E.16—Summary of Issue

"In Section I.D of Chapter 2, the sorptive properties of the soil should be included as a natural barrier to mitigate adverse effects of radionuclide releases to the environment by groundwater ... the retardation to migration factor effected by various geologic media should be compared, to determine the ratio of the rate of water movement to the rate of radionuclide movement." This mitigation should also be mentioned in Section I.A.2(b) of Chapter 4.

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy agrees that the sorptive properties of the soil would retard the rate of radioactivity movement and would thereby mitigate the adverse effects of radioactivity release to the environment by groundwater. However, the evaluation showed that radiation exposure to people would be negligibly small, even though the calculations conservatively took no credit for this effect. Since no credit was taken for sorption in the EIS, inclusion of a discussion comparing the retardation to migration factors for various geologic media is not necessary, and would needlessly increase the volume of the statement.

Information was added to each of the referenced sections stating that an additional mitigating effect would be provided by the sorptive properties of the soil, which would retard the rate of radioactivity movement from the burial site to sources of drinking water.

E.17—Summary of Issue

The cumulative effects of land disposal, including (for Savannah River) radiation from the "L-reactor," Barnwell low-level radioactive waste, decommissioning waste from existing commercial nuclear plants, and background radiation should be provided in the Environmental Impact Statement.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Mr. John Runkle	18 or 468
Mrs. A. E. Wasserbach	703

Response

A conservative estimate of the maximum annual population dose from disposal of reactor plants at the Savannah River Plant is approximately 2.1 man-rem (Appendix C, Section VI). Cumulative effects resulting in offsite dose commitments from other Savannah River Plant operations were estimated to be approximately 130 man-rem per year due to atmospheric and aqueous releases combined (page III-36 of Reference C.5). Natural radiation sources in this area would result in a population dose of approximately 78,000 man-rem per year, and artificial radiation sources (medical diagnostic X-rays) would add to this approximately 71,000 man-rem per year.

Of the total population dose that would result from all of these (approximately 150,000 man-rem per year), waste management operations including the land disposal option would contribute a very small fraction (0.09 percent). Of the total population dose that would result from just the waste management operations (approximately 132 man-rem per year), the land disposal option for submarine reactor plants would contribute a very small fraction (1.6 percent).

In this context, it is clear that the land disposal option would be a very small fraction of the cumulative effects of waste management operations. These estimates exclude for convenience the effects attributable to other radioactive sources in the area, but they would not be expected to add significantly to the total dose (including background) and would not increase the very small fraction of the total that would be attributable to the land disposal option.

Since the effects of radiation doses are linearly additive and there is no known synergistic effect between radiation sources, the small effects due to radiation from other sources in the area do not affect the assessment of the land disposal option. The low values of estimated radiation exposure and health effects of land disposal are provided in the EIS (Summary, Tables 1 and 2; Chapter 4, Section I.A.2(c); and Appendix C, Section VII).

E.18—Summary of Issue

The location of the proposed site at Hanford, relative to the commercial burial site, is not clear.

Those Identifying Issue	Identification Number
Dr. Ruth F. Weiner	39a

Response

In 1964, the Federal Government leased 1000 acres of land near the "200 Areas" (See map in Chapter 3, Figure 3-1) to the State of Washington for commercial nuclear use. Commercial solid waste burial service is provided on 100 acres of this tract under a license from the State. The leased land is between the southern portions of the 200-W area and the 200-E area.

E.19—Summary of Issue

The two reactor compartment pressures (27 psia and the differential of 7.4 psi) identified in the discussion on normal transport for land disposal appear inconsistent and should be clarified with respect to the design capability (Appendix B, Section III.F.1).

Those Identifying Issue	Identification Number
EPA	694

Response

The two different pressures refer to two separate requirements for normal transport specified by 10CFR71. Results of analyses reported in Appendix B, Section III.F.1 demonstrate compliance, and both pressures are well within the design capability of the reactor compartment.

E.20—Summary of Issue

The DEIS should address the specific question of potential problems in barge operations on the Savannah River, where experience with barge traffic is slight, the channel project depth is not routinely maintained, and very little clearance would exist for the loaded barge under some of the bridges. Because of these special problems, are historical data on accidents for the entire nation valid for the Savannah River?

Those Identifying Issue	Identification Number
EPA	694
Mr. Heyward G. Shealy	236

Response

Discussion with an operator of barges and tugs with extensive experience on the Savannah River indicates that a reactor compartment could be barged up the Savannah River as described in the EIS. The specific question of the potential difficulties of barge operations where water depth is limited is discussed in Appendix B, Sections III.D.1.b and III.D.2.b. The latter section includes a statement that a clearance of 1 1/2 feet could be maintained between the lowest bridge and the load, and between the barge and the river bottom, and that it would be necessary to verify the low-water level river depths under the two limiting bridges prior to shipment. This of course implies that shipments on the Savannah River would be deferred at times of high water level. In addition, the river might need to be dredged in some areas, as discussed in Issue E.21.

The validity of applying national-based statistics to operations in a specific area can be questioned, but the extremely conservative approach used in applying the barge accident data (see Issue K.14) provides confidence that the likelihood of a serious barge accident has not been underestimated.

E.21—Summary of Issue

The discussion of transportation to the Savannah River Plant by barge (pages B-13 to B-31) should be expanded to include impacts on existing river users, resuspension of river sediments, and impacts on aquatic life during low flow conditions.

Those Identifying Issue	Identification Number
EPA	694
Governor Joe Frank Harris	340

Response

The Savannah River is navigable for shallow draft vessels and for barges from its mouth to Augusta, which is approximately 50 river miles upstream of the Savannah River Plant. The river is used extensively for hydroelectric, flood control, and navigation purposes. The impacts of three or four additional barge trips per year would be coincidental to current river traffic that exists on the river now.

During the years from 1971 to 1980, the waterborne commerce on the Savannah River averaged approximately 65,000 short tons per year. Four disposal trips per year would add approximately six percent to this amount of traffic. The potential for resuspension of river sediments and the risk to aquatic life during low flow conditions would be very minor, corresponding to the small increase in existing traffic due to the disposal trips.

The Savannah River would have to be dredged in some areas before the first disposal trip to the Savannah River Plant, but the impact of dredging, which has been assessed by the U.S. Army Corps of Engineers, would be temporary and not detrimental to fish or benthic organisms (Appendix L, Section IV). See also Issue K.10.

The impacts on the river associated with barge slip construction were described in detail in the DEIS (Appendix B, Section III.D.4.b and Appendix L, Section IV). Long-term impacts due to barge traffic and the frequency of the potential barge trips are not considered to be great enough to harm the environment.

E.22—Summary of Issue

Land disposal at the U.S. Department of Energy Savannah River burial site seems beset with barge transit difficulties and minimal available burial depths that together may disqualify this alternative as a viable option. More information may resolve this issue.

Those Identifying Issue	Identification Number
EPA	694

Response

The EIS presents enough information to demonstrate that barge transit capability and available burial depths are adequate to accommodate disposal at the Savannah River site.

E.23—Summary of Issue

The DEIS should describe the shortest, safest transportation routes to the disposal sites.

Those Identifying Issue	Identification Number
Mr. James Puckett	38
Ms. Joyce Rosenthal	13, 13a
Ms. Cathy Ryan	99

Response

The routes identified in the DEIS are the safest feasible routes (Appendix B, Sections III.D.1 and 6, and Appendix D, Section III.A).

E.24—Summary of Issue

The DEIS should give more details on the kinds of traffic restrictions that would be applied, on the role and capability of accompanying vessels, and weather condition restrictions.

Those Identifying Issue	Identification Number
Mr. Martin F. Golden	634

Response

The specific details suggested are not relevant to evaluation of possible environmental impacts. The Navy would comply with all applicable Department of Transportation, Department of Energy and Nuclear Regulatory Commission regulations for transportation of radioactive material.

E.25—Summary of Issue

The lack of regulations on tug boats (Appendix B, Section III.D.3.a) should not prevent proposing beneficial safety requirements.

Those Identifying Issue	Identification Number
Mr. Martin F. Golden	634

Response

The special procedures that could be used, the number of tugs, and the equipment that such tugs would have were discussed (Appendix B, Section III.D.3.a).

E.26—Summary of Issue

The discussion of barge operations should include: detailed tug boat criteria, consideration of a trial run up each river with a dummy load and a description of "special grounding techniques" which ensure barges remain stable and level.

Those Identifying Issue	Identification Number
EPA	694

Response

This level of detail is not relevant to the evaluation of possible environmental impacts of reactor plant disposal and is not appropriate because environmental impact statements are required by the Code of Federal Regulations Title 40, Part 1500 to be concise.

E.27—Summary of Issue

The DEIS should note that passage on the Columbia River was severely disrupted in 1981 when Mount St. Helens erupted and that Mount St. Helens continues to be active.

Those Identifying Issue	Identification Number
EPA	694

Response

Temporary interruption of river traffic would not cause any significant problem since there would be no need for any individual reactor compartment barge shipment to arrive at any particular time. Therefore, it is not necessary to include this information in the EIS.

E.28—Summary of Issue

The evaluations of land burial sites other than Hanford and Savannah River are not adequate.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Ms. Joyce Rosenthal	13a
Dr. Ruth F. Weiner	39a

Response

Chapter 2, Section IV.A describes land burial selection criteria which eliminated other land burial sites from practical consideration, as described in Appendix B, Section III.B.3.

E.29—Summary of Issue

Hanford and Savannah River are considered because they are already used for low level waste, not because they are particularly suited for that use.

Those Identifying Issue	Identification Number
Dr. Ruth F. Weiner	39a

Response

Detailed descriptions of the geohydrology of both Hanford and Savannah River as well as the disadvantages of other land disposal sites, including DOE sites currently used for disposal of low level radioactive waste, are provided in Chapter 2, Sections IV.A through IV.D and in Appendix B, Sections III.B.1 through III.B.3.

E.30—Summary of Issue

At the Hanford Site, the Yakima Indian Nation is opposed to the continued radioactive contamination of the federal reserve, but this concern does not appear in the DEIS.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Ms. Rebecca Matthews	693
Dr. Marvin Resnikoff	13b

Response

The Yakima Indian Nation has not commented to the Navy on this subject.

E.31 —**Summary of Issue**

The EIS should include some discussion regarding the type of analysis to be conducted to assure compliance with 10CFR71.

Those Identifying Issue	Identification Number
Governor Joe Frank Harris	340

Response

These analyses were discussed in Section F of Appendix B of the DEIS.

E.32 —**Summary of Issue**

In determining the appropriate NRC waste classification applicable to land disposal of submarine reactor compartments, it is incorrect to use the total reactor compartment volume in calculating the radioactivity concentration in curies per cubic meter.

Those Identifying Issue	Identification Number
EPA	694
NRC	445a

Response

After the DEIS was issued, the NRC revised 10CFR61 (Licensing Requirements for Land Disposal of Radioactive Waste) and issued it in final form. Table 2.1 and Section I.E of Chapter 2 which were affected by these revisions have been updated to be consistent.

The two respondents proposed different ways to calculate the waste classification. If calculated in the way suggested by the first respondent, the reactor compartment would still be Class B waste. If calculated in the way suggested by the second respondent, the waste would be Class C.

Even if the waste were considered to be Class C, no additional disposal measures would be required at the site because the thick steel hull and bulkheads and the massive walls of the reactor pressure vessel would provide an adequate barrier against intrusion in accordance with this classification. The estimated environmental impact would be the same whether the waste were classified as Class B or C.

E.33 —**Summary of Issue**

The compliance of land disposal of the reactor compartments with NRC requirements and other suggestions for structural stability should be discussed.

Those Identifying Issue	Identification Number
EPA	694
Mr. Robert B. Ginnis	24
Mr. Wm. A. Lochstet	443
NRC	445
Ms. Beverly Roberts et al.	32a

Response

Waste stability was reviewed for compatibility with the final form of 10CFR61 (NUREG-0945, Vol. 3, Appendix F) and was found to be satisfactory. The stability of the waste is provided by the great strength and the sealed condition of the reactor compartment and of the reactor vessel. The reactor vessel is very thick and contains over 99 percent of the radioactivity. The stability of these forms provides protection for the health and safety of the personnel at the disposal site. The engineered features for transporting and securing the reactor compartment would facilitate handling at the disposal site as well. The structural strength of the reactor compartment, particularly the hull and the reactor vessel, provide assurance of long term stability of form and protection for the inadvertent intruder for much more than 300 years after disposal, based on the known thicknesses of the steel walls and conservative estimates of long-term corrosion rates in such soils.

Some respondents suggested that added stability and protection could be provided by the use of concrete to fill the voids in the reactor compartment or by the use of cement and iron casings. Pathways analysis in the EIS, using a very conservative scenario, concluded that the maximum-exposed individuals would not be exposed to more than 1.3 mrem per year without the use of any concrete, even assuming subsidence and infiltration of water far in excess of normal expectations (Chapter 4, Section I.A.2.(c)(4) and Appendix C, Section V).

One respondent requested discussion of the adequacy of the earth cover. The amount of earth cover over the buried reactor compartment was specified in the EIS in accordance with the requirements provided by the disposal-site operators. In the far distant future, unanticipated activities of people at the surface might expose the outer surface of the hull structure of the reactor compartment, but it is concluded that the durability of the hull and reactor vessel would be adequate to provide protection for as long as it would be needed (Chapter 2, Section I.E). Exposures that might occur beyond that time would be safe and environmentally acceptable since such exposures are estimated to be a very small fraction of the natural background radiation (Chapter 4, Section I.A.2.(c)).

E.34—Summary of Issue

"Footnote 2 [of Table 2-1] should be clarified to give the actual activity of one cc of Cobalt-60."

Those Identifying Issue	Identification Number
EPA	694

Response

The referenced footnote has been deleted since the basis for the footnote has been removed. The final form of Table 1 of 10CFR61, which was issued subsequent to the issuance of the Navy's DEIS, contains the phrase "no limit established" for Cobalt-60 activity for Class B and Class C waste instead of the phrase "theoretical maximum specific activity." Table 2-1 has been revised to be consistent with the final form of 10CFR61.

E.35—Summary of Issue

The statement on page 2-8 that "No maintenance of the earth cover would be required" is probably incorrect as pertains to the Savannah River site, based on annual rainfall and actual experience at that site.

Those Identifying Issue	Identification Number
EPA	694

Response

As discussed in Issue E.33, the thick submarine hull would remain intact for at least 300 years and would therefore prevent the trench slumping that can occur with less structurally stable waste. The radioactivity will have decayed by that time to low enough levels that earth cover maintenance would not be required.

SECTION F

This Section (F.1—F.36) contains issues related to Chapter 2, Section II and Appendix D of the Environmental Impact Statement.

F.1 —Summary of Issue

"In Chapter 2, Section II.C, it would be useful to cite quantitative values in support of the phrase 'very low external radiation levels'."

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy agrees with the statement.

The text in Section II.C of Chapter 2 was modified to include the statement that the dose rate outside the hull would be 0.001 mrem/hr or less.

F.2 —Summary of Issue

The Navy program and the DEIS should be modified as necessary to comply with the recent Amendment to the Marine Protection, Research, and Sanctuaries Act of 1972.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. H. Wayne Beam	339	Mr. Scott McCreary	86
Mr. Bruce R. Campbell	421	Ms. Susan Moretta	328
Ms. M. R. Crook	230	NOAA	444
Mr. Robert Crook	230	Mr. George D. Noble	333
Mr. Clifton E. Curtis	695	Mr. Charles Orth	88
Dr. Jackson Davis	76	Ms. Jane Smith Patterson	8
Mr. Ronald V. Dellums	447	Mr. Robert E. Ragland	315
Mr. Norman DeVall	73	Ms. Judith Redwing	96
Ms. Dobie Dolphin et al.	131b	Ms. Arlene Reiss	344
EPA	694	Mr. Christopher D. Roosevelt	695
Mr. Thad Eure	719	Mr. James F. Ross	486
Ms. Donna Feiner	280	Mr. Robert S. Sanyak	413
Ms. Lydia Raas Ford	326	Mr. Lewis Seiler	707
Ms. Gretchen G. Grant et al.	385	Mr. Hanon Sells et al.	441
Dr. Michael J. Herz	37b, 37c	Atty. Gen. John K. Van DeKamp	446
Mr. Thomas C. Jackson	37b	Mr. Greg Wellish	103
Honorable Walter B. Jones	9	Ms. Emily F. Whittlesey	358
Ms. Karen A. Massey	674	Mr. Timothy Wilson	586

(Continued on next page)

Response

Late in 1982, shortly after the Navy issued the DEIS, an amendment to the Marine Protection, Research, and Sanctuaries Act was included in legislation passed by the Congress. This amendment limited EPA's authority to issue permits for ocean diposal of radioactive wastes for two years except for research purposes. After this period expires, the amendment establishes a requirement for preparation of a Radioactive Material Disposal Impact Assessment and submission of such an assessment to the Congress.

The EIS has been revised to recognize these new provisions.

The Navy would comply with the requirements of the Marine Protection, Research, and Sanctuaries Act if the ocean disposal option were to be selected.

F.3—Summary of Issue

Using a three-part test identified by the Ninth Circuit Court for consideration in "determining whether a DEIS should be delayed to await new information," the respondent asserts that the Navy must delay to undertake needed research and then prepare a supplemental DEIS after the current two year moratorium period is over.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher D. Roosevelt	695

Response

The two year moratorium referenced by the respondent restricts Environmental Protection Agency approval of permits for ocean disposal of radioactive material. However, this Environmental Impact Statement is limited to the evaluation of the impacts of available options for disposal of submarine nuclear reactor plants and is only intended to lead to a decision on whether to use land disposal or to pursue collection of data and permit application for ocean disposal. It does not involve any permit for ocean disposal. This EIS, related to the method of disposal to be pursued, is being issued at this time to satisfy the requirement of the Council on Environmental Quality to prepare an Environmental Impact Statement as close as possible to the time a proposal is being developed, consistent with meaningful evaluation of environmental effects, (40CFR 1502.5 and 40CFR 1508.23).

If a decision were made to pursue a course of action involving ocean disposal, the Environmental Protection Agency would have the responsibility to designate a site, and to approve a Navy application for a permit for the actual disposal.

F.4—Summary of Issue

It is not clear that there is any need for the ocean disposal option ("need" is a requirement of EPA's ocean dumping regulations).

Those Identifying Issue	Identification Number
EPA	694

Response

The Environmental Protection Agency regulation governing disposal of wastes at sea (40CFR220) provides for the issue of permits for disposal of radioactive material at sea, including a requirement for determination of the need for ocean disposal through comparison of environmental impacts, risks and costs for feasible alternatives (40CFR 227.15(c)). The regulations state that a need for ocean dumping will be considered to have been demonstrated when there are no practicable alternatives which have less adverse environmental impact or potential risks to other parts of the environment than ocean dumping. (40CFR227.16(a)).

The Navy DEIS concluded that either option would have no significant environmental impact. Because there is no option for disposal of the submarine reactor compartments with less environmental impact than ocean disposal, the demonstration of need established in 40CFR 227.16(a) would be satisfied.

F.5—Summary of Issue

The international legality of the Navy's program would be a matter to be decided by the contracting parties to the LDC.

Those Identifying Issue	Identification Number
Dr. Jackson Davis	76
Mr. Lewis Seiler	707
Mr. Stuart Smith	54

Response

If ocean disposal is pursued, a site specific environmental evaluation would be prepared and the evaluation would comply with requirements established by the U.S. Environmental Protection Agency in consideration of U.S. and international laws and treaties. See Chapter 2, Section II.

F.6—Summary of Issue

The U.S. Navy should actually obtain an EPA ocean disposal permit rather than attempting to comply with all possible permit conditions without actually obtaining a permit.

Those Identifying Issue	Identification Number
Governor Joe Frank Harris	340

Response

An EPA ocean disposal permit would be requested if the ocean disposal option were selected. The U.S. Navy has no intention of bypassing the permit process.

F.7—Summary of Issue

"... the statement that 'no new regulations are needed' seems at odds with the statement that an EPA permit request would be required. Such a permit request may necessitate rulemaking procedures on the part of EPA."

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy's statement that "no new regulations are needed" is based upon EPA testimony before a Congressional committee. The director of the EPA's Office of Radiation Programs submitted the following statement in prepared testimony before the House Committee on Merchant Marine and Fisheries on October 19, 1982:

"For EPA evaluation of a potential permit from the Navy, we have five sources of domestic and international criteria. We believe these existing criteria are adequate for such a permit evaluation."

However, since this EPA comment on the DEIS indicates that the EPA now believes that new regulations may be needed, the "no new regulations are needed" statement has been deleted from the Final EIS.

F.8—Summary of Issue

Ocean disposal of submarines would result in a change in national policy. The EIS should describe the impacts of submarine disposal at sea on domestic and international radioactive waste disposal policy.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Patrick Agnello	75	Mr. D. Paul DeMayo	33
Mr. Alfred W. Anderson	493	Ms. Dobie Dolphin et al.	131b
Ms. Jane O. Ballus	19	Mr. Peter Douglas	68a
Mr. Bill Barlow	17	Mr. Fred Eissler	664
Ms. Jennie Barnhardt et al.	240	Mr. Scott Elliott	56
Dr. H. Wayne Beam	339	Mr. Thad Eure	719
Mr. Vincent J. Bellis	255	Ms. Donna Feiner	280
Mr. Darrell Bennett	338	Mr. John K. Flynn	545
Mr. Doug Boone	108	Mr. William E. Gramley	656
Ms. Janet P. Brooks	693	Ms. Theresa L. Greenlaw	535
Ms. Kimberly J. Christman	671	Mr. Ron Guenther	105
Ms. Rainbow Trout Cornelia	308	Mr. Dan Hauser	67a
Mr. Clifton E. Curtis	695	Dr. Michael J. Herz	37b
Mr. Jon Daunt	669	Mr. Keith Houck	301
Dr. Jackson Davis	76	Mr. Thomas C. Jackson	37b
Mr. Gary DeGraff	51	Ms. Jane Jarrett	245

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Honorable Walter B. Jones	9	Mr. Kendall Reid	479
Mr. Larry Kaplan et al.	616	Mr. Arlene Reiss	344
Honorable Barry Keene	67, 67b	Mr. Christopher D. Roosevelt	695
Mr. Mike Landen	569	Ms. Joyce Rosenthal	13a, 13b
Mrs. Eleanor Lewallen	3b	Ms. Sally Rulison	666
Mr. Doug Lowe	21	Mr. John Runkle	468
Ms. Karen A. Massey	674	Mr. Robert S. Sanyak	413
Ms. Rebecca Matthews	693	Mr. Lewis Seiler	707
Ms. Teresa Matta	382	Mr. Heyward G. Shealy	236
Ms. Maxine McCloskey	689	Mr. Ron Shehee	407
Mr. Scott McCreary	86	Ms. Elizabeth A. Sickinger	367
Ms. Janet Morrison	341	Mr. Eric Simmons	59
Ms. Dena Mossar	442	Mr. Stuart Robert Smith	54
Ms. Julie Kay Norman	709	Mr. Chris Thompson	343
Ms. Rebecca Paterson et al.	631	Ms. Kelly Townsend	503
Ms. Jane Smith Patterson	8	Ms. Susie Van Kirk	229
Mr. James Puckett	38	Mr. Tortuga Vine	266
Mr. Robert E. Ragland	315	Mr. Greg Wellish	103
Ms. Karen Rakofsky	272	Mr. Michael Winks	701
Mr. Daniel F. Read	12	Ms. Sharon Winters	479

Response

The National Environmental Policy Act requires that the Navy consider all reasonable alternatives for permanent disposal. Ocean disposal is permissible under international treaties to which the U.S. is a signator. Currently a two year moratorium exists. After this moratorium expires, ocean disposal will be legal under U.S. Law if conducted in accordance with the Marine Protection, Research and Sanctuaries Act. Thus, the Navy is not changing national or international policy by evaluating ocean disposal.

F.9—Summary of Issue

Since the United States did not sign the Law of the Sea Treaty, criteria for ocean disposal of radioactive material that the U.S. Navy will follow should be included in the Environmental Impact Statement.

Those Identifying Issue	Identification Number
Mr. John Runkle	18 or 468

Response

If the sea disposal option is chosen, criteria established by the EPA, including the requirements of the London Dumping Convention established by the International Atomic Energy Agency (Reference 3.5) would be used. See Chapter 3, Section II.A for discussion of such criteria.

F.10—Summary of Issue

The Navy plan for possible sea disposal does not meet the criteria presently accepted for ocean disposal of high level radioactive waste, and does not, or may not, meet the criteria for low-level dumping under the London Dumping Convention.

Those Identifying Issue	Identification Number
Mr. Bruce R. Campbell	421
Mr. Jim LeCuyer	84
Mr. John E. Madison	170
Mr. Jim Marotta-Jaenecke	194
Mr. James F. Ross	486

Response

Ocean disposal of defueled nuclear submarines meets the criteria for low-level dumping under the London Dumping Convention, as stated in Chapter 2, Section II.H. Since submarines would be defueled prior to disposal, no high level radioactive waste would be present in the submarines at the time of disposal.

F.11—Summary of Issue

The Navy must obtain a determination that disposal would be consistent with the approved Coastal Zone Management Plans of the various states.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Nathaniel S. Bingham	78a	Ms. Margaret Livingston	247
Mr. Jon Daunt	669	NOAA	444
Mr. D. Paul DeMayo	33	Mr. Robert E. Ragland	315
Ms. Dobie Dolphin et al.	131b	Mr. James F. Ross	486
Mr. Peter Douglas	68, 68a	Atty. Gen. J. K. Van DeKamp	446
Ms. Donna Feiner	280		

Response

The Navy fully recognizes its responsibilities set forth in the Coastal Zone Management Act (CZMA) (16 U.S.C. § 1451, et seq.). The requirements of the CZMA are independent from those of NEPA and as such stand alone. The Navy will use this EIS to decide what, if any, further action is required by CZMA; however, the EIS itself is not the appropriate place to make such determinations.

F.12—Summary of Issue

The EIS should include recent and current studies on ocean dumping, such as the EPA's current study and the 1970 CEQ report.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. H. Wayne Beam	339	Dr. Jackson Davis	76
Mr. Wesley Chesbro	69	Honorable Ronald V. Dellums	447
Ms. Deborah L. Clifford	498	Mr. Robert Eidus	23

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Ron Guenther	105	Ms. Nancy Tuttle	537
Dr. Michael J. Herz	37b	Mr. Will Tuttle	537
Mr. Thomas C. Jackson	37b	Mr. Timothy Wilson	586
Mr. Lewis Seiler	707	Mr. G. Nelson Wolfe	104

Response

Reports of research carried out or sponsored by the EPA are available and were reviewed during preparation of the EIS. However, this material was not specifically referenced in the EIS because the recent EPA studies are concerned with different radionuclides than would be contained in submarine reactor compartments, the containment packages are vastly different from the reactor compartment's hull and bulkhead containment barriers, and the characteristics of locations studied generally differed significantly from the deep and distant locations that would be required for submarine sea disposal.

Studies of previous sea disposal sites for radioactive material, such as the Farallon Islands dumpsite, were reviewed during the preparation of the EIS, but there was no suggestion in any studies that any health hazard existed, or that any potentially hazardous aspect of submarine disposal at sea had been overlooked in the preparation of the EIS. This view is consistent with the conclusions of the U.S. General Accounting Office (GAO) reported in Reference 2.7 that "Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized," and subsequently confirmed in the GAO review of this conclusion, GAO/RCED-83-45, December 17, 1982, which was conducted at the request of Congressman N. E. D'Amours.

F.13—Summary of Issue

The technology to safely conduct disposal of submarine reactor plants at sea is considered inadequate at the present time.

Those Identifying Issue	Identification Number
Mr. Richard Archambault	287
Ms. Carolyn J. Christman	200

Response

Appendix D describes the sequence of steps that would carry out the sea disposal option. This technology has been verified by tests with models of various scales, computer analyses, and evaluation of previous scuttlings, as discussed in the appendix.

F.14—Summary of Issue

It doesn't seem logical to tow, by cable, an unmanned submarine as shown in Figure D-1, the long distance from Pearl Harbor to a sea disposal site.

(Continued on next page)

Those Identifying Issue	Identification Number
EPA	694

Response

Submarines have in the past been towed long distances by the Navy. The towing stability of submarines in the sea disposal configuration has been tested using models in towing tanks. As discussed in Appendix D, Section III.A of the DEIS, the Navy would take all steps necessary to assure that it could be safely transported using procedures that have been proven safe by long experience by the Navy in similar tasks.

Section D.III.A of the Final EIS was expanded to include the above discussion.

F.15—Summary of Issue

The hazards of ocean towing operations, sensitivity to weather conditions or unforeseen factors should be factors in selection of a disposal option because such hazards may favor land disposal.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Kimberly J. Christman	671	Ms. Mary Sue Noe	2
Ms. Rainbow Trout Cornelia	308	Mr. Robert E. Ragland	315
Mr. Clifton E. Curtis	695	Mr. Christopher D. Roosevelt	695
Ms. Donna Feiner	280	Mr. Ron Shehee	407
Mr. James Arthur Ferrara	665		

Response

These hazards and factors have been evaluated and determined to not be significantly different between the land and ocean disposal options since ocean towing operations are required for both options. Refer to Chapter 4, Sections I.B.1, I.B.2, II.B.1, and II.B.2; and Appendices B and D.

F.16—Summary of Issue

LSD's [Landing Ship, Dock], should be used to transport the submarines to ocean dump sites.

Those Identifying Issue	Identification Number
Mr. Henry M. Plymire	494

Response

Details on transportation to an ocean disposal site are provided in Section III.A of Appendix D. Since the submarine would be seaworthy, towing was determined to be safe, as well as the most technically feasible and most economical method of transportation.

F.17—Summary of Issue

Full flooding is probably achievable only under slow and deliberate operations in a static condition; i.e., in a dry dock (Chapter 4, Section II.A.3(e)).

Those Identifying Issue	Identification Number
EPA	694

Response

According to Navy planning if ocean disposal were used, the reactor compartment would be filled with water in the shipyard with any necessary topping off completed prior to transportation to the disposal location. Full flooding of the remaining compartments would be accomplished during sinking within a short time and distance after the submarine became fully submerged. This would be assured because, unlike the experience cited by the respondent, a number of large vents would have been provided in each remaining compartment. Since the entire compartments, inside and out, would be subjected to water pressures many times atmospheric pressure, all of the small volume of remaining air would be compressed and eventually dissolved. Because the pressure inside and outside the hull would be equal at all times, there would be no pressure differential to cause damage.

F.18—Summary of Issue

The statement (in the Summary) that "the submarine would be towed to the disposal location and sunk in a controlled flooding operation" is not completely accurate. It implies that sinking is controlled throughout the descent.

Those Identifying Issue	Identification Number
EPA	694

Response

As described in Section II.A of Chapter 2 and Section II of Appendix D, planned modifications to the submarines would limit the terminal velocity and control oscillation, glide angle and maximum horizontal displacement from the release point during descent. Hull modifications would also provide rapid, complete flooding of all compartments other than the reactor compartment, which would be filled prior to sinking. These modifications would ensure that each submarine would come to rest on the bottom with the reactor compartment and primary system containments intact.

F.19—Summary of Issue

A number of respondents stated that the DEIS does not adequately support its statement that the submarines would remain intact after they had landed on the sea floor.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693	Ms. Julie Kay Norman	709
Ms. Kimberly J. Christman	671	Ms. Judith Redwing	96
Mr. Clifton E. Curtis	695	Mr. Christopher D. Roosevelt	695
Mr. Walter Dodds	571	Mr. Ron Shehee	407
Ms. Dobie Dolphin et al.	131b	Mr. Gordon K. Van Vleck	715
EPA	694	Mr. James Widmeyer	678
Ms. Rebecca Matthews	693		

(Continued on next page)

Response

Chapter 2, Section II.A and Appendix D, particularly Sections VI, VII, and VIII, describe experience, testing, and ocean conditions supporting this conclusion. The reactor compartment would be expected to remain intact because the forces encountered during sinking would be insufficient to damage the compartment.

Pressure difference is the force that at great depth tends to crush air-filled compartments. This force would not exist during planned submarine sinkings because the reactor compartment would have been completely flooded prior to sinking to remove all air and the reactor compartment bulkhead would be fitted with a one-way valve to compensate for the slightly reduced volume occupied by a given weight of seawater when it is subjected to high pressure. Other compartments in the submarine would flood rapidly early in the sinking process due to the many flooding and air venting openings that would be placed in all compartments other than the reactor compartment, thus preventing breakup of other portions of the submarine.

For a planned submarine sinking, with predictable and limited terminal velocity and at a selected location where the bottom conditions are known, the impact shock would be less than 2g, or well below the shock at which damage might occur to the submarine. Other aspects of the planned sinking, such as the submarine's attitude and its depth of penetration into the sediment, are important details that have been examined during testing but nevertheless are not essential to the question of reactor compartment integrity after the submarine reaches the ocean bottom.

None of the respondents listed above offered any specific technical arguments that would affect the conclusion in the DEIS that the submarines would land intact.

As stated in response to related issues, the safety of the sea disposal option would not depend on preserving the integrity of the reactor compartment of any of the 100 submarines, even though such integrity would be expected to be maintained. In the first place, the containment provided by the radioactive atoms being an inseparable part of solid metal cannot be reduced by any accident during disposal. The accident in which no containment beyond this inherent property of the solid metal was conservatively calculated as stated in Section II.B.1 of Chapter 4, with only minor consequences. Second, even if all of the 186,000 curies that would be involved at a disposal rate of three submarines per year were immediately released into the environment, the annual release limits of the IAEA would not even be approached.

F.20—Summary of Issue

The effect of impact of the submarine on the sea bottom should be analyzed with respect to the momentum of the water in the compartments and the possibility of rupturing the bulkheads, especially after having been stored for some time.

Those Identifying Issue	Identification Number
Mr. Wells Eddleman	20

Response

The suggested analysis was performed as a part of the structural analysis of reactor compartment integrity, but was not reported explicitly in the DEIS because there was no environmental impact. The results of the analysis show conclusively that the bulkhead would not be ruptured or even severely strained.

In the normal case, the submarine would land on the bottom with its long axis horizontal, essentially parallel to a relatively flat bottom. Tests reported in Section VI.A of Appendix D confirm this. In the horizontal position, the momentum forces on the bulkheads of the reactor compartment would be equal on both sides of each bulkhead and there would be no pressure difference to strain the bulkhead. There might be a small tilt in the axis of the submarine and in the flatness of the sea floor, but conservative analysis indicates that the pressure difference would be very small. In the worst case, where the submarine might land nose down on the bottom, the calculated deceleration and pressure difference would still be within the design capability of the bulkheads.

These results are considered to be valid for either prompt disposal or disposal after storage of the submarine for some time because the interior humidity of the submarine compartments would be controlled during protective storage so that the structural integrity of the bulkheads would be maintained.

F.21 —Summary of Issue

The EIS should describe the basis for believing that the pressure-equalizing valve in the reactor compartment bulkhead would not allow leakage from the reactor compartment sooner than the time of general corrosion penetration of the bulkheads and that the integrity of the valve would be adequate to survive the impact on the sea bottom.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
EPA	694, 694a
Mr. Christopher D. Roosevelt	695
Atty. Gen. John K. Van DeKamp	446

Response

The purpose of the pressure-equalizing one-way valve in the bulkhead is to allow flow into the reactor compartment during the submarine's descent to the ocean floor, so that large differences in pressures do not occur on opposite sides of the reactor compartment bulkheads. After the submarine is on the bottom, with the pressure inside the reactor compartment approximately equal to or less than the pressure in the adjacent compartment, there would be no driving force for leakage from the reactor compartment. The only leakage through the valve would be into the reactor compartment if pressure in the adjacent compartment were greater.

Because compatible materials would be used and the valve would be designed to handle the same pressure differentials as the bulkhead, there is no reason to expect that corrosion of the valve installed on the bulkhead would cause premature penetration of the outer containment barrier. The

(Continued on next page)

size and design of the valve would be such that dirt or small objects would not cause it to stick open and there would be no loose debris remaining in the ships' compartments large enough to interfere with proper function. Since the predicted impact on the sea bottom is less than 2g (Appendix D, Section I), the check valve would not be expected to suffer any mechanical damage or fail to function properly.

Even if premature penetration of the check valve were to occur, the result would be only a small potential for additional release of radioactive material because of the additional containment provided by the reactor vessel and piping and the radioactive atoms being a part of the metal itself. The maximum amount of such release would not be significant.

F.22—Summary of Issue

Multiple loss of containment due to seismic effects and one submarine landing on another should be discussed.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Patrick Agnello	75	Mr. Christopher S. Hayes	603
Mr. George Balding	77	Mr. Jim Marotta-Jaenecke	194
Mr. Bruce R. Campbell	421	Ms. Teresa Matta	382
Mr. Emmett Carson	415	Lt. Governor Leo McCarthy	65
Mr. Wesley Chesbro	69	Mr. Bruce Meachem	512
Ms. Randi Dalton	161	Mr. Thomas D. O'Neil	80
Dr. Jackson Davis	76	Ms. Karen Rakofsky	272
Mr. Dwight Donovan	228	Mr. James F. Ross	486
Mr. Peter Douglas	68a	Mr. Lewis Seiler	707
Mr. Conrad Golich	713	Atty. Gen. John K. Van DeKamp	446
		Mr. James Widmeyer	678

Response

Loss of containment due to seismic effects is not considered to be credible because ocean disposal sites would be selected to be away from geologically active features (Reference 3.14, pp 9, 17, and 48) and because the hull is designed to withstand greater shocks than would occur even in typical ground-shaking events. One respondent referred to an "attached U.S. Geological Survey Open File Report," but it was not received and was not identified sufficiently for it to be obtained from USGS for review and discussion.

The accident where one submarine would land on another is not considered to be credible because they would be disposed of with detailed knowledge of the locations of previously-disposed-of submarines (Appendix D, Sections IV.B and IX). See Issue F.23 for consequences of such an unlikely occurrence.

F.23—Summary of Issue

The discussion of reactor compartment integrity should include the possibility that a free-falling submarine would strike a previously emplaced submarine, a rocky outcropping, or some other object.

Those Identifying Issue	Identification Number
Mr. Patrick Agnello	75
EPA	694
Mr. Doug Lowe	21

Response

Since the area that would be chosen as a disposal site would have been verified before use to be quite flat, with sediment depths of several hundred meters, the presence of a rocky outcropping or some other object is not reasonably expected. The possibility of a falling submarine striking a previously emplaced one is also extremely small, since new sinkings would not take place within about a mile of previous sinkings. This distance would be verified by sonar and would be used to assure that the sinking submarine could not drift far enough to approach previously disposed submarines.

But even if there would be an impaction upon any object, the possible consequences could be no worse than the accident sequence already discussed in Chapter 4, Section II.A.3(b), where all containment is assumed to be open to the sea, including the reactor vessel. The calculated radiation exposures from this worst case situation are extremely small, for example, 2×10^{-8} mrem per year (best estimate) to the maximum exposed individual.

F.24 —Summary of Issue

More discussion is needed in Appendix D to describe other sea disposal methods than the "freefall" mode. Appendix A presents costs for other methods.

Those Identifying Issue	Identification Number
EPA	694

Response

More expensive sea disposal methods other than the method of flooded freefall are summarized in Appendix A, Sections II.C.1 through II.C.4. The free fall method would be able to deliver the submarines to the bottom with containments intact so other emplacement methods would provide no different environmental impacts. Since the results and the environmental impacts are the same for the various emplacement methods, there is no reason for further discussion of more expensive methods in the EIS.

F.25 —Summary of Issue

The Navy should consider some kind of full scale test to verify the sinking method.

Those Identifying Issue	Identification Number
EPA	694

Response

Appendix D, Sections V and VI, describes briefly the wide variety of tests that have already been performed. These include many model tests in the Navy Undersea Weapons Tank which were documented with still and motion picture and television cameras; computer simulations, with the computer results verified by comparison with the model tests in the Undersea Weapons Tank; larger scale impact tests on the sea floor, and model submarine tests in the deep ocean. Valuable information was also obtained from the sinking of two obsolete submarines in Project Thurber even though in that test, unlike the sinkings evaluated in the EIS, the submarines were planned to implode because the test sinkings were designed to determine what would happen as a result of the implosions. The Navy considers that the results of all this testing provide adequate assurance that the sinkings would proceed as described, and that no full scale testing is necessary.

F.26—Summary of Issue

The sediment properties in the Port Hueneme, California test areas do not greatly resemble those on the abyssal plain.

Those Identifying Issue	Identification Number
EPA	694

Response

Sediment shear strength properties in the 1200 foot deep test area (Appendix D, Section VI.C) are similar to the properties on the abyssal plain in terms of effect on relevant test factors, such as deceleration and impact forces. The tests at the 1200 foot deep area simulated drops onto a relatively soft bottom similar in strength to deep ocean clays. As described in Appendix E, the ocean floor at the Hatteras Abyssal Plain study area and the Pacific Ocean study area is almost entirely clay.

F.27—Summary of Issue

The DEIS should include, along with data for clay floors, the actual and predicted values for sandy floor drops. (Appendix D, Section VI.C.)

Those Identifying Issue	Identification Number
EPA	694a

Response

Appendix D, Section VI.C, includes only the data for a clay bottom because that would be typical of sites which might eventually be selected for ocean disposal. The sand bottom data are not relevant.

However, for information, the actual cylinder penetration in sandy soil was 0.25 to 0.5 feet, compared to the predicted penetration of 0.25 feet. Actual deceleration in sandy soil was estimated to be between 6.6g and 17.6g, while the predicted value had been 14.1g.

F.28—Summary of Issue

Certain site selection criteria in the DEIS should be quantified. For example, a minimum distance of separation of 200 kilometers has been suggested between a sea disposal site and areas of potential volcanic or earthquake activity and continental margins.

Those Identifying Issue	Identification Number
EPA	694

Response

Under the Marine Protection, Research, and Sanctuaries Act the Environmental Protection Agency is responsible for establishing criteria for sea disposal sites ana to designate acceptable sites. The Navy would comply with any applicable EPA rules or requirements.

The site selection criteria in the DEIS have been used only to identify areas to be employed in the analysis of the limiting case. Therefore, it is not necessary that the particular EIS criteria that are identified above be as specific as proposed.

F.29—Summary of Issue

The orderly disposal pattern shown in Figure D-5 of the DEIS is unlikely to be achieved.

Those Identifying Issue	Identification Number
EPA	694

Response

The figure that is referred to is used to indicate the maximum diameter of a circular area required for 100 submarine sea disposals. A more likely pattern would be one with a substantially smaller diameter since the actual glide distance would generally be less than the maximum and previously disposed submarines could be accurately located using currently available sonar equipment. The surface release point for each sinking would be selected to ensure that the submarine being sunk would not strike a previously sunk submarine.

F.30—Summary of Issue

An allowance for horizontal displacement is 10% of the depth (Appendix D, Section VI.D). Is this allowance conservative? How conservative?

Those Identifying Issue	Identification Number
EPA	694

Response

The 10% allowance for maximum horizontal displacement is based on the sinking of a submarine as described in Appendix D, with minimal pitch and roll motion, in the absence of current, which would be allowed for separately. The 10% allowance is conservative because it is a factor of about 1.4 times the experimental average horizontal displacement of 7.2% (four runs), and slightly greater than the experimental maximum of 9.9%. Actual experience would be used to modify this allowance, if determined to be necessary.

(Continued on next page)

One of several important factors in this aspect of the sea disposal option is that a substantial number of disposals could be carried out with much larger allowances for variability in the horizontal displacement. The initial disposal would require no allowance at all, and the succeeding five to ten disposals could be made using even a 20% allowance, while additional experience on actual horizontal displacements was being acquired. Later disposals could then be carried out with allowances based on the best possible empirical information.

The second important factor in this aspect of the sea disposal option is that the probability of one submarine accidentally hitting another during sinking would be very small, and the consequences of collision would be very small. (Refer to Issue F.23.)

F.31 —Summary of Issue

The DEIS should be clarified to show that even if all nuclides were immediately available for migration once a submarine reached the sea floor, the proposed disposal would still be acceptable under the London Dumping Convention.

Those Identifying Issue	Identification Number
NOAA	444

Response

Chapter 2, Section II.H provides an explicit demonstration that the amounts of radioactivity present in submarine reactor plants are less than the amounts permissible for ocean disposal under the London Convention. Since the analyses used to develop the limits for the London Convention inherently assumed that all radioactive atoms in a disposal would be immediately available for migration, this issue has already been adequately treated.

Of course, since the radioactive atoms are an inseparable part of thick, solid metal, it would actually be impossible for all the atoms to be available for migration immediately. Appendix G describes the methods used to calculate possible releases of radioactive material for disposal at sea when the presence of the radioactive atoms within the metal is considered, both for cases when all containment would be intact and when only the minimum containment might remain as the result of a hypothetical accident.

F.32—Summary of Issue

"In Chapter 2, Section II.D the natural barrier consisting of ocean sediments and its capabilities for radionuclide retention should be included in the multiple barrier concept."

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy agrees that the sediments could adsorb large amounts of corrosion products and would thus provide an additional barrier. No credit was taken for this barrier in the analysis because of the conservative approach used.

The text in Chapter 2, Section II.D Measures to Mitigate Adverse Effects was modified to add ocean sediment as an additional barrier by its capability to retain radionuclides by adsorption.

F.33—Summary of Issue

The DEIS should provide information on ocean site measuring techniques.

Those Identifying Issue	Identification Number
EPA	694

Response

The details of the oceanographic measurements are discussed in the Sandia Report (SAND 82-1005 Vol. 1 and 2 dated September 1982), which is more than 650 pages long. The Council on Environmental Quality regulations state that an environmental impact statement should be concise and a detailed discussion of the measurement techniques is not relevant to the environmental impacts and is unnecessary.

F.34—Summary of Issue

The General Accounting Office report [Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized] contains controversial statements that do not make it a good document for reference.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695, 695a
Dr. Robert Kay	373
Mr. Christopher D. Roosevelt	695

Response

Based on a request from Congress, the General Accounting Office (GAO) (an independent investigative agency of the U.S. Congress) recently reviewed ocean disposal of radioactive material that took place during the period of 1946-1970. The input to the GAO investigation came from

1. Previous evaluation by the National Academy of Sciences (NAS)
2. Previous evaluation by the National Oceanic and Atmospheric Administration (NOAA)
3. Previous evaluation by the Environmental Protection Agency
4. Interviews with over 30 scientists having detailed technical knowledge of the concerns, and
5. A number of environmental and public interest groups.

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Based on the findings of the previous evaluations and on their interviews, the GAO reached the following conclusion:

"The overwhelming body of scientific research and opinion shows that concerns over the potential public health and environment consequences posed by past ocean dumping activity are unwarranted and overemphasized."

The GAO report also contained the following statement:

"In attempting to obtain information supporting dissenting views on this issue, we contacted a number of environmental and public interest groups. These included organizations such as the National Resource Defense Council, the Union of Concerned Scientists, Greenpeace, and several others. While some of their representatives had definite beliefs about the environmental and public health and safety hazards of past dumping activities, they were unable to provide us with any scientific data in support of their claims."

The GAO conclusions were previously disputed by Mr. Curtis, representing the Center for Law and Social Policy. As a result, Congressman N. E. D'Amours (Chairman, Subcommittee on Oceanography, Committee on Merchant Marine and Fisheries) requested the GAO to re-evaluate their investigation. After evaluating their investigation in light of the criticism, the GAO concluded that their findings were indeed correct. (Reference 1)

Reference

1. Comments on Critique of GAO's Radioactive Waste Ocean Dumping Report (GAO/RCED-83-45), Letter No. B-204946, J. D. Peach to Honorable N. E. D'Amours Chairman, Subcommittee on Oceanography, Committee on Merchant Marine and Fisheries, December 17, 1982

F.35—Summary of Issue

In Appendix B [land disposal], it is stated that there is contaminated piping beyond the reactor compartment which would be cut away and stored in the reactor compartment for disposal. In Appendix D [sea disposal], no mention of radioactive material outside the reactor compartment occurs. Is there such material? If so, it should be discussed in this section as to how it will be disposed.

Those Identifying Issue	Identification Number
EPA	694

Response

The small amount of radioactive material (crud) outside the reactor compartment would be sufficient to cause the piping and equipment in which it is contained to be considered contaminated. For the land disposal option, this piping and equipment would have to be removed from portions of the ship that would not be disposed of as radioactive waste. For the sea disposal option, this piping and equipment would represent an extremely small quantity of radioactive material which would be fully contained and therefore it would be left in place.

F.36—Summary of Issue

The confidence range in experimental impact effects of ±50% (Appendix D, Section VI.C of the DEIS) does not seem to be "reasonable accuracy" as stated in the DEIS.

Those Identifying Issue	Identification Number
EPA	694

Response

Section VI.C of Appendix D compares results of impact experiments with analytical predictions of deceleration and sediment penetrations. Since the analytical model appears to overestimate the forces of impact by the specified amount and since the submarines could withstand decelerations much greater than the predicted results, there is no reason to disagree with the judgment that ±50% accuracy is reasonable.

SECTION G

This Section (G.1 — G.7) contains issues related to Chapter 2, Section III of the Environmental Impact Statement.

G.1 — Summary of Issue

The disposal alternatives were not treated equally. Ocean disposal is discussed in much greater detail than is land disposal and quantitative data that might support more careful consideration of protective storage as an alternative, rather than as a "no action" alternative, is not included.

Those Identifying Issue	Identification Number
EPA	694

Response

The alternatives received equal treatment. Five Environmental Impact Statements have been prepared for the Hanford Site and the Savannah River Plant and the burial of submarine reactor compartments at these locations would be a continuation of their use for disposal of low level radioactive waste. Therefore, it was possible to incorporate this information by reference as directed by 40CFR 1502.21. Additionally, the NRC has developed methods for evaluating land disposal. For ocean disposal, it was necessary to describe the evaluation techniques and general environment in greater detail in Appendices because it was not possible to incorporate as much information by reference. Protective storage of nuclear powered vessels is an established practice that has no environmental impact. Hence to uncritically devote the same amount of space to land and sea disposal and protective storage would have required the inclusion of a great deal of information on some choices that was easily referenced or the deletion of information necessary for an understanding of other choices.

Protective storage is the no action alternative because it is not a permanent solution and it represents the minimum action that can be implemented to safeguard people and the environment. In fact, the term "storage" means that the material is in safekeeping for future permanent disposition. The environmental aspects of protective storage are described in Chapter 4, Section III.

G.2 — Summary of Issue

Protective storage should be used indefinitely or until some less hazardous method of disposal is developed.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Brian N. Baird	55a	Mr. Edwin Carlson	434
Mr. George Balding	77a	Mr. Michael Carney	660
Mr. David Bankston	269	Mr. Greg Carr	672
Ms. Jennie Barnhardt et al.	240	Mr. Emmett Carson	415
Ms. Rebecca Batell	135	Mr. Wesley Chesbro	69
Ms. Carol Bertnick	525	Ms. Linda Childs	202
Mr. Gary Bertnick	525	Ms. Carolyn J. Christman	200
Mr. Nathaniel S. Bingham	78a	Mr. William H. R. Clark	271
Mr. Jose L. Briseno	374	Mr. Paul Clemmons	387
Ms. Coral Carlson	434	Ms. Marjorie Cofer	635

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Janet Crone	113	Ms. Linda Peters	97
Ms. M. R. Crook	230	Mrs. W. R. Phillips	332
Mr. Robert Crook	230	Ms. E. Rangares	329
Mrs. Jim Culberson	457	Mr. Arthur J. Rocque Jr.	697
Mr. Stephen E. Davenport	34	Ms. Joyce Rosenthal	13b
Honorable Ronald V. Dellums	447	Mr. John Runkle	18 or 468
Mr. Chuck Dietzel	458	L. S. Russell	435
Mr. Dwight Donovan	228	Ms. Cathy Ryan	99
Dr. Justin M. Elliott	485	Mr. Paul Scala	375
Ms. Judith Evered	71	Mr. David Schomer	48
Dr. Judith E. Gordon	420	Ms. Carolyn L. Sears	491
Ms. Elizabeth Ann Hathcock	160	Ms. Josephine Silva	263
Mr. Laurence D. Houlgate	295	Mr. Stuart Robert Smith	54
Ms. Torre Houlgate-West	294	Mr. Charles Stover	431
Mr. H. W. Ibser	391	Mr. Erik Sunswheat	478
Honorable Barry Keene	67	Ms. Janet I. Tatz	410
Mr. Kingsley H. Klarer	378	Dr. Sarah J. Taylor	644
Mr. Jim Marotta-Jaenecke	194	Mr. Marcus Tengesdal	61
Mr. Ronald E. Martin	219	Mr. Michael Tuck	411
Mrs. Ann Matteson and Family	615	Unknown	213
Lt. Governor Leo McCarthy	65	Mr. Gordon K. Van Vleck	715
Ms. Ellen McCord	274	Mr. Don Weber	231
Ms. Jane Kyle McCoy	386	Ms. Linda Weber	231
Mr. Jonathan McHugh	87	Mr. Greg Wellish	103
Mr. Donald S. Muir	604	Mr. Charles B. Williams	688
Ms. Ivana Noell	645	Ms. Dianne G. Williams	658
Mr. Gregory E. Parker	523		

Response

This issue implicitly assumes that both sea disposal and land disposal are unacceptably hazardous. However, no substantive evidence has been presented to support this assumption or to counter the conclusion of the DEIS that both disposal methods present vanishingly small hazards to the public, very much less than the normal periodic fluctuations in the natural radiation background to which everyone is exposed, and much less than the variation that exists from one part of the country to another.

G.3—**Summary of Issue**

The submarines should be reused or put into protective storage or kept available for reuse in military applications or non-military applications.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Nathaniel S. Bingham	78a	Mr. J. D. Crash Conner	605
Ms. Elizabeth Bock	692	Mr. William Crooks	114
Mr. William H. R. Clark	271	Ms. Gretchen Crosson	408
Ms. Deborah L. Clifford	498	Mr. Kevin Crosson	408

(Continued on next page)

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Stephen E. Davenport	34	Lt. Governor Leo McCarthy	65
EPA	694	Mrs. W. R. Phillips	332
Ms. Maxine Groner	163	Mr. Shawn Walsh	26
Mr. James S. Lanham	559		

Response

As a submarine reaches the end of its service life, it becomes more difficult and costly to maintain and operate. At some point, the cost of continued operation of the submarine and its propulsion plant is no longer justified. Therefore, continued operation of the nuclear propulsion reactor plant after the service life of the submarine has been exceeded would not be economically viable, even if such operation were strictly for the purpose of producing electrical power. Additionally, the amount of electricity which each plant generates is a fraction of the total power, since most of the power goes to the propeller to drive the ship.

Since submarines are designed for a highly specialized purpose, conversion to other military or non-military applications would result in greater costs for conversion and operation than use of equipment designed and built for the specific application. But above all, any reuse application merely postpones the safe disposal of the submarine's reactor plant and therefore the above suggestions do not provide a permanent alternative disposal method.

A submarine would not be assigned for disposal by the Navy unless and until an evaluation had shown that no future Naval use could exist for it. This statement has been added to the Environmental Impact Statement.

G.4—Summary of Issue

There is no discussion of protective storage of portions of submarines which may reduce storage costs and make protective storage a more attractive alternative or of submerged protective storage in coastal water.

Those Identifying Issue	Identification Number
EPA	694
Mr. William F. Danielson	691

Response

Protective storage, no matter how it is done, is still storage. It is not disposal, and it is still a "no action" alternative because it only postpones to some future time the problem of safely disposing of the long-lived radioactivity in the submarine's nuclear reactor plant. Furthermore, any alterations to the submarine, such as sectioning it as suggested by one commenter, would only increase the costs of storage and make subsequent disposal more difficult by reducing the available options.

G.5—Summary of Issue

Mothballing would have an effect on the quality of the environment and should be evaluated as an alternative because the submarines would have to be transported to the storage site and storage would allow release of radioactivity.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Ms. Rebecca Matthews	693

Response

Protective storage does not qualify as an alternative for permanent disposal and there would be no release of radioactivity during anticipated storage periods (Chapter 2, Section III). The potential environmental impacts due to transport of a submarine to a storage site would be minimal, would be consistent with current practices, and would be similar to the transportation impacts discussed for the disposal options (Chapter 4).

There would be no release of radioactivity from a submarine in protective storage because the hull would provide durable containment and would be prevented from deteriorating by periodic maintenance. It is this requirement for periodic maintenance that precludes protective storage from being an option for permanent disposal.

G.6—Summary of Issue

Certain aspects of the interim storage option and the comparison of land and sea disposal need to be clarified:

a. The need for maintenance every 20 years seems to be inconsistent with Navy claims that once the sub is sunk, thousands of years must pass before water can enter the submarine compartment.

b. It seems inconsistent that lower worker radiation doses are associated with immediate disposal than with delayed disposal, and that the worker doses for land disposal would not be higher than those for sea disposal.

c. The EIS claims that protective storage would not lessen radiation exposures to the public.

Those Identifying Issue	Identification Number
EPA (b)	694
Dr. Marvin Resnikoff (a, b, c)	13b

Response

a. Maintenance

The need for maintenance during protective storage refers primarily to periodic maintenance to assure buoyancy, repairs, if necessary, and periodic cleaning and repainting required to ensure that the submarine will be suitable for continued protective storage and ultimate transfer to the shipyard in preparation for final disposal. It would not be prudent to allow the submarine to deteriorate while it continues to be in protective storage.

The Navy did not claim that the compartment would be intact for thousands of years. Penetration of the reactor compartment and releases from the reactor plant are predicted to occur at approximately 100 years after sea disposal.

(Continued on next page)

The distinction between these two situations is that for protective storage prudence requires periodic maintenance; whereas, for sea disposal progressive deterioration by persistent corrosion processes would be permitted to proceed naturally, but a long time would be involved because the metal sections are thick.

b. Worker Doses

The details of the worker doses are provided in the EIS (Appendix A, Section III.D.1), where the actions that result in doses are tabulated with the corresponding estimated doses. The reason that disposal after protective storage results in a larger dose estimate is due primarily to the fact that so much work needs to be done initially to inactivate the reactor plant and prepare it for protective storage before much decay has occurred.

Later on, though most of the radioactivity has decayed away, significant amounts of additional work need to be done to prepare the ship for actual disposal. The benefit of decay is seen in the last item of Table A-3 (Appendix A), where preparations for final disposal involve only 1 man-rem, reflecting the decay of the radiation field. The greater overall effort required for delayed disposal compared to prompt disposal is also indicated by the higher cost of inactivation for disposing of an inactive ship compared to an active one (Table A-4).

Worker doses are estimated to be essentially the same for land and for sea disposal because the tasks required for inactivation and preparation for disposal that involve effort within the radiation area are essentially the same. Work areas involved in removal of the reactor compartment and in other effort on the rest of the ship are either sufficiently shielded or sufficiently distant from the radiation area that significant dose differences between land and sea disposal are not expected to occur.

c. Public Dose

For either land or sea disposal, the potential public dose is due mostly to the longer-lived nuclides, such as Nickel-63 and Nickel-59, with half-lives of a hundred years or more. The shorter-lived nuclides, such as Cobalt-60 and Iron-55, would not contribute significantly to the potential public dose because the effectiveness and multiplicity of containments allow these nuclides to decay in place almost completely before they could be released to the environment. Consequently, a 20-year delay in disposal might practically eliminate the short-lived nuclides, but it would have little or no significant effect on the nuclides that would be the dominant contributors to the public dose. This is the conclusion for either land or sea disposal; interim storage for 20 years would not reduce the public dose by any significant amount. Refer to Appendix C, Table C-2 and Appendix J, Table J-2 for specific examples of the estimated nuclide contributions to the potential public dose.

Only in the extremely unlikely event of a severe transportation accident, which has been assumed to release a small quantity of crud to the environment, would decay of the shorter-lived activities result in any reduction of radiation exposure to the public. This minor effect was discussed in Chapter 4, Sections III.A.3 and III.B.3.

G.7—Summary of Issue

Submarines should be stored for 25 to 50 years for Cobalt-60 radioactivity to decay, then dismantled and the reactor vessel buried in a deep underground repository because the presence of Niobium-94 does not allow land surface disposal. [Disposal of the remainder of the reactor compartment is unspecified.]

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692	Dr. Michael J. Herz	37b
Mr. James Puckett	38	Mr. Thomas C. Jackson	37b
Dr. Marvin Resnikoff	13b	Ms. Karen A. Massey	674
Others, quoting Resnikoff:		Ms. Rebecca Matthews	693
Ms. Janet P. Brooks	693	Mr. Christopher D. Roosevelt	695
Mr. Clifton E. Curtis	695	Mr. Clifton Troy Toth	659
Mr. James Arthur Ferrara	665		

Response

The basic premise for this comment is that the presence of Niobium-94 renders this waste unsuitable for near-surface land disposal. This premise is incorrect. As shown in Table 2-1, the concentration of Niobium-94 in the activated metal is far below the concentration permitted by the NRC in 10 CFR 61 for Class B wastes in near-surface land burial. In fact, even the reactor vessel, if buried separately, would satisfy the Class B waste criterion for Niobium-94 for near-surface land burial. The dismantlement required for such separate burial would be undesirable for two reasons: the radiation exposure of shipyard workers would be increased, and costs would also be increased because the remainder of the reactor compartment would still have to be disposed of as low level radioactive waste just as if the reactor vessel were still in the compartment.

Since deep underground burial has been shown to be unnecessary, the remainder of the issue becomes merely that interim protective storage should be employed for an extended time to reduce radiation exposure. As discussed in Chapter 2, Section III, protective storage followed by disposal incurs both increased radiation exposure and increased cost relative to immediate disposal, and is therefore disadvantageous.

SECTION H

This Section (H.1—H.16) contains issues related to Chapter 2, Section IV of the Environmental Impact Statement.

H.1—Summary of Issue

The DEIS is deficient because some alternatives were rejected with discussion which was "too sketchy to qualify as a 'rigorous exploration' of these options." (40CFR 1502.1 was cited as a reference for this requirement.)

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher D. Roosevelt	695

Response

Council on Environmental Quality (CEQ) regulations do not require "rigorous exploration" of every conceivable alternative. 40CFR 1502.1 states that the preparing agency should "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss (emphasis added) the reasons for their having been eliminated." The DEIS was prepared in accordance with these regulations.

H.2—Summary of Issue

The defueled submarine nuclear reactor should be buried in a deep underground rock formation, on land or beneath the sea floor.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692	Ms. Janet T. Orselli	593
Ms. Louise Ewens	573	Ms. Betty Rader	164
Mrs. Eleanor Lewallen	3b	Mr. James Widmeyer	678
Mr. Wm. A. Lochstet	443		

Response

The respondents' claim that the submarine reactors require disposal in a deep rock formation is evidently based on a belief that the contained radioactivity is so hazardous that it requires the same disposal treatment as that planned for high-level radioactive waste. This belief is incorrect. Table 2-1 of Chapter 2 shows that the submarine reactor compartments fall within the category of Class B wastes, as defined by the Nuclear Regulatory Commission in 10CFR61, "Licensing Requirements for Land Disposal of Radioactive Waste", and are therefore suitable for shallow land burial, if disposed of on land. Section II.H of Chapter 2 shows that the reactor compartments also meet the IAEA criteria for ocean disposal on the sea floor.

H.3—Summary of Issue

The DEIS should discuss other alternatives, such as above ground storage in specially designed buildings or in an arid environment.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. H. Wayne Beam	339a	Mr. Doug Lowe	21
Ms. Elizabeth Bock	692	Ms. Karen A. Massey	674
Honorable Barbara Boxer	66	Ms. Rebecca Matthews	693
Ms. Janet P. Brooks	693	Ms. Janet Orselli	593
Mr. Clifton E. Curtis	695	Ms. Sheila M. Prindiville	700
Mr. Carl R. Deskins	46	Mr. James Puckett	38
Mr. Frances Dollar	562	Mr. John Runkle	18 or 468
Mr. Wells Eddleman	20	Mr. Lewis Seiler	707
Mr. William J. Haber	389	Ms. Ruth Thomas	31
Mr. Dan Hamburg et al.	72a, 72b	Ms. Maxine Wardauer	690
Mr. Jeffrey T. Harris	507	Dr. Ruth F. Weiner	39, 39a
Dr. Michael J. Herz	37a, 37b	Mr. James Widmeyer	678
Mr. Thomas C. Jackson	15, 37b		

Response

Placement of the reactor compartments above ground in specially designed buildings or in an arid atmosphere was recommended by some as an interim storage measure, and by others as a permanent disposal method. As an interim measure, such storage would incur all of the impacts and costs associated with land disposal with no added benefit, since even when buried, the thick submarine hull and bulkheads would remain intact for hundreds of years. This is much longer than typical storage buildings last.

As a permanent measure, long term dry storage, whether above ground in an arid atmosphere or in a special building, has no real advantage over burial. Even assuming that the buried hull and reactor vessel would corrode as rapidly as if they were in seawater, Table C-1 shows that only those nuclides with half-lives in the thousands of years are released to the ground in any appreciable fraction and only 75,000 year half-life Nickel-59 has more than 1 curie released over all time. Therefore, Nickel-59 is the only significant contributor to radiation exposure to people, as shown in Appendix C, Sections III and IV. Because of its long half-life, the radioactivity from Nickel-59 would be expected to be present long after any above-ground structures had deteriorated and vanished and after the hull and the reactor vessel and its contents had all turned to rust. Therefore, above-ground storage would still need to contend with exposure from Nickel-59 just as land burial would. The recommended options would not constitute permanent disposal in compliance with current regulations since they do not permanently isolate the radioactivity from inadvertent contact with people, but they would incur all the environmental impacts associated with land burial, including those associated with worker exposure, transportation, and eventual deposition of radioactive material in the soil. In fact, placement above ground would increase the possible exposure because the radioactive material would end up on the surface where humans and foodstuff could be more directly affected.

In addition, the conservatively calculated estimated radiation exposure from land burial of 100 submarines, 0.006 mrem per year to an average individual, is so small in relation to the normal variation in background radiation levels that its effect on people is insignificant.

The FEIS includes a discussion of above ground storage in Chapter 2, Section IV.

H.4 —Summary of Issue

These reactor compartments should be buried in Nevada at the bomb test site where radiation is already present..

(Continued on next page)

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Garrett Connelly	81	Mr. Jim LeCuyer	84
Dr. Michael J. Herz	37a	Mrs. Eleanor Lewallen	3b
Mr. John Hylinger	45	Mr. Gary Thompson	318

Because of their large size and weight (more than thirty feet in diameter and twenty feet long, weighing approximately 1000 tons) the reactor compartments can be transported over long distances only by barge. For short distances of a few miles over land, large capacity transporters which move about one mile per hour can be used. Therefore, it is not feasible to transport the reactor compartments to the state of Nevada, which can not be reached by barge from the ocean. (DEIS Appendix B, Section III.B)

Burial at approved U.S. Department of Energy land burial sites currently in use at the Hanford Site or at the Savannah River Plant, both of which can be reached by barge and special transporter (DEIS Chapter 2, Section I.A), has been evaluated in the Environmental Impact Statement and would not introduce radioactive material into areas not already used for such purposes.

H.5—Summmary of Issue

The Draft Environmental Impact Statement should explore the possibility of entombment of the radioactively contaminated components in civilian nuclear reactors that are scheduled for decommissioning.

Those Identifying Issue	Identification Number
Ms. Jane O. Ballus	19

Response

Use of this approach would require disassembly of the submarine reactor plant and shipment of the individual components. This option would entail unnecessary work, radiation exposure and cost, as discussed in Chapter 2, Section IV.B of the DEIS.

H.6—Summary of Issue

A patented method is suggested for enclosing the submarine in a protective shell for permanent land storage as a fourth option.

Those Identifying Issue	Identification Number
Mr. Conrad Golich	713

Response

The suggested method involves electrodeposition of certain minerals naturally occurring in seawater to form a shell-like material on the surface of the submarine. The suggested concept would store the coated submarine permanently in a lagoon where neither the sea nor the land would be exposed to the submarine. However, this method would be only a storage method because it would not remove the radioactive material from proximity with people and their activities.

Since the environmental assessment of the options in the DEIS disclosed no significant environmental impact and since the costs to coat the submarine by such a method would be extra costs without compensating benefit, the suggested method would not be a viable option. The respondent stated that further development would be required for the process, that the process had some environmental disadvantages, and no cost estimate was provided.

H.7—Summary of Issue

Disposal into the active volcano in Antarctica should be considered.

Those Identifying Issue	Identification Number
Mr. Johnny K. O. Malin	168, 168a

Response

Disposal of radioactive waste in an active volcano would be unacceptable because the radioactivity could be released if the volcano erupted.

H.8—Summary of Issue

The DEIS did not consider removal and land burial of the pressure vessel and sea burial of the remainder of the submarine. This alternative would be cheaper than those considered.

Those Identifying Issue	Identification Number
Mr. William F. Danielson	691

Response

The respondent's basic premises are incorrect; his suggested alternative was considered and eliminated because it would be more costly and would involve higher radiation exposures to the workers than the land burial alternative evaluated in detail in the DEIS. See Appendix B, Section III.A.

H.9—Summary of Issue

The Navy did not consider the alternative of a chemical dissolution plant to reduce the volume of radioactive waste to near zero.

Those Identifying Issue	Identification Number
Mr. William F. Danielson	691

Response

Dissolving the reactor plant would be ineffective in reducing the amount of radioactive material to be disposed of, because it is not possible to separate radioactive atoms from non-radioactive atoms of the same element by chemical means; that is, the radioactive Iron-55 from non-radioactive iron, Cobalt-60 from non-radioactive cobalt, or Nickel-59 and Nickel-63 from non-radioactive nickel, etc. The dissolution plant would therefore produce hundreds of thousands of gallons of acid solution

(Continued on next page)

contaminated with radioactive metal atoms. Disposal of this solution would create additional difficulties, environmental impacts and costs greater than any of the disposal methods evaluated in the EIS.

H.10—**Summary of Issue**

Radioactive liquid wastes should be converted into solid form for long term storage.

Those Identifying Issue	Identification Number
Mr. Gerald K. W. Johnson	201

Response

No free radioactive liquid would be in the submarine reactor plant at the time of disposal, as stated in Appendix B, Section III.C.1.a and Appendix D, Section II.A.

H.11—**Summary of Issue**

The sturdy hulls could be used to store or dispose of other radioactive materials. This would be more cost effective than disposing of the other materials in fabricated containers.

Those Identifying Issue	Identification Number
Mr. B. Donoghue	506
EPA	694

Response

The volume of "commercial" low-level radioactive waste that is generated annually in the United States is about 3 million cubic feet (Reference C.1 of the DEIS, Volume 1, page 5); therefore, a submarine hull could be used as a container for less than 0.3 percent of the total waste generated per year.

A second point that must be considered is that the options for submarine reactor plant disposal, how these options are engineered, and their environmental impacts, should not be obscured at this stage by other sources of potential radioactive material release that would be introduced by the suggested use of the strong containment features of submarine hulls.

H.12—**Summary of Issue**

The production of submarines should be reduced until an acceptable solution to this problem is found.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Roberta Charlton	611	Mr. Ken Kelley	612
Ms. Laura Drey	25a	Mr. Ron Shehee	407
Mr. Ron Guenther	105	Ms. Sandra Strong et al.	414
Ms. Liz Helenchild	132		

Response

Practical methods for the permanent disposal of defueled and decommissioned submarines identified in the Draft Envrionmental Impact Statement have been evaluated and determined to be acceptable solutions because they cause no significant environmental impact. See Chapter 2 and Chapter 4.

H.13—Summary of Issue

Disposal of radioactive waste by a method described in "Borderland Research" should be evaluated.

Those Identifying Issue	Identification Number
Ms. Elsie Allbright	714

Response

A copy of "The Journal of Borderland Research" was obtained. This journal is published by the Borderland Sciences Research Foundation which "is a non-profit organization of people who take an active interest in unusual happenings along the borderland between the visible and invisible worlds." The referenced article describes a device called a "Reich Cloudbuster" which is purportedly able to "completely and safely deactivate nuclear waste and weapons for great distances by draining away the soft particle concentration from any nuclear source in the vicinity."

There is no evidence that such a device exists or that it would do what this journal says it would.

H.14—Summary of Issue

A better disposal method may be found in the future:

a. The statement "ultimately the submarine must be disposed of by land burial or sinking in the deep ocean" is only an assertion, based on current options available. The possibility of some other alternative cannot be precluded.

b. The Navy should offer a reward—a million dollars, for someone to come up with a safe, permanent disposal method for radioactive waste.

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin (b)	131a
EPA (a)	694

Response

The Navy has no reason to believe that any other practicable permanent disposal method will be developed in the foreseeable future, and no respondent identified any other practicable methods for permanent disposal.

As stated in Section IV of Chapter 4 in the DEIS, the Navy has concluded that both the land and sea disposal options would have negligible environmental impact, and either could be chosen.

H.15—Summary of Issue

An option that permits retrievability should be favored because of the possibility of a technical breakthrough in the future that would make the radioactivity harmless.

Those Identifying Issue	Identification Number
Mr. Edward J. Larson	241

Response

The respondent expressed his hope that someone would discover a bug that would eat radioactivity, such as the oil-eating bacteria that scientists have discovered within the last few decades. The respondent's point was that reactor compartments should be stored in such a way that penetration would be delayed so there would be time to search for the hoped-for organism, retrieve the reactor compartment, and apply the organism before releases would occur.

There is no technical basis on which to predict the existence of a radioactivity-eating organism because there is no practical way to destroy the radioactivity without further nuclear reactions (transmutation) (Chapter 2, Section IV.C). Since the possibility of such a future discovery is extremely unlikely, the actual expenditure of time, effort and radiation exposure to provide for long-term retrievability is not appropriate when the material can be safely disposed of without further hazard (Appendix A, Section III.B).

H.16—Summary of Issue

Use of outer space should be considered as a disposal option.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Ann Bauer	5a	Ms. Gretchen G. Grant et al.	385
Mr. Emmett Carson	415	Mr. Mark H. Remlinger	379
Ms. Lee Ann Chambers	685	Mr. Erik Sunswheat	478
Mr. Jon Daunt	669g	Ms. Ruth A. Vest	316 or 452
Ms. Deborah Filbeck	474	Mr. Robert Werner	353

Response

This option was evaluated in the DEIS and is described briefly in Section IV.D of Chapter 2.

SECTION I

This Section (I.1—I.16) contains issues related to Chapter 3, Section I and Appendix K of the Environmental Impact Statement.

I.1—Summary of Issue

It is indicated that the Department of Energy will not prepare an environmental impact statement if land disposal is selected. This may not be true if the volume of material(s) for disposal, from this and other sources, requires an entirely new site.

Those Identifying Issue	Identification Number
EPA	694

Response

Chapter 3 of the DEIS clearly stated that while the current Hanford burial area is large enough to handle all of the reactor compartments, the current burial area at Savannah River is projected to be filled in 1994. The subject of where Savannah River waste would go after 1994 is beyond the scope of this EIS.

I.2—Summary of Issue

Environmental concerns that may have been raised by the public near the Hanford and Savannah River sites should be included in the EIS.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Ms. Cathy Ryan	99

Response

Environmental concerns associated with the subject of land disposal at these locations have been addressed in detail in the Hanford Site Final Environmental Statement on Waste Management Operations, ERDA-1538 (Reference 3.1) and in the Savannah River Plant Final Environmental Impact Statement on Waste Management Operations, ERDA-1537 (Reference 3.4). This statement briefly summarized the content of these references as they relate to the disposal of nuclear submarine reactor plants.

I.3—Summary of Issue

The EIS should appraise the benefits and disadvantages of conducting multiple activities at Hanford and Savannah River.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692

(Continued on next page)

Response

Multiple activities, including the disposal of low-level solid radioactive wastes, are currently being conducted both at Hanford and at Savannah River. Waste disposal does not interfere with the other activities nor do they affect the waste disposal operations.

The potential radiation exposure that the disposal of these defueled submarine reactor compartments either at Hanford or at Savannah River could cause to humans is so small (0.006 mrem per year to the average exposed individual) that it is negligible both in absolute magnitude and in relation to the observed variations in background radiation from place to place. Thus, a submarine disposal operation would cause no measurable difference in the radiation exposure of people living near either site. For these reasons, then, the presence of existing multiple activities at either Hanford or Savannah River has no bearing on the possible use of either of these sites for disposal of defueled submarine reactor compartments and there is no need for an appraisal of such multiple uses in this EIS.

I.4 — Summary of Issue

The assessments of land disposal sites do not include the latest information because some of the information used is from 1975, and some recent changes in environmental conditions have not been included.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692	Ms. Karen A. Massey	674
Mr. Bruce R. Campbell	421	NRC	445a
Mr. Clifton E. Curtis	695	Mr. Christopher D. Roosevelt	695
Mr. Doug Lowe	21	Dr. Ruth F. Weiner	39a

Response

The descriptions in Appendix B of the EIS of the Hanford Site and the Savannah River Plant, principally the site geology and hydrology, were taken from more detailed descriptions in documents from 1975 to 1977 (References B.1 and B.3). These descriptions are still valid because the geology and hydrology have not changed. A 1976 document from the National Research Council (Reference B.2) reports the results of an independent review of past practices at Hanford and Savannah River in the land burial of solid low-level radioactive waste (Appendix B, Section III.B.1 and III.B.2) and is still relevant. Other descriptive matter might become superseded in some details, but the significant character of careful control of the waste management operations will remain valid.

Since the estimated maximum population dose commitment for land disposal is approximately 2 man-rem per year (Appendix C, Section VI), and since the estimated population dose due to natural background radiation is so much greater (approximately 27,000 man-rem per year at the Hanford Site and 86,000 man-rem at the Savannah River Plant, Appendix B, Section III.G, Table B-3), it is clear that the land disposal option would contribute nothing of practical significance to the total population dose even if other environmental conditions were to change. Contributions from a nearby commercial site, or a high-level waste repository, or any other suitably designed and operated radioactive waste disposal facility must be considered on their own merit. However, if the contributions from other operations are equally small, then the natural radiation background will continue to provide the only significant radiation exposure to the public.

Cost projections reported in Appendix A were developed independently and did not use the data reported in the Environmental Impact Statements for waste management operations at Hanford and at Savannah River. The estimated costs do not need to be revised to reflect current data because they are already current.

Two respondents failed to cite any specific detail or reference to support concerns regarding "latest information" on the safety of the sites so no further discussion can be provided in these cases.

I.5—Summary of Issue

The descriptions of the potential land burial sites should include the texture and mineral composition of the soil.

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS clearly stated in Appendix B, Sections III.B.1 and III.B.2 that further details on the burial grounds were available in References B.1, B.2, and B.3. There is no reason to repeat this information in this EIS.

I.6—Summary of Issue

The base of the Hanford Site is Columbia Basalt which is filled with cracks, and the Columbia River is only 2 miles away, so any drainage may seep through.

Those Identifying Issue	Identification Number
Ms. Elizabeth H. Lagergren	304

Response

At the potential land disposal site, the Columbia Basalt lies below the saturated groundwater zone. It is the saturated groundwater zone that provides the greatest potential pathway to the Columbia River, rather than cracks in the basalt. The environmental assessment was based on the conservative (highly unlikely) assumptions that all of the radioactive corrosion products would be dissolved or suspended uniformly in the groundwater, that this water would flow into the river, and that no credit should be taken for retardation or diminution by adsorption on soil particles or by deposition in the river bed. (Appendix C, Sections II and III.B).

In reality, any radioactive corrosion products at the Hanford Site would be expected to be deposited in the dry soils where they are buried. A buffer zone of approximately 250 feet of the unsaturated sandy-gravelly soils lies between the potential land disposal site and the ground water below. Tests have shown that these soils are very dry in nature since the rainfall received does not penetrate to the groundwater table, but rather penetrates only to a shallow depth and subsequently evaporates into the air (Appendix B, Section III.B.1).

If any radioactive corrosion products were to move downward, for any reason, they would reach the groundwater before they would reach the basalt. It was assumed in the assessment that the groundwater might carry some radioactivity to the river. Such an event is highly unlikely.

I.7—Summary of Issue

"At the Hanford land disposal site, the contamination of groundwater is apparently not a problem. It is not clear that this is true at the Savannah River site. Some comparison of data is needed."

Those Identifying Issue	Identification Number
EPA	694

Response

Although precipitation does not percolate to the water table at the Hanford site and radioactive contamination remains immobilized in soil between the ground surface and the water table, the evaluation conservatively assumes that any radioactive material released from the burial site would be transported via groundwater and streams to the Columbia River without delay (Chapter 3, Section I.A). At the Savannah River site, where the burial area is underlain predominately by sandy clays and drained by tributaries of the Savannah River, the same conservative assumption is made that any radioactive material released from the burial site is transported to the Savannah River without delay (Chapter 3, Section I.B). Thus although there may be in fact a difference between the two sites in the rate of transfer of released radioactivity to groundwater and thence to the river, the conservative assumption is made that the transfer to the river is instantaneous in both cases.

I.8—Summary of Issue

The Savannah River Plant is located in a Class III Seismic (Earthquake) Zone.

Those Identifying Issue	Identification Number
Dr. Mary T. Kelly	30
Mr. Michael F. Lowe	29

Response

The seismicity of the Savannah River Plant is described and analyzed in detail on pages II-160 through II-166 of ERDA-1537, the Final Environmental Impact Statement on Waste Management Operations at the Savannah River Plant (Reference 3.4). This analysis places the Savannah River Plant in an area classified as Seismic Zone 2, based on earthquake risk predictions by the U. S. Coast and Geodetic Survey. This analysis of seismicity is incorporated in this Environmental Impact Statement by reference.

No information was presented to indicate that the U. S. Coast and Geodetic Survey risk prediction should be revised.

I.9—Summary of Issue

The Savannah River Plant appears to be a less desirable land burial site than Hanford because of its high water table, low river levels, and the extensive river channel dredging that would be required.

Those Identifying Issue	Identification Number
EPA	694
Dr. Judith E. Gordon	420
Dr. Mary T. Kelly	30
Mr. Doug Lowe	21
Ms. Joyce Rosenthal	13a

Response

This information concerning the Savannah River Plant was recognized and included in the evaluation of this option.

I.10—Summary of Issue

Savannah River Plant may be used for the burial of saltcake, a low-level waste by-product of processing high-level waste. Any operational or monitoring conflict resulting from the disposal of reactor compartments and saltcake in the same burial area should be addressed.

Those Identifying Issue	Identification Number
NRC	445a

Response

There would be no conflict in burial operations or in monitoring because the reactor compartments and the monoliths of concrete and decontaminated salt (saltcrete) would be buried in different burial areas. The proposed saltcrete burial area (Z-Area) is located approximately 2 km from the nearest burial ground that is being considered for reactor compartments (Defense Waste Processing Facility, DOE/EIS-0082, p. 3-13).

I.11—Summary of Issue

National Academy of Science reports on radioactive wastes at Savannah River Plant were not included as references in the Draft Environmental Impact Statement.

Those Identifying Issue	Identification Number
Ms. Ruth Thomas	31

Response

The National Research Council/National Academy of Sciences report "The Shallow Land Burial of Low Level Radioactively-Contaminated Solid Waste," documenting studies of low-level radioactive waste burial at Department of Energy repositories was included as a reference in Chapter 3 (Reference 3.2) and Appendix B (Reference B.2) of the DEIS. The studies described in this report include the Savannah River Plant. Appendix H of ERDA-1537, the Final Environmental Impact Statement on Waste Management Operations at the Savannah River Plant (Reference 3.4) provides a history of reviews of long-range waste management program at the Savannah River Plant prior to the referenced NRC/NAS report.

I.12—Summary of Issue

The description of the results of monitoring at the Hanford and Savannah River sites as provided in Appendix K is inadequate.

Those Identifying Issue	Identification Number
Ms. Karen A. Massey	674

Response

Existing monitoring programs at Hanford and at Savannah River have demonstrated that disposals of radioactive solid waste have not produced significant releases. Details are available in references such as K.1, K.2, and K.3.

I.13—Summary of Issue

Discussion of long-term planning for land disposal monitoring is required, including cost projections.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Honorable Barbara Boxer	66	Mr. Thomas C. Jackson	15, 37b
EPA	694	Ms. Joyce Rosenthal	13a
Dr. Michael J. Herz	37, 37b, 37c	Ms. Cathy Ryan	99

Response

Monitoring plans are summarized in Appendix K which states that land disposal would use monitoring programs that are already in operation at Hanford Site and at Savannah River Plant, and the details are provided in the Final Environmental Impact Statements for waste management operations at those sites which are incorporated by reference (Section III of Appendix K). Summaries are provided in Section III of Appendix K.

Long term surveillance and monitoring at these sites can be expected to be adequate because current plans are updated periodically to reflect new technical developments and changes in policies and criteria (Reference K.2, page II-2 and Reference K.1, page ii, for example).

The operating costs of the waste management systems at the Hanford Site and at the Savannah River Plant are already included in the total facility operating costs and are not identified separately (Reference K.2, page IX-2). Disposal of submarine reactor plants at these DOE sites would be a part of the normal operations of the facilities and would not affect monitoring programs.

I.14—Summary of Issue

A report by the U. S. Geological Survey identifying problems with radioactive material disposal at the Savannah River Plant and the possibility that radionuclide migration may not be detected by monitoring wells was not included in the Draft Environmental Impact Statement.

Those Identifying Issue	Identification Number
Ms. Ruth Thomas	31

Response

The report mentioned was not specifically identified by the individual identifying the issue and no report presenting the material specified could be located.

I.15—Summary of Issue

The Navy should verify that adequate security would be maintained at the land disposal site, that records and files of disposals would be preserved, and that durable markers would be installed (Appendix B, Section III.G).

Those Identifying Issue	Identification Number
EPA	694

Response

Long term maintenance of the potential land disposal sites is the responsibility of the DOE as a part of the normal operations of these repositories. The potential sites are already being used for radioactive waste and the DOE has been and would be responsible for security, records preservation, and waste markers at the disposal sites. DOE has detailed requirements and procedures for ensuring the adequacy of the waste management operations at these sites. Details are available in the corresponding Final EISs for Waste Management Operations, References B.1 and B.3.

I.16—Summary of Issue

The DEIS should state how long recovery operations would require in the event of an accident in a harbor or river, during barging of a reactor compartment to a burial site.

Those Identifying Issue	Identification Number
Mr. Heyward G. Shealy	236

Response

The required time for recovery operations would depend on the specific situation. However, the Navy has extensive expertise and experience in salvage operations. If the barge were to sink in a location which caused an immediate problem, a salvage operation could be quickly initiated. One example of such an operation involved the 1000 ton Coast Guard Cutter BLACKTHORN, which sank on January 29, 1980 in the main shipping channel at Tampa Bay, Florida. The Navy quickly mounted a salvage operation and the BLACKTHORN was raised and the channel reopened to deep draft traffic within three weeks.

SECTION J

This Section (J.1—J.85) contains issues related to Chapter 3, Section II, Appendices E and K, and Annex to Appendix D of the Environmental Impact Statement.

J.1—Summary of Issue

All of the ocean area studies already made by the Navy should be contained in the EIS.

Those Identifying Issue	Identification Number
Mr. John Runkle	468

Response

The available information is summarized in Appendix E and described in greater detail in Reference 3.14 and its appendices.

J.2—Summary of Issue

Some persons are concerned that it is likely that the ocean study areas would be selected as dumpsites because few other areas would satisfy the selection criteria or because these areas have already been studied.

Those Identifying Issue	Identification Number
Mr. Dan Hamburg et al.	72, 72a, 72b
Dr. Michael J. Herz	37, 37c
NOAA	444

Response

The Navy was advised by a number of oceanographers at the start of the evaluation of the alternatives for submarine reactor plant permanent disposal that specific information on certain subjects, such as current speed and direction and ocean floor sediments, would be needed to evaluate the impact of ocean disposal. As a result, two groups of oceanographers were asked to review the existing ocean data and recommend candidate study areas for collecting the needed information. One of these groups (Reference 3.8) identified two areas off the Pacific Coast and the other group identified two general areas off the Atlantic Coast. With the advice of these oceanographers, the Navy chose study areas off both coasts that were expected to be representative of the sorts of areas that might be designated as disposal sites by the U.S. Environmental Protection Agency.

Experimental observations and measurements have been performed in these study areas to support the determination of environmental impacts in the Environmental Impact Statement. However, the study areas selected by the Navy for the DEIS are not the only locations in the oceans that might meet the EPA requirements for a disposal site. It is also entirely possible that the EPA might determine that other locations are more suitable.

J.3—**Summary of Issue**

There is uncertainty in the Navy's meaning of "study areas" with respect to potential disposal sites. This ambiguity should be clearly addressed.

Those Identifying Issue	Identification Number
EPA	694

Response

The purpose of this environmental impact statement is to determine whether land or sea disposal should be pursued. If sea disposal is pursued, a separate environmental evaluation would be required to select and qualify a disposal site. The deep ocean study areas off both the East and West coasts discussed in this DEIS are not designated as potential ocean disposal sites. They were selected as representative study areas in order to develop data for the proper technical evaluation of issues required to be addressed in the DEIS.

J.4—**Summary of Issue**

Both the Lower Continental Rise and the Hatteras Abyssal Plain Study areas appear to satisfy the generic requirements; however, there are several potential problems that have not been addressed or convincingly resolved particularly with regard to the Lower Continental Rise Area.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. J. A. Musick	419
Ms. Sheila M. Prindiville	700
Mr. Christopher D. Roosevelt	695

Response

This EIS was developed to provide information needed to determine if ocean disposal, land disposal or interim storage should be pursued. This EIS is not intended to identify or qualify specific sites. The conservative evaluation coupled with the very small potential exposures effectively demonstrate that additional information is not required for this conceptual evaluation. If ocean disposal were to be pursued, additional site specific information would be required.

J.5—**Summary of Issue**

Many researchers recognize the Western Boundary Undercurrent as extending upward to a depth of 1000 meters off Cape Hatteras. The DEIS states a depth of 3500 meters for this current.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
EPA	694
Mr. J. A. Musick	419
Ms. Sheila M. Prindiville	700
Mr. Christopher D. Roosevelt	695

(Continued on next page)

Response

Some of the latest information available on the Western Boundary Undercurrent (Science, Vol. 215, #4535, 2/19/82, Bullfinch, et al., pages 970-973) indicates that this current may extend to within 1500 meters of the surface but that the high velocity core of the current is restricted to depths on the slope regions between 4400 meters and 5200 meters. Further, the current meter measurements which have been obtained in the Atlantic study areas do not indicate that the Western Boundary Undercurrent extends to these study areas. The EIS has been clarified.

J.6—Summary of Issue

"Some residents of Mendocino County already feel uneasy that one reason our area was chosen instead of San Diego is because it is less populated. If ocean dumping of radioactive wastes is so safe, why search for a low density location?"

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin et al.	131b
Rella	98
Ms. Sandra Strong et al.	414

Response

Sea disposal sites have not been selected. This EIS evaluates methods available for the disposal in order to determine the disposal option to be pursued. The area in the Pacific Ocean approximately 160 nautical miles west of Cape Mendocino, California was selected to be a study area because it was considered to be a representative location that met study area identification criteria detailed in Chapter III, Section II.A.

J.7—Summary of Issue

If sea disposal were so harmless, the subs could be dumped in many sites off all coasts to save the costs of towing.

Those Identifying Issue	Identification Number
Mr. William Crooks	114

Response

Study area identification criteria (Chapter 3, Section II.A) for ocean disposal are based primarily on the requirements of the International Atomic Energy Agency (Reference 3.5). The Navy considers the criteria to be prudent and they are binding by treaty under the London Dumping Convention.

J.8—Summary of Issue

The EIS must make clear the weight to be given to site selection guidelines developed by Hollister and Heath.

Those Identifying Issue	Identification Number
Mr. Thomas C. Jackson	15, 15a

Response

In this evaluation the study area identification criteria have been discussed with essentially equal weight. The study area selection criteria were established to provide guidelines in identifying the factors important to minimizing a pathway to man. In this EIS the criteria have not been used to select a site but have been used to perform a conceptual evaluation of ocean disposal.

J.9—Summary of Issue

The EIS should include additional information on the resources, uses, biology, and other characteristics specific to ocean disposal sites.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Brian N. Baird	55, 55a	Honorable Barry Keene	67a
Ms. Jane O. Ballus	19	Mr. John E. Madison	170
Honorable Douglas H. Bosco	66	Lt. Governor Leo McCarthy	65
Mr. Greg Carr	672	Ms. Dena Mossar	442
Dr. Gordon L. Chan	85	Mr. J. A. Musick	419
Dr. Ruthann Corwin	112	NOAA	444
Mr. Clifton E. Curtis	695	Ms. Morere Paradise	85
Mr. Dwight Donovan	228	Ms. Rebecca Paterson et al.	631
Mr. Peter Douglas	68a	Ms. Sheila M. Prindiville	700
EPA	694	Mr. Daniel F. Read	12
Ms. Cecelia J. Gregori	298	Mr. Christopher D. Roosevelt	695
Mr. Gilbert J. Gregori	298	Mr. John Runkle	18
Mr. Ron Guenther	105a	Mr. Lewis Seiler	707
Mr. Dan Hauser	67a	Unknown	213
Dr. Michael J. Herz	37, 37b, 37c	Atty. Gen. John K. Van DeKamp	446
Ms. Camilia Ingram	686	Mr. Gordon K. Van Vleck	715
Mr. Thomas C. Jackson	15, 37b	Mr. G. Nelson Wolfe	104
Honorable Walter B. Jones	9		

Response

The purpose of this EIS is to develop information needed to determine if ocean disposal, land disposal, or interim storage should be pursued. The ocean locations described in the EIS are study areas used to characterize the parts of the ocean which might be used and to provide data for use in preparing an estimate of the potential effects on ocean disposal. This EIS is not intended to identify or designate specific sites. If ocean disposal were pursued, a site specific environmental evaluation would be performed.

Sufficient information was collected to characterize several areas of the ocean. These areas are discussed in the context of current knowledge, including potential drawbacks. To assure that the evaluation was conservative, a worst-case type analysis was performed. For example, in the biological transport evaluation all radioactive material was assumed to be deposited in the sediment at the

(Continued on next page)

disposal site and fish assumed to be feeding from benthic communities supported by this sediment were assumed to be caught on the bottom at the site in 14,000 feet of water and eaten by man. Then in the physical ocean transport, all radioactive material was assumed to be transported by the water and never removed except by radioactive decay. In addition, the entry point for pathways to man was assumed to be at a depth of approximately 14,000 feet. Even with these worst-case evaluations, the estimate of the potential exposure was very small in comparison to normal fluctuations in radiation exposure due to an individual's geographic location, food consumption, and activities.

The worst-case evaluation coupled with the very small potential exposures effectively demonstrates that additional information is not required for this conceptual evaluation. If ocean disposal were to be pursued further, additional site specific information could be required.

The Summary and Chapter 1 of the Final EIS have been revised to emphasize the generic nature of the evaluation of ocean disposal.

J.10—Summary of Issue

"Two references to IAEA criteria are identified as 'rules' or 'requirements' for dumpsite selection. Actually, the criteria for dumpsite selection in IAEA Information Circular #205/Add./Rev. 1 are 'recommendations'."

Those Identifying Issue	Identification Number
EPA	694

Response

The reference, IAEA INFCIRC/205/Add. 1/Rev. 1, uses both terms, "recommendations" and "requirements", essentially interchangeably. The words "rules" and "requirements" are used in the EIS to emphasize that the Navy considers these criteria as requirements which would have to be met.

J.11—Summary of Issue

It appears that a number of species are exploited on the margins of the area in question and above it. Nothing is known about the concentration of fish or their tendency to migrate or congregate near old submarine hulls.

Those Identifying Issue	Identification Number
EPA	694
Mr. Ron Guenther	105a

Response

Over the last twenty-two years the National Marine Fisheries Service (NMFS, a branch of NOAA) in LaJolla, California has been sampling the albacore catch off the west coast by one degree coordinate squares and the albacore information in the EIS was obtained from these NMFS data. During these 22 years, the NMFS program has identified the coordinates where approximately 12,165,000 albacore have been caught. The catch in the Pacific study area was 0.02 percent of this total and in many years this catch was zero. This would not make this particular area an important fishery or indicate an unusually high concentration of marine life.

In spite of this the analysis in the EIS assumed that all fish for commercial markets were caught at a depth of 6,600 feet in water containing radioactive corrosion products from disposed submarines. Since most fish are taken at a depth less than 1500 feet and only a small fraction of the marketed fish could be caught at the single area assumed, this is extremely conservative.

It is generally accepted by oceanographers (Reference 1) that the bottom waters (14,000 feet) in areas such as the study areas have a very sparse fish population. This was confirmed at the W-N study area where large otter trawls had to filter more than 35,000 cubic feet of water to obtain 0.025 to 0.12 pounds of fish. This was expected because of the low temperature, the small food supply and the lack of sunlight for photosynthesis.

On the subject of the tendency of fish in the deep ocean to concentrate near sunken hulls, the IMO has concluded that this would be extremely unlikely (Reference 1). Further, observations in 1983 at the site of the THRESHER sinking, twenty years after her loss, have shown no significant effects of the sort described. Observations at the site of the SCORPION sinking produced similar conclusions.

Reference

1. IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
Joint Group of Experts on the Scientific Aspects of Marine Pollution—GESAMP—, Reports and Studies No. 19, An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea, Vienna, June 1983

J.12—Summary of Issue

Surface waters in the Pacific Study Area are alleged to be teeming with marine life and the fisheries data presented in the EIS may be obsolete.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. George Balding	77	Mr. Ron Guenther	105a
Ms. Christine Berchen	381	Mr. Dan Hamburg et al.	72, 72a, 72b
Ms. Alice Berg	203	Dr. Michael J. Herz	37b, 37c
Mr. Nanthaniel S. Bingham	78a	Mr. Robert A. Hooper	711
Mr. Bruce R. Campbell	421	Mr. Thomas C. Jackson	37b
Mr. Wesley Chesbro	69	Ms. Carol E. Mone	627
Mr. Clifton E. Curtis	695	Ms. Julie Kay Norman	709
Honorable Ronald V. Dellums	447	Ms. Rebecca Paterson et al.	631
Mr. Dobie Dolphin et al.	131b	Ms. Beverly Roberts	32
Mr. Dwight Donovan	228	Ms. Sara Schatz	533
Ms. Katharine Emerson	370	Atty. Gen. J. K. Van DeKamp	446
Ms. Donna Feiner	280	Mr. Gordon K. Van Vleck	715
Mr. John K. Flynn	545	Mr. James Widmeyer	678

Response

The albacore fishery data in the DEIS were based on published information which covered the period 1961 through 1970. Unpublished data for the period of 1971 through 1982 have been obtained and combined with the earlier data for the Final EIS. Even though the unpublished data indicate more catch than that in the period 1961 through 1970, the conclusion in the DEIS that "commercial fishing in the surface waters [of the Pacific Study Area] occurs with low productivity" remains unchanged. For a summary of the fishing information, see Issue J.11 and Figure E-20 of the Final EIS.

J.13—Summary of Issue

Although selection criteria are to avoid areas which have the potential for future use and areas that have the potential to be exploited either directly by mining or the harvest of marine products or indirectly as feeding gounds for marine organisms important to man, for the Pacific Study Area the DEIS portrays only the present commercial fishery for albacore, and only in terms of catch per unit effort.

Those Identifying Issue	Identification Number
Mr. Gordon K. Van Vleck	715

Response

The fishing data have been revised to eliminate the catch per unit effort. For more details related to the present and potential fishery in the Pacific study area, see Issue J.1.1 and Appendix E, Figure E-20 of the Final EIS.

J.14—Summary of Issue

The DEIS ignores the fact that California has a growing fishery for sablefish. The DEIS should reflect the potential for growth of this and other fisheries (grenadier). Techniques for fishing deeper and deeper waters have evolved and it can be expected that this trend will continue to increase.

Those Identifying Issue	Identification Number
Mr. Gordon K. Van Vleck	715

Response

It is generally accepted by marine biologists (Reference 1) that the very deep bottom waters in areas such as the study areas have a very sparse fish population. This was confirmed at the W-N study area where trawls netted only 0.025 to 0.12 pounds of fish in more than 35,000 cubic feet of water. This low population density combined with the time and fuel required to lower and raise extremely long lengths of cable to depths of 14,000 feet means this area will never be suitable for commercial fishing.

The analysis in the EIS assumed that all fish for commercial markets were caught at a depth of 6,600 feet in water containing radioactive corrosion products from disposed submarines. Since this is unrealistically deep, it means that the treatment is even more conservative than the respondent suggests.

Reference

1. IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
Joint Group of Experts on the Scientific Aspects of Marine Pollution—GESAMP—, Reports and Studies No. 19, An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea, Vienna, June 1983

J.15—Summary of Issue

The Navy's failure to conduct hearings in places accessible to the commercial fishermen who are most familiar with the study area casts doubt on the accuracy and reliability of the information.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Sidney Abbott	153	Ms. Lorie Leaf	538
Mr. Patrick Agnello	75	Mr. Jim LeCuyer	84
Mr. Richard Archambault	287	Ms. Eleanor K. Leek	284
Mr. George Balding	77a	Ms. Margaret Livingston	247
Ms. Ann Bauer	5a	Ms. Laura Maguire	524
Ms. Elizabeth Bengtson	273	Mr. John Maloney	139
Mr. Nathanial S. Bingham	78a	Mr. David Martinovich	190
Honorable Douglas H. Bosco	66	Mr. Jim McCay	483
Mr. Daniel Brown	243	Ms. Ellen McCord	274
Ms. Star Capralis	233	Mr. Scott McCreary	86
Mr. Wesley Chesbro	69	Mr. Marshall McNeil	141
Mr. Joe Chucchiara	608	Ms. Dani S. Moyer et al.	180
Ms. Deborah L. Clifford	498	Ms. Adriane Nicolaisen	347
Ms. Barbara Connelly	143	Mr. George D. Noble	333
Ms. Jane Corey	111	Mr. Charles Orth	88
Ms. Rainbow Trout Cornelia	308	Mr. Gary W. Owen	210
Mr. William Crooks	114	Ms. Linda Peters	97
Ms. Cecile Cutler	351	Ms. Jane Plankinton	313
Ms. Randi Dalton	161	Ms. Karen Rakofsky	272
Mr. D. Paul De Mayo	33	Yanow Righter	519
Mr. Warren Detriedt	282	Mrs. M. M. Rowland	534
Ms. Dobie Dolphin	131	Ms. Cathy Ryan	99
Mr. J. Edmondson	285	Mr. Daniel Sampson	6, 6a
Ms. Susan Enteen	283	Mr. Robert S. Sanyak	413
Ms. Donna Feiner	280	Ms. Lark Savides	218
Ms. Theresa L. Greenlaw	535	Ms. Sara Schatz	533
Ms. Cecelia J. Gregori	298	Mr. Howard Seidell	355
Mr. Gilbert J. Gregori	298	Mr. Hanon Sells et al.	441
Ms. Jan Gross	302	Ms. Elizabeth A. Sickinger	367
Ms. Gisela Grossman	299	Mr. Stuart Robert Smith	54
Mr. Dan Hamburg	72	Ms. Sandra Solberg	310
Mr. Doug Hansen	536	Mrs. Jill Stassinos	696, 696a
Ms. Christine Harmony	311	Mr. John Thurston	291
Mr. Garland Harris	153	Ms. Suzanne Thurston	291
Mr. John P. Harville	290	Kelly Townsend	503
Ms. Elizabeth Ann Hathcock	160	Unknown	267
Mr. Dan Hauser	67a	Atty. Gen. John K. Van DeKamp	446
Ms. Jeanna L. Heard	209	Mr. Tortuga Vine	266
Dr. Larry Heiss	248	Mr. Karl J. Wagener	369
Ms. Liz Helenchild	132	Mr. Greg Wellish	103
Ms. Nancy W. Hine	508	Mr. Ocean Wells	401
Ms. Judith Horvath	481	Ms. Roberta Whiteside	323
Robin E. Hutchens	404	Ms. Emily F. Whittlesey	358
Ms. Helen Jacobs	278	Ms. Sarah Williams-Wright	321
Ms. Sue Kaye	288	Ms. Roanne Withers	354
Honorable Barry Keene	67, 67a		

Response

Public hearings were held in California, Washington, South Carolina and North Carolina. The interest and convenience of the residents of communities concerned with commercial fishing were

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considered by the Navy in selecting hearing locations. It is important to understand that the purpose of this EIS is to determine whether sea disposal or disposal at an existing land burial site should be pursued. If sea disposal were to be pursued, a separate site-specific environmental assessment would be required. During that evaluation potential disposal sites would be designated. Selecting hearing locations based on sea disposal site selection consideration would not be appropriate at this time since that issue is not addressed in this EIS.

The information used in the evaluation is well documented in the environmental impact statement and supporting references. Also, public input was sought and obtained through letters and public hearings so that everyone had the opportunity to respond.

J.16—Summary of Issue

In Chapter 3, Section II.A it is stated "'Continental margins are excluded to avoid ...'. the continental rise is, by definition, part of the continental margin. The northern study area (E-N2) lies within the Atlantic Continental Margin."

Those Identifying Issue	Identification Number
EPA	694

Response

Though the more northerly study area in the Atlantic as pictured on Figure 3-5 does include the lower continental rise, and thus includes a part of the continental margin, the study area of 44,600 km^2 is much larger than any possible disposal site. IAEA requirements limit a dump site to no more than 10,000 km^2, and the EIS estimates in Appendix D, Section IX that the area required for disposal of 100 ships would be only about 250 km^2. Thus the disposal site would be only about 1/200th as large as the E-N2 study area, and a site meeting the requirements might be found within the E-N2 study area or nearby. The EIS emphasizes that the study areas are not final locations for disposal sites, but are generic areas, representative of the kinds of locations which could meet IAEA requirements, used in this statement for the purpose of estimating any possible environmental effects associated with sea disposal.

J.17—Summary of Issue

Deep ocean trenches should be considered as disposal sites in the sea disposal option.

Those Identifying Issue	Identification Number
Mr. Thomas D. Brown	178
Dr. Thomas W. C. Hilde	27
Mrs. Jaman	453
Mr. Henry M. Plymire	494

Response

Deep ocean trenches have not been considered suitable candidate sites for sea disposal because there is concern that they are, or may be, geologically active and biologically more productive than the more level abyssal areas, as discussed on pages 3-9 and E-6 of the DEIS.

J.18—Summary of Issue

The EIS should clarify the purpose of including the 200 mile limit in the ocean disposal study area selection criteria.

Those Identifying Issue	Identification Number
EPA	694
Honorable Walter B. Jones	9
Mr. James F. Ross	486
Mr. Ron Shehee	407

Response

The President of the United States signed a proclamation on March 10, 1983 which established a U.S. Exclusive Economic Zone to a distance of 200 nautical miles. This proclamation gives the U.S. the rights to all resources in the water column and in and on the seabed within the designated zone. Therefore, disposal within that zone would be within the Exclusive Economic Zone. There is no technical requirement for disposal within 200 miles of the U.S. coast, but this guideline was used in the analyses in the EIS to assure that impact would be estimated for the limiting case.

Clearly, sites beyond 200 miles should not be necessarily excluded when determining an appropriate site for sea disposal. For example, the current Northeast Atlantic disposal site used by several European nations is well beyond 200 miles of the coast.

Chapter 3, Section II.A of the Final EIS has been revised to clarify this point.

J.19—Summary of Issue

The DEIS should include additional site selection criteria as follows:

a. ... explicitly include turbidity currents.

b. ... the ability to monitor the site remotely.

c. ... insure no anomalies by using side-scan survey.

d. ... not subject to ground shaking stresses that could disrupt the sea floor or damage vessel integrity.

Those Identifying Issue	Identification Number
Mr. George Balding (d)	77, 77a
Mr. Bruce R. Campbell (d)	421
Mr. Wesley Chesbro (d)	69
Mr. Clifton E. Curtis (d)	695
Dr. Jackson Davis (d)	76
Mr. Peter Douglas (d)	68a
EPA (b)	694
Mr. Martin F. Golden (a and c)	634
Mr. Conrad Golich (d)	713
Lt. Governor Leo McCarthy (d)	65
Mr. Christopher D. Roosevelt (d)	695
Mr. Lewis Seiler (d)	707
Mr. James Widmeyer (d)	678

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Response

Since turbidity currents would not necessarily shorten the pathways to man and, in fact, by their nature might tend to cover the disposed material or carry it farther out to sea and thus farther from man, it would be inappropriate to exclude candidate areas simply on this basis. However, since turbidity currents could affect future monitorability and might cause resuspension of deposited material, this factor would very likely be weighed by the EPA under such considerations during the disposal site designation process.

For any site that would satisfy the criteria shown in Appendix E, Section III of the DEIS, remote monitoring would be possible, as demonstrated by much deep oceanographic research accomplished under similar conditions and the Navy's recent monitoring of the THRESHER site. Therefore, it would not be necessary to add a criterion to cover this topic.

The absence of obstacles, irregularities, or other anomalies at a site would have been verified during the site selection work without the need to add a specific criterion calling for the use of side-scan survey.

Ground-shaking stresses that could disrupt the sea floor or damage the submarine's integrity would be avoided at any potential site where criterion 6 of Appendix E, Section III would be satisfied.

J.20—Summary of Issue

The DEIS lacks oceanographic data or has very limited data on which to base estimates of impacts.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Brian N. Baird	55a	Mr. John W. Harris	85
Dr. Ruthann Corwin	112	Dr. Michael J. Herz	37b
Ms. Randi Dalton	161	Ms. Camilla Ingram	686
Mr. Peter Douglas	68a	Mr. Thomas C. Jackson	37b
EPA	694	Mr. Robert Kay	373
Ms. Donna Feiner	280	Ms. Ivana Noell	645
Mr. Martin F. Golden	634	Mr. Robert E. Ragland	315
Ms. Theresa L. Greenlaw	535	Mr. Lewis Seiler	707
Mr. Dan Hamburg et al.	72, 72a	Mr. Arthur Wang	159

Response

During the preparation of the EIS, a thorough review of the available data was made and all applicable data were used as a base. Further, experts knowledgeable in all facets of ocean studies, ranging from biologists to physical oceanographers, were asked to determine additional information required to provide a valid evaluation of the potential effects associated with the disposal of defueled nuclear submarines on the ocean floor. These experts and other members of the oceanographic community have been engaged in the necessary ocean research to obtain data pertaining to the deep ocean environment as part of the overall effort associated with the EIS. Their results have been published in the references to the EIS and are summarized in SAND82-1005, Reference 3.14.

J.21—Summary of Issue

The DEIS and the Summary of the Sandia Laboratories Report 82-1005, (Volume I, September 1982) misrepresent information from the Oceanographic Studies (Volume II).

Those Identifying Issue	Identification Number
Dr. Michael J. Herz	37, 37a, 37c

Response

No specific examples were provided to support the comment. The principal researchers who authored Volume II of the Sandia Report reviewed the summary of their work in Sandia Volume I and in the Draft EIS for consistency. No inconsistencies were identified by the principal researchers.

J.22—Summary of Issue

Adequate maps of possible geologic and sea bed resources are not included in the DEIS. Since this is a developing field for commercial exploitation, it is questioned whether the ocean study areas identified in the DEIS contain no commercially exploitable resources.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692

Response

Initial investigations reported in Reference 3.14 indicated that all of the study areas would not contain any commercially exploitable resources. However, as stated in Appendix E, Section II.B.1 of the FEIS, the most recent studies showed that in the Atlantic Ocean-Lower Continental Rise Area only a relatively small portion now appears suitable for further study, in part because the potential for exploitable hydrocarbons eliminates other portions of the Study Area. Since with this exception, there are no commercially exploitable resouces in the study areas, there is no need to include resource maps in the FEIS.

J.23—Summary of Issue

The DEIS fails to take into account offshore mining or oil exploration, and how these would be affected by ocean disposal.

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin, et al.	131b

Response

Offshore mining and oil exploration were specifically considered, as shown by the ocean study area identification criteria discussed in Chapter 3, Section II.A. One criterion specifically states "Areas shall be avoided that have potential sea-bed resources which may be exploited either directly by mining or by harvest of marine products, or indirectly." No commercially exploited minerals are present on the sea floor of the identified ocean study areas. See Reference 3.14 and Chapter 3, Section II.A and Section II.B.

J.24—Summary of Issue

Site selection criteria should include the requirement that there be no hydrothermal activity in the area, which might result in increased temperature and higher biological activity.

Those Identifying Issue	Identification Number
Mr. Walter Dodds	571

Response

It is not the purpose of this EIS to select specific sites for ocean disposal of radioactive waste. However, this criterion was already embodied in criteria (3) and (5) in Chapter 3, Section II.A of the DEIS.

J.25—Summary of Issue

The DEIS should discuss why it is desirable to select an ocean disposal site with a depth of 4000 or more meters, where bottom water circulation is slower. Has the Navy considered whether currents could be an asset in diluting radionuclide releases?

Those Identifying Issue	Identification Number
EPA	694

Response

The 4000 meter minimum depth criterion is among those established by the IAEA under the London Dumping Convention, to which the United States is signatory. For this reason the 4000 meter depth criterion was taken to be a requirement and was included in the 12 guidelines for identifying study areas. The depth requirement and the basis for it were discussed in Chapter 3, Section II.A of the DEIS. The desirability of avoiding areas with relatively rapid bottom currents is implicit in three of the 12 DEIS guidelines in Appendix E, Section III. In particular, guidelines 9, 11, and 12 deal with bottom currents and the objective of avoiding rapid movement of released material, possibly shortening the pathways to man.

Currents would obviously be an asset from the viewpoint of diluting radionuclide releases. However, the currently accepted principle of radioactive waste disposal is to isolate and contain the material rather than diluting and dispersing it and the very slow current conditions specified are consistent with this philosophy.

J.26—Summary of Issue

The fauna at the Lower Continental Rise Area and at the Hatteras Abyssal Plain Area are not essentially the same as implied by the DEIS.

Those Identifying Issue	Identification Number
Mr. J. A. Musick	419
Ms. Sheila M. Prindiville	700

Response

The EIS has been revised to remove this ambiguity.

J.27—**Summary of Issue**

Despite the IAEA requirements calling for avoidance of dumping in areas of intense mesoscale eddy activity, such activity was admitted in the DEIS (referring to Pacific study area).

Those Identifying Issue	Identification Number
Mr. Bruce R. Campbell	421

Response

It is not the purpose of this EIS to select specific ocean sites for radioactive waste disposal nor to provide all data necessary to do so. The criterion cited is not an IAEA requirement but is added guidance contained in Chapter 3, Section II.A with the following words:

"Sites should be away from areas of intense mesoscale eddy activity. This is intended to avoid areas of enhanced eddy diffusivity which could shorten pathways to man."

Measurements have not shown intense mesoscale eddy activity to exist in the Pacific study area. It is recognized that eddies do occur in the area and this criterion does not exclude eddy activity from an area. The discussion of eddy currents given in response to Issue J.29 should provide an understanding of this response.

J.28—**Summary of Issue**

The current at a proposed disposal site must be determined.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Danny Barca	677	Ms. Jane Jarrett	245
Mr. Greg Carr	672	Honorable Barry Keene	67a
Mr. Emmett Carson	415	Ms. Lea Lackey-Zachmann	459
Honorable Ronald V. Dellums	447	Ms. Dena Mossar	442
Mr. Dwight Donovan	228	Ms. Julie Kay Norman	709
Mr. Peter Douglas	68, 68a	Mr. Thomas D. O'Neil	80
Mr. Dan Hauser	67a	Mr. Daniel F. Read	12
Ms. Jeane L. Heard	209	Mr. John Runkle	18
Dr. Michael J. Herz	37b	Atty. Gen. John K. Van DeKamp	446
Mr. Thomas C. Jackson	15, 37b	Ms. Kathleen Walden	629
Mrs. Jaman	453	Mr. Timothy Zachmann	459

Response

Current measurements used to estimate possible environmental impacts have been made at the study areas and were reported in the Draft Environmental Impact Statement and Reference 3.14.

(Continued on next page)

These measurements are sufficient to perform a generic evaluation of ocean disposal. Should ocean disposal be pursued, a site-specific environmental evaluation would be prepared and appropriate current measurements would be performed.

J.29 – Summary of Issue

Current velocities as low as 7 cm/sec are capable of suspending and transporting radionuclides, and mesoscale eddy currents ranging up to 16 cm/sec have been measured at the Pacific study area.

Those Identifying Issue	Identification Number
Dr. Jackson Davis	76
Mr. Lewis Seiler	707

Response

The velocity which could cause resuspension of sediment is site-dependent and cannot be used as a general term. For example, application of suspension and traction curves (Reference 1) shows that currents as low as 7 cm/sec are only capable of resuspending incohesive sediments whereas the sediments at the Pacific study area are cohesive. Therefore, it is a misrepresentation to imply that a 7 cm/sec current would cause sediment resuspension at the Pacific study area. The fact that the Pacific study area is not affected by resuspension has been verified by numerous bottom measurements. The measurements have been made with sediment traps, photographs of the bottom which provide visual indications of the effects of resuspension, and suspended particulate measurements with transmissometer type equipment.

Even though the Pacific study area measurements demonstrate that resuspension is not a problem, the analyses of possible corrosion product transport in this EIS very conservatively included the assumption that all radioactive material would remain transportable. This means that all radioactive material would remain suspended in the water and would be available for transport to a pathway to man. Deposit in the sediment and resuspension would only have the effect of providing additional time for radioactive decay and would reduce the calculated exposures. Even with this very conservative assumption the calculated exposure was very small in comparison to fluctuations in exposure resulting from variation in activities, food consumption, and geographic location.

Reference

1. Heezen, B. C. and Hollister, C. D. (1971), *The Face of the Deep*, New York; Oxford University Press.

J.30 – Summary of Issue

Data on the critical bottom current velocity which would be energetic enough to resuspend sediment in the ocean study areas is needed.

Those Identifying Issue	Identification Number
EPA	694

Response

Methods are available which can be used to establish the likelihood of resuspension of sediments at the ocean study areas. These include various sediment cores and samples, photographs of the bottom to provide visual evidence of sediment suspension, transmissometer measurements of suspended particulates, sediment trap experiments and current meter readings. In general, the available evidence indicates that any resuspension of sediments which might occur does not result in any significant long distance transport of the sediments.

The critical velocity for resuspension of sediments is highly dependent on the characteristics of the specific location so such information would only be appropriate if disposal sites were actually being selected. For the purpose of determining the relative impact of the options available for disposal, the purpose of this EIS, a determination that no resuspension occurs at typical locations which might result in an impact on man is adequate.

J.31 —Summary of Issue

The possibility of upwelling and its effects should be evaluated.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. George Balding	77	Honorable Barry Keene	67a
Mr. Danny Barca	677	Mr. Michael Matthay	398
Mr. Nathanial S. Bingham	78a	Mr. Peter Nahigian	158
Mr. Bruce R. Campbell	421	Mr. Thomas D. O'Neil	80
Ms. Barbara Connelly	143	Mr. Walbridge J. Powell	448
Mr. Wells Eddleman	20	Mr. John Runkle	18
Mr. Ron Guenther	105a	Mr. Eric Simmons	59
Mr. Dan Hauser	67a	Unknown	213
Mrs. Jaman	453	Mr. Gordon K. Van Vleck	715

Response

Coastal upwelling in the California current system has been the subject of large scale studies off California and Baja California and of small scale studies off Oregon. Active coastal upwelling is restricted to a narrow band approximately 10 to 25 km wide along the entire coast (Reference 1). This is consistent with simple theories of time-dependent coastal upwelling (Reference 2) that indicate that the width of the upwelling zone is given by the Rossby radius of deformation which is about 10-20 km over the shelf along the entire coast. Classical coastal upwelling such as that off the coast of northern California can only raise water from depths of approximately 250 meters (Reference 3).

Where strong upwelling persists, rare and short-lived filaments of upwelled water may travel along the surface as far offshore as the Pacific study area, but they produce no communication between surface and deeper water at such locations. This effect is consistent with the meager fish catch in the W-N area relative to the region closer to shore.

The Pacific study area is centered about 275 km from the coast in approximately 4,200 meters of water. The fact that coastal upwelling only occurs about 10 to 25 km from the coast and can only raise water from approximately 250 m makes it clear that upwelling from the Pacific study area is not a concern.

In spite of this, the analysis in the EIS assumed that all fish for commercial markets were caught at a depth of 2000 meters (6,600 feet) in water containing radioactive corrosion products from sunken submarines. Since most fish are taken at a depth less than approximately 400 to 500 meters and only a small fraction of the marketed fish could be caught at the single area assumed, this is extremely conservative.

(Continued on next page)

References

1. Huyer, A., Coastal Upwelling in the California Current System, Progress in Oceanography, August 1983

2. Allen, J. S. "Upwelling and Coastal Jets in a Stratified Ocean," Journal of Physical Oceanography, 3, 245-257, 1973.

3. Freeland, H. J. and Denman, K. L., "A Topographically Controlled Upwelling Center off Southern Vancouver Island," Journal of Marine Research, Volume 40 #4, 1982.

J.32—**Summary of Issue**

It would be useful to calculate nuclide concentrations for the Atlantic sites as well as the Pacific site. This would allow comparisons of the sensitivity of the model to various factors and give at least an idea of the range of effects.

Those Identifying Issue	Identification Number
EPA	694

Response

An estimate of effects associated with the sensitivity of the nuclide concentrations to various parameter values can be obtained by comparing the results of the "best" and "conservative" estimates. The parameter variation range is much greater between the "best" and "conservative" estimates than between the Atlantic and Pacific sites.

J.33—**Summary of Issue**

"Some information on the dumping that has been conducted at the North Atlantic Dumpsite by some of the OECD nations might put the proposed ocean disposal of submarines in better perspective."

Those Identifying Issue	Identification Number
EPA	694a

Response

This information was not considered to be relevant because of the significant difference in containment and isotopic composition between the two types of waste. It is not the number of curies that is important, but rather the environmental effect that matters, and both the extent of confinement and the isotopic composition are paramount in determining the environmental impact. The multiple levels of containment provided by the submarine hull and bulkheads, the reactor pressure vessel walls, and the radioactive material being in the form of solid metal provide much more effective barriers to the release of radioactivity from disposed, defueled submarines than is provided by the normal packaging of low level waste.

However, for information, the amount of radioactivity deposited in the Northeast Atlantic dumpsite through the year 1981 (Reference 1) was approximately 12,300 curies of alpha radioactivity (actinides) and 885,000 curies of beta-gamma activity (including tritium).

Reference

1. Templeton, W. I., and A. Preston, "Radioactive Waste Management and the Nuclear Fuel Cycle", Vol. 3, No. 1, p. 75ff (1982)

J.34—**Summary of Issue**

Data on radioactive materials should be included from the Glomar Explorer's attempt to raise the Russian submarine.

Those Identifying Issue	Identification Number
Dr. Michael J. Herz	37a, 37b, 37c
Mr. Thomas C. Jackson	37b
Dr. Ruth Weiner	39a

Response

A book by R. D. Varner and W. R. Collier (*A Matter of Risk*, Random House, New York. 1978) indicates that the submarine was diesel powered and did not have a nuclear power plant.

J.35—**Summary of Issue**

Areas north of the Pacific study area (Juan de Fuca Ridge and Gorda Ridge) have mineral development potential and contain waters much warmer than 1° to 2°C used to calculate corrosion rates.

Those Identifying Issue	Identification Number
Mr. James F. Ross	486

Response

The comment refers to conditions in areas other than the Pacific study area. This is not relevant to conditions in the Pacific study area.

J.36—**Summary of Issue**

Superficially similar photos from the two Atlantic study areas do not allow statements to be made (Appendix E, Section IV.B.7) that the quantity and type of organisms on and near the ocean floor are comparable.

Those Identifying Issue	Identification Number
Ms. Camilla Ingram	686

Response

The observation is true; however, the statement in Appendix E, Section IV.B.7 was limited to the following: "Based on bottom photographs taken in this area, and the proximity to the Hatteras Abyssal Plain study area, the observations of Section IV.A.7 are applicable to the Lower Continental Rise study area."

(Continued on next page)

In Section IV.A.7, the following observations were made: the bottom-dwelling life is described as "believed to be typical of the forms and population density to be found in the deep areas of the Atlantic Ocean."; "It is expected from the evidence in these photographs that the predominant large macrobenthic animals in this area will be holothurians and brittle stars. . . "; "The benthic-community is not fished because of the depth of the water and the sparse population; one of the bases for its selection was the likelihood that it will never attract commercial or other interest." These observations are considered to be applicable to the Lower Continental Rise Area.

J.37—Summary of Issue

The EIS should discuss the impact on national security if an enemy nation recovered a U.S. submarine from an ocean disposal site.

Those Identifying Issue	Identification Number
Mr. Ron Shehee	407

Response

This issue is not an environmental impact and is therefore considered beyond the scope of the matters covered by the Environmental Impact Statement.

J.38—Summary of Issue

Measured bioturbation is not well studied with small cores. Therefore, the claim that there is minimal bioturbation below 5 cm is not well substantiated.

Those Identifying Issue	Identification Number
EPA	694

Response

The particular paragraph in the EIS to which this issue refers states that the lack of Co-60 in the sediments below a depth of 5 cm indicates minimal bioturbation in these regions of the sediments. This paragraph simply states a fact and identifies a reasonable inference which can be drawn from the data. These results were obtained using cores with diameters of 5 and 7 cm. A similar conclusion was reached by the EPA at the Farallons dump site based upon 3.8 cm wide core samples as is reported in "Environmental Surveys of Two Deep Sea Radioactive Waste Disposal Sites Using Submersibles" presented by R. S. Dyer, Office of Radiation Programs, US EPA at the International Symposium on the Management of Radioactive Wastes from the Nuclear Fuel Cycle, IAEA, Vienna, March 1976.

More recent results obtained from the THRESHER site and reported in Section IV.E of the Annex to Appendix D suggest a greater influence of bioturbation since Co-60 was found in one 10 to 15 cm depth segment and in a greater percentage of cores in the 5 to 10 cm segment. This depth of bioturbation is similar to that reported at the Pacific Study Site (12 cm) in Reference E.7 of the DEIS.

J.39—Summary of Issue

In contrast to the statement in Annex to Appendix D, Section II.A, considerable mixing may be occurring between the Western Boundary Undercurrent and the continental shelf water. This point should be clarified since such mixing may have implications for transport of radionuclides into waters which support fisheries.

Those Identifying Issue	Identification Number
EPA	694
NOAA	444

Response

There clearly is mixing between the waters of the WBUC (Western Boundary Undercurrent) and the surrounding waters. For example, while the total transport in the WBUC remains approximately constant, the concentration of tritium decreases by a factor of 5 to 7 in a 3300 km stretch between 53°N and 32°N which is transversed in approximately 1 - 2 years (SAND80-2573). Thus a large fraction of the water in the WBUC has been replaced during this period.

However, as the result of requirements for minimum depth and other criteria, the region where a deep ocean disposal site might be located would be 200 km or more away from the WBUC. Further, the WBUC would be moving away from any major fishing grounds. Thus the effect of the possible entrainment of radionuclides by the WBUC from a deep ocean disposal site in the Atlantic and the resulting movement of these nuclides to major fishing grounds is not expected to be a significant factor in the choice of possible disposal sites in the Atlantic.

J.40 — Summary of Issue

Can useful information be gained through studying the already sunken USS SCORPION and USS THRESHER?

Those Identifying Issue	Identification Number
Honorable Jesse Helms	708

Response

Information gained through study of these two sunken submarines has been used to corroborate the conclusion that the release of radioactive material from a submarine would be extremely slow. The results of analysis of marine life samples taken adjacent to the THRESHER and SCORPION debris are consistent with the expectation that there would be little accumulation of radioactivity by nearby marine life.

J.41 — Summary of Issue

Monitoring of the THRESHER and SCORPION debris sites raises worrisome questions because radioactivity has already been found nearby.

Those Identifying Issue	Identification Number
Ms. Dena Mossar	442
Mr. Arthur Wang	159

(Continued on next page)

Response

Only trace amounts of radioactivity originally contained in the reactor cooling water system have been found during several surveys. See Appendix D, Section V and the Annex to Appendix D. See also Issue J.42 for additional discussion.

J.42—**Summary of Issue**

The information obtained from the THRESHER and SCORPION is not adequate to demonstrate the safety of ocean disposal.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Randi Dalton	161	Ms. Mary Sue Noe	2
EPA	694	Mr. Charles Orth	88
Mr. Martin F. Golden	634	Mr. Daniel F. Read	12
Dr. Michael J. Herz	37a	Ms. Arlene Reeves	487
Ms. Camilla Ingram	686	Mr. Ron Shehee	407
NOAA	444		

Response

Information from the THRESHER and SCORPION provides significant corroboration to the conclusion, reached through detailed analyses, that the release of radioactivity from the submarine will be extremely slow. The fact that only minute amounts of Co-60 and Ni-63 activity were found adjacent to the wreckage of both plants, and the fact that this radioactivity was associated with the magnetic iron oxide formed during plant operation and therefore did not come from seawater corrosion of the reactor vessel, which produces non-magnetic rust, is significant evidence that although a direct path exists from the reactor compartment to the sea, there has been no radioactivity released by low temperature corrosion of reactor structure or uranium fuel. Furthermore, the absence of any detectable Co-60 or Ni-63 activity in marine life samples taken adjacent to the THRESHER and SCORPION debris is consistent with the expectation that there would be lttle pickup of radioactivity by nearby marine life (and even less, by more distant occupants).

Some respondents have stated that the 15 year period between the THRESHER and SCORPION sinkings and the surveys of the areas is too short a time to learn anything regarding the long term effects of radiation on the surroundings. This view is incorrect. Both the THRESHER and SCORPION sinkings, because they were uncontrolled, catastrophic events, caused massive structural damage which opened a direct path from the reactor compartment to the sea. In contrast, the controlled, uniform flooding of the disposal procedure is expected to maintain the integrity of both the hull and the reactor coolant system boundaries, until corrosion finally opens a path through the reactor vessel after about 400 years, as discussed in Appendix G, Section II.A.2.b. At the time of sinking, both THRESHER and SCORPION contained more radioactivity available to be released to the ocean than the 1000 curies expected to be remaining in a disposed submarine after 400 years, as shown in Figure 1-2.

Therefore, if only a very small (millicurie) quantity of radioactivity escaped at this time when the radioactivity available for escape was highest, much less would be expected to escape from THRESHER and SCORPION in the future. Even without containment, no significant effect on the environment is evident. Therefore, these results provide some practical experience confirming the prediction that no significant long term effect on the environment would occur from the controlled disposal of defueled submarines.

J.43—Summary of Issue

The data from the THRESHER and SCORPION wrecks are insufficient to establish the lack of environmental impact. It is necessary to ascertain the precise proximity of the sampling stations to the THRESHER and SCORPION wreckage and to determine if the reactor compartments are breached or unbreached.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Michael J. Herz	37a, 37b
Mr. Thomas C. Jackson	37b
Mr. Christopher Roosevelt	695

Response

The locations of the sampling stations relative to the wreckage were presented on page D-A9 of the DEIS. In addition, the Annex to Appendix D describes trace amounts of Cobalt-60 found at the THRESHER and SCORPION sites that originated from within the reactor plant. Clearly the only way for this material from within the reactor plant to be in the sediment would be for the submarine's compartments to have been breached.

Furthermore, the data obtained at the THRESHER and SCORPION sites were not used to evaluate the potential environmental impacts. The potential "worst case" accidents were evaluated assuming the immediate release of all available radioactive material.

J.44—Summary of Issue

The Navy should publish results of the THRESHER and SCORPION monitoring in public, peer-reviewed scientific literature instead of an agency report.

Those Identifying Issue	Identification Number
EPA	694

Response

Publication of the results of Federally funded technical work in Government reports is a standard practice that is used by many Federal agencies including the EPA.

J.45—Summary of Issue

Because of the small sample size, the bottom water at the THRESHER site may have contained the minimum detectable 3 to 10 pCi/1 of Cobalt-60. This means that the 100 meters of bottom water over the 30,000 m^2 THRESHER site could have contained from 9 to 30 mCi of Cobalt-60 and not have been detected.

Those Identifying Issue	Identification Number
EPA	694a

(Continued on next page)

Response

If a volume of 3,000,000 cubic meters or 3,000,000,000 liters of seawater contained 3 to 10 pCi of Cobalt-60 per liter, then it is true that the total amount of Cobalt-60 in the water would be 9 to 30 mCi. This follows directly from the information in the footnote to Table D-A1. However, the respondent's choice of this volume of water is arbitrarily large, and it is unlikely that all of the water would have an activity concentration equal to the minimum detectable. In the summer of 1983, large volume seawater samples ranging from 392 to 587 liters were obtained from the THRESHER debris site using both a surface-deployed and a submersible-mounted pumping system for in-situ extraction of particulate and dissolved materials. For these samples, the detection limit for Cobalt-60 was less than 0.1 picocuries per liter. This is as much as 100 times more sensitive than the previous measurements. Based on these results, the 3,000,000 cubic meters of seawater would contain less than 0.30 mCi of Cobalt-60. It is also noted that the assumed volume of seawater would contain approximately 900 mCi of naturally-radioactive Potassium-40.

A discussion of the 1983 results from the THRESHER site water sample analyses was added to the Environmental Impact Statement.

J.46—Summary of Issue

The Potassium-40 measurement in seawater from the SCORPION site is only 72% of that normally expected in sea water, leading one to question the accuracy of the entire analytic program.

Those Identifying Issue	Identification Number
EPA	694a

Response

Referring to Table D-A1, the K-40 value referred to is 236 pCi/1, the measured concentration in water from the SCORPION site, 79% of the K-40 natural value of 300 pCi/1 in seawater (not 72%). Similarly, from Table D-A1, the K-40 value measured in water from the THRESHER site is 328 pCi/1 or 109% of the natural value. These measured values do not necessarily lead one to question the accuracy of the entire analytic program, but instead provide an indication of the variability and reproducibility of the measurement technique. Experimental values that are 21% lower and 9% higher than the accepted average do not indicate an unacceptable level of accuracy.

When the limits of error on the K-40 results are included, the results are 328 ± 90 pCi/liter for the THRESHER samples and 236 ± 96 pCi/liter for the SCORPION sample at the 90% confidence level. Thus, within statistical error, both results include the accepted value of about 300 pCi/liter. The 90% confidence limits for K-40 were added to Table D-A1.

J.47—Summary of Issue

"The analyses of bottom water [at the sites of the THRESHER and SCORPION sinkings] (pages D-A6 to D-A7) are not useful. Analyses were performed on a sample of one liter, which is too small a volume to detect Cs-137 or Co-60 at realistic concentrations. Furthermore, the results given for K-40 are inconsistent, casting further doubt on the analyses. The two samples should produce the same results for K-40."

Those Identifying Issue	Identification Number
NOAA	444

Response

The Navy does not agree with NOAA's statement that one liter water samples are too small to be useful. It is possible to detect in one liter samples concentrations of Co-60 and Cs-137 far less than the concentrations which the EPA allows in drinking water, according to the Code of Federal Regulations, 40CFR141. It is highly significant that these samples did not contain any detectable Co-60 or Cs-137 since these ships sank without any special precautions to enhance containment of radioactivity and with their uranium fuel still installed.

The Navy recognizes that samples of larger size would have been desirable for Cs-137 and Co-60 analyses. However, in 1977 and 1979 when the THRESHER and SCORPION samples were obtained, it was not feasible to obtain larger samples at the 8500 and 10,000 foot depths where the wreckage is located. The deep submergence vehicle TRIESTE which was employed to obtain the water samples was not equipped to transport and manipulate sample containers of larger size.

In the summer of 1983, large volume seawater samples were obtained from the THRESHER debris site using both a surface-deployed and a submersible-mounted pumping system for in-situ extraction of particulate and dissolved materials. These pumping systems were designed, built and deployed by Woods Hole Oceanographic Institution's scientists and obtained samples ranging from 392 to 587 liters. No radioactivity attributable to the THRESHER debris was detectable in any of the samples analyzed. The detection limits for Cobalt-60 and Cesium-137 were less than 0.1 picocurie per liter.

A discussion of the results of this sampling was added to the Annex to Appendix D of the Final EIS.

With regard to K-40, when the limits of error on these samples are included, the results are 328 ± 90 pCi/liter for the THRESHER samples and 236 ± 96 pCi/liter for the SCORPION sample, at the 90% confidence level. Thus within statistical error both results include the accepted value of about 300 pCi/liter. The 90% confidence limits for K-40 were added to Table D-A1.

J.48—Summary of Issue

These data (water sample data in Section IV.A of the Annex to Appendix D) are of no value in establishing that no leakage had occurred from the sunken THRESHER and SCORPION submarines.

Those Identifying Issue	Identification Number
EPA	694

Response

The statement is correct. However, as intended, the data are of value in showing that the amount of radioactive material being released from these two accidentally sunken submarines is sufficiently small that the water in the immediate vicinity of the subs has not become contaminated.

J.49 — **Summary of Issue**

The DEIS should state whether analyses were conducted for the presence of transuranic isotopes at the THRESHER and SCORPION sites. (Section IV.B of the Annex to Appendix D).

Those Identifying Issue	Identification Number
EPA	694

Response

The number of curies of fission products in used nuclear fuel greatly exceeds the transuranic curie content by several orders of magnitude. Since there was no evidence of fission product leakage, there would be no reason for expecting transuranic nuclides to have leaked.

J.50 — **Summary of Issue**

Referring to THRESHER/SCORPION data, one cannot conclude, based on the 0.3 millicurie found in the sediments, that the other 9.7 millicuries (sic) must be in the submarine. Dilution and dispersion in the water would have been expected.

Those Identifying Issue	Identification Number
NOAA	444

Response

The respondent has misinterpreted statements in Annex to Appendix D, Sections III and IV.B.1. The DEIS nowhere refers to a total of 10 millicuries of Co-60, nor states that all but 0.3 millicurie must be in the submarine. The DEIS says in Section III, "Less than 10 curies of radioactivity, predominantly Cobalt-60 and Nickel-63, is estimated to be currently present in these [high temperature] corrosion products [or crud]. . ." (emphasis added), and in Section IV.B.1, "the total amount of Cobalt-60 activity present in the upper layer of ocean bottom sediment" was estimated at about 0.3 millicurie, based on core sediment samples and in-situ measurements. Some dispersion may have occurred, and the total amount of Cobalt-60 released from the submarines may have been greater than 0.3 millicurie. The significant point is that although a direct path obviously exists from the reactor compartment to the open sea, there is no sign of low temperature corrosion of either reactor structure or fuel in the environment.

J.51 — **Summary of Issue**

The pore water drained from core sediment samples should have been analyzed (Section IV.B of the Annex to Appendix D).

Those Identifying Issue	Identification Number
EPA	694

Response

The pore water was not drained from the core and it was analyzed with the sediment. The water that was drained had been in the coring device above the core. Because the coring device was transported from the ocean bottom through the water column to the surface, this water would be of limited value. This point has been clarified in Section IV.B of the Annex to Appendix D.

J.52—**Summary of Issue**

The DEIS should include more detail on the properties of the magnetic Co-60 (crud) discussed in the Annex to Appendix D.

Those Identifying Issue	Identification Number
EPA	694

Response

In the past, the EPA has studied the physical and chemical characteristics of the magnetic Co-60 from Naval nuclear propulsion plants in marine sediments. The results of this investigation were reported in the EPA Journal, Radiation Data and Reports, June 1972, pp 323-334. The behavior and properties of the magnetic Co-60 found at the THRESHER and SCORPION sites were consistent with those reported earlier by the EPA.

J.53—**Summary of Issue**

The DEIS should clarify whether the "small magnetic oxide particles" were unique to THRESHER and SCORPION or would be found in sea-disposed submarines. Would such magnetic particles be released at the sea disposal site in the event of a reactor compartment rupture?

Those Identifying Issue	Identification Number
EPA	694a

Response

The "small magnetic oxide particles" represent the smallest of the three principal categories of radioactive material within the THRESHER and SCORPION debris, as stated in Section III of the Annex to Appendix D. It is clear in the DEIS that this material, also referred to as crud, would not be unique to the two sunken submarines, but would be present in all decommissioned, defueled nuclear submarine reactor plants. Based on the THRESHER and SCORPION results, the assumption made in the minimum containment scenarios in the DEIS, that all crud is released within the first year, is extremely conservative. The adherent corrosion product particles in a decommissioned submarine reactor plant would be available for slow release at the sea disposal site, in the event of a reactor compartment rupture.

J.54—**Summary of Issue**

The DEIS should document what is meant by "statistically" significant in connection with releases from THRESHER or SCORPION.

(Continued on next page)

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS did not use the phrase " 'statistically' significant" in connection with the studies at the THRESHER and SCORPION sites described in the Annex to Appendix D.

J.55 – **Summary of Issue**

The "state-of-the-art" techniques and their accuracy in connection with releases from THRESHER or SCORPION should be discussed in the Annex to Appendix D.

Those Identifying Issue	Identification Number
EPA	694

Response

The basic counting techniques and minimum counting sensitivities were described in the Annex to Appendix D for the in-situ gamma monitoring equipment and the water, marine life, and sediment samples reported.

J.56 – **Summary of Issue**

Why weren't Iron-55, Nickel-63, or Carbon-14 analyzed for in the samples from the THRESHER and SCORPION?

Those Identifying Issue	Identification Number
Ms. Camilla Ingram	686

Response

Those sediment samples that contained detectable concentrations of Cobalt-60 and several marine life specimens were analyzed for Nickel-63. Although Nickel-63 was not detectable in individual samples of sediment and marine life, it was possible to detect Nickel-63 by performing a magnetic separation and concentration of corrosion products by combining those sediment samples from each site that contained the highest levels of Cobalt-60 contamination. The data obtained indicate that Nickel-63 would not be currently detectable in individual samples unless much higher concentrations of Cobalt-60 were present.

Iron-55 and Carbon-14 were not analyzed for based on their low probability of detection at expected concentrations estimated from Cobalt-60 and Nickel-63 measurements.

The Environmental Impact Statement was revised to include the Nickel-63 data.

J.57 — Summary of Issue

Were collection techniques other than mud samples used to monitor the THRESHER and SCORPION sites? If other techniques were used they should be discussed in the Annex to Appendix D.

Those Identifying Issue	Identification Number
EPA	694

Response

Several techniques were used and were discussed in the Annex to Appendix D. The techniques included measurements of water samples, sediment samples, marine life, and debris. In fact the sediment was monitored with both in-situ techniques and laboratory measurements.

J.58 — Summary of Issue

It is considered doubtful that, as reported in the DEIS in Section II.A of the Annex to Appendix D, spiders were observed at the THRESHER site.

Those Identifying Issue	Identification Number
EPA	694

Response

The animals described on the cited page were spider crabs. The sentence referenced contains a typographical error which produced this comment.

The statement in Section II.A of the Annex to Appendix D, was corrected to read ". . .amphipods, spider crabs, lobsters, . . .".

J.59 — Summary of Issue

The discussion of animal life observed in Annex to Appendix D, Section II.B appears to be comparing animal counts in a published photo atlas of a mid-Atlantic Ridge hard bottom area to the SCORPION site, which is noted as being a soft bottom environment.

Those Identifying Issue	Identification Number
EPA	694

Response

Biomass densities of approximately one gram per square meter are compared among three available sources of data, and the conclusion is drawn that the observed biomass density at the SCORPION site area may be lower by a factor of two or three.

Such data from the deep ocean are sparse and this conclusion is limited by the nature of the data. These data and the conclusion were used in the environmental assessment to note that the population of sea life in the vicinity of a disposal site would be small (Chapter 4, Section II.A.3(d)(4)).

J.60—Summary of Issue

The DEIS should specify the level of instrument background referred to in Section IV.C of the Annex to Appendix D.

Those Identifying Issue	Identification Number
EPA	694

Response

The instrument background level described above was added parenthetically at the end of the section.

J.61—Summary of Issue

The DEIS should include, in the Annex to Appendix D, a comparison of the actual amount of corrosion release of radioactivity with the predicted amount based on corrosion models, including a determination of the activity levels of Nickel-59 and Nickel-63 in the environment at the THRESHER and SCORPION sites. Is there fractionation between Cobalt and Nickel after release to the environment?

Those Identifying Issue	Identification Number
EPA	694a

Response

Release of radioactive corrosion products due to corrosion after the THRESHER or SCORPION accidents has not yet been detected, since the semi-quantitative method of magnetic separation described in the Annex to Appendix D, Section IV.B showed that the corrosion products detected had been formed during high temperature operation of the nuclear reactor plant. Quantitative comparison of this experience with predictions of submarine disposal is thus not possible. However, even a comparison of the total amount of radioactive material inferred to be in the sediment at the THRESHER and SCORPION sites with the best estimate minimum containment releases given in Tables G-16 through G-22 indicates that the corrosion models are very conservative. This conclusion is to be expected because the EIS predictions were intentionally developed in a manner that assured that they would be very unlikely to be exceeded.

As is discussed in the Final EIS in the Annex to Appendix D, Ni-63 and Co-60 were both present in the magnetic high temperature corrosion products found at the THRESHER and SCORPION. Fractionation did not occur.

J.62—Summary of Issue

To generate good information on what has happened around SCORPION and THRESHER, the following could apply:

1. Develop a numerical model incorporating release rates, currents, sediment absorption and food chains to guide research at the sites.

2. Monitor the sites, periodically, to quantify unknowns in the above numeric model.

Those Identifying Issue	Identification Number
EPA	694

Response

The small amount of radioactivity found at the SCORPION and THRESHER sites appears to be high temperature corrosion products (crud) that were probably released at the time of sinking. There is no evidence that any measurable radioactivity has been released since these accidents. Therefore, it is not feasible to develop a numerical model for these sites that incorporates actual release rates and food chain effects since there appears to be no ongoing release of radioactivity and there is no detectable radioactivity in the nearby marine life.

The Navy has periodically monitored these sites as discussed in the Annex to Appendix D.

J.63—Summary of Issue

Describe whether the THRESHER and SCORPION reactor compartments are deeply buried.

Those Identifying Issue	Identification Number
EPA	694

Response

In both cases, the submarine wreckage was partially buried.

J.64—Summary of Issue

The EIS should provide more detailed descriptions of the monitoring at the THRESHER and SCORPION debris sites because no evidence is presented that radiological monitoring is being conducted within thousands of feet of either submarine's nuclear reactor.

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin et al.	131b
Mr. Ron Guenther	105a
Dr. Michael J. Herz	37b, 37c
Mr. Thomas C. Jackson	37b
Dr. Ruth Weiner	39a

Response

Figures D-A4 and D-A5 in the Annex to Appendix D in combination with Tables D-A2 through D-A8, provided explicit identification of the locations and types of monitoring done at the two locations. The large black dots labeled "Debris" in the center of the concentric circles in these figures indicated the location of the submarines. Additional data obtained in 1983 at the THRESHER site were added to the Final EIS.

J.65—Summary of Issue

Were water samples at THRESHER and SCORPION sites taken upstream or downstream of the debris?

(Continued on next page)

Those Identifying Issue	Identification Number
EPA	694

Response

The bottom currents in the vicinity of both the THRESHER and SCORPION debris exhibited a tidal influence on direction and velocity. Water samples were taken at downstream and upstream locations at the THRESHER and SCORPION debris sites. Only the downstream sample from the SCORPION site was analyzed for radioactivity. The other samples were used for dissolved oxygen measurements.

The current data and water sample information obtained in 1983 at the THRESHER debris site were added to the Environmental Impact Statement.

J.66—**Summary of Issue**

The current meter data discussed in the site descriptions in Appendix E should include the maximum current velocities observed. In near shore waters, most bottom sediment transport occurs as short-lived, episodic events.

Those Identifying Issue	Identification Number
EPA	694

Response

The information presented in Appendix E is basically a summary of the data available to describe the ocean study areas and is not meant to be an all-inclusive presentation of the data which has been gathered at these sites. The detailed information, including the maximum current meter readings, were presented in the references, such as SAND82-1005.

J.67—**Summary of Issue**

The ocean bottom currents reported in Section IV of Appendix E are given as averages, not maximum values ("worst case storms"). Much of the sea bed material may not be realistic when based on limited samplings and quiet situations.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692

Response

The net long term velocity is one of the basic parameters which define the movement of radionuclides over the distance and time scales necessary to represent the possible transport of nuclides from deep ocean disposal sites to the pathway entry points nearer shore. This value incorporates the effects of all velocities including the maximum as well as the minimum currents and, as such, portrays a considerably more realistic view of the potential nuclide movement in the ocean waters than would be obtained by only using the maximum currents encountered. It should be noted that the velocities reported in the EIS are based upon continuous current meter readings which are some of the most extensive which have ever been obtained at a given site. In general, current meter readings are taken over much shorter time periods and with a much larger spacing between moorings.

J.68—Summary of Issue

Statements that "photographs indicate that the [animal] population density in the ocean study areas is low relative to near-shore areas, with none of the sea life used by man or part of the food chain leading to man . . . are not based on any substantial evidence in this document."

Those Identifying Issue	Identification Number
EPA	694

Response

Many bottom photographs, of which EIS Figures E-4, E-5, E-11, E-13, and E-14 are examples, indicate a relatively low density of bottom-dwelling animals. The animals visible in these photographs have been generically identified and are not used by man. Further, there are no known pathways by which radioactivity can be carried from bottom-dwelling animals to people, and a recent review concluded "the probability of a biological route of low-level radionuclide and metal transfer from the deep-sea bed to man is low" (Reference 1). This is consistent with the view generally accepted by oceanographers (Reference 2) that the bottom waters (14,000 feet) in areas such as the study areas have a very sparse fish population.

References

1. Young, J. S., "Food Web Transport of Trace Metals and Radionuclides from the Deep Sea: A Review," Report PNL-2960, Pacific Northwest Laboratory, June 1979, as quoted and concurred in by Stein, D. L., "Biological Transport and Pathways to Man; Preliminary Results for the Eastern North Pacific," Appendix D of Report SAND 82-1005, September 1982.

2. IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
Joint Group of Experts on the Scientific Aspects of Marine Pollution—GESAMP—, Reports and Studies No. 19, An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea, Vienna, June 1983.

J.69—Summary of Issue

Using manganese occurrences to identify oxic and anoxic conditions in ocean-bottom cores is an excellent approach, but pH and Eh measurements, if available, should be included with the data for confirmation (Appendix E, Section IV.C.6).

Those Identifying Issue	Identification Number
EPA	694

Response

Such measurements are available and were included in the reports for the applicable cruises (Reference E.13, for example).

J.70—**Summary of Issue**

The basic reference for oceanographic techniques is a 1969 engineering handbook (Reference E-4) which does not cover most of the techniques that are briefly described, and does not contain anything approaching a state-of-the-art description of a deep sea ecological study.

Those Identifying Issue	Identification Number
EPA	694

Response

The modern oceanographic techniques and equipment used to support this EIS were reported in detail in Reference E-14. Reference E-4 was provided to give an overview of general concepts for a person not involved in oceanography.

J.71—**Summary of Issue**

"Fish catch per unit effort' is not defined in the text or in the Glossary."

Those Identifying Issue	Identification Number
EPA	694

Response

The term "fish catch per unit effort" was defined in Appendix E, Section IV.C.7 of the DEIS. However, in order to clarify the amount of fish actually caught, the term "fish catch per unit effort" has been deleted from the EIS. Figure E-20 and related discussions in Chapter 3, Section III.C and in Appendix E, Section IV.C.7 have been revised, and now employ the concept "average number of fish landed per year" based on a sampling plan.

J.72—**Summary of Issue**

There is minimal discussion of benthic organisms present in ocean disposal sites and the potential ecological impact on abyssal fauna is not seriously addressed.

Those Identifying Issue	Identification Number
EPA	694

Response

Discussions of the marine life which is present in the ocean study areas is provided in Sections IV.A.7, IV.B.7, and IV.C.7 of Appendix E and references are identified where further information may be obtained. The possible effects on bottom dwelling marine life of radionuclides arising from the disposal of defueled submarines on the deep ocean floor are presented in Secton II.A.3 of Chapter 4. These results indicate that such disposal actions will have no significant impact on marine life at deep ocean disposal sites.

J.73—**Summary of Issue**

The DEIS fails to specify the method for collection of bottom samples taken at the Pacific Study Area (Appendix E, Section IV.C.6).

Those Identifying Issue	Identification Number
Mr. Gordon K. Van Vleck	715

Response

A large North Sea or Aberdeen otter trawl with a 100 ft headrope and 117 ft footrope was used to collect fauna in the bottom waters. As stated in Appendix E, Section IV.C.6 of the DEIS, gravity cores and box cores were used to collect samples of the bottom.

J.74—**Summary of Issue**

Concerning the "bathysaurus fish" shown in Figure E-13 of Appendix E of the DEIS, the document should clearly state how this identification was made because the respondents believe the fish could be a sablefish, based on rudimentary morphometric analysis.

Those Identifying Issue	Identification Number
Mr. Gordon K. Van Vleck	715

Response

Approximately 700 photographs of the sea floor were taken at the Atlantic and Pacific study areas. The task of identifying the benthic megafauna shown on these photographs, and estimating the density of the various species, was undertaken by the Scripps Institution of Oceanography, La Jolla, California.

The fish shown in the cited photograph was tentatively identified as a "Bathysaurus mollus (pisces)" by the cognizant scientist at the Scripps Institution of Oceanography.

J.75—**Summary of Issue**

"Data on the clay-mineral content for both Atlantic and Pacific Ocean study areas should be included to document sorptive properties for radionuclide retention in the sediments."

Those Identifying Issue	Identification Number
EPA	694

Response

Although the sorptive properties of the sediment would undoubtedly have a beneficial effect in reducing the transfer of radioactivity to people, evaluation has shown that radiation exposure to people would be negligibly small, even though the calculations conservatively took no credit for this effect. Since no benefit was claimed for adsorption in the EIS, and since the sediment composition in

(Continued on next page)

the study areas might not necessarily be the same as the composition at an actual disposal site if sea disposal were selected, inclusion of sediment composition data for the study areas was not necessary.

J.76 – Summary of Issue

The Navy must provide a detailed description of plans to implement a sustained monitoring proposal for sea disposal which is adequate in terms of identifying evolving ecological impact, duration of the monitoring effort, and commitment of Navy funds on a long-term basis. Further, the DEIS must reflect the degree of development needed to attain viable deep sea monitoring technology describing the costs and time needed to complete that effort.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Sidney Abbott	153	Mr. Dan Hamburg et al.	72a, 72b
Mr. Patrick Agnello	75	Mr. Doug Hansen	536
Mr. George Balding	77	Mr. Garland Harris	153
Ms. Jane O. Ballus	19	Mr. Jeffery T. Harris	507
Mr. Nathanial S. Bingham	78a	Mr. John P. Harville	290
Ms. Elizabeth Bock	692	Ms. Nancy Haskins	244
Honorable Barbara Boxer	66	Mr. Dan Hauser	67a
Ms. Anne Bringloe	36	Dr. Michael J. Herz	37, 37b, 37c
Ms. Janet P. Brooks	693	Mr. Jeff Hohensee	116
Mr. Thomas D. Brown	178	Mr. Laurence D. Houlgate	295
Mr. Bruce R. Campbell	421	Ms. Torre Houlgate-West	294
Mr. Wesley Chesbro	69	Mr. Thomas C. Jackson	37b, 15
Ms. Linda Childs	202	Ms. Jane Jarrett	245
Mr. Edgar D. Christman	572	Honorable Barry Keene	67, 67a
Mr. Jean S. Christman	572	Mr. Ken Kelley	612
Ms. Deborah L. Clifford	498	Dr. Mary T. Kelly	30
Ms. Barbara Connelly	143	Ms. Lea Lackey-Zachmann	459
Mr. Larry Coolidge	225	Mr. Jim LeCuyer	84
Dr. Ruthann Corwin	112	Ms. Marie Lee	214
Ms. M. R. Crook	230	Ms. Jeanie Lopez	235
Mr. Robert Crook	230	Mr. Doug Lowe	21
Ms. Gretchen Crosson	408	Mr. Jim Marotta-Jaenecke	194
Mr. Kevin Crosson	408	Mr. Ronald E. Martin	219
Mr. Clifton E. Curtis	695	Mr. Karen A. Massey	674
Mr. Jon Daunt	669d	Ms. Laure Mastrella	637
Dr. Jackson Davis	76	Ms. Teresa Matta	382
Honorable Ronald V. Dellums	447	Ms. Rebecca Matthews	693
Ms. Dobie Dolphin et al.	131b	Ms. Maxine McCloskey	689
EPA	694, 694a	Ms. Ellen McCord	274
Ms. S. K. Eanes	454	Mr. Scott McCreary	86
Mr. Wells Eddleman	20	Ms. Linda Miller	682
Mr. Fred Eissler	664	Mr. Gary Moran	368
Mr. Thad Eure	719	Ms. J. B. Morninglight	439
Mr. Herb Everett	371	Ms. Estelle V. Mueller	212
Mr. James Arthur Ferrara	665	Mr. Peter Nahigian	158
Ms. Lydia Raas Ford	326	NOAA	444
Mr. James French	468	Ms. Janet T. Orselli	593
Ms. Melissa Gehrman	16	Mr. Charles Orth	88
Dr. Judith E. Gordon	420	Ms. Jane Smith Patterson	8
Mr. Ron Guenther	105a	Ms. Donna M. Pinkey	360

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Robin Rabens	352	Mr. Marcus Tengesdal	61
Mr. Robert E. Ragland	315	Ms. Jo Ann Thomas	646
Ms. Molly Randall	570	Mr. Clifton Troy Toth	659
Mr. Kendall Reid	479	Unknown	213
Ms. Arlene Reiss	344	Atty. Gen. John K. Van DeKamp	446
Ms. Beverly Roberts	32	Mr. Gordon K. Van Vleck	715
Mr. Arthur J. Rocque, Jr.	697	Ms. Susan Wade	66
Mr. Christopher D. Roosevelt	695	Dr. Ruth F. Wiener	39a
Ms. Sally Rulison	666	Ms. Emily F. Whittlesey	358
Mr. John Runkle	18 or 468	Mr. James Widmeyer	678
Ms. Cathy Ryan	99	Ms. Sharon Winters	479
Mr. Lewis Seiler	707	Mr. G. Nelson Wolfe	104
Ms. Polly Smith	366	Mr. Timothy Zachmann	459
Mr. Randall Stemler	348		
Ms. Sandra Strong et al.	414		

Response

As discussed in the DEIS, a monitoring program would be needed for either land disposal or sea disposal to determine the radiological condition of the disposal site environment. For sea disposal, a monitoring program tailored specifically for each site would be required, following the three-phase plan described in Appendix K (Sections IV.A, B, and C). The estimated cost of monitoring was included in the estimated costs of the sea disposal options in Appendix A (Section III.D.2).

All of the major components of the monitoring program described in Appendix K (Section IV) have been successfully utilized by the Navy and the oceanographic scientific community for a number of years, and would be available for implementing such a monitoring program.

Ongoing monitoring programs at the THRESHER and SCORPION sites have used standard oceanographic techniques, including a manned submersible to collect samples and take measurements and unmanned devices deployed from a surface ship to acquire equivalent information. These programs have demonstrated that monitoring of the ocean floor and waters can be accomplished using surface-deployed sampling equipment and at reasonable cost. A summary of results is reported in the Annex to Appendix D, and a summary of monitoring techniques demonstrated is reported in Appendix K.

The estimated costs of sea disposal monitoring have been provided in Appendix K (Section IV) and in Appendix A (Section III.D.2). The estimated costs include $6 million to qualify a sea disposal site and $9 million to fund the ongoing monitoring program during and after the period of active disposal. The estimated costs were obtained from recent Navy experience with monitoring the THRESHER site, from the experience of knowledgeable oceanographers, and from values published in the literature (Reference K.4, for example).

The scope of the monitoring described in Appendix K is sufficient to indicate the efforts that would be required. The monitoring program would be well-focused in terms of radionuclides which might be significant and where they might be found. The program would include all work needed to determine the radiological condition of the disposal site environment and the impacts of the disposal program.

J.77—Summary of Issue

Planning for post-disposal monitoring should include the effects of currents, topography, and other ocean features.

Those Identifying Issue	Identification Number
EPA	694
Mr. Martin F. Golden	634
Honorable Walter B. Jones	9

Response

Bottom current is a factor in the guidelines for site selection in Appendix E, Section III. Guideline 11 (Bottom current shear stress should not exceed the critical erosional shear stress) is designed to prevent high rates of resuspension of sediments at the site to prevent rapid movement of material. This factor would be measured and evaluated during pre-disposal monitoring. One consideration in this guideline is that monitoring at the disposal site (pre-disposal, during disposal, and after disposal) would benefit from having relatively low bottom currents and stable bottom sediments which would tend to retain material deposited on the bottom, and would provide a sampling medium that would be essentially undisturbed by bottom currents.

Two respondents requested consideration of the effects of turbidity currents in the ocean. Turbidity currents, which tend to sweep sediments seaward from the continental shelf regions, occur in some locations in the oceans. However, these events are relatively rare. For example, in one of the Atlantic Ocean study areas, there is evidence of only four weak turbidity currents occurring in the last 11,000 years. There is no evidence of the passage of such turbidity currents in the other Atlantic Ocean study area or in the Pacific Ocean study area.

Site topography would be a factor in selecting a suitable ocean disposal site and also would be a part of pre-disposal monitoring. This may be seen from the second of the guidelines provided in Appendix E, Section III, which states the requirement for depth at the site to be 4,000 meters or more, derived partially from the fact that topographical gradients tend to flatten below 4,000 m. Further details on the consideration of site topography as a factor in site suitability are provided in Reference K.4 of Appendix K (Monitoring Program). In general, these criteria are intended to facilitate monitoring by ensuring that the site would be susceptible to monitoring.

J.78—Summary of Issue

The appendix on monitoring reflects little detailed planning for the sea disposal monitoring program. There are markedly unequal treatments for the land and ocean options: the discussion of ocean monitoring is inadequate and there is no discussion whether monitoring in the deep sea would be seriously hampered by the lack of data on ecology (Appendix K, Section IV).

Five specific revisions or additions were suggested for use in Sections IV.A and IV.B of Appendix K (Monitoring Program).

Those Identifying Issue	Identification Number
EPA	694, 694a

Response

The Navy does not agree that Appendix K reflects insufficient planning. This Appendix reflects actual Navy experience in monitoring the THRESHER and SCORPION sites and is based upon demonstrated capability.

Since land disposal at the potential DOE sites is an existing and ongoing program, monitoring details exist and were described in Appendices B and K for information as a part of the discussion of land disposal. Data on ecology at the ocean study areas have been acquired and are reported in Reference 3.14. Similar data would need to be acquired to qualify an actual sea disposal site. Such an operation would benefit greatly from the work already completed.

The suggested changes related to very specific perceived needs to acquire information about background levels, geochemical and biological processes, and specific activities, and to the use of a grid around the submarine. Such details are beyond the scope of an assessment of potential environmental impacts, and would not enhance the assessment or modify the conclusions regarding the environmental impacts, the scope of the monitoring program, or its estimated costs.

J.79—Summary of Issue

Institutional impediments to conducting such a long-term monitoring project for sea disposal were not explored in the DEIS. Institutions charged with the responsibility to monitor a sea disposal site might not do so for as long as they should, and reference was made to a 400-year period.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695	Mr. Thomas C. Jackson	15, 15a, 37b
Mr. Wells Eddleman	20	Mr. Arthur J. Rocque, Jr.	697
Dr. Michael J. Herz	37b	Mr. Christopher D. Roosevelt	695

Response

As was discussed in Appendix K, monitoring would be needed very infrequently after the period of active disposal if early monitoring would corroborate the Navy's analysis of the submarines' containment features. Institutional controls, such as the performance of monitoring, are expected to continue satisfactorily during the period after disposal when containment is expected to be effective and the bulk of the radioactivity is simply decaying in place.

Peak release rates are not expected to occur before 400 years after disposal at which time less than 2 percent of the initial radioactivity would remain in the submarines. The peak annual release would be approximately 46 curies (Table G-2). This is less than the IAEA annual limit of 10^7 curies by more than 5 orders of magnitude. The duration of releases in excess of half the peak value was estimated to be 340 years (Figure G-2). This is less than the IAEA assumption of 40,000 years at the IAEA limiting value by more than a factor of 100 (Appendix G, Section III.A.1). On this basis, the concern for institutional impediments is considered unwarranted.

J.80—Summary of Issue

The Navy's proposal to determine the frequency of post-disposal monitoring based on initial results—results from a period when the DEIS predicts no release of radioactivity to the marine environment—is clearly inadequate (Appendix K, Section IV.C).

(Continued on next page)

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher D. Roosevelt	695

Response

The initial results from monitoring surveys performed after commencement of disposal operations would determine if significant concentrations of radionuclides were present in the environment near the submarines. If the concentrations were found to be consistently extremely low, as would be expected from the environmental assessment, there would be no need to continue monitoring so frequently because the concentrations would be expected to remain low. This means that the frequency of these ongoing surveys could be adjusted to that required to assure that no unanticipated event had resulted in increased releases and to maintain confidence in the continued safety of the environmental conditions.

J.81 — **Summary of Issue**

Specific attention must be given to locating monitoring stations for sea disposal within 25 meters of the reactor compartment and in a network of sites where the plume of radioactivity from a submarine can be monitored.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Thomas C. Jackson	15a
Mr. Christopher D. Roosevelt	695

Response

The monitoring results at the THRESHER and SCORPION sites which are discussed in the Annex to Appendix D clearly indicate that this capability already exists.

J.82 — **Summary of Issue**

The DEIS should provide cost data associated with monitoring the THRESHER and SCORPION to provide a means to evaluate monitoring costs for sea disposal.

Those Identifying Issue	Identification Number
EPA	694

Response

The cost of the most recent survey of the THRESHER site is included in Appendix K. These actual costs were considered in developing the projected costs of an ongoing monitoring program which are included in Appendices A and K.

J.83—**Summary of Issue**

Trapping should not be relied upon as the only means of monitoring sea disposal sites (Appendix K). A minimal monitoring program should also sample the macro and meiofauna in and on the sediment.

Those Identifying Issue	Identification Number
Ms. Camilla Ingram	686

Response

Trapping was identified in the DEIS as a typical action for collecting fish and benthic invertebrates (Appendix K, Section IV.A). Other techniques have been used and would be available for use in monitoring, including the collection of macrofauna and meiofauna from the sediment. As a part of the oceanographic studies performed in support of the assessment of sea disposal, mid-water trawls, benthic/bottom trawls, and surface sediment samples were obtained and analyzed. The results are summarized in the Biology section of Reference 3.14 and details are available in the companion volume. During recent sampling at the THRESHER site, as reported in the Final EIS (Section IV.E of the Annex to Appendix D), hundreds of macro and meiofauna were collected and analyzed for gamma emitting radionuclides.

J.84—**Summary of Issue**

There should be some provision for special monitoring if an accident related to sea disposal occurs (Appendix K, Section IV).

Those Identifying Issue	Identification Number
Mr. Martin F. Golden	634

Response

If the sea disposal option were chosen, there would be provisions for special monitoring if an accident were to occur during the disposal process.

J.85—**Summary of Issue**

The SEAWOLF reactor vessel, which was disposed of at sea in the late 1950's, cannot be found. The inability to find and monitor the SEAWOLF reactor vessel raises doubts about whether the Navy would be able to locate and adequately monitor submarines disposed of in the ocean.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Janet R. Brooks	693	Mr. Charles Orth	88
Mr. Clifton E. Curtis	695	Mr. James Puckett	38
EPA	694	Mr. Christopher D. Roosevelt	695
Mr. Ken Kelly	612	Mr. Stuart Robert Smith	54
Ms. Rebecca Matthews	693	Mr. Arthur Wang	159

(Continued on next page)

Response

The Navy would be able to monitor submarines disposed of in the ocean. As stated in Appendix D, Section IV.B of the DEIS, the location of the disposed submarines would be carefully determined by sonar systems during emplacement. Through the use of this instrumentation, the submarine's final location can be determined accurately.

When the SEAWOLF reactor vessel was disposed of in 1958, no such instrumentation was available to pinpoint its location. In addition, the barge which carried the SEAWOLF reactor vessel was much smaller and harder to find than an entire submarine. The Navy has been able to locate and monitor both the THRESHER and the SCORPION.

SECTION K

This Section (K.1 —K.14) contains issues related to Chapter 4, Section I of the Environmental Impact Statement.

K.1 —Summary of Issue

The DEIS should indicate in Table 4-1 that "total release over all time" includes the effect of radioactive decay before and during release time.

Those Identifying Issue	Identification Number
EPA	694

Response

The suggested addition to the table is not necessary since the point is obvious by comparison to Table 1-1. Also, the text on Page 4-2 which discusses Table 4-1 states that "all but the longest lived radionuclides will have decayed to stable form before any release can occur."

K.2 —Summary of Issue

It should be mentioned in Section I.A.2(b) of Chapter 4 that Niobium-94 will also be released in the long term with Nickel-59.

Those Identifying Issue	Identification Number
EPA	694

Response

Table 4-1 shows the releases of all nuclides, including Nickel-59 and Niobium-94. In Section I.A.2(b) of Chapter 4, immediately after the statement that 118 curies of Nickel-59, per reactor compartment, would eventually be released, the DEIS continued as follows: "The maximum annual releases of all nuclides, and the corresponding releases over all time, are shown in Table 4-1 below." This discussion is considered to provide adequate mention of the nuclides other than Nickel-59.

K.3 —Summary of Issue

The DEIS assumes that Ni-59 is the dominant nuclide for the land disposal option, contrary to the current understanding that Nb-94 will dominate after several decades.

Those Identifying Issue	Identification Number
Mr. William A. Lochstet	443

Response

The "current understanding that Nb-94 will dominate" is based on the direct radiation dose rate in close proximity to (one cm distant, in air) some irradiated components, as is shown for example in

(Continued on next page)

Figure 7.4-1 of NUREG/CR-0130 Volume 1 (Reference 1), which shows that the dose rate from Nb-94 is twenty times that of Ni-59 and is governing after the Co-60 has decayed in about 90 years. However, there is a significant difference in the relative abundance of the two nuclides between Naval plants and commercial plants: the Ni-59 is more than 10 times more abundant, relative to Nb-94, in naval plants than in the referenced commercial plant. Furthermore, only in the case of the so-called "agricultural intruder" is direct radiation a factor. This person is assumed to come on the site after several thousand years have passed. By this time the reactor pressure vessel and its contents are assumed to have disintegrated from corrosion, leaving the corrosion products distributed in the ground. Unaware of the previous use of the site, he is assumed to live there and eat food grown on the site. In this case the calculated exposures from Ni-59 and Nb-94 are comparable. In all other cases, where exposure to radiation would come from ingestion of radioactivity released by corrosion, Ni-59 is more significant than Nb-94. In all cases, as shown in Appendix C, the radiation exposure from both nuclides is small.

Reference

1. R. I. Smith, G. J. Konzek, & W. E. Kennedy, Jr., "Technology, Safety, and Costs of Decommissioning a Referenced Pressurized Water Power Station," June 1978.

K.4—Summary of Issue

Would the delay times in the DEIS of 200 years for reactor compartment penetration, and several thousand years for the reactor vessel to remain intact, apply for land burial or sea disposal?

Those Identifying Issue	Identification Number
Mrs. A. E. Wasserback	703

Response

The cited delay times are a part of Chapter 4, Section I, "Land Disposal Option", and are included in a discussion of the potential release of radioactive material associated with land burial.

K.5—Summary of Issue

1970 Census data were used. Why was the current data not used?

Those Identifying Issue	Identification Number
Mr. James Widmeyer	678

Response

Current data (1980 census) were used in most cases. Note that Reference 3.13 (or 4.19) is the "Statistical Abstract of the United States (1980)." Census figures for 1970 were extrapolated to 1982 for the purpose of updating the estimated population within 50 miles of the Hanford waste management area (page 3-1) and within 50 miles of the center of the Savannah River Plant (page 3-4) because such specialized population data were not available at the time the DEIS was prepared. The population growth rates of two percent per year (Hanford area) and 1.5 percent per year (Savannah River area) were taken from the 1980 data (Reference 3.13), so the extrapolated populations are considered to be acceptably accurate.

K.6—Summary of Issue

"The advantage of increasing the compartment bulkhead thickness to match the integrity of the hull should be considered for the land disposal option."

Those Identifying Issue	Identification Number
Mr. Wm. F. Danielson	691

Response

The bulkhead is conservatively estimated in Chapter 4, Section I.A.2.b. to remain intact for at least 200 years in land burial and the reactor vessel for an additional several thousand years. Appendix C, Section III.F shows that the conservatively calculated radiation exposure to an average exposed individual would be very small, about 0.006 mrem per year of exposure. Therefore, the bulkhead thickness is considered more than adequate.

K.7—Summary of Issue

The possible effects from land disposal of heavy metals should be addressed. (Section I.A.3(c) of Chapter 4).

There is insufficient data in Chapter 4 and Appendix F to verify independently that corrosion of lead shielding in land disposal would not result in maximum concentrations of lead in wells and streams that exceed EPA water quality standards (Chapter 4, Section I.A.3(c)).

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS discussed the fact that heavy metals such as lead, nickel, chromium, cobalt, and cadmium would be buried in the land disposal option. As stated in Section I.A.3(c) of Chapter 4, the disposal of all non-radioactive solid waste would be consistent with normal practice at the land burial sites and the end result would be at least as good as other available means for disposing of this material.

The corrosion rate of lead, the method for calculating the maximum concentration in ground water, and the EPA water quality criteria were provided in the DEIS (Chapter 4, Section I.A.3(c), and Appendix F, Section III.D.1).

Metallic lead, such as lead pipe and lead shielding, is not considered to be a hazardous waste. It is not listed as a hazardous waste on the list of hazardous wastes published by EPA in conjunction with the Resource Conservation and Recovery Act (RCRA) (Federal Register, May 19, 1980). It also would not be expected to exhibit any of the characteristics of hazardous waste, including the toxicity characteristic (extraction procedure) (EPA Office of Water and Waste Management, SW-853, 1980).

K.8—Summary of Issue

The DEIS does not adequately discuss the interaction between sorptive minerals of soils or ocean sediments and radionuclides. Long-term considerations should include both the natural barrier and the interaction of components of the geologic media with the corrosion products taken into solution in groundwater.

Those Identifying Issue	Identification Number
EPA	694

Response

The EIS does not take credit for any mechanisms that would retard and thus diminish the movement of radionuclides released after disposal, through absorption on soil particles, deposition in ocean floor sediments, or removal by other means. This approach is conservative and consistent with the objective of stating environmental consequences in terms of upper limits of the effects. The EIS generally takes two separate conservative analytical approaches. In one, all radioactive material is assumed to be deposited in sediment close to the disposal site and available to the possible pathways to man. In the second, no deposition of radioactive material is assumed to occur at the disposal site so that a maximum fraction of the material can be transported by water to the beginning point of the possible pathway.

K.9—Summary of Issue

The DEIS should consider the possibility of putting a man-made aquifer beneath the land burial area that would facilitate monitoring any leakage of radioactive material and stopping it before it gets any further.

Those Identifying Issue	Identification Number
Mr. Charles B. Williams	688

Response

Existing monitoring facilities are judged adequate for protection of the public without the need for a man-made aquifer.

Extensive exploratory drilling, routine surveillance wells, laboratory tests with SRP soils, and thirty years of experience at SRP have shown that actual radionuclide movement from buried, low-level waste has been minimal.

Actually, it has been observed that adsorption by the soil will greatly retard the motion of released radioactivity to groundwater and streams to the adjacent Columbia River (at Hanford) or the Savannah River at the Savannah River site. But even though the EIS in Chapter 3, Sections I.A and I.B conservatively assumed that all the radioactivity released by corrosion would enter the river immediately, the resulting radiation exposure to people would be negligible (0.006 mrem per year to the average exposed individual), much less than the normal variation in background radiation level.

It is doubtful that introducing a man-made aquifer beneath the land burial area but above the water table would be feasible. This would require that an impervious layer be inserted, underground, to prevent the added water from reaching the water table. It would also require that all the water added to the man-made aquifer be collected and purified in order than none of the leached radioactivity reach the river by moving horizontally past the edges of the added impervious layer.

K.10—Summary of Issue

The characteristics of the dredge spoil from construction of the barge slip at Savannah River should be considered in the final EIS.

Those Identifying Issue	Identification Number
NRC	445a

Response

Implementation of the land disposal option at the Savannah River Plant would require construction of a barge slip (Chapter 4, Section I.A.3(e)) and excavation of the slip and dredging of the river bottom for depth continuity would require disposal of approximately 7800 cubic yards of material. The excavated material would be placed in an upland area where no runoff from this mass would reach the river. The dredge spoil would be discharged into the river if hydraulic dredges were used, or into land disposal areas if bucket dredges were used. Neither action would cause any irreversible, adverse impact to the floodplain or wetlands because this material is simply river-bottom sediment, identical to the sediment already in the river, but it would temporarily increase turbidity and sedimentation in the river without significant consequence (Appendix L, Section IV.A). If sediments from hydraulic dredges are discharged into the river, this would be timed to avoid spawning periods of important aquatic biota. See also response to Issue E.10.

K.11—Summary of Issue

"Was consideration given to the placement of barriers in the soil around the submarines [for land disposal] to reduce the migration of corrosion products"?

Those Identifying Issue	Identification Number
EPA	694a

Response

Since the heavy steel walls of the submarine pressure hull and bulkheads provide a barrier lasting for decades, and the thick walls of the reactor pressure vessel and components provide additional barriers to the release of radioactivity from corrosion of the corrosion resistant alloys inside the reactor vessel, no added barriers are considered necessary.

K.12—Summary of Issue

Very little information is provided on external radiation fields, either within or without the reactor compartment.

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

The external radiation information provided in Chapter 4, Section I.A.2 and Section II.A.3, and in Appendix C, Section IX, is adequate to assess possible environmental impacts and compliance with applicable regulations for land or sea disposal.

K.13—Summary of Issue

The external radiation exposures associated with land disposal are not trivial when longer exposure times and closer proximities are considered.

Those Identifying Issue	Identification Number
Dr. Judith E. Gordon	420

Response

Radiation levels outside the reactor compartment during normal transport would be in compliance with the criterion specified in 49CFR173 that exposures be 10 mrem per hour or less at 6 feet from the package (Appendix B, Section III.F.2.).

The respondent provided sample calculations which assumed continuous exposure by one individual six feet away from the reactor compartment for a 60-day shipping time. This would not be realistic because there is no need for anyone to be in that location for that length of time nor would anyone actually do so. In a second case, the respondent assumed continuous exposure to an individual for the entire first year at the burial site location. This would not be realistic either.

K.14—Summary of Issue

The barge accident rate used in the Draft Environmental Impact Statement should be higher (9.3 per million miles vs 5.8 per million miles used in DEIS).

Those Identifying Issue	Identification Number
Dr. Marvin Resnikoff	13b.

Response

The difference between the two rates cited above is that the lower rate is based on cargo barge accidents (page 5-16 of Reference 4.1 of the DEIS). The lower rate, as used in the DEIS, is appropriate. However, the particular value used is of minor significance, for if the higher rate were used (on page 4-7 of the DEIS), the calculated number of accidents for the entire program of shipping 100 reactor compartments via barge would be 0.5 instead of 0.3.

Of greater interest is the fact that only about 0.03% of the accidents that occurred are in the "severe" or "extra-severe" categories (page 5-19 of Reference 4.1). Therefore, the calculated number of serious barge accidents for the entire program is (0.3) × (.0003) or 0.00009, implying that there would be a very small probability of a serious barge accident throughout the entire land disposal program. This information has been added to Chapter 4, Section I.B.2.(c) of the Final EIS.

SECTION L

This Section (L.1—L.64) contains issues related to Chapter 4, Section II of the Environmental Impact Statement.

L.1 — Summary of Issue

The information necessary to determine the acceptability of sea disposal is inadequate at this time.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Natasha Atkins	167	Ms. Karen A. Massey	674
Mr. Brian Baird	55	Ms. Teresa Matta	382
Ms. Rebecca Batell	135	Ms. Rebecca Matthews	693
Honorable Barbara Boxer	66	Ms. Maxine McCloskey	689
Ms. Janet P. Brooks	693	Ms. Ellen McCord	274
Dr. Gordon L. Chan	85	Mr. Jonathon McHugh	87
Mr. Wesley Chesbro	69	Mr. Bruce Meacham	512
Ms. Gretchen Crosson	408	Ms. Dena Mossar	442
Mr. Kevin Crosson	408	Mr. George D. Noble	333
Mrs. Jim Culberson	457	Ms. Ivana Noell	645
Mr. Clifton E. Curtis	695	Ms. Janet T. Orselli	593
Dr. Jackson Davis	76	Ms. Morere Paradise	85
Ms. Dobie Dolphin et al.	131b	Mr. Gregory E. Parker	523
Mr. John R. Donaldson	461	Ms. Rebecca Paterson et al.	631
Mr. Fred Eissler	664	Ms. Jane Smith Patterson	8
EPA	694	Mr. Walbridge J. Powell	448
Mr. Thad Eure	719	Mr. Daniel F. Read	12
Ms. Judith Evered	71	Mr. Kendall Reid	479
Ms. Donna Feiner	280	Ms. Carole Roberts	516
Mr. James Arthur Ferrara	665	Mr. Arthur J. Rocque, Jr	697
Ms. Melissa Gehrman	16	Mr. Christopher D. Roosevelt	695
Mr. Conrad F. Golich	713	Ms. Joyce Rosenthal	13a
Ms. Theresa L. Greenlaw	535	Ms. Cathy Ryan	99
Mr. Ron Guenther	105a	Mr. Don Schrader	416
Mr. K. Hackett	450	Mr. Gary Schudel	451
Mr. Dan Hamburg et al.	72, 72a	Mr. Lewis Seiler	707
Ms. Christine Harmony	311	Mr. George L. Sosson	496
Mr. Jeffery T. Harris	507	Mr. Edward D. Smith	429
Ms. Alicia Heim	460	Ms. Janet I. Tatz	410
Ms. Louise M. Henry	426	Ms. Barbara Toshalis	384
Dr. Michael J. Herz	37b	Atty. Gen. John K. Van DeKamp	446
Mr. Thomas C. Jackson	37b	Mr. Gordon K. Van Vleck	715
Mrs. Jaman	453	Ms. Kathleen Walden	629
Ms. Carol H. Jones	437	Mr. Arthur Wang	159
Dr. Robert Kay	373	Mrs. A. E. Wasserbach	703
Mr. Ken Kelley	612	Mr. Daniel Wells	185
Dr. Mary T. Kelly	30	Ms. Sharon Winters	479
Ms. Lea Lackey-Zachmann	459	Mr. G. Nelson Wolfe	104
Mr. Mike Landen	569	Mr. Ronald Yoerger	418
Mr. Jim LeCuyer	84	Mr. Timothy Zachmann	459

(Continued on next page)

Response

This EIS is not intended to identify or designate specific ocean sites. If ocean disposal were pursued, a site specific environmental evaluation would be performed.

Sufficient information was collected to characterize the important impacts of ocean disposal. The reader is referred to DEIS Appendices D and E and Reference 3.14 for information about the characteristics of the ocean study areas, and to Appendices F through J for a complete description of the way this information was used to estimate the radiation exposure that could result from ocean disposal. To assure that the evaluation was conservative, worst-case type analyses were performed. The worst-case evaluation coupled with the very small potential exposures effectively demonstrates that additional information is not required for this conceptual evaluation.

L.2—Summary of Issue

Does the fact that any fishing is done in the Pacific Study area preclude its potential use as a disposal site?

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
EPA	694
Ms. Camilla Ingram	686
Mr. Christopher D. Roosevelt	695
Mr. James Widmeyer	678

Response

The applicable IAEA requirement (Reference 1) refers to avoiding areas where there are potential sea-bed resources which might be mined or harvested or could enter the food chain to man. However, since the EPA would have to designate an ocean disposal site, it is not possible to state at this time whether a small amount of fishing at shallow depths would preclude the designation of a particular area as a disposal site.

Reference

1. IAEA INFCIRC/205/Add. 1/Rev. 1, para. C.2.1(5), which reads "Areas shall be avoided that have potential sea-bed resources which may be exploited either directly by mining or by the harvest of marine products, or indirectly (e.g., spawning) as feeding grounds for marine organisms important to man."

L.3—Summary of Issue

Disposal of nuclear wastes on the ocean floor would preclude other possible uses of the disposal site, such as sea floor mining, raising lobsters in captivity, raising kelp, etc.

Those Identifying Issue	Identification Number
Ms. Maxine King	465

Response

In accordance with IAEA Requirement 5 in Section II.A of Chapter 3, disposal would avoid ocean areas that have potential seabed resources which may be exploited either directly by mining or by harvest of marine products or indirectly as spawning or feeding grounds for marine organisms important to man. The impact of designating disposal sites is discussed in Chapter 4, Section II.A.1.

L.4—**Summary of Issue**

"The proposed ocean option breaches and is in conflict with published national and international regulations relating to ocean dumping."

Those Identifying Issue	Identification Number
Mr. Dan Hamburg et al.	72b

Response

The Navy was required under Council on Environmental Quality regulations to include all practicable options in any environmental assessment. The DEIS did not propose any specific option.

As discussed in Section II.A.2 in Chapter 4 of the EIS, the ocean disposal option is consistent with current U.S. and international regulations, including the recent amendment to the Marine Protection, Research, and Sanctuaries Act. It is not prohibited and is, in fact, specifically permitted, subject to compliance with established requirements.

L.5—**Summary of Issue**

There appears to be no regulatory structure to control ocean disposal of low level radioactive wastes.

Those Identifying Issue	Identification Number
Ms. Jane Smith Patterson	8
Ms. Joyce Rosenthal	13a

Response

The U.S. Environmental Protection Agency is responsible for administering the regulations pertaining to ocean disposal of low level radioactive wastes under U.S. law and international agreement. See Chapter 4, Section II.A.2 for additional information.

L.6—**Summary of Issue**

The effects of previous U.S. disposal of radioactive waste at sea should be considered in the Environmental Impact Statement.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Patrick Agnello	75	Ms. Christine Berchen	381
Ms. Ruth J. Albertson	663	Mr. Mark Berkich	106
Ms. Natasha Atkins	167	Ms. Elizabeth Bock	692

(Continued on next page)

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Marlene Boone	109	Ms. Laura Maguire	524
Ms. Janet P. Brooks	693	Mr. Ted Mahr	47
Mr. Bruce R. Campbell	421	Ms. Teresa Matta	382
Mr. Michael Carney	660	Ms. Rebecca Matthews	693
Mr. Greg Carr	672	Lt. Governor Leo McCarthy	65
Mr. Wesley Chesbro	69	Ms. Susan Moretta	328
Ms. Carolyn J. Christman	200	Ms. Bettye Myers	462
Ms. Laura Compton	300	Ms. Janet T. Orselli	593
Ms. Rainbow Trout Cornelia	308	Mr. Charles Orth	88
Dr. Ruthann Corwin	112	Mr. Gary W. Owen	210
Mr. Jon Daunt	669b, 669c	Ms. Mary T. Phillips	207
Dr. Jackson Davis	76	Mr. Robert E. Ragland	315
Honorable Ronald V. Dellums	447	Ms. Arlene Reeves	487
Ms. Dobie Dolphin et al.	131b	Ms. Joyce Rosenthal	13a
Mr. Peter Douglas	68a	Mrs. M. M. Rowland	534
Mr. Robert Eidus	23	Ms. Cathy Ryan	99
Ms. Judith Evered	71	Ms. Janice Ryavec	673
Ms. Donna Feiner	280	Mr. Robert S. Sanyak	413
Mr. Conrad F. Golich	713	Mrs. Marian E. Scully	495
Ms. Theresa Greenlaw	535	Mr. Lewis Seiler	707
Mr. Carlos Gross	636	Ms. Polly Smith	366
Mr. Wm. J. Haber	389	Mr. Stuart Robert Smith	54
Mr. Dan Hamburg et al.	72, 72a, 72b	Mr. George L. Sosson	496
Mr. Garland Harris	337	Mr. John Teller	390
Dr. Michael J. Herz	37	Kelly Townsend	503
Mrs. Jaman	453	Ms. Sheila Tracy	129
Ms. Jane Jarrett	245	Mayor Bruce Van Allen	607
Mr. Ken Kelley	612	Atty. Gen. John K. Van DeKamp	446
Ms. Maxine King	465	Ms. Edith Webber	211
Ms. Judy Koretsky	376	Mr. James Widmeyer	678
Mr. Jim LeCuyer	84	Mr. Michael Winks	701
Mr. Nelson Lindley	476		

Response

Previous disposal of radioactive waste into the ocean has caused much controversy, but testimony by the Environmental Protection Agency (Reference 1) and a recent report by the General Accounting Office (Reference 2) have stated that there is no evidence that any harm to the environment or humans has resulted from those disposals.

The Navy was aware of these results and took them into consideration during preparation of the DEIS. However, the previous U.S. disposal of radioactive waste at sea has not been discussed in this Environmental Impact Statement because it is not considered to be useful for assessing the possible environmental impacts of submarine reactor plant disposal. The materials and form of the waste involved in the previous disposal were different from the thick activated metal involved in submarine reactor disposal and the radionuclides were generally different so the chemical and physical behavior of the radioactive atoms would be different. Also, the containments provided for the submarine reactor plants would be superior to that in previous disposals and the sites would be much deeper and further from any possible interaction with human activities. Such major differences led to the conclusion that previous disposals at sea could not be used as the basis for evaluating submarine reactor plant disposal.

References

1. Hearing on Radioactive Waste Disposal Oversight, U.S. House of Representatives, Subcommittee on Oceanography, Committee on Merchant Marine and Fisheries, Thursday, November 20, 1980.

2. Report by the U.S. General Accounting Office, "Hazards of Past Low-Level Radioactive Waste Ocean Dumping Have Been Overemphasized," EMD-82-9, October 21, 1981.

L.7—Summary of Issue

The cumulative effects of submarine disposal when added to past, present, and reasonably foreseeable future ocean disposal of radioactive waste should be evaluated in the EIS.

Those Identifying Issue	Identification Number
Mr. George Balding	77
Mr. Nathaniel S. Bingham	78
Ms. Elizabeth Bock	692
Honorable Barbara Boxer	66
Ms. Janet P. Brooks	693
Mr. Greg Carr	672
Ms. Carolyn J. Christman	200
Dr. Ruthann Corwin	112
Mr. Joe Cucchiara	608
Mr. Clifton E. Curtis	695
Ms. Randi Dalton	161
Honorable Ronald V. Dellums	447
Ms. Dobie Dolphin et al.	131, 131b
Mr. Peter Douglas	68a
Mr. Wells Eddleman	20
Mr. Fred Eissler	664
Mr. James Arthur Ferrara	665
Mr. Ronald Glick	115
Mr. Ron Guenther	105a
Mr. Dan Hamburg et.al.	72, 72a, 72b
Mr. Jeffery T. Harris	507
Mr. Dan Hauser	67a
Dr. Michael J. Herz	37b
Mr. Thomas C. Jackson	15b, 37b
Honorable Barry Keene	67
Dr. Mary T. Kelly	30
Mr. Doug Lowe	21
Ms. Karen A. Massey	674
Ms. Teresa Matta	382
Ms. Rebecca Matthews	693
Mr. Scott McCreary	86
Ms. Dena Mossar	442
NOAA	444
Ms. Ivana Noell	645
Ms. Janet T. Orselli	593
Mr. James Puckett	38
Mr. Kendall Reid	479
Dr. Marvin Resnikoff	13b
Mr. Christopher D. Roosevelt	695a
Ms. Joyce Rosenthal	13a, 13b
Mr. Ron Shehee	407
Unknown	213
Atty. Gen. John K. Van DeKamp	446
Mrs. A. E. Wasserbach	703
Dr. Ruth Weiner	39a
Mr. Greg Wellish	103
Ms. Sharon Winters	479

Response

The incremental environmental impact of disposal of all one hundred submarine reactor plants at one ocean disposal site would be so small that there would be no significant cumulative impact resulting from this action. For example, based on very conservative calculation, the effects of ocean disposal might produce at most an incremental exposure of 0.0002 millirem/year to a typical member of the population most directly affected. This potential exposure is very small in comparison to fluctuations in exposure resulting from variations in individual activities and geographic location. The EIS has demonstrated that there is no potential for submarine disposal to contribute to a significant cumulative impact. Since such potential does not exist, the requirements of 40CFR1508 are satisfied. Section II.C has been added to Chapter 4 in the EIS to explain this point.

L.8—Summary of Issue

The cumulative impact of several dozen reactor vessels situated in relatively close proximity remains uncertain.

Those Identifying Issue	Identification Number
Ms. Mary Sue Noe	2

Response

Chapter 4 provides a detailed description of the potential environmental consequences resulting from the permanent disposal of approximately 100 defueled submarines at one site.

L.9—Summary of Issue

A decision to employ ocean disposal by the Navy would be followed by further domestic licenses for other radioactive waste. The DEIS should analyze the type and quantities of waste that would be disposed of.

Those Identifying Issue	Identification Number
Mr. Patrick Agnello	75
Mr. Alfred W. Anderson	493
Mrs. B. C. Andrews et al.	264
Ms. Jane O. Ballus	19
Ms. Jennie Barnhardt et al.	240
Dr. H. Wayne Beam	339
Mr. Vincent J. Bellis	255
Mr. James F. Berry	22
Ms. Elizabeth Bock	692
Honorable Douglas H. Bosco	66
Mr. Greg Carr	672
Ms. Kimberly J. Christman	671
Mr. Paul Clemmons	387
C. A. Collicutt	330
Ms. Rainbow Trout Cornelia	308
Dr. Ruthann Corwin	112
Mr. William Crooks	114
Mr. Clifton E. Curtis	695
Mr. Jon Daunt	669
Dr. Jackson Davis	76
Mr. Peter Douglas	68a
Mr. Fred Eissler	664
Ms. Donna Feiner	280
Mr. John K. Flynn	545
Ms. Melissa Gehrman	16
Mr. Conrad Golich	713
Mr. William E. Gramley	656
Ms. Theresa L. Greenlaw	535

Those Identifying Issue	Identification Number
Mr. John P. Harville	290
Mr. Dan Hauser	67a
Ms. Jeane L. Heard	209
Dr. Michael J. Herz	37
Mr. Keith Houck	301
Honorable Walter B. Jones	9
Honorable Barry Keene	67
Mr. Ken Kelley	612
Ms. Karen A. Massey	674
Ms. Teresa Matta	382
Ms. Maxine McCloskey	689
Mr. Bruce Meacham	512
Mr. Dick Myers	148
Mr. Peter Nahigian	158
Ms. Ivana Noell	645
Ms. Julie Kay Norman	709
Mr. Thomas D. O'Neil	80
Mr. Charles Orth	88
Ms. Jane Smith Patterson	8
Mr. James Puckett	38
Mr. Robert E. Ragland	315
Ms. Karen Rakofsky	272
Mr. Daniel F. Read	12
Mr. Kendall Reid	479
Ms. Arlene Reiss	344
Mr. Christopher D. Roosevelt	695
Ms. Joyce Rosenthal	13
Ms. Sally Rulison	666

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. John Runkle	468	Tortuga Vine	266
Mr. Lewis Seiler	707	Mr. Don Weber	231
Ms. Jane Sharp	14	Mr. Don R. Weber	242
Mr. Ron Shehee	407	Ms. Linda Weber	231
Ms. Elizabeth A. Sickinger	367	Mr. Greg Wellish	103
Mr. Eric Simmons	59	Mr. Michael Winks	701
Mr. Kelly Townsend	503	Ms. Sharon Winters	479
Atty. Gen. John K. Van DeKamp	446	Ms. Pamela Wooten	268

Response

It is impossible to predict whether a Navy decision to pursue ocean disposal would lead to ocean disposal permit requests by other individuals or organizations. Furthermore, the Navy can not predict what action the EPA would take on these requests. Therefore, such an analysis would not be possible. By law, any proposed disposal would be evaluated on its merit, independent of the disposition of the submarines.

L.10—Summary of Issue

The DEIS should consider adverse synergistic effects.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Dr. Ruthann Corwin	112
Mr. Peter Douglas	68a
Ms. Ivana Noell	645
Atty. Gen. John K. Van DeKamp	446

Response

No evidence for synergism among radiation effects is known; i.e., the total effect of radiation exposure from several sources is simply the sum of the individual effects. The United Nations Scientific Committee on the Effects of Atomic Radiation has reviewed in depth the possibility of synergism between radiation and other physical, chemical, and biological agents. Its 1982 report, Ionizing Radiation: Sources and Biological Effects (UNSCEAR 1982), states, on page 32:

> Except for the case of tobacco smoke, which may act synergistically with radiation in producing lung cancers under some working conditions, this study has been unable to document in man any clear case of interaction, at least of the kind which may result in substantial modifications of the estimates of risk for significant sections of the population.

As emphasized in the DEIS, the potential exposure from ocean disposal of submarines is insignificant when compared to background radiation or even to variations in background radiation due to altitude, types of soil, and human activities (for example flying). Simply stated, the potential exposure from ocean disposal is so small that even the concept of synergistic effects between radiation and biological and chemical constituents in the environment does not have a practical relevance to ocean disposal.

L.11—Summary of Issue

A section titled "Endangered and Threatened Marine Species" should be added to the EIS.

Those Identifying Issue	Identification Number
NOAA	444

Response

Effects of disposal on marine life at a possible disposal site were described in Chapter 4, Sections II.A.3(a) and II.A.4(b) of the DEIS and are estimated to be minimal. This is corroborated by the healthy marine life observed and sampled at the THRESHER and SCORPION sites. No endangered or threatened marine species are known or expected to exist at the sorts of areas which might be considered for the ocean disposal option.

L.12—Summary of Issue

The DEIS should estimate ranges of dosages to deep sea fauna and provide degrees of uncertainty based on the available data.

Those Identifying Issue	Identification Number
EPA	694

Response

The range of dosage to deep sea fauna attributable to submarine sea disposal has been estimated as zero to less than 9 rad per year and was described in Chapter 4, Section II.A.3. The degree of uncertainty in the estimated values can be understood by considering the very conservative basis of the calculation such as the assumption that the fauna live continuously in the reactor compartment within four feet of the reactor vessel.

L.13—Summary of Issue

The effect of radioactivity on organisms has to be evaluated for the sea disposal option.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Jane O. Ballus	19	Ms. Maxine McClosky	689
Ms. Janet P. Brooks	693	Mr. Charles Orth	88
Dr. Gordon L. Chan	85	Ms. Morere Paradise	85
Dr. Ruthann Corwin	112	Mr. Arthur J. Rocque, Jr	697
Ms. Randi Dalton	161	Mr. Lewis Seiler	707
EPA	694	Mr. Eric Simmons	59
Ms. Jeane L. Heard	209	Kelly Townsend	503
Ms. Lea Lackey-Zachmann	459	Mr. Gordon K. Van Vleck	715
Ms. Rebecca Matthews	693	Mr. Timothy Zachmann	459

Response

The possible effects on bottom-dwelling sea life associated with radiation from the submarines and from corrosion products deposited in the sediment near the submarines were described in Chapter 4, Section II.A.3(a). The radiation exposure to sea life living on or near the submarines would be small compared to the background radiation to which they would normally be exposed.

L.14—Summary of Issue

Radioactivity resulting from ocean disposal will have a harmful effect on fish, or other sea life.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Karen Ankersmit	539	Ms. Torre Houlgate-West	294
Mrs. V. E. Artman	362	Mr. Fred C. Hummel	162
Ms. Gail E. Ashburn	455	Ms. Karin Humphrey	402
Ms. Natasha Atkins	167	Mr. Paulo Ibanez	188
Ms. Mary Lou Avanzino	657	Ms. Marcia Jackson	174 or 597
Mr. George Balding	77	Mrs. Jaman	453
Ms. Jennie Barnhardt et al.	240	Mr. Richard Jergenson	251
Dr. H. Wayne Beam	339	Ms. Sue Kaye	288
Mr. Mark Bemberg	270	Ms. Lillie Kocher	639
Ms. Elizabeth Bengtson	273	Ms. Judy Koretsky	376
Mr. John K. Bermel	227	Ms. Helen P. Kovarsky	602
Mr. James F. Berry	22	Ms. Diane Lehrenbaum	393
Ms. Kay Bollinger	40	Mrs. Eleanor Lewallen	3
Mr. Greg Carr	672	Mr. Ted Mahr	47
Ms. Kimberly J. Christman	671	Mr. David Martinovich	190
Ms. Virginia Citrino	187	Mr. Frank Morello	555
Mr. Leonard Cosky	327	Ms. Dena Mossar	442
Ms. Nancy Cragin	137a	Ms. Bettye Myers	462
Mr. Clifton E. Curtis	695	Mr. Walbridge J. Powell	448
Ms. Randi Dalton	161	Ms. Sara Press	91
Ms. Linda Dietike-Yolo	307	Robin Rabens	352
Ms. Frances Dollar	562	Ms. Karen Rakofsky	272
Ms. Laura Drey	25a	Ms. Beverly Roberts	32
Ms. Linda D. Fannin et al.	205	Mr. Christopher D. Roosevelt	695
Mr. Sean Fannin	204	Ms. Susan Schafer	392
Mr. James Arthur Ferrara	665	Mr. Kevin Scotti	195
Mr. Aaron Ford	325	Mrs. Violet Soo-Hoo et al.	568
Mrs. E. M. Fossa	683	Ms. Kim Stanley	675
Ms. Virginia Gibson	522	Ms. Judith Tannenbaum	246
Mr. Conrad F. Golich	713	Mr. Marcus Tengesdal	61
Ms. Julie Green	89	Ms. Nancy Tuttle	537
Ms. Cecelia J. Gregori	298	Mr. Will Tuttle	537
Mr. Gilbert J. Gregori	298	Ms. Kay H. Upchurch	334
Mr. Dan Hamburg et al.	72b	Ms. Susie Van Kirk	229
Mr. Garland Harris	337	Ms. Ruth A. Vest	316 or 452
Ms. Jeane L. Heard	209	Dr. & Mrs. Lawrence J. Wieland	661
Ms. Alicia Heim	460	Mr. Michael Winks	701

(Continued on next page)

Response

Chapter 4, Section II.3.(a) included a detailed discussion of possible exposures to bottom-dwelling sea life and showed that these exposures would be far less than doses which have been observed to cause damage to marine life. (Refer also to Reference 4.9) More recent references indicate that bottom-dwelling marine life in the deep oceans may be exposed to internal doses of hundreds of rads each year due to ingested, naturally-occurring Polonium-210. (Refer to Reference 4.29.) Doses to any other sea life from ocean disposal would be thousands of times smaller than this and would cause no harm to sea life.

L.15—Summary of Issue

The DEIS should include in Section II.A.3(a) of Chapter 4 the bioaccumulation effect of Nickel-63 as well as Nickel-59, from sediments. Possible doses to local organisms might be 30 to 300 rad per year if the concentration factors of 100 to 1000 in reference 4.21 were used.

Those Identifying Issue	Identification Number
EPA	694

Response

As stated in Chapter 4, Section II.A.3(a), the maximum rate of exposure for animals on the sea floor was estimated by assuming that a large fixed fraction (25 percent) of the animal would, independent of its size, contain the sediment in which released radioactive material is concentrated (7300 picocuries of Nickel-59 per gram of sediment).

Including Nickel-63 in this calculation would not affect the calculated dose. As shown on Table 4-4, the total Nickel-63 release over all time would be about half that of Nickel-59. However, because of the much shorter half-life of Nickel-63, none of it would remain at the time when the maximum amount of radioactivity would be in the sediment.

The concentration factors in Reference 4.21 relate the concentration of a radionuclide in an organism to that radionuclide's concentration in seawater. They do not relate the radionuclide's concentration in the sediment to that in the organism, and any attempt to use concentration factors in that way is a misuse of Reference 4.21. The estimated maximum dose rate of 0.3 rad per year to animals from the Nickel-59 and Nickel-63 in the sediment is conservative.

L.16—Summary of Issue

It is fallacious to compare the exposure of a hypothetical benthic organism at a depth of 2 to 3 miles with one measurement for one midwater dwelling organism at 600 to 1500 feet.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Dr. Ruthann Corwin	112
Ms. Rebecca Matthews	693

Response

The primary purpose of the segment of the EIS (Chapter 4, Section II.A.3(a)) where this comparison is made is to demonstrate that the worst case estimate of the radiation exposure to the marine organisms which might be most affected by submarine disposals is significantly less than the maximum exposure to which marine organisms are naturally exposed due to the presence of naturally occurring radionuclides in the ocean waters. Thus a maximum estimate of the dose rate which might be received by a marine organism as the result of the deep ocean disposal of defueled nuclear submarines was made using a procedure that would be sure to produce a significant overestimate of the actual dose rate to which a marine organism might be subjected.

This maximum estimated dose rate was then compared to the maximum dose rate received by marine organisms due to their exposure to naturally occurring radionuclides as reported in the literature. This maximum reported value is for a marine organism which was taken from midwater depths between 600 and 1500 meters. If this maximum value has been obtained from a surface dwelling organism or a bottom dwelling organism, then the comparison would have been made with these creatures so the choice of a midwater organism for the comparison was simply the result of being the location of the maximum exposure. In the same reference (Reference 4.29) in which the maximum dose was reported, activity concentrations in organisms from other depths, including two from 4000 meters, were reported as 1.4 pCi/kg and 18 pCi/kg. If the ratio of the maximum dose of 195 rem/year corresponding to a 534 pCi/kg concentration is used with these concentrations, then the bottom dwelling organisms would have received doses of 0.5 rem/year and 6 rem/year due to naturally occurring Po-210. Thus it appears that the doses which marine organisms might receive due to exposure to activity released from defueled submarines are less than those received from natural sources and there is no basis for concern for somatic or genetic hazards to deep ocean water marine organisms.

L.17—**Summary of Issue**

Concerning deep sea marine organisms, the implication in the EIS that a small additional exposure relative to the normal body burden of polonium-210 would be negligible does not necessarily follow (Chapter 4, Section II.A.3).

Those Identifying Issue	Identification Number
Ms. Camilla Ingram	686

Response

The small potential radiation dose calculated for marine life Chapter 4, Section II.A.3 of the DEIS was less than 1% of the exposure that some marine organisms receive from naturally occurring radionuclides. Such a small increment would be well within the variation of natural background radiation exposure and can be reasonably expected to have a negligible impact.

L.18—**Summary of Issue**

"... when 22,000 (curies) of it is that very nasty species, Cobalt-60 ... and I'm particularly concerned with the cobalt, because as you know, many forms of marine life have cobalt based blood."

Those Identifying Issue	Identification Number
Mr. Wells Eddleman	20

(Continued on next page)

Response

The above issue does not identify any form of marine life which is purported to have cobalt based blood and review of available sources did not reveal any. However, if any such marine life with cobalt based blood would ever be found, it would be handled by the concentration factor method in the same manner as the marine life with iron based blood is currently treated in the EIS.

L.19—Summary of Issue

Complex ecological considerations are not discussed in detail.

Those Identifying Issue	Identification Number
EPA	694

Response

Conservative treatments were used in evaluating the potential effects on the fauna. Even with the conservative evaluation, the estimated potential radiation exposure was very small in comparison to their normal background radiation exposures, and other ecological effects would be similarly small. Furthermore, observations at the THRESHER and SCORPION sites as well as many samples of marine life collected at these sites have shown no sign of any ecological damage. Thus, there is no need for a more detailed examination of ecological effects.

L.20—Summary of Issue

Leakage from the containment would or might occur because the containers would not last as long as the radioactivity and there would be no control over the disposed material after the submarine is sunk.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Gail E. Ashburn	455	Mr. Emmett Carson	415
Ms. Natasha Atkins	167	Mr. Wesley Chesbro	69
Ms. Mary Lou Avanzino	657	Ms. Linda Childs	202
Ms. Jane O. Ballus	19	Ms. Pearl Childs	196
Mr. Bill Barlow	17	Ms. Carolyn J. Christman	200
Ms. Ann Bauer	5	Mr. Edgar D. Christman	572
Mrs. Betty M. Beale	173	Ms. Jean Christman	572
Dr. H. Wayne Beam	339	Ms. Virginia Citrino	187
Ms. Christine Berchen	381	Ms. Barbara Connelly	143
Ms. Alice Berg	203	Ms. Rainbow Trout Cornelia	308
Mr. Mark Berkich	106	Ms. Nancy Cragin	137a
Mr. John Black	580	Ms. Randi Dalton	161
Ms. Margie Blake	403	Ms. Laura Danae	166
Ms. Elizabeth Bock	692	Mr. Jon Daunt	669a, 669d
Honorable Douglas H. Bosco	66	Honorable Ronald V. Dellums	447
Ms. Anne Bringloe	36	Mr. Warren Detreidt	282
Mr. Thomas D. Brown	178	Mr. Chuck Dietzel	458
Mr. Bruce R. Campbell	421	Ms. Frances Dollar	562

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Dobie Dolphin et al.	131b	Mr. Bruce Meacham	512
Mr. Dwight Donovan	228	Mr. Kenneth L. Mobert	117
Mr. David Drell	412	Mr. Peter Nahigian	158
Ms. Ellen Drell	412	Mr. George D. Noble	333
Ms. Laura Drey	25a	Ms. Mary Sue Noe	2
Mr. Wells Eddleman	20	Ms. Julie Kay Norman	709
Dr. Justin M. Elliott	485	Mr. Thomas D. O'Neil	80
Ms. Katherine Emerson	370	Mr. Charles Orth	88
Ms. Louise Ewens	573	Mr. Gary W. Owen	210
Mr. Thad Eure	719	Ms. Rebecca Paterson et al.	631
Ms. Donna Feiner	280	Ms. Linda Peters	97
Mr. Cricket Feringer	42	Ms. Mary T. Phillips	207
Mr. John K. Flynn	545	Ms. Jane Plankinton	313
Mr. Conrad F. Golich	713	Mr. Walbridge J. Powell	448
Ms. Julie Green	89	Mr. Robert E. Ragland	315
Ms. Cecelia J. Gregori	298	Ms. Karen Rakofsky	272
Mr. Gilbert J. Gregori	298	Ms. Judith Redwing	96
Ms. Emily Hall	513	Mr. Dan Roberts	126
Mr. Jed Handler	466	Mrs. M. M. Rowland	534
Mr. Doug Hansen	536	Ms. Sally Rulison	666
Mr. Garland Harris	337	Mr. John Runkle	18
Dr. John W. Harris	85	Mr. Daniel Sampson	6
Mr. Christopher S. Hayes	603	Mr. Robert S. Sanyak	413
Ms. Liz Helenchild	132	Ms. Sara Schatz	533
Mr. Jeff Hohensee	116	Mr. David Schlesinger	297
Mr. Keith Houck	301	Ms. Janet Seaforth	134
Mr. Paulo Ibanez	188	Mr. Lewis Seiler	707
Ms. Marcia Jackson	174 or 597	Ms. Nancy Sheehan	517
Ms. Helen Jacobs	278	Mr. Thomas H. Slone	552
Ms. Sue Kaye	288	Mr. Stuart Robert Smith	54
Mr. Ken Kelley	612	Mrs. Jill Stassinos	696
Ms. Katherine Kelly	482	Ms. Sandra Strong et al.	414
Ms. Mamie Lee Kiyohara	542	Mr. John R. Swanson	720
Mr. Marvin Kramer	698	Ms. Jo Ann Thomas	646
Ms. Yvonne Kramer	698	Ms. Susie Van Kirk	229
Mr. Jim LeCuyer	84	Mr. Authur Wang	159
Ms. Margaret Livingston	247	Ms. Maxine Wardauer	690
Mr. Dennis L. Lundblad	372	Dr. Ruth F. Weiner	39a
Mr. John E. Madison	170	Mr. Ocean Wells	401
Ms. Laura Maguire	524	Ms. Roberta Whiteside	323
Mr. Ted Mahr	47	Ms. Emily F. Whittlesey	358
Ms. Teresa Matta	382	Mr. Ronald Yoerger	418

Response

The technical assessment of environmental impacts anticipated that containment would be penetrated eventually by normal corrosion processes and that some of the residual undecayed radioactivity would be released to the environment by corrosion and dispersion processes. The assessment was based on the premise that either land or sea disposal would be considered further only because they were shown by assessment to be safe and environmentally acceptable without further control over the disposed material.

(Continued on next page)

One of the reasons that the "leakage" of radioactivity is so slow is that approximately 99 percent of the radioactivity is actually an inseparable part of the metallic structures of the reactor plant, and it cannot be released any faster than these alloys can be corroded away by their natural environment. By the time they are corroded away and released to the environment, the initial amount of radioactivity will have decayed until residual radioactivity is so low that further containment is not necessary. The total release to the environment would amount to approximately 0.3 percent of the initial inventory. The other 99.7 percent would decay in place prior to release. Refer to Volume I, Appendix G, Figure G-2.

The long-term release of radioactive material to the environment is discussed in the Environmental Impact Statement. For land disposal, refer to Chapter 4, Section I.A.2.(c)(4). For sea disposal, refer to Chapter 4, Section II.A.3.(b). Further details of the corrosion process for ocean disposal are presented in Appendix F.

L.21 – Summary of Issue

The statement in the DEIS declaring that if problems result from a submarine dumping, then followup submarines would not be dumped is not very encouraging. Considering the quality of the proposed monitoring plan, it is doubtful that significant damage to the oceans would be discovered until after a number of followup submarines had been dumped.

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin et al.	131b
Mr. Mike Landen	569

Response

The respondents refer to a statement in Chapter 4, Section II.A.3.(b). Damage to the reactor compartment could be detected by monitoring of disposal operations, including the engineered instrumentation packages described in Appendix D, Section IV that would be used during each sinking operation to provide data on the fate of the disposed submarine and by photography of the hulls following emplacement.

L.22 – Summary of Issue

The radioactive material is unjustifiably assumed to be either (1) soluble or (2) insoluble.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Honorable Ronald V. Dellums	447	Lt. Governor Leo McCarthy	65
Dr. John W. Harris	85	Ms. Dena Mossar	442
Mr. Ken Kelley	612	Mr. Lewis Seiler	707

Response

Since the radioactive material would consist of a variety of nuclides and would be in a variety of chemical forms, some of the compounds would be soluble under certain conditions and some would be insoluble under the same conditions. Even in the same nominal environment, such as groundwater or seawater, the fraction of the total that would be soluble or the concentration of radioactivity in the soluble phase might change from time to time depending on the chemical and physical nature of the actual local environment. For example, passage through the digestive systems of certain animals might alter the chemical form of some nuclides.

The situation is complicated further because some of the insoluble material could occur in such finely divided particle sizes that it could be transported in water and in biological systems as effectively as though it were soluble; because some of the insoluble material would be dissolving and some of the soluble material would be precipitating at any given time; and because some of the material that might otherwise be soluble may be adsorbed onto the surface of some insoluble material or may be incorporated in the crystal structure of some insoluble material.

The assessment in the DEIS was done two ways to be sure that environmental impacts were not underestimated. Those situations in which the dose to man would be greater if the radioactive material were soluble were calculated as though all of the radioactive material were soluble even though it would not be. In those situations in which the dose to man would be greater if the radioactive material were insoluble, the calculations were performed as though all of the radioactive material were insoluble even though it would not be. Thus, the dose-to-man estimates were calculated so that a hypothetical calculation of the true situation (part soluble, part insoluble) could be no worse than the values calculated. Refer, for example, to Appendix J (Dose Commitment Estimates, Sea Disposal), Sections III.D.1. and 2.

Actually, most of the radioactivity is expected to be associated with insoluble material because the bulk of the radioactivity is in corrosion resistant alloys, and, by the nature of their corrosion resistance, the corrosion products of corrosion resistant alloys are quite insoluble in water. In laboratory tests cited in Appendix F, Section III.D.3, the amount of corrosion products released from specimens of corrosion resistant alloys exposed to seawater at 2°C for 12 months did not exceed 2.2 percent of the amount of corrosion, and since only part of the released material is soluble, the soluble portion of the total amount of corrosion would be less than a few percent.

In summary, radioactive material was assumed to be soluble in some circumstances and to be insoluble in some similar circumstances to simplify the assessment and to obtain conservative estimates of the actual doses that might be committed, calculated in such a way that the actual dose would be no worse than the estimated values.

The details of the dose calculations and the corresponding assumptions are provided in the following appendices:

- Appendix C—Dose Commitment Estimates, Land Disposal

- Appendix J—Dose Commitment Estimates, Sea Disposal

L.23—Summary of Issue

The Navy claims that once a submarine is sunk, thousands of years must pass before water can enter the submarine compartment.

Those Identifying Issue	Identification Number
Dr. Marvin Resnikoff	13b

Response

Table 4-2 and Table 4-3 clearly show that the analysis to evaluate the ocean disposal option included assumptions that seawater might enter the reactor compartment and reactor primary system in 100 years or less. In fact, the analysis of the minimum containment accident (Table 4-3) which assumes that all radioactive metal would be exposed to open seawater immediately following disposal, does not result in large exposures.

L.24—Summary of Issue

The calculated times to penetrate the metal containments and the radioactivity release rates are difficult to check because the actual thickness and the total activity of each radionuclide in the various metal components are not provided.

Those Identifying Issue	Identification Number
Ms. Jane O. Ballus	19
EPA	694, 694a
Dr. Judith E. Gordon	420

Response

The thickness of primary concern is the thinnest part of the reactor compartment containment because perforation of the outermost containment barrier would occur at this location first. This thickness was provided in Chapter 4, Section I.A.2(b) and is one-half inch. The penetration time was estimated to be 100 years for sea disposal based on a corrosion rate of 0.0025 inch per year per exposed surface of low alloy steel (Chapter 4, Table 4-2).

The corresponding penetration times were calculated directly from the known thicknesses and the corresponding corrosion penetration rates, as described in the DEIS (Appendix F, Sections IV.A.2 and 3, and Appendix G, Section IV.A.4). Therefore, the calculated penetration times are considered to be as conservative as the assigned corrosion rates. Typically, the assigned corrosion rates are the highest average rates, as obtained from the literature (Appendix G, Section II.A.2.a).

Similarly, all of the radionuclide release rates were calculated from well-established values of the activity of each radionuclide in the various metal components, as was described in Appendix G, Section IV.A.2. The total activity of each radionuclide was provided in Table 1-1.

L.25—Summary of Issue

It is poor practice to sum the various isotopes to obtain "total curies", in Table 4-4.

Those Identifying Issue	Identification Number
EPA	694

Response

It is common practice in technical documents addressing issues in radioactive waste management to sum the quantities of individual isotopes. This is not a poor practice so long as the effects due to each isotope are calculated separately as was done in the Navy's DEIS. A similar approach was used by the EPA's Office of Radiation Programs in their DEIS for 40CFR91: Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes (EPA 520/1 82 025, December 1982).

L.26—Summary of Issue

The accuracy of the "total released curies" beyond two significant figures is questioned (Tables 4-5 and 4-6).

Those Identifying Issue	Identification Number
EPA	694

Response

It is agreed that no more than two significant figures should generally be used for the results of such calculations. The preferred approach was used to present the results of almost all of the calculations that were tabulated throughout the DEIS. However, more than two significant figures were used for some entries in tables of estimated releases for individual nuclides (such as Tables 4-1, 4-4, 4-5, and 4-6), because somewhat greater precision for the more important nuclides was considered to be useful for reviewers. This was probably unnecessary, so all values have been rounded off to two significant figures in the Final EIS.

L.27—Summary of Issue

The EIS should evaluate the capacity of the ocean to safely absorb radioactive material. This would provide a proper and meaningful perspective.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Robert Kay	373
Mr. Christopher D. Roosevelt	695

Response

An evaluation of the capacity of the oceans to safely absorb radioactive material is beyond the scope of the Environmental Impact Statement. However, to provide a perspective on submarine disposal a comparison can be made to the IAEA evaluation of permissible capacity.

When the IAEA evaluated limits for ocean disposal of radioactive material, they assumed that man would continue to dispose of radioactive material in the ocean for the next 40,000 years and that the volume of an ocean was somewhat smaller than the North Atlantic. They concluded that it would be permissible to release 10^8 curies/year of mixed beta and gamma emitters to each ocean. The maximum annual release from the disposal of 100 submarines would only be 0.00004 percent of that recommended by the IAEA. Even if one assumed that all of the radioactivity in a submarine were released immediately upon disposal, the disposal of three submarines per year would be less than 0.2 percent of the rate permitted by the IAEA for an ocean. Since the radioactive material is an integral part of thick metal components, this would be physically impossible even if the containment of the reactor compartment and reactor vessel were lost.

L.28—Summary of Issue

The radioactivity introduced into the oceans from the disposal of defueled nuclear submarines could be more than is currently present in the oceans worldwide.

Those Identifying Issue	Identification Number
Ms. Alicia Heim	460
Ms. Diane Lehrenbaum	393

Response

The radioactivity which might be introduced into the oceans due to the disposal of defueled submarines in the ocean is insignificant in comparison to that which is naturally present in the ocean waters. The IAEA Report No. 172 "Effects of Ionizing Radiation on Aquatic Organisms and Ecosystems" published in 1976, reports the total concentration of all the natural radionuclides in ocean waters to be 327 picocuries per liter of seawater. This corresponds to approximately 4.5×10^{11} curies (450,000,000,000 curies) of radioactivity in the world's oceans due to the presence of naturally occurring radionuclides.

The total quantity of activity which is present in a defueled nuclear submarine at the earliest time it might be disposed is 62,000 curies (Chapter 1, Table 1-1). Thus a total of 6.2×10^{6} curies of activity would have originally been present in all 100 submarines. Of this amount only 184 curies would be expected to be released over all time from any submarine on the deep ocean floor if the ocean option were selected (Chapter 4, Table 4-4). This corresponds to a total of 1.84×10^{4} curies to be released into the world's oceans over all time from 100 submarines, representing an insignificant fraction (0.00000004) of the total activity in the world's oceans due to the presence of the naturally occurring radionuclides.

L.29—Summary of Issue

The DEIS should avoid comparisons with ocean discharges of U-238, Th-232, and K-40 since their concentrations are more or less at equilibrium (Table 4-7); that is, the annual input equals the annual output via sedimentation.

Those Identifying Issue	Identification Number
EPA	694
Ms. Ivana Noell	645
Dr. Ruth F. Weiner	39, 39a

Response

The discharges of natural radioactive material described in Table 4-7 included radioactive uranium and thorium but did not include potassium (K-40).

It is likely that the concentrations of natural radioactive materials in seawater are more or less at equilibrium, as noted by the commenters. Thus the discharges of natural radioactive material end up in the sediment and it is the quantity in the sediment which is increased each year. Since most of the radioactive material that would be released from disposed submarines would also end up in the sediment, it is not unreasonable to make the comparison shown in Table 4-7. The comparison serves the purpose of putting into context the small amounts of long-term released radioactive material that would be expected in the event that sea disposals were actually carried out.

L.30—Summary of Issue

The Naval Nuclear Propulsion Program has long professed the policy "to reduce to the minimum practicable the amounts of radioactivity released to the environment." The Navy DEIS should indicate how this policy interacts with each of the disposal alternatives being considered, and whether a decision to implement any of the disposal alternatives is likely to impact on this policy.

Those Identifying Issue	Identification Number
EPA	694

Response

Tables 4-1 and 4-4 of the DEIS demonstrated that either of the options for permanent disposal would be consistent with the Navy's long-standing policy.

L.31—Summary of Issue

The DEIS contains no discussion of how valid the ocean disposal impact models are, or how reasonable are the resulting estimates.

Those Identifying Issue	Identification Number
EPA	694

Response

The appendices to the Environmental Impact Statement contain extensive detail on the construction of the mathematical models and the sources of information drawn upon. The appendices also contain the results of calculations performed to demonstrate the range of variation using both very conservative values and more likely values for the parameters. The models used are intended to determine estimates of the impacts which are unlikely to be exceeded in any actual application and are appropriate for such use. Refer to Appendices G, H, I, and J for a detailed discussion concerning the ocean impact models used and the corresponding results.

L.32—Summary of Issue

Most of the situations explored in the DEIS are so extremely conservative that the estimated radiation exposures are grossly overestimated and, hence, they are not realistic.

Those Identifying Issue	Identification Number
EPA	694
Mr. Harold A. Rogers	662

Response

Conservative treatments were used in evaluating the potential environmental radiation exposures from the disposal options. Even with the conservative evaluation the estimated potential exposure was very small in comparison to normal fluctuations in radiation exposures due to an individual's geographic location, food consumption, and activities.

(Continued on next page)

The fact that there would be no significant environmental impact from any of the disposal methods, even based on extremely conservative evaluations, clearly provides the decision-makers with the information they need. To provide additional refinements for this conceptual evaluation would not aid the NEPA process.

L.33—Summary of Issue

Natural background in coastal areas should be about 75 mrem per year, not 100 mrem per year (Chapter 4, Section II.A.3(d)(4).

Those Identifying Issue	Identification Number
EPA	694

Response

As discussed in Appendix J, Section I of the DEIS (page J-2), an average adult individual in the United States receives a total body exposure between approximately 30 and 150 mrem per year from natural sources of radioactivity. An average annual exposure of 100 mrem from natural background radiation is used only for comparison purposes. The effect on the impact analysis of changing this value from 100 mrem to 75 mrem, or to any other value in the range 30 to 150 mrem, would be inconsequential.

L.34—Summary of Issue

The DEIS should have considered only those people who live within 500 miles of the dump site, not the entire population of the U.S. West Coast in obtaining the per capita exposure levels. This "dilution of data" approximates fraud.

Those Identifying Issue	Identification Number
Mr. James Widmeyer	678

Response

The respondent evidently believes that the disposal of a submarine produces a fixed number of mrem exposure to humans, and that the larger the number of people who are assumed to be exposed to radioactivity the lower would be the average exposure levels. This concept is incorrect. The radiation exposure to the average individual is based on the amount of food he eats and the concentration of radioactivity in it and not on the number of people affected.

The total affected population was used only to estimate the total possible radiation exposure to humans. This was obtained by multiplying the dose to the average individual by the assumed number of people affected. Therefore, the larger the population assumed, the larger the total exposure.

If the respondent's suggestion had been followed, the calculated dose to the average individual would have been exactly the same as listed in the DEIS Chapter 2 and Chapter 4, and the population exposure would have been less than that listed in Chapter 2, Section II.C.1, because fewer persons would have been assumed to be exposed at the same rate per person.

L.35—Summary of Issue

All pathways to humans associated with ocean disposal should be considered in the Environmental Impact Statement.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Honorable Ronald V. Dellums	447	Mr. Thomas C. Jackson	37b
Ms. Dobie Dolphin	131	Mr. Scott McCreary	86
Mr. Dan Hamburg et al.	72, 72a	Mr. Jonathon McHugh	87
Dr. Michael J. Herz	37, 37b	Mr. James F. Ross	486

Response

See Pages 4-15 to 4-27 and Appendices I and J of the DEIS.

L.36—Summary of Issue

Radioactivity, resulting from the sea disposal, will be returned to humans via the food chain.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Sidney Abbott	153	Dr. Richard L. Comen	238
S. Andres	365	Ms. Barbara Connelly	143
Ms. Gail E. Ashburn	455	Ms. Jane Corey	111
Ms. Natasha Atkins	167	Ms. Rainbow Trout Cornelia	308
Mr. George Balding	77	Mr. Leonard Cosky	327
Ms. Jane O. Ballus	19	Ms. Nancy Cragin	137a
Ms. Jennie Barnhardt et al.	240	Mrs. Gretchen Crosson	408
Ms. Carol Bath	490	Mr. Kevin Crosson	408
Ms. Ann Bauer	5a	Mr. Joe Cucchiara	608
Mrs. Betty M. Beale	173	Ms. Deborah Da Pron	223
Dr. H. Wayne Beam	339	Mr. Jon Daunt	669d, 669f
Ms. Alice Berg	203	Honorable Ronald V. Dellums	447
Mr. Mark Berkich	106 or 317	Mr. Warren Detriedt	282
Mr. John K. Bermel	227	Mr. Norman DeVall	73
Mr. John Black	580	Ms. Linda Dietike-Yolo	307
Ms. Patricia C. Blackford	587	Mr. Chuck Dietzel	458
Ms. Margie Blake	403	Ms. Frances Dollar	562
Honorable Douglas H. Bosco	66	Ms. Dobie Dolphin	131
Mr. Thomas D. Brown	178	Mr. Dwight Donovan	228
Ms. Janet P. Brooks	693	Mr. David Drell	412
Mr. Thomas Bussard Jr.	514	Ms. Ellen Drell	412
Mr. Bruce R. Campbell	421	Ms. Laura Drey	25
Mr. Michael Carney	660	S. K. Eanes	454
Mr. Greg Carr	672	Mr. Robert Eidus	23
Ms. Carolyn J. Christman	200	Mr. Fred Eissler	664
Mr. Edgar D. Christman	572	Dr. Justin M. Elliott	485
Ms. Jean S. Christman	572	Ms. Katherine Emerson	370
Mr. Paul Clemmons	387	Ms. Judith Evered	71
Ms. Deborah L. Clifford	498	Mr. Thad Eure	719

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Those Identifying Issue	Identification Number
Ms. Donna Feiner	280
Mr. Cricket Feringer	42
Ms. Emilie Ferris	182
Ms. Beverly H. Forbus	560
Ms. Lydia Raas Ford	326
Ms. E. M. Fossa	683
Mr. Conrad Golich	713
Ms. Julie Green	89
Ms. Theresa L. Greenlaw	535
Ms. Cecelia J. Gregori	298
Mr. Gilbert J. Gregori	298
Ms. Gisela Grossman	299
Mr. David Gurney	193
Ms. Mary L. Hague	546
Mr. John J. Hall	363
Mr. Dan Hamburg et al.	72b
Mr. Roy Harleman	281
Mr. Garland Harris	153
Mr. John P. Harville	290
Mr. Christopher S. Hayes	603
Mr. Pete Hayes	43
Ms. Jeane L. Heard	209
Ms. Alicia Heim	460
Dr. Larry Heiss	248
Ms. Liz Helenchild	132
Ms. Sally H. Henckell	475
Dr. Michael J. Herz	37c
E. Hodges	497
Mr. Brian Hoeve	428
Mr. Fred C. Hummel	162
Ms. Karin Humphrey	402
Ms. Marcia Jackson	174 or 597
Mrs. Jaman	453
Ms. Jane Jarrett	245
Mr. Richard Jergenson	251
Mrs. Brenda S. Johnson	422
Mr. Larry Kaplan, et al.	616
Ms. Kyla Karch	184
Ms. Sue Kaye	288
Mr. Ken Kelley	612
Ms. Katherine Kelly	482
Ms. Mamie Lee Kiyohara	542
Mr. Kingsley H. Klarer	378
Ms. Margery Knyper	624
Ms. Lillie Kocher	639
Mr. Edward J. Larson	241
Mr. Jim LeCuyer	84
Ms. Eleanor K. Leek	284
Mr. Jonathan M. Leising	289
Mrs. Eleanor Lewallen	3
Mr. Carl Lincoln	504

Those Identifying Issue	Identification Number
Ms. Margaret Livingston	247
Mr. Douglas M. MacDonell	395
Mr. Ted Mahr	47
Mr. John Maloney	139
Mr. Jim Marotta-Jaenecke	194
Mr. Joseph C. Marshall et al.	706
Mr. David Martinovich	190
Ms. Laure Mastrella	637
Ms. Teresa Matta	382
Mr. Michael Matthay	398
Ms. Rebecca Matthews	693
Ms. Helen H. Maxon	518
Mr. Yale Candee Maxon	518
Ms. Heidi McCarthy	261
Mr. L. Kyle McCarthy	260
Lt. Governor Leo McCarthy	65
Mr. Jonathan McHugh	87
Ms. Carol E. Mone	627
Mr. Frank Morello	555
Ms. Susan Moretta	328
Ms. Janet Morrison	341
Ms. Dena Mossar	442
Ms. Dani S. Moyer et al.	180
Mr. Donald S. Muir	604
Ms. Kei Murrell	183
Ms. Bettye Myers	462
Mr. Peter Nahigian	158
Ms. Adriane Nicolaisen	347
Mr. George D. Noble	333
Mr. Thomas D. O'Neil	80
Ms. Janet T. Orselli	593
Mr. Charles Orth	88
Ms. Janice Palma	626
Ms. Jane Plankinton	313
Mr. Walbridge J. Powell	448
Mr. James Puckett	38
Mr. Robert E. Ragland	315
Ms. Karen Rakofsky	272
Ms. Molly Randall	570
Ms. E. Rangares	329
S. Raphael	650
Ms. Judith Redwing	96
Mr. Kendall Reid	479
J. P. Richardson	613
Ms. Marlene River	510
Ms. Beverly Roberts	32
Mr. Dan Roberts	126
Ms. Debbie L. Roberts	591
Ms. Susan Ronis	286
Ms. Maxine Rosenthal	610
Mrs. M. M. Rowland	534

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Daniel Sampson	6	Kelly Townsend	503
Mr. Robert S. Sanyak	413	Unknown	213
Ms. Susan Schafer	392	Unknown	267
Ms. Sara Schatz	533	Atty. Gen. John K. Van DeKamp	446
Mr. David Schlesinger	297	Ms. Susie Van Kirk	229
Mrs. Marian E. Scully	495	Ms. Ruth A. Vest	316, 452
Ms. Janet Seaforth	134	Ms. Kathleen Walden	629
Mr. Scott Sears	654	Mr. Arthur Wang	159
Mr. Howard Seidell	355	Dr. B. D. Wapen	590
Ms. Nancy Sheehan	517	The Warburton Family	306
Mrs. Violet Soo-Hoo et al.	568	Dr. Ruth F. Weiner	39a
Mr. George L. Sosson	496	Mr. Greg Wellish	103
Ms. Kim Stanley	675	Mr. Ocean Wells	401
Rev. E. Straatsma	216	Ms. Emily F. Whittlesey	358
Mr. Erik Sunswheat	478	Dr. & Mrs. Lawrence J. Wieland	661
Ms. Judith Tannenbaum	246	Ms. Sara Williams	305
Mr. Marcus Tengesdal	61	Mr. William T. Wilson	464
Ms. Ruth Thomas	31	Ms. Sharon Winters	479
Mr. Gary Thompson	318	Mr. Michael Winks	701
Ms. Barbara Toshalis	384	Mr. Rick Yabroff	191

Response

The analysis in this statement demonstrates that it is unlikely that any radiation exposure to the public would occur from the submarine sea disposal option. However, hypothetical pathways to humans via food chains have been evaluated, resulting in very small amounts of exposure. Refer to Chapter 4, Sections II.A.3(d)(4) through IV, Tables 4-9 through 4-11, and Appendices I and J.

L.37—Summary of Issue

The Environmental Impact Statement should consider effects of bioaccumulation for the sea disposal option.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. George Balding	77a	Mr. Jonathon McHugh	87
Mr. Nathaniel S. Bingham	78a	Ms. Susan Moretta	328
Mr. Greg Carr	672	Ms. Dena Mossar	442
Mr. Clifton E. Curtis	695	Mr. Peter Nahigian	158
Honorable Ronald V. Dellums	447	Ms. Ivana Noell	645
Ms. Dobie Dolphin	131	Mr. Charles Orth	88
Mr. Peter Douglas	68a	Ms. Sherry Pimsler	680
Ms. Laura Drey	25	Mr. James Puckett	38
Mr. Wells Eddleman	20	Mr. Christopher D. Roosevelt	695
Mr. Donna Feiner	280	Ms. Jane Sharp	14
Mr. John K. Flynn	545	Atty. Gen. John K. Van DeKamp	446
Mr. Jim LeCuyer	84	Mr. Arthur Wang	159
Ms. Teresa Matta	382		

(Continued on next page)

Response

Bioaccumulation is considered and its effects are evaluated in all analyses described in Chapter 4, Section II.3. In these calculations, the concentration factor method was used to describe the effects of bioaccumulation within the food chains. The concentration factor for each important pathway is named for the end product or activity which might produce an impact on man. The concentration factor represents the net accumulation of radioactivity in the end product resulting from all steps between the affected environment and the actual contact with man. This method is commonly used to calculate environmental effects. (Refer to References I.1, I.2, I.4, and I.5.)

L.38—Summary of Issue

"If the Navy does not understand how radioactivity enters the food chain, how can it have a hypothetical example [of individual exposure via a hypothetical pathway, in Chapter 4, Section II.A.3(d)(4)]?"

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin, et al.	131b

Response

The dictionary* defines hypothetical as "highly conjectural; not well supported by available evidence." As explained in Chapter 4, Section II.A.3(d)(4), it is in precisely this context that the Navy calculated what the radiation exposure to a person might be, if they ate throughout the year large quantities of fish or other sea life that lived continuously in the region of maximum concentrations of radioactivity either in the water or in the sediment, directly adjacent to the disposal site at the bottom of the deep ocean. This is a hypothetical example, because there is no known sea life that meets this description, but it is included to demonstrate that even in this worst imaginable situation the radiation exposure to humans would be entirely negligible.

*The Random House College Dictionary, Revised Edition, 1980. Random House, Inc. N.Y., N.Y.

L.39—Summary of Issue

The EIS should discuss the uncertainty inherent in attempting to predict the long-term behavior of the ocean.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Sidney Abbott	153	Mr. Clifton E. Curtis	695
Mrs. R. Albertson	633	Mr. Stephen E. Davenport	34
Mr. Brian N. Baird	55	Ms. Linda D. Fannin et al.	205
Ms. Jane O. Ballus	19	Ms. Donna Feiner	280
Ms. Ann Bauer	5	Ms. Melissa Gehrman	16
Dr. H. Wayne Beam	339	Mr. Dan Hamburg et al.	72b
Mr. Vincent J. Bellis	255	Ms. Marge Harburg	551
Mr. John K. Bermel	227	Mr. Garland Harris	153
Mr. Thomas D. Brown	178	Mr. H. W. Ibser	391
Mr. Greg Carr	672	Mrs. Jaman	453
Ms. Carolyn J. Christman	200	Ms. Lynne Penney Janbergs	364
Ms. Rainbow Trout Cornelia	308	Dr. Robert Kay	373
Dr. Ruthann Corwin	112	Mr. Ken Kelley	612
Ms. Janet Crone	113	Ms. Lillie Kocher	639

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Elizabeth Lagergren	304	Ms. Marian Roden	336
Ms. Diane Lehrenbaum	393	Mr. Christopher D. Roosevelt	695
Mr. Wm. A. Lochstet	443	Ms. Susan Schafer	392
Ms. Andrea H. Lohneiss	35	Mr. John Schubert	53
Mr. Edward Luben	197	Mr. Scott Sears	654
Mr. Ronald E. Martin	219	Mr. Daniel C. Shively	293
Ms. Jane Kyle McCoy	386	Mr. Eric Simmons	59
Mr. Marshall McNeil	141	Ms. Janet I. Tatz	410
Mr. & Mrs. Jerry Meilan	628	Mr. Victor G. Taylor	221
Ms. Dena Mossar	442	Ms. Sheila Tracy	129
Ms. Dani S. Moyer et al.	180	Mr. Will Tuttle	537
Ms. Beverly G. Murdock	652	Ms. Nancy Tuttle	537
NOAA	444	Atty. Gen. John K. Van DeKamp	446
Ms. Janet M. Orth	396	Ms. Kathleen Walden	629
Mr. Robert E. Ragland	315	Western Governors' Conference	723
Ms. Carole Roberts	516		

Response

The Environmental Impact Statement has evaluated the best-estimate, conservative estimate, and worst-case outcomes to assess the potential radiation exposure to humans. The worst-case analysis made assumptions designed to significantly over-estimate the impact. For example, in the biological transport evaluation all radioactive material was assumed to be deposited in the sediment at the disposal site and fish assumed to be feeding from benthic communities supported by this sediment were assumed to be caught on the bottom at the site in 14,000 feet of water and eaten by man. Then in the physical ocean transport, all radioactive material was assumed to be transported by the water and never removed except by radioactive decay. In addition the entry pathway to man was then assumed to be at a water depth of approximately 14,000 feet.

Even with the worst-case evaluation, the estimate of the potential exposure was very small in comparison to fluctuations in exposure resulting from variations in an individual's activities, food consumption, and geographic locations.

The worst-case analytical evaluation coupled with the very small potential exposures account for uncertainty in the long-term behavior of the oceans.

L.40—Summary of Issue

The DEIS makes many assumptions in estimating the effects of sea disposal. They may be, and probably are, wrong. After the assumptions are found to be wrong, it would be too late to do anything.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Rebecca Batell	135	Mr. Robert Eidus	23
Ms. Ramona Crooks	82	Mr. Jeff Hohensee	116
Mr. Wells Eddleman	20	Ms. Rebecca Paterson et al.	631

(Continued on next page)

Response

The realistic calculations in the EIS are based primarily on measurements, not on assumptions. Quantities like the corrosion rate of the steel hull, or the current velocity and direction at a representative study site—these were measured. Assumptions were used primarily to estimate what the results would be if something not expected to happen, did happen.

Thus, based on known corrosion rates and the thicknesses of the reactor compartment bulkheads and of the massive reactor pressure vessel, the DEIS presented calculations in Appendix G, Section II.A.3.b, that 100 years would elapse before corrosion would penetrate the bulkheads, and 1300 years before the reactor vessel would corrode through. However, to be conservative (i.e., pessimistic), a "minimum containment" situation was also imagined, in which all the surfaces inside the reactor vessel were assumed to be immediately exposed to sea water and able to release radioactivity by corroding. Table 4-9 shows that the radiation exposure for even this case would be negligible. Again, though there is absolutely no evidence that such a situation could occur, it was assumed, in Chapter 4, Section II.A.3.(d)(4), that a so-called "biological shortcut" could exist, in which people might eat fish which lived on the bottom at the disposal site, where the concentration of radioactivity in the water and sediment would be the greatest. The results, as shown in this Section, are that the radiation exposure would be extremely small, even if this highly unlikely situation would exist.

Pessimistic assumptions such as these are not expected to reflect actual sequences of events; therefore, the radiation exposures are expected to be even less, more like the "best estimate" values of Table 4-9.

The results of monitoring at the THRESHER and SCORPION sites provide significant corroboration of the Navy's conclusion that the release of radioactivity from disposed submarines will be extremely slow and that the Navy's analysis of low radiation exposure is reasonable.

L.41—Summary of Issue

The determination of radioactivity exposure of the average individual (Chapter 4, Table 4-9) should be explained more clearly.

Those Identifying Issue	Identification Number
Ms. Randi Dalton	161

Response

Estimates of individual exposures resulting from the ocean disposal option are contained in Chapter 4, Section II.A.3(d)(4). The determination of this exposure, and of the other contrasting cases that were calculated, is described in detail in the pertinent appendices.

L.42—Summary of Issue

The Navy should describe the formula used to equate how many peoples' health and safety equals one dumped radioactive submarine.

Those Identifying Issue	Identification Number
Ms. Dobie Dolphin, et al.	131b

Response

Public health and safety are not directly equated to one dumped submarine. The procedure used is to convert public exposure to radiation, measured in man-rems, to cancer cases as described in Chapter 4, Section II.A.3(d)(4). The maximum number of additional cases of cancer predicted for the year of highest exposure associated with sea disposal was evaluated using estimates of sensitivity representing the range of scientific opinion. See also Issue B.1.

L.43—Summary of Issue

The EIS should discuss radiation exposure in terms of its genetic effects.

Those Identifying Issue	Identification Number
D. Gordon L. Chan	85
Mr. Jeff Hohensee	116
Ms. Morere Paradise	85
Mr. Lewis Seiler	707
Mr. Stuart Robert Smith	54
Dr. and Mrs. Lawrence J. Wieland	661

Response

The DEIS discussed radiation exposure in terms of cancer cases (Chapter 4, Sections I.A.2(c)(4) and II.A.3(d)(4) which are more numerous than genetic effects in a given population for the same radiation exposure (Reference C.5, pages III-38 and III-39). Since it is estimated that no cancer cases would occur as the result of disposal actions associated with defueled nuclear submarines because the estimated number is significantly less than one, there would be no genetic effects expected from these proposed disposal actions. Thus the discussion of radiation exposure in terms of genetic effects is not considered to be warranted in the EIS.

L.44—Summary of Issue

The EIS should discuss the length of time that radioactive material is required to be kept from the environment to be safe with respect to genetic damage and environmental pollution.

Those Identifying Issue	Identification Number
Ms. Randi Dalton	161
Mr. Warren Detriedt	282

Response

Chapter 4 and associated appendices of the Draft Environmental Impact Statement describe the time of effective containment and expected time sequences of events having environmental effects.

L.45—Summary of Issue

The DEIS fails to adequately inform the reader of the effects of radiation exposure at the levels which would result from submarine disposal or of the consequences if food consumption were concentrated in a short time period rather than spread throughout the year.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Ms. Kimberly J. Christman	671
Mr. Dan Hamburg et al.	72b
Mr. Gordon K. Van Vleck	715

Response

In Chapter 4, Sections I.A.2.(c)(4) and II.A.3(d)(4) explicitly stated what the possible effects of radiation exposure might be at the very low levels that could result from land or sea disposal of 100 defueled, decommissioned submarines.

All calculations conservatively assumed the linear, no-threshold model of radiation exposure, which takes no credit for spreading out the exposure over a long time, and conversely involves no penalty for concentrating the exposure in a short time span. Therefore, there would be no difference in the negligible health effects if the ingestion were spread over a year's time or concentrated in a short time period.

L.46—Summary of Issue

The isotopes Niobium-94, Nickel-59, and Technetium-99 are often overlooked in the Environmental Impact Statement.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Dr. Larry Heiss	248
Ms. Rebecca Matthews	693
Mr. James Puckett	38
Mr. Greg Vinson	50

Response

A careful reading of the Environmental Impact Statement will show that these radioisotopes are not overlooked. On the contrary, all of them were listed in Tables 1-1, 2-1, 4-4, 4-5, and 4-6 of the main body of the DEIS, and the text discussing these tables includes the effect of these nuclides. Many additional references to these nuclides are found in Appendices C, G, H, I, and J.

L.47—Summary of Issue

The DEIS dose commitment estimates provided in Table 4-11 in Chapter 4 suggest high exposures (approximately 3 to 45 times greater depending upon the terms selected for comparison) associated with the sea disposal option relative to the land disposal option for the population exposure estimates for disposal of 100 submarines. This is not consistent with the conclusion of EIS that the radiation exposure estimates show no significant difference between the two options.

Those Identifying Issue	Identification Number
Mr. Nathaniel S. Bingham	78a
Dr. Jackson Davis	76
Mr. Lewis Seiler	707
Atty. Gen. John K. Van DeKamp	446

Response

The dose commitments presented in Table 4-11 of Chapter 4 are "conservative" estimates which were developed to represent dose commitment estimates which could not conceivably be encountered. For example the population dose commitment estimates for the sea disposal option were obtained by assuming that all sea food eaten by 30 million people (approximately 25,000 tons) is taken from one location on the ocean floor and that this location corresponds to the position at which the maximum nuclide concentration in the vicinity of the coast at a depth of 4000 meters is calculated. This represents an impossible situation and, as a result, a considerable overestimate of the actual exposures which might be received by the general public due to the sea disposal of defueled nuclear submarines. Thus comparisons of the nature of those delineated in the above issue are not meaningful and do not provide a valid reason for selecting one disposal method over the other.

The EIS conclusion was that all of the numbers are so low that no comparison is meaningful.

L.48—Summary of Issue

In Chapter 3, "there is no population information presented for either ocean study area and no discussions of this aspect in the chapter.".

Those Identifying Issue	Identification Number
EPA	694

Response

The population information associated with ocean disposal was given in Chapter 4 under the subheading "Population Exposures" (Chapter 4, Section II.3.d(4) of the DEIS).

L.49—Summary of Issue

Substituting fish in the diet does not alter the body burden of K-40 because it is in equilibrium (Chapter 4, Section II.A.3(d)(4)). It is best to delete discussion of exposure to K-40.

Those Identifying Issue	Identification Number
EPA	694

Response

The example referenced was intended to show what the estimated exposure from a naturally occurring radionuclide would be when calculated using the same methods as for the radionuclides present in nuclear submarine reactor plants. It was recognized that fish consumption would not alter the Potassium-40 exposure to humans. However, this example has been deleted from the Final EIS.

L.50—Summary of Issue

The DEIS should include concepts for reducing corrosion, thereby retarding the release of radioactive material. These concepts should include the use of sacrificial metals (such as zinc), filling the reactor compartment with oil or other rust retarding material, and the addition of various corrosion inhibitors to the water within the reactor compartment.

Those Identifying Issue	Identification Number
Mr. William F. Danielson	691
EPA	694
Mr. Charles B. Williams	688

Response

The use of corrosion retarding techniques such as those mentioned was considered during the preparation of the EIS. The potential benefits such methods might be expected to produce are very limited and would be realized only if the techniques were effective for longer than 400 years. It would be impossible to demonstrate such long-term effectiveness.

The reason such techniques would have little effect may be seen by referring to Table 4-6 of Chapter 4. This table shows that only about 0.3 percent of the original radioactivity would be released to the environment over all time. Of this small amount, approximately two thirds would be Nickel-59, a radionuclide with a half-life of 75,000 years so corrosion-retarding techniques would be of no benefit in preventing release of this radioactivity. The remaining one-third of the released radioactivity would be Nickel-63, a radionuclide with a half-life of 92 years. As shown in Figure G-2 of Appendix G, nearly all of the Nickel-63 release would occur only after about 400 years had elapsed following disposal.

Since long-term enhancement of the resistance to corrosion is not necessary and has very limited potential benefit, the use of such techniques was not included in the EIS.

L.51—Summary of Issue

The Navy should clarify its intentions regarding filling the reactor compartment with water prior to leaving the shipyard for sea disposal: state whether that will be fresh, brackish or sea water (Appendix D, Section I). A simple way to slow all corrosion reactions would be to fill with deaerated fresh water.

Those Identifying Issue	Identification Number
EPA	694

Response

Fresh water would be used to fill the reactor compartment. Seawater would be more corrosive and would not be significantly less expensive. Distilled (or deionized) water would be more expensive, but it would not be significantly better because contamination by seawater would be expected to occur during sinking as some seawater would flow into the reactor compartment through a pressure relief valve installed to prevent collapse of the reactor compartment at great depths.

There is no plan to specify the use of deaerated fresh water to fill the reactor compartment. The utility of such a measure would be short lived relative to the estimated 100-year lifetime of the containment, and the gain would be so marginal that the cost of the effort could not be justified.

L.52—Summary of Issue

Improvements to the containment integrity for sea disposal should be discussed in the DEIS.

Those Identifying Issue	Identification Number
Ms. Virginia Citrino	187
Governor Joe Frank Harris	340
Mr. Paulo Ibanez	188
Mr. Carl Stuebner	565

Response

Improvements to the containment integrity for sea disposal were discussed in the DEIS. Disposal sites, pre-disposal preparations, and at-sea disposal operations have been evaluated and numerous actions and prohibitions have been identified that would ensure and improve containment integrity (Chapter 2, Section II.H; Chapter 4, Section II.A.3(e); and Appendix D, Sections III.A, III.B, VII, and VIII). In addition some other engineered improvements were considered and evaluated but were not selected because of expected high costs and essentially no gain in containment effectiveness (Chapter 4, Section III.A.3(e)).

Some respondents mentioned specific measures, such as encapsulation, filling of certain void spaces, and coating the radioactive structures to improve containment. Evaluation of measures such as these indicated a lack of net benefit because the added radiation exposure to the shipyard workers exceeded by far the potential reduction in the population exposures (Chapter 4, Section II.A.3(e)).

Other respondents expressed concern that the submarines would leak and radioactive waste would leak out and kill lots of fish and sea life. The radiation effects on bottom-dwelling sea life were calculated and found to be very small—too small to kill, and even less than the effects of the naturally-occurring radionuclide Polonium-210 from naturally-occurring minerals, containing uranium which exist everywhere in the ocean (Chapter 4, Section II.A.3(b)).

L.53—Summary of Issue

Disposal of nuclear submarines in the ocean would contaminate the sea food, beaches, or other resources which might cause an economic impact on the fishing and tourist industries.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Karen Ankersmit	539	Mr. Thomas D. Brown	178
Ms. Natasha Atkins	167	Mr. Greg Carr	672
Mr. George Balding	77	Mr. Wesley Chesbro	69
Mr. Danny Barca	677	Mr. Paul Clemmons	387
Ms. Carol Bath	490	Ms. Barbara Connelly	143
Ms. Ann Bauer	5a	Ms. Nancy Cragin	137a
Mr. & Mrs. Warren Beth	189	Ms. Janet Crone	113
Mr. Nathaniel S. Bingham	78a	Ms. Randi Dalton	161
Ms. Patricia C. Blackford	587	Mr. Jon Daunt	669d
Mr. Mark Bolin	275	Mr. Stephen E. Davenport	34
Mr. John Bone	11	Dr. Jackson Davis	76
Mr. Doug Boone	108	Mr. Warren Detriedt	282
Honorable Barbara Boxer	66	Mr. Norman DeVall	73

(Continued on next page)

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Dobie Dolphin et al.	131b	Mr. David Martinovich	190
Mr. John R. Donaldson	461	Ms. Laure Mastrella	637
Mr. Peter Douglas	68a	Ms. Helen H. Maxon	518
Mr. J. Edmondson	285	Mr. Yale Candee Maxon	518
EPA	694	Mr. L. Kyle McCarthy	260
Mr. Thad Eure	719	Ms. Janet Morrison	341
Mr. Sean Fannin	204	Ms. Dani S. Moyer, et al.	180
Ms. Donna Feiner	280	Ms. Kei Murrell	183
Mr. James Arthur Ferrara	665	Ms. Mary Sue Noe	2
Ms. Deborah Filbeck	474	Ms. Julie Kay Norman	709
Ms. Beverly H. Forbus	560	Mr. Joseph M. O'Brien	388
Ms. Lydia Raas Ford	326	Mr. Thomas D. O'Neil	80
Mr. Robert Gansowski	550	Mr. Charles Orth	88
Ms. Melissa Gehrman	16	Mr. John V. Outzen Jr.	394
Mr. Alan Graham	277	Mr. S. Chris Payne	169
Ms. Cecelia J. Gregori	298	Ms. Linda Peters	97
Mr. Gilbert J. Gregori	298	Ms. Sarah Press	91
Ms. Gisela Grossman	299	Robin Rabens	352
Mr. David R. Gurney	133 or 193	Mr. Robert E. Ragland	315
Mr. Dan Hamburg et al.	72, 72a, 72b	Ms. Arlene Reiss	344
Mr. Roy Harleman	281	Ms. Marlene River	510
Ms. Christine Harmony	311	Ms. Beverly Roberts	32
Mr. John P. Harville	290	Ms. Maxine Rosenthal	610
Mr. Dan Hauser	74	Mr. James F. Ross	486
Mr. Christopher S. Hayes	603	Mr. John Runkle	18 or 468
Ms. Jeane L. Heard	209	Mr. Lewis Seiler	707
Dr. Larry Heiss	248	Mr. Hanon Sells et al.	441
Ms. Liz Helenchild	132	Ms. Jane Sharp	14
Dr. Michael J. Herz	37b	Mr. Ron Shehee	407
E. Hodges	497	Mr. Stampfli	199
Mr. Fred. C. Hummel	162	Mr. Randall Stemler	348
Mr. Thomas C. Jackson	37b	Ms. Sharon E. Strasser	472
Ms. Helen Jacobs	278	Mr. Victor G. Taylor	221
Mrs. Brenda S. Johnson	422	Mr. Marcus Tengesdal	61
Honorable Walter B. Jones	9	Ms. Mary Tenneson	622
Ms. Donna Joyce	198	Kelly Townsend	503
Mr. Ronald A. Joyce	198	Ms. Beth Troy	425
Ms. Deborah Ann Judd-Rogoff	406	Atty. Gen. John K. Van DeKamp	446
Mr. John M. Lawson	699	Mr. Gordon K. Van Vleck	715
Ms. Lorie Leaf	538	Don & Linda Weber	231
Mr. Jim LeCuyer	84	Mr. Don R. Weber	242
Ms. Julia Lerma	265	Mr. Edmund B. Welch	9
Mrs. Eleanor Lewallen	3	Western Governors' Conference	723
Mr. Nelson Lindley	476	Ms. Emily F. Whittlesey	358
Ms. Margaret Livingston	247	Ms. Leah Williams	292
Mr. Doug Lowe	21	Ms. Roanne Withers	354
Mr. Douglas M. MacDonell	395	Mr. G. Nelson Wolfe	104
Ms. Kate Marianchild	140		

Response

The analyses reported in Chapter 4, Sections II.A.3 and II.A.4, and described in Appendix I showed that even with very conservative treatments there would be no limitation on the use of beaches, ocean waters, fisheries, or other resources.

L.54—Summary of Issue

The Sandia Reports and the DEIS failed to disclose any study related to bacterial (microbiological) studies associated with research directed toward the environmental effect of introduced substrates on the marine environment.

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS stated, in Chapter 4, Section II.A.4.(b)(1), that the non-radiological effects associated with sea disposal are the same as those associated with the sinking of surplus ships that are not nuclear powered, which is already permitted under EPA regulations (40CFR229.2). Therefore, no discussion of additional research is necessary.

L.55—Summary of Issue

The DEIS should contain more discussion of the artificial reef effect and its impact on the benthic fauna which may be expected to colonize the sunken hulls. Relevant information from previous Navy benthic surveys should be included.

Those Identifying Issue	Identification Number
Mr. George Balding	77
Ms. Jane O. Ballus	19
Ms. Kay Bollinger	40
Ms. Janet P. Brooks	693
Mr. Bruce R. Campbell	421
Ms. Kimberly J. Christman	671
Mr. Clifton E. Curtis	695
Mr. Warren Detriedt	282
EPA	694
Mr. Wells Eddleman	20
Mr. Conrad Golich	713
Dr. Judith E. Gordon	420
Mr. Ron Guenther	105a
Ms. Jeane L. Heard	209
Dr. Michael J. Herz	37, 37b
Mr. Thomas C. Jackson	15, 37b
Ms. Lea Lackey-Zachmann	459
Mr. Wm. A. Lochstet	443
Mr. Scott McCleary	86
Ms. Maxine McCloskey	689
Ms. Rebecca Matthews	693
Mr. Thomas D. O'Neil	80
Ms. Janet T. Orselli	593
Ms. Molly Randall	570
Ms. Beverly Roberts	32
Mr. Arthur J. Rocque Jr.	697
Ms. Susan Ronis	286
Ms. Joyce Rosenthal	13a
Mr. Christopher D. Roosevelt	695
Mr. Ron Shehee	407
Unknown	213
Mr. Gordon K. Van Vleck	715
Mr. Timothy Zachmann	459

Response

The Final EIS contains an expanded discussion of "Effects on the Ocean and Seabed Ecology" (Chapter 4, Section II.A.4.(b)(2)). The Annex to Appendix D was also updated to include August 1983 observations and sampling results from the THRESHER debris site. As discussed in those sections, visual and photographic examinations of marine life at the THRESHER debris site indicate that no significant reef effect has occurred during the approximately 20 years that the THRESHER has rested on the bottom. There were no discernible differences in biomass concentrations between the debris site and the surrounding area. These observations are consistent with the

(Continued on next page)

expected situation from such deep ocean areas where photosynthesis is impossible, making increased nutrient production impossible. As discussed in a recent report (Reference 1) by an international group of experts, it is unlikely that such a structure would appreciably increase biomass and production because the energy supply at the bottom is universally low and the submarines would not contribute to the actual energy available.

Radioactivity measurements of a large number of fish and smaller marine life specimens from the THRESHER debris site were in no case greater than natural background or fallout levels.

Reference

1. IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
   Joint Group of Experts on the Scientific Aspects of Marine Pollution—GESAMP—, Reports and Studies No. 19, An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea, Vienna, June 1983

L.56—Summary of Issue

The Navy should consider examining the sites of previous sinkings to obtain information on the artifical reef effects.

Those Identifying Issue	Identification Number
EPA	694

Response

The SCORPION which sank in May 1968 was inspected shortly after it sank and again in 1979. In addition, the THRESHER which sank in April 1963 was inspected in 1965, 1977, and most recently in 1983 after it had been on the bottom for 20 years. No significant reef effects were observed, as expected because of the small food supply, low temperatures, and the lack of sunlight for photosynthesis. The Annex to Appendix D has been revised to include observations related to reef effects.

Investigation of ships sunk during World War I and World War II was not practicable, because ships whose location is known well enough for feasible investigation are sunk in relatively shallow, often warm, water which is not representative of conditions at a possible disposal site.

L.57—Summary of Issue

The draft EIS does not adequately discuss accidents, or treats accidents optimistically.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Ann Bauer	5a	Dr. Michael J. Herz	37, 37c
Ms. Janet. P. Brooks	693	Mr. Thomas C. Jackson	15, 37b
Ms. Nancy Cragin	137a	Mr. Doug Lowe	21
Mr. Clifton E. Curtis	695	Ms. Rebecca Matthews	693
Ms. Randi Dalton	161	Mr. Daniel F. Read	12
Mr. Jon Daunt	669a	Mr. Christopher D. Roosevelt	695
Dr. Jackson Davis	76	Ms. Joyce Rosenthal	13a
Mr. Walter Dodds	571	Mr. Lewis Seiler	707
Ms. Dobie Dolphin et al.	131b	Mr. Ron Shehee	407
Mr. James A. Ferrara	665	Dr. Ruth F. Weiner	39a
Mr. Jeffrey T. Harris	507	Mr. James Widmeyer	678

Response

Hypothetical accidents and their possible environmental consequences were treated in detail in the DEIS, using very pessimistic assumptions, in Chapter 4, Sections I.B.1 (b) and II.B.1, including an accident that might occur between the shipyard and the disposal site, and in Chapter 4, Section II.A.3(b), for an accident that might occur at a sea disposal site. Tables 4-3 and 4-5, respectively, provide the sequence of events and radioactive material release for the minimum containment or accident condition.

The treatment of an accident which might occur during transit from the shipyard is applicable to either the land option (reactor compartment on barge) or the sea option (entire submarine under tow). Such an accident was assumed to take place at a relatively shallow depth and near shore location, deep enough that recovery would not be possible, but where the maximum effect on man might result.

The accident that occurs at a sea disposal site was estimated to have 50 times less impact than an accident nearer shore because of the greater depth at the sea disposal site and the greater distance from man's activities. The exposures from either accident would have no effect on the individuals who might be exposed.

In both hypothetical accident evaluations the analyses in the DEIS included the very pessimistic assumptions that not only would the reactor compartment containment be destroyed, but also the reactor vessel would be immediately open to sea bottom currents. The latter assumption is even more pessimistic than specified by the respondents and is particularly important and particularly pessimistic since it would remove an extremely strong containment barrier inside of which almost all of the radioactive material is contained. It should be remembered, however, that no conceivable accident can damage the containment which is provided by the fact that the radioactive atoms are an inseparable and integral part of the solid metal.

In assuming destruction of the reactor vessel containment, the worst case analysis in the DEIS goes beyond the "reasonably foreseeable" effects that an agency needs to examine, according to recent proposed guidance on 40CFR1502 and 1508, published by the Council on Environmental Quality in the Federal Register for August 11, 1983, pages 36486-7.

L.58—Summary of Issue

Navigational hazards during transportation of submarines to a disposal site should be considered in the EIS.

Those Identifying Issue	Identification Number
Ms. Kimberly J. Christman	671
Mr. Thomas C. Jackson	15
Mr. Ron Shehee	407

Response

The probability and consequences of hazards during movement have been evaluated for both options. Refer to Chapter 4, Sections I.B.2, II.B.1, and II.B.2, Appendix B, Section III and Appendix D, Sections I and III.

L.59—Summary of Issue

The DEIS examines a transport accident which occurs at 25 km from the shore. If a submarine sinks in transit at a location much closer to shore than 25 km, doses may be higher than those for the transport accident postulated in the DEIS, if the submarine cannot be removed in a reasonable period of time.

Those Identifying Issue	Identification Number
NRC	445

Response

The calculations were performed for a location 25 km from shore because an accident closer to shore would be in a depth where it was judged that the submarine could be recovered or encapsulated within a year of its loss. A submarine sunk within the relatively shallow waters close to the shore could be recovered or encapsulated in a much shorter time than would be required for corrosion to penetrate containments and begin the release of radioactive materials. Additionally, nearly all (99.9%) of the radioactive atoms are within the thick metal of the reactor structure itself, a containment that cannot be lost in any accidental sinking. When the nature of the containments and the ability to recover or encapsulate are coupled with the fact that a transportation accident would be extremely unlikely, the possibility of such an impact is so remote that further evaluation is not warranted.

L.60—Summary of Issue

The Navy must prepare a worst case analysis evaluating the adverse impacts resulting from at least one towing accident in which a submarine was lost in coastal waters.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
EPA	694
Mr. Doug Lowe	21
Mr. Christopher Roosevelt	695

Response

An accident including premature sinking of a submarine in waters deep enough to preclude rapid recovery but closer to human activities than possible disposal sites was evaluated in the DEIS. See Chapter 4, Section B.1.

L.61—Summary of Issue

There is a probability of 0.3 that a submarine being towed to a sea disposal site would be sunk.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695	Ms. Denise R. Kim	702
Dr. Michael J. Herz	37, 37b, 37c	Mr. Robert B. Kusner	702
Mr. Thomas C. Jackson	15, 37b	Mr. Christopher Roosevelt	695

Response

The issue as stated above is based on a misunderstanding of the DEIS. The probability of an accident during barge transportation of a reactor compartment to a land disposal site was assumed in the DEIS to be 0.3, that is in 100 barge trips a total of 0.3 accidents would be expected. (As discussed in the response to Issue K.14 this includes minor accidents; if only severe accidents are considered the expected number of accidents is 0.00009 in 100 barge trips to land disposal sites, and the number of accidents which would result in the barge sinking is even smaller.)

The probability of accidental sinking of a submarine during the towing to a sea disposal site was not estimated in the DEIS because comparable statistics are not available. However, the probability of even one such sinking during 100 towing operations would similarly be extremely small, on the basis of extensive Navy experience in such operations, and the special precautions that would be taken to avoid problems during transit to the disposal site. The expected number of accidental sinkings would be at least as low as that for commercial barge towing operations.

This issue is also in error because it implies that the EIS should have considered multiple accidental sinkings during transit to disposal sites. The EIS considers one such sinking, in Chapter 4, Section II.B.1, and the probability of this accident is very small, as discussed in the EIS and above. The possibility of more than one accidental sinking is remote, and beyond what is reasonably foreseeable so no additional sinkings were analyzed.

L.62—Summary of Issue

What would be the likelihood (quantitatively) of premature sinking and/or loss of the tow ship during transport in the sea disposal option? What specific measures would be taken in either event?

Those Identifying Issue	Identification Number
EPA	694
Ms. Joyce Rosenthal	13a

Response

The probability of any accident during disposal, let alone one which might lead to premature sinking of a submarine, would be much less than the one chance in one hundred disposals that is implicit in the analysis described in Chapter 4, Section II.B.1 of the DEIS. (Also see the response to Issue L.61). The Final EIS has been modified to include an explicit treatment of this probability or quantitative likelihood.

The specific measures that would be taken in the event of a casualty such as premature sinking or loss of the tow ship are related to contingency planning which is beyond the scope of the Council on Environmental Quality specifications for environmental impact statements, as identified in 40CFR1500 and discussed in the response to Issue N.10.

L.63—Summary of Issue

Transportation accidents and their effects must be evaluated for possible impacts.

Those Identifying Issue	Identification Number
Mr. Dennis L. Lundblad	372
Mr. Kendall Reid	479
Mr. Ron Shehee	407
Ms. Sharon Winters	479

Response

Evaluations of transportation accidents and their effect were included in the DEIS. See Chapter 4, Sections I.B.1, I.B.2, II.B.1, and II.B.2; and Appendix D, Section III.A.

L.64—Summary of Issue

The Environmental Impact Statement should discuss the consequences of the following events occurring (in relation to the sea disposal option).

"terrorism"
"sabotage"
"political hostage of the ocean"
"ocean suicide/murder"

Those Identifying Issue	Identification Number
Ms. Randi Dalton	161

Response

These issues are outside of the scope of the NEPA process.

However, to provide a perspective the following information is provided. A defueled decommissioned submarine contains no nuclear fuel and the radioactive material is contained within the metal matrix of heavy components. The transportation accident evaluation was extremely conservative in that it evaluated the unrealistic situation where all surfaces of the radioactive metal were assumed to be exposed to the ocean. Because the radioactive material is part of the metal, the situations proposed in this issue are not significantly different from the way the transportation accident was evaluated.

SECTION M

This Section (M.1) contains an issue related to Chapter 4, Section III of the Environmental Impact Statement.

M.1 —Summary of Issue

"The Navy fails to discuss the option of temporary protective storage to allow radioactivity to decay substantially prior to disposal."

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher Roosevelt	695

Response

This issue is fully covered in Chapter 4, Section III.A, entitled "Land Disposal Option combined with Protective Storage" and Section III.B., entitled "Sea Disposal Option Combined with Protective Storage."

SECTION N

This Section (N.1—N.15) contains issues related to Chapter 4, Section IV of the Environmental Impact Statement.

N.1—Summary of Issue

If the potential population doses for land and for sea disposal were presented with a range of uncertainty, such as one or two standard deviations, it is likely that there would be no basis for distinguishing between them.

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy agrees. The estimated doses show no significant difference between land and sea disposal as well as no significant impact from either option.

N.2—Summary of Issue

Case law under NEPA does not permit the comparative costs of the various disposal alternatives to be the determining factor in the selection.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Ms. Rebecca Matthews	693

Response

The Council on Environmental Quality explicity allows the record of decision to consider relevant factors such as economics (40CFR 1505.2(b)).

N.3—Summary of Issue

The choice of a disposal option should be based on safety, not cost.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Marcia E. Andrew	64	Ms. Carolyn J. Christman	200
Ms. Karen Ankersmit	539	Mr. Edgar D. Christman	572
Mr. George Balding	77	Ms. Jean S. Christman	572
Ms. Gwendolyn Behen	257	Ms. Cyndi Clarke	150
Mr. Mark Bemberg	270	Mr. Garrett Connelly	81
Ms. Christine Berchen	381	Ms. Nancy Cragin	137a
Ms. Alice Berg	203	Ms. Janet Crone	113
Mr. John K. Bermel	227	Mrs. Gretchen Crosson	408
Honorable Douglas H. Bosco	66	Mr. Kevin Crosson	408
Ms. Joan Burleigh	309	Ms. Randi Dalton	161
Mr. Bruce R. Campbell	421	Mr. Gary DeGraff	51

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Honorable Ronald V. Dellums	447	Ms. Kate Marianchild	140
Mr. Dwight Donovan	228	Lt. Governor Leo McCarthy	65
Dr. Justin M. Elliott	485	Mr. Scott McCreary	86
Ms. Katherine Emerson	370	Ms. Dena Mossar	442
Ms. Louise Ewens	573	Mrs. W. R. Phillips	332
Mr. Dan Hamburg et al.	72a, 72b	Ms. Sara Press	91
Mr. Jed Handler	466	Mr. Arthur J. Rocque Jr.	697
Ms. Jeane L. Heard	209	Ms. J. Rosenthal	13b
Dr. Michael J. Herz	37a	Ms. Sharon Ryals	206
Mr. Jeff Hohensee	116	Mr. Stuart Robert Smith	54
Mrs. Brenda S. Johnson	422	Ms. Nancy Tuttle	537
Ms. Sue Kaye	288	Mr. Will Tuttle	537
Mr. Jim Le Cuyer	84	Unknown	213
Ms. Julia Lerma	265	Ms. Kathleen Walden	629
Ms. Mary Jo Leyden	138	Mr. G. Nelson Wolfe	104
Ms. Laura Maguire	524	Mr. John Wood	62
Mr. Johnny K. O. Malin	168a	Mrs. J. C. Youngberg	529

Response

Based on the environmental impact statement's findings, either the land or sea option would have negligible environmental impact so that either option could be chosen based on safety considerations.

N.4—Summary of Issue

In the ocean disposal section, exposure is described for a "typical" person (page S-12 of DEIS Summary) based on "realistic" assumptions. Such is not the case for the exposure discussion in the land disposal section.

Those Identifying Issue	Identification Number
EPA	694

Response

Since land disposal is currently being conducted, several extensive studies already exist. The Navy relied heavily on these already existing studies and incorporated their calculational techniques as described in References C.1 and C.2. These studies did not include realistic assumptions, but rather included conservative assumptions. Therefore, realistic or best estimate exposures for land disposal are not available. However, sea disposal was also evaluated with very conservative assumptions. In fact the same paragraph referred to by the respondent (page S-12 of the DEIS) also describes the conservative estimate of the impact from ocean disposal. The important fact is that comparisons of potential environmental impacts from land and sea disposal (pages S-13 through S-16 of the DEIS) were based on conservative estimates that are comparable.

N.5—Summary of Issue

In the DEIS Summary, ambiguity exists between the terms "practical choices" and "proposed alternatives."

Those Identifying Issue	Identification Number
EPA	694

Response

The term "proposed alternatives" was not used in the DEIS Summary.

N.6—Summary of Issue

It should be indicated (in the Summary) where the average individual is located in relation to the burial ground for the stated dose of 0.006 mrem/yr.

Those Identifying Issue	Identification Number
EPA	694

Response

The average individual is assumed to live downstream of the burial ground. This is discussed in Chapter 4, Section I.A.2(c)(4) and in Appendix C, Section III.A. Words have been added to the Summary to clarify this point.

N.7—Summary of Issue

It is the respondent's position that the Navy has not met its obligation to fully explain its "course of inquiry", analysis and reasoning as required in *Massachusetts v. Andrus*, citing *Silva & Lynn*, to permit the Court to determine whether an agency has made an objective good faith effort to take into account the values NEPA seeks to protect.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher Roosevelt	695

Response

An examination of Appendices A, B, D, and E will indicate that extensive work was done to determine the feasibility and estimated impacts of the two principal options. Appendices C, F through J, and L describe the results of extensive analysis of the environmental effects associated with the two principal options. Appendix K discusses the necessity of a long-term monitoring program.

The Navy considers it has met the requirement to fully explain its analysis and reasoning consistent with the CEQ requirement (40CFR 1500.2b) that environmental impact statements be concise, clear and to the point, and supported by evidence that the necessary environmental analyses have been made.

N.8—Summary of Issue

It is inappropriate to compare radiation health effects from submarine disposal with those from television viewing.

Those Identifying Issue	Identification Number
EPA	694

Response

As reported in the Summary of the EIS, where the comparison between the health effects estimated to result from submarine disposals on the deep ocean floor and those estimated for watching television two hours a day is presented, the health effects being considered are additional cancer cases per hundred thousand people. Since one of the standards used to define health effects due to exposure to hazardous material is the number of additional cancer cases which might occur in a given population group, it is entirely appropriate to compare the additional cancer cases which might occur due to submarine disposal actions with those that occur from television watching or any other activity.

N.9—Summary of Issue

There is no discussion of retrievability (in the Summary).

Those Identifying Issue	Identification Number
EPA	694

Response

Appendix M has been added to the Final Environmental Impact Statement to discuss the subject of retrievability in greater detail in response to widespread interest in this topic. However, there is no need to discuss this issue in the Summary.

N.10—Summary of Issue

A section should be added to the DEIS that presents the scope of emergency plans and coordination that would be implemented with the states that may be impacted in the unlikely event of an accident.

Those Identifying Issue	Identification Number
Health and Human Services (HHS)	28

Response

The requested material related to contingency planning is beyond the scope of the Council on Environmental Quality specifications for Environmental Impact Statements, as identified in 40CFR1500. Any necessary contingency plans or other coordination with states involved will be developed for the option selected if not already adequate.

N.11—Summary of Issue

The DEIS authors include a number of engineers and mathematicians, but few biologists.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Martin F. Golden	634	Mr Lewis Seiler	707
Dr. John W. Harris	85	Ms. Nancy Tuttle	537
Ms. Sara Schatz	533	Mr. Will Tuttle	537

Response

The list of preparers of the DEIS (final two pages of DEIS) reflects the fact that the problems that needed to be solved to assess the environmental impacts of submarine disposal involved engineering, environmental analysis, biology, and oceanography. Important data and consultations, technical support and reviews were provided by the people listed in the document under "Other Contributors" and "Technical Support." The persons in these lists included oceanographers, marine biologists, and other scientists.

The primary reason few biologists were needed was because previous work by other biologists has established the principles of the internationally accepted concentration-factor method. Similarly, the numerous values for concentration factors cited in the text were available from recognized references.

N.12—Summary of Issue

The U.S. Navy's plans to dispose of the aircraft carrier with eight reactors aboard and other future nuclear powered Navy vessels should be discussed in the DEIS.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. Jackson Davis	76	Mr. Ted Mahr	47
Ms. Dobie Dolphin	131b	Mr. John Runkle	18 or 468
EPA	694	Mr. Lewis Seiler	707
Mr. Dan Hamburg et al.	72, 72a	Atty. Gen. John K. Van DeKamp	446
Mr. Melvin L. Holland	477	Dr. Ruth F. Weiner	39a
Mr. John E. Madison	170	Mr. John Wood	62

Response

This Environmental Impact Statement is being prepared to identify and evaluate alternative disposal methods for only the approximately 100 nuclear powered submarines which are planned to be defueled, decommissioned and made available for disposal by the end of the century. Therefore, disposal of surface ships or other Navy vessels is considered beyond the scope of matters covered by the Environmental Impact Statement.

N.13—Summary of Issue

Most references are of limited circulation and not readily obtainable and many important technical references are restricted in their availability. The EIS should contain information as to the accessibility of related materials used as references.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
Ms. Janet P. Brooks	693
Ms. Dobie Dolphin et al.	131b
EPA	694
Ms. Rebecca Matthews	693

Response

All documents referenced in the EIS are in the open literature and may be obtained through the normal channels provided by any good library. These documents are either United States government reports, books published by major publishing firms, documents available through the National Technical Information Service (NTIS), papers published in major journals, reports published under international forums such as the IAEA, or documents available from other governments such as the United Kingdom.

N.14—Summary of Issue

"There is excessive citation of recent technical reports and summaries which have not undergone careful review and critical evaluation since they are not readily obtainable (i.e., Sandia Report #82-1005 which contains data essential to understanding the DEIS)."

Those Identifying Issue	Identification Number
EPA	694

Response

The technical document referenced is available from the National Technical Information Service. Because this document was only recently published, the Navy provided copies of this document to the EPA and other interested respondents who requested it.

N.15—Summary of Issue

Several persons who spoke during the meeting at Olympia, Washington felt that the Navy, perhaps deliberately, had provided an incorrect address for the location of that meeting.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Brian Baird	55	Mr. Stuart Smith	54
Dr. Michael J. Herz	37	Mr. Marcus Tengesdal	61
Mr. Ted Mahr	47	Dr. Ruth Weiner	39
Mr. David Schomer	48	Mr. Riede Wyatt	52

Response

The notice published by the Navy provided the correct address. Apparently, broadcast or print news items identified the meeting location incorrectly or in such a way that some people were confused. As soon as the Navy became aware of the confusion, notices were posted at the other location.

SECTION O

This Section (O.1—O.34) contains issues related to Appendix A of the Environmental Impact Statement.

O.1—Summary of Issue

The column headings in Tables A-1 and A-4 should be revised to be "Immediate Disposal" and "Disposal After Storage" to avoid confusion regarding inactivation and inactive ships (Appendix A).

Those Identifying Issue	Identification Number
EPA	694

Response

The column headings in Tables A-1 and A-4 (Active Ship and Inactive Ship) refer to disposal directly following active service and to disposal following prior inactivation and protective storage, respectively. These briefer terms are preferred, and a clarifying note has been added to Tables A-1 and A-4.

O.2—Summary of Issue

Insufficient information is provided to verify the cost figures given for disposal alternatives.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695	Honorable Barry Keene	67
Mr. Fred Eissler	664	Mr. Christopher Roosevelt	695
EPA	694	Atty. Gen. John K. Van DeKamp	446
Mr. Dan Hauser	67a	Mr. Gordon K. Van Vleck	715
Mr. Michael J. Herz	37b	Dr. Ruth Weiner	39a
Mr. Thomas C. Jackson	37b		

Response

The estimated costs presented in the DEIS were based on actual experience wherever possible and were developed by experienced cost estimators where no actual experience was available. Details are provided in Appendices A, B, and K.

The estimators applied standard cost estimating techniques to each step of the alternative disposal processes, using actual costs when available and estimated costs when necessary, based on previous experience in the performance of work associated with naval nuclear propulsion plants. The guidelines for preparation of the cost estimates specified that the effort should be estimated as the minimum amount of effort needed to satisfy the general requirements under an austere program. The total estimated costs are considered to be within 15 percent of the actual costs (Appendix A, Section III.D).

Prorated capital costs were included in the cost estimates where appropriate. Provisions for future payments, including capitalization and replacement if necessary, were included for the entire duration of the program.

O.3—Summary of Issue

Details of the various cost analyses are not presented in the Summary.

Those Identifying Issue	Identification Number
EPA	694

Response

The details of the cost analysis are contained in Appendix A. It is unnecessary to also include the details in a summary section.

O.4—Summary of Issue

Disposal costs should be considered a minimal factor in selection of the disposal option because these costs are small when compared with building and operating costs of a submarine.

Those Identifying Issue	Identification Number
Mr. Bill Barlow	17
Ms. Kimberly J. Christman	671
Mr. Craig S. Harrison	527
Mr. Ron Shehee	407

Response

The costs of building and operating ships are independent of costs associated with the disposal method to be selected, so this approach would not assist in the decision making process.

O.5—Summary of Issue

The economic benefit of having a "mothballed" submarine which could be used in the future should be discussed in the cost analysis and should be subtracted from the cost of the storage option so that a true cost comparison of alternatives can be made.

Those Identifying Issue	Identification Number
EPA	694

Response

The purpose of the EIS is to evaluate alternatives for disposal of submarines after they reach the end of their useful life. Therefore, a submarine in protective storage awaiting disposal would have zero economic benefit, and the cost comparison in the EIS is correct.

O.6—Summary of Issue

Although the text indicates that preparations for land disposal would be normal shipyard work, the cost analysis should discuss the design, licensing, construction, operation, and decommissioning of a dismantling facility (Appendix A).

Those Identifying Issue	Identification Number
EPA	694

Response

As was discussed in Chapter 2, Section I.A, and Appendix B, Sections III.A and III.C, preparations for land disposal could be performed in existing drydocks. No new dismantling facility would be needed.

O.7—Summary of Issue

Consideration of the land alternative is sketchy and inadequate in areas such as civilian contractors, profit margins, perpetual care and maintenance fund, payments to state, use of commercial site.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Michael J. Herz	37b
Mr. Thomas C. Jackson	37b
Mr. Christopher Roosevelt	695

Response

These comments are related to commercial radioactive waste burial grounds and not to DOE sites already operated for such purposes. Consideration of a commercial site for land disposal of a submarine reactor compartment is unacceptable due to the classified nature of the waste package. (Refer to Chapter 2, Section IV.A.) A cost analysis of the land disposal alternative covering costs appropriate to burial at an existing DOE site is provided in Appendix A.

O.8—Summary of Issue

The cost analysis should include detailed information on the availability of equipment for anticipated transport for land disposal, and should discuss whether the equipment needed would be available from Government, whether commercial equipment would be needed, and the comparative costs.

Those Identifying Issue	Identification Number
EPA	694

Response

Information concerning a barge and a heavy load transporter is provided in Appendix B, Sections IV.A and IV.B. The costs of transportation are included in Appendix A analyses in adequate detail for the evaluation of alternatives.

O.9—Summary of Issue

Salvage costs in one of the land disposal options should be looked at with respect to the overall effect on the U. S. economy (Appendix A, Section III.D.3).

Those Identifying Issue	Identification Number
EPA	694

Response

The salvage costs which would arise in land disposal of the reactor compartment when the rest of the submarine would be demilitarized and sold for scrap would exceed the credit that would be expected from sale of the scrap. The amount of non-salvaged material involved in land/sea or sea disposal, while substantial in total quantities, would not approach a significant fraction of the U. S. production during the disposal period (e.g., less than 0.01% for steel), as reflected by the low value of the scrap cited in Chapter 4, Section II.A.4(a). The impact on the U. S. economy from salvaging the submarine materials would be infinitesimal, as may be seen from the amounts provided in Appendix A.

O.10—Summary of Issue

The uncontaminated portion of the submarine that remains after the reactor compartment is removed should be sold for scrap or re-used.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Robert Eidus	23	Mr. John R. Swanson	720
Mr. Harold J. Hoey	44	Mr. Shawn Walsh	26
Ms. Judy Koretsky	376	Ms. Edith Webber	211
Mr. Michael Lowery	377		

Response

The scrap value of the remainder of the submarine was considered in the DEIS (Summary, Comparison of Disposal Methods and Table 3; Chapter 2, Section I.B., Costs; and Appendix A, Section III.D.2, Economic Costs). It was found that the cost of scrapping the remainder far exceeded the value of the scrap, due mostly to the amount of labor involved in cutting the ship apart and in demilitarizing the material before scrapping it. Land disposal with scrapping the remainder was estimated to cost $6 million more than land disposal with sea disposal of the remainder, including the credit for approximately $300,000 worth of scrap.

Re-use of the remainder of the ship would not be practical because the Navy's reason for declaring the submarine to be excess would be that the equipment could no longer perform the required mission. If the submarine could be militarily useful, the Navy would not declare it excess.

For clarification, Appendix B (Land Disposal) was revised to add identification of the alternatives that were considered for the remainder of the ship with the land disposal option. Refer to Section III.A., Concepts of Land Disposal.

O.11—Summary of Issue

The EIS should include the fact that there will be substantially greater employment benefits as a result of land-based disposal.

Those Identifying Issue	Identification Number
Mr. Scott Elliott	56
Ms. Carol E. Mone	627

Response

The higher cost land disposal option would not affect overall employment in the nation.

O.12—Summary of Issue

The choice of which option has the lowest cost should be re-evaluated with due consideration of the following factors:

1. The cost of sea disposal of the rest of the ship should not be charged to land disposal of the reactor compartment.
2. Human health and safety should take precedence over cost.
3. Future fluctuations in scrap prices may affect the cost differences in land disposal.
4. Salvage and re-use of onboard equipment instead of buying new equipment may affect the apparent cost differences.

Those Identifying Issue	Identification Number
Mrs. B. C. Andrews et al.	264
C. A. Collicutt	330
Mr. Clifton E. Curtis	695
Mr. John Donaldson	461
EPA	694
Mr. Gilbert Friedman	484
Dr. Michael J. Herz	37a, 37b
Mr. Thomas C. Jackson	37b
Mr. Jim Marotta-Jaenecke	194
Ms. Ellen McCord	274
Ms. Carol E. Mone	627
Ms. Dena Mossar	442
Robin Rabens	352
Mr. Christopher D. Roosevelt	695
Ms. Sharon Ryals	206
Mr. John W. Thurston	291
Ms. Suzanne G. Thurston	291
Unknown	213
Mr. Don R. Weber	242
Mr. Don Weber	231
Ms. Linda Weber	231

Response

1. The EIS describes the alternate ways for disposing of nuclear-powered submarines (Summary) and the cost of each disposal option is the estimated cost to dispose of the entire submarine (Summary, Table 3). Sea disposal of the rest of the ship and land disposal of the separated reactor compartment constitute one of the six options evaluated in detail. The cost to dispose of the submarine includes the cost of disposing of both the reactor compartment and the rest of the ship (Summary, Table 3). The costs of removing the reactor compartment as well as the costs of welding the rest of the ship back together and towing to a disposal site are all part of the overall cost of disposal of the submarine in this alternative and must be included to provide a valid comparison.

2. Human health and safety received foremost attention in the EIS. Most of the text and appendices are devoted to evaluations of topics that are related directly to human health and safety, and the Summary of the EIS concludes that there would be no significant environmental impact from any of the disposal methods. The estimated radiation exposures for the general public are so small for all available courses of action that such exposures provide no basis for selection (Summary).

3. The EPA cited fluctuations in the price of steel scrap. Since 1960, the prices have ranged between approximately $30 and $100 per short ton, and the scrap value of 3000 tons of steel was credited in the cost estimate at $100 per ton: $300,000 per ship (Chapter 4, Section I.A.3). This value is a small part of the $6 million dollar difference between the estimated cost of scrapping the rest of the ship or sinking it at sea. It is considered that the price of scrap is not likely to increase enough to offset such a difference.

4. Salvage or re-use of needed onboard equipment would not alter the relative cost of disposal alternatives because such salvage could be performed equally well regardless of the disposal option selected. Also, such salvage costs are not included in the disposal cost estimates since salvage would only be performed if the value of the equipment to be salvaged exceeded the salvage cost.

These factors have been included among those that were considered in establishing the disposal options and in estimating the corresponding costs of those alternatives that appeared to be technically and operationally feasible with respect to safety and environmental considerations.

O.13—Summary of Issue

The cost analysis should discuss a difference in cost in the protected storage of existing decommissioned submarines for land and sea disposal.

Those Identifying Issue	Identification Number
EPA	694

Response

Protective storage of existing decommissioned submarines would cost the same regardless of the method selected for their eventual disposal. Refer to Appendix A, Section III.D.2.

O.14—Summary of Issue

The cost analysis should state whether or not the disposal cost estimates are based on using one ocean disposal site (Appendix A).

Those Identifying Issue	Identification Number
EPA	694

Response

One ocean disposal site was used as the basis for tabulating the estimated costs of the sea disposal option (Table A-4). Note (9) of Table A-4 stated the cost impact if two sea disposal sites would be used.

O.15—Summary of Issue

The cost analysis to qualify a sea disposal site should specify the number of ships over which the fixed costs would be amortized, and should discuss the costs for possible multiple sites which may be needed for 100 submarines (Appendix A, Section III.D.2).

Those Identifying Issue	Identification Number
EPA	694

Response

One hundred ships was used throughout as the number of ships under consideration, and the estimated fixed costs to qualify a sea disposal site were amortized over this number of ships.

As shown in Appendix D, all of the submarines could easily be accommodated at a single site. If multiple sites were to be used, the costs would be altered as described in Note (9) of Table A-4.

O.16—Summary of Issue

The cost information in Table A-2 is at variance with costs in Tables A-1 and A-4. It is not clear and should be explained (Appendix A).

Those Identifying Issue	Identification Number
EPA	694

Response

Table A-2 is different from Tables A-1 and A-4. The costs in Table A-2 are provided to support the discussion of other sea disposal methods that were considered. As stated in the associated text, the costs in Table A-2 are partial costs based on preliminary evaluations and are used only to establish the rank of the relative costs among these alternatives; they include pre-disposal preparations, but not the costs of inactivation work in the reactor compartment because these would be essentially constant. Table A-2 illustrates that the other sea disposal alternatives would be much more costly than the flooded freefall method (Appendix A, Section III.C.4).

O.17—Summary of Issue

The cost analysis should include the costs of preparing site specific EIS's, particularly to note any identifiable difference in this regard between land and sea disposal.

Those Identifying Issue	Identification Number
Ms. Karen A. Massey	674

Response

The cost of preparing a site specific environmental assessment, though not mentioned, was included as a part of the estimated cost of qualifying a sea disposal site (Appendix A, Secton III.D.2 and Appendix K, Section IV.A). As shown in Table A-4, under monitoring costs, these costs are included in the sea disposal option, but are not necessary for land disposal because the potential disposal sites are already qualified.

O.18—Summary of Issue

The cost analysis should include the amount of time and effort that would be required to identify and select potential sea disposal sites that would meet the criteria of IAEA (Appendix A).

Those Identifying Issue	Identification Number
EPA	694

Response

The costs of the effort the Navy expects would be necessary to qualify a sea disposal site were included in the DEIS (See Appendix A, Section III.D.2).

O.19—Summary of Issue

It is suggested that the Navy identify (in the Summary) the additional research and cost necessary for such a site-specific assessment at East or West Coast sites as part of the cost estimates for land and sea disposal.

Those Identifying Issue	Identification Number
EPA	694

Response

The cost for ocean disposal site qualification work considered appropriate by the Navy was included in the ocean disposal cost estimates. These costs are discussed in Appendix K, Section IV.A. An extensive discussion of this is not appropriate in the Summary.

No additional research would be required for land disposal sites because disposal would be at locations currently in use for such a purpose.

O.20—Summary of Issue

The costs of escorting the submarines out to sea should be included in the EIS.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Jon Daunt	669d	Mr. Robert E. Ragland	315
Ms. Dobie Dolphin et al.	131b	Ms. Arlene Reiss	344
Ms. Donna Feiner	280		

Response

The costs of escorting the submarines were included in the towing operations of the sea disposal option. See Table A-4 and Appendix D, Section III.A.

O.21—**Summary of Issue**

The cost analysis of the sea disposal option should discuss whether the expenditures for sealing the reactor compartment and cooling systems would be worthwhile in terms of reduced releases and dose effects.

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS did not include a cost-benefit analysis of the measures that would be taken to ensure containment for the sea disposal alternative because containment is required by EPA sea disposal regulations (40CFR 227.11).

O.22—**Summary of Issue**

Costs associated with missile compartment removal and the declassification of certain items should not be omitted (Appendix A, Table A-4).

Those Identifying Issue	Identification Number
Mr. James Widmeyer	678

Response

The removal of the missile compartment is not a part of the disposal program because this action must be accomplished for either option under current U. S. policy (Appendix A, Section I). The costs associated with demilitarization, prior to scrapping the hull, were included in the costs of the land/scrap option (Appendix A, Section III.D.2).

O.23—**Summary of Issue**

What would be the cost effect of early abandonment of the sea disposal option, before completing all of the planned disposals (Appendix A, Table A-4)?

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS contained the information necessary to evaluate this scenario. If the sea disposal option were to be selected, instituted and subsequently abandoned before completion of the planned disposals, the remaining submarines and reactor plants would still need to be disposed of. Land disposal would be the only apparent alternative, although protective storage might be required for some of the plants as an interim measure.

The estimated costs of subsequent land disposal (and any interim protective storage) would be as provided in Appendix A. The cost of monitoring the sea disposal site would continue unchanged.

O.24—Summary of Issue

The cost analysis should include the cost of replacing any failed or nonrecovered instrumentation used to measure ship attitudes and accelerations during disposal at sea (Appendix A, Section III.D.2).

Those Identifying Issue	Identification Number
EPA	694

Response

The cost analysis included the cost of replacing any failed or non-recovered instruments as a part of the monitoring cost (Appendix A, Table A-4), but this cost was not identified explicitly because its magnitude was relatively so small.

O.25—Summary of Issue

The DEIS does not appear to account for the cost to insure any of the various disposal programs against mishap.

Those Identifying Issue	Identification Number
Ms. Denise R. Kim	702
Mr. Robert B. Kusner	702

Response

The engineering of the various disposal options was designed so that no mishap could occur that would have costly consequences. For each option, the potential accidents have been examined and found to be either incredible or without significant environmental consequence. If a mishap were to occur in spite of these precautions, the actual cost of recovery from the accident would be borne by the Navy. There is no estimate for this cost because it is expected to be so unlikely that the mishap would occur.

O.26—Summary of Issue

The DEIS should include the costs of recovery from accidents or unforeseen events for ocean disposal.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Brian Baird	55	Mr. Peter Nahigian	158
Dr. Ruthann Corwin	112	Mr. Thomas D. O'Neil	80
Dr. Jackson Davis	76	Mr. Arthur J. Rocque, Jr.	697
EPA	694	Mr. Lewis Seiler	707
Ms. Maxine McCloskey	689		

(Continued on next page)

Response

The DEIS included discussion of accidents with both land and sea disposal, including accidents involving radioactive material and those that do not (Chapter 4, Sections I.B and II.B). Details of these accidents and their potential environmental consequences are discussed in Appendices B, C, D, G, H, and J.

Even the worst credible accidents have been shown to have no significant consequences and would have relatively small cost impact. Appendix M, which has been added to the Final EIS, includes cost estimates for the removal or additional containment of disposed submarines, should such action ever be needed in the future.

O.27—**Summary of Issue**

The oceanographic research and monitoring costs may be so great that the apparent cost advantage of ocean disposal may not be real.

Those Identifying Issue	Identification Number
EPA	694
Ms. Donna Feiner	280
Mr. John P. Harville	290
Mr. Peter Nahigian	158

Response

The estimated cost for ocean disposal site qualification work and monitoring is included in the ocean disposal cost estimates. These costs are discussed in Appendix K, Section IV.A. The uncertainty in the disposal costs is discussed in Section II.D of Appendix A.

O.28—**Summary of Issue**

The discussion of costs to qualify a sea disposal site should include provisions for reviewing the suitability of ocean dumpsites at least every five years, as required by the NEA Consultation and Surveillance Mechanism, for possible additional corrosion studies specific to sea disposal, and for international consultations under the London Ocean Dumping Convention (Appendix A, Section III.C.2).

Those Identifying Issue	Identification Number
EPA	694

Response

Administrative and technical efforts required to fulfill regulatory and treaty requirements may incur occasional costs that would be associated with the sea disposal option. Such costs that are properly within the scope of the sea disposal program would be funded as a part of the monitoring program and are included in the estimated cost. Since these costs are relatively small and there would be no significant environmental consequence, the cost analysis did not include discussion of such costs.

There does not appear to be any need for additional corrosion studies because there is adequate quantitative information with which to assess the environmental consequences of the corrosion processes. Consequently, there is no explicit item for corrosion studies in the estimated cost of sea disposal.

O.29—Summary of Issue

The cost analysis should discuss the feasibility of conducting "test" disposals by each method to better identify actual cost factors (Appendix A).

Those Identifying Issue	Identification Number
EPA	694

Response

Test disposals by each method would be an expensive and unnecessary exercise. Among the alternative methods that were considered for sea disposal (Appendix A, Section III.C.4), capital costs alone ranged up to as much as $203 million, and non-capital costs ranged up to approximately $5 million. Since most of these methods were rejected because of assuredly higher cost, it would not be prudent to expend such large sums merely to confirm how large they would be.

Among the six methods that were included in the selected disposal options (Appendix A, Table A-4), the estimated costs are considered to be reliable within 15 percent of the estimated cost (Appendix A, Section III.D). There does not appear to be any significant incentive to identify actual costs any closer than this. Although it is concluded that a test disposal for the sea disposal option, using a non-nuclear submarine, would be feasible, it has been estimated that it would cost approximately $2.6 million and would require approximately 15 months to accomplish. For these reasons, a test disposal to better identify costs would not be appropriate.

O.30—Summary of Issue

The EIS should discuss whether non-radiological occupational hazards could be more significant than the radiological hazards.

Those Identifying Issue	Identification Number
EPA	694

Response

The occupational hazards associated with either disposal option would not be significantly different from each other or from normal shipyard work, either from a radiological or non-radiological aspect.

O.31—Summary of Issue

The DEIS fails to adequately discuss the relationships between the "cost/benefit analysis" and "unquantified environmental impacts, values and amenities," and the DEIS fails more broadly in its discussion of unquantified environmental impacts.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Mr. Christopher D. Roosevelt	695

(Continued on next page)

Response

One respondent cited regulations of the Council on Environmental Quality which state ". . . the statement shall, when a cost-benefit analysis is prepared, discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities" (Section 1502.23 of CFR Title 40).

The DEIS included a 17-page "Cost Analysis" (Appendix A) which provided estimated costs (both economic and radiation doses) associated with the disposal options. The DEIS did not include a cost-benefit analysis since the difference between the potential radiation exposures associated with land and sea disposal was found by detailed analysis to be not significant in either context or intensity. In addition, the Summary conclusion of the DEIS states that there would be no significant environmental impact from any of the disposal methods and the estimated radiation exposures for the general public are so small for all available courses of action that such exposures provide no basis for selection.

On this basis, there was no range of benefits over which to analyze the costs. Consequently, a cost/benefit analysis could not be performed and is not applicable in this case.

The DEIS contains discussion of unquantified qualitative factors, consistent with CEQ requirements for conciseness, in Chapter 3 in the description of provisions of the London Dumping Convention pertaining to site selection and in Chapter 4 in the various sections on possible effects.

O.32—**Summary of Issue**

Current and future environmental costs are not considered in the analysis of the option in which 4000 tons of potentially salvageable material per ship would not be recovered.

Those Identifying Issue	Identification Number
Ms. Ivana Noell	645

Response

Permanent disposal of 3000 to 4000 tons of steel from each of 100 submarines over 30 years would have an effect of less than 0.01% on U. S. steel production. This would have an insignificant environmental impact.

O.33—**Summary of Issue**

The disadvantages listed for land disposal are technical while those listed for sea disposal appear to be political only. It should be explained how technical and political factors will be balanced so that objective criteria for decision-making can be applied.

Those Identifying Issue	Identification Number
EPA	694

Response

The purpose of an EIS is to provide information about the impacts of alternative courses of action to the decision-maker prior to a decison being made among the alternatives. Therefore, it is not possible for an EIS to predict in advance how a decision-maker will balance technical and political factors.

O.34—Summary of Issue

Several comments on the Draft Environmental Impact Statement argue that there could be an economic impact on the fishing and tourist industries caused by a public perception that submarine disposal might contaminate sea food or beaches.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. George Balding	77	Mr. Robert A. Hooper	711
Mr. Nathaniel S. Bingham	78a	Honorable Walter B. Jones	9
Mr. John Bone	11	Mr. Doug Lowe	21
Mr. William A. Brobst	7	Ms. Rebecca Matthews	693
Ms. Janet P. Brooks	693	NOAA	444
Mr. Wesley Chesbro	69	Mr. S. Chris Payne	169
Ms. Rainbow Trout Cornelia	308	Ms. Arlene Reiss	344
Ms. Kimberly J. Christman	671	Mr. Christopher D. Roosevelt	695
Ms. Janet Crone	113	Mr. John Runkle	18 or 468
Mr. Clifton E. Curtis	695	Mr. Lewis Seiler	707
Dr. Jackson Davis	76	Ms. Jane Sharp	14
Ms. Dobie Dolphin et al.	131b	Mr. David B. Swoap	721
Mr. John R. Donaldson	461	Mr. Victor G. Taylor	221
Mr. Peter Douglas	68a	Atty. Gen. John K. Van DeKamp	446
EPA	694	Mr. Gordon K. Van Vleck	715
Mr. Thad Eure	719	Mr. Don Weber	231
Ms. Melissa Gehrman	16	Mr. Don R. Weber	242
Mr. Dan Hamburg et al.	72b	Ms. Linda Weber	231
Mr. John P. Harville	290	Mr. James Widmeyer	678
Mr. Dan Hauser	74		

Response

This issue is considered to be outside the scope of this EIS because the speculative impact of a purely economic nature in the fishing and tourist industries, indirectly resulting from the psychological effects of a perception of risk, is not closely related to any change in the physical environment which could be caused by submarine disposal at sea.

SECTION P

This Section (P.1—P.22) contains issues related to Appendix C of the Environmental Impact Statement.

P.1—Summary of Issue

Any data from 30 years experience at the Savannah River Plant should be taken into account in estimating the consequences of burial there.

Those Identifying Issue	Identification Number
Mr. Heyward G. Shealy	236

Response

Technical personnel at the Savannah River Plant and Savannah River Laboratory were consulted during the planning of the potential disposal actions and the environmental assessment. Their guidance and assistance were incorporated into the preparation of the plans for land disposal.

Specific technical background was provided by reference to the Final Environmental Impact Statement for Waste Management Operations at the Savannah River Plant (ERDA-1537, September 1977). The approach used in Appendix C to estimate the long-term consequences of reactor compartment burial was obtained from established methods using site specific information for the Savannah River Plant (Appendix C, Section III.A). In addition, technical personnel at Savannah River provided critical review and helpful comments on the EIS.

P.2—Summary of Issue

The estimated releases of radioactive material for land disposal in the DEIS are not conservative because (1) the assumed corrosion rates are too low; (2) water will be able to flow through the reactor vessel as soon as the first connecting pipes are penetrated, at an earlier time than stated in the EIS; (3) when the pipe walls are initially penetrated there will be a sudden release of radioactive material; and (4) the steam generator will present an additional pathway for corrosion products because its walls would corrode at a different time scale than the reactor vessel.

Those Identifying Issue	Identification Number
Mr. William A. Lochstet	443

Response

The corrosion rates employed in radioactive material release estimates were reasonable and conservative. The respondent is referred to Appendix C, Table C-1 and Appendix F, Table F-3, Note (3). The respondent presents no technical basis for his contention that these rates are not appropriately conservative. Where the appropriate materials, wall thicknesses, and corrosion rates of the piping and the reactor vessel are used, the calculated penetration times are as stated in the DEIS, and the piping would not be penetrated earlier than the reactor vessel. Thus in the land disposal option there is no mechanism by which a large release of radioactive material could be initiated prior to the complete penetration of the reactor vessel.

The steam generator does present a pathway for a small amount of radioactive corrosion products. However, because the reactor vessel would be sealed off from the steam generator, (Appendix C, Section II), because the steam generator's contaminated walls are contained within a heavy vessel, and because the entire quantity of radioactive material outside the reactor vessel is relatively small, and nearly all of this radioactive material will have decayed before the reactor compartment is penetrated, this pathway would not produce important environmental effects. This pathway has already been considered in the estimates of release of radioactive material.

P.3—Summary of Issue

The land disposal dose estimate model is too simplified, unrealistic, and exaggerates dose commitment estimates. Because geological retention was neglected, estimates are too high by several orders of magnitude. The Savannah River simulation model should be used in the DEIS.

Those Identifying Issue	Identification Number
EPA	694

Response

The land disposal dose estimate model is very simplified and is known to have the tendency to exaggerate dose commitment estimates. This fact is clearly stated in Appendix C, Section I. Even with this conservative model, the dose estimates are exceedingly small, and the land disposal option was not penalized in any way as a result of the fact that the dose estimates are exaggerated since the model chosen for estimating potential exposures for ocean disposal also would exaggerate the doses.

For the purposes of the EIS, it is not necessary to estimate radiation doses with extreme accuracy if the doses are very small. In such a case, the important requirement is that the doses be estimated in such a way that the estimates will not be exceeded and as noted by the respondent, this requirement has been accomplished.

Use of a simulation model such as that proposed by the respondent would be appropriate if the dose estimates for land disposal were not demonstrated to be extremely small by a more conservative model. However, the doses estimated with the simpler, more conservative model are so small that the additional complexity that would be associated with using a simulation model is unnecessary.

P.4—Summary of Issue

Population dose estimates for land disposal in Appendix C are based on radiation exposure due to radionuclides in river water. Experience from nuclear facilities which discharge radioactive effluents into rivers indicates that radionuclides accumulate in river sediments. Therefore, direct exposure to dried river beds and exposure due to consumption of bottom feeding organisms, water fowl, and aquatic plants should be considered.

Those Identifying Issue	Identification Number
EPA	694a

(Continued on next page)

Response

It has been observed that some radionuclides accumulate in river sediment when they are discharged directly to rivers from nuclear facilities. However, direct discharge to a river does not occur in the case of buried reactor compartments. The analysis of Appendix C, Section IV is based on the extremely conservative assumption that corrosion products from the reactor compartments pass unimpeded through the earth to rivers. It is unrealistic to expect that radioactivity that passes through long distances of soil and earth while migrating to a river would accumulate on the river bottom.

The estimated exposures from the most likely and most important pathways were found to be very small. Therefore, hypothetical pathways which would produce even smaller effects, such as those mentioned, were not considered explicitly in the EIS. However, as a check on the estimates of Appendix C, Sections II through VII, alternate estimates were presented in Section VIII.A, based on the methods of Reference C.1, the Nuclear Regulatory Commission's EIS on licensing requirements for land disposal of radioactive waste. The purpose of the check calculations was to ensure that no significant pathway had been overlooked in Sections II through VII. As stated in Appendix C, Section VIII.A, the extreme estimates of that section are comparable to the maximum individual exposure estimates of Section V. It was concluded that Appendix C of the DEIS did not overlook any significant exposure pathway.

P.5—**Summary of Issue**

Page C-3 of the EIS should include some explanation for the calculation of dose due to drinking water to explain why the direct ingestion of contaminated groundwater before dilution was not considered.

Those Identifying Issue	Identification Number
Governor Joe Frank Harris	340

Response

The dose calculations shown on Pages C-3 through C-10 are applicable to water in streams and thus include the dilution appropriate for such water supplies. The calculations for a well at the burial site, on Pages C-11 through C-14 are performed according to the Nuclear Regulatory Commission prescription in Reference C.1 of the DEIS (NUREG-0782).

The Final EIS has been modified to include a footnote on Page C-10 that refers the reader to an alternate dose estimate (on page C-13) in which the diluting flow is the minimum rate associated with a well and the annual source of radioactive material is the value calculated using the NUREG-0782 prescription.

P.6—**Summary of Issue**

On Page S-10, the term "average individual," although defined in the glossary is somewhat confusing. Some reference to the exposed population (for land disposal) is needed.

Those Identifying Issue	Identification Number
EPA	694

Response

For land disposal, the population associated with the average individual is identified in Chapter 3, Section I.B, Chapter 4, Section I.A.2(c)(4) and discussed at length in Appendix C, Section VI. The pathways to man which provide the detailed conditions for the average individual are described at length in Appendix C, Section III.

P.7—Summary of Issue

There is no adequate basis provided for limiting the land disposal source to 10 of 100 reactor compartments (page C-4).

Those Identifying Issue	Identification Number
EPA	694

Response

The respondent is referred to Sections IV and V in Appendix C. The exposure to average individuals was estimated based on a source of radioactive material release from 100 reactor compartments to a river with a flow of 7500 cubic feet per second (Appendix C, Section IV). The exposure to hypothetical maximum-exposed individuals was estimated based on the radioactive material release to a local stream with a flow of 20 cubic feet per second (Appendix C, Section V). As stated in that section, the 20 cubic feet per second flow could represent a 15 foot wide stream one foot deep, moving at approximately one mile per hour. While it is possible that radioactive material releases from all reactor compartments buried at the site could find their way into such a small stream, limiting the releases entering the small stream to those from 10 reactor compartments was considered more appropriate because this is the number that would be in the path of the stream traversing a roughly square disposal pattern (10 × 10). This approach produced water concentrations for use in determining exposure to maximum-exposed individuals approximately 37.5 times as high as for the average individual.

P.8—Summary of Issue

The fresh water fish consumption rate of 6.9 kg per year is too high because Rupp (Health Physics Vol. 39, pp. 165-175, 1980) reports that the average current estimates range from 0.11 to 0.85 kg per year (Appendix C, Section IV)

Those Identifying Issue	Identification Number
EPA	694

Response

The consumption rate of 6.9 kg per year appears in Table E-4 of Reference C.2: "USNRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I, Revision 1, October 1977. This is the most recent revision of Regulatory Guide 1.109.

If the consumption rate were 0.85 kg per year instead of 6.9 kg per year, the average individual total body exposure estimate, based on all pathways (Appendix C, Section IV.F) would be reduced from 6.0×10^{-3} mrem per year to 5.0×10^{-3} mrem per year.

P.9—Summary of Issue

The values used in the DEIS for "transfer coefficient to milk" and "transfer coefficient to meat" are too high, based on the *Nuclear Safety* article by Y. C. Ng (1982, 23:57-71).

Those Identifying Issue	Identification Number
EPA	694a

Response

The values used in the DEIS appear in Table E-1 of Reference C.2: "USNRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50 Appendix I, Revision 1, October 1977." This is the most recent revision of Regulatory Guide 1.109. Use of these higher values yields a conservative result and decreasing the values would only decrease the already insignificant estimated exposures.

P.10—Summary of Issue

The minimum flow of the Savannah River is stated (Page C-5) to be 7500 cubic feet per second. The DEIS should indicate if this is the minimum annual average flow.

Those Identifying Issue	Identification Number
EPA	694, 694a

Response

Page C-5 has been revised to clarify that 7500 cubic feet per second is the minimum annual average flow.

P.11—Summary of Issue

The period for the long-term buildup in soil (Appendix C, Section IV.C of DEIS) should not be 15 years, but rather much higher. The 15 year figure is based on the average lifetime of a light-water reactor (hence not applicable in the present case).

Those Identifying Issue	Identification Number
EPA	694a

Response

Referring to the cited section, the hypothetical concentration of a long-lived radionuclide in soil is directly proportional to the assumed period of long-term buildup of soil contamination, for example the 15 year period referred to by the respondent. If a period of 150 years had been employed in the estimate, the annual hypothetical exposure to the total body from crops would have been increased from 7.8×10^{-4} mrem per year to 1.3×10^{-3} mrem per year, and the sum of exposures via all pathways would have been increased from 6.0×10^{-3} mrem per year to 6.5×10^{-3} mrem per year. In view of this minor effect on estimated exposure and on the generally conservative nature of other portions of the exposure estimate, no additional study is necessary.

P.12—Summary of Issue

There seems to be a major error or inconsistency in Part 5 of Section VIII.A, Appendix C. Logically the source term, S, would seem to be the product of the total curies (120) times an availability factor f_c. Thus

$$S = C \times f_c$$

$$S = 120\,Ci \times 9.6 \times 10^{-6}/yr$$

$$S = 1.15 \times 10^{-3}\,Ci/yr$$

This source would be about 100 times as high as the source stated in the draft EIS.

Those Identifying Issue	Identification Number
EPA	694a

Response

The respondent is in error. The cited calculation follows Appendix G of Reference C.1, as stated in the introductory paragraphs of Section VII.A of Appendix C. When equations G.15, G.16, G.18, G.19, G.22, G.23 and G.24 of Reference C.1 are combined, for one long-lived radionuclide only ($\lambda \approx 0$) and one waste stream, with simplifications that set the values of fo, fdi, fi, rg, and J to unity then the exposure H is:

$$H = \left(\frac{C_w}{T} V_w f_c\right)\left(\frac{PDCF}{Q}\right)$$

Considering the right hand side of this expression, the first parenthesis contains the source term of Part 5, Section VIII.A, Appendix C, while the second parenthesis contains the steps of Parts 6 and 8. This shows that the method of calculation follows the analysis method of Reference C.1, as stated.

Furthermore, the source must be measured in curies per year. Contrary to the respondent's equation above, the availability factor f_c is dimensionless; i.e., f_c is 9.6×10^{-6}, not $9.6 \times 10^{-6}/yr$. The respondent's suggestion therefore would result in a calculated source in curies, not curies per year. The suggested approach, therefore, would not be valid.

P.13—Summary of Issue

The EIS should assume that for land burial, dose rates should be calculated as if no institutional safeguards were present after 100 years as required by interim EPA standards.

Those Identifying Issue	Identification Number
Dr. Marvin Resnikoff	13b
Ms. Joyce Rosenthal	13b

Response

Although the interim EPA standards referred to by the respondents have been withdrawn by EPA, the DEIS dose rate calculations for land disposal (Appendix C, Sections IV through VII) did not assume that any institutional safeguards would be present. The fact that the largest dose rates would occur only after several thousand years is a consequence of the multiple containment barriers to the release of radioactive material.

P.14—Summary of Issue

What is the basis for the statement that "several thousand years after disposal" are required to make agricultural intrusion credible? (Section VIII.A of Appendix C)

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS does not state that agricultural activity, that is, farming at a disposal location, would not be credible prior to several thousand years after disposal. Such activity would be conceivable at any time after control of the site was no longer exercised.

The cited passage refers to the length of time that would be required before agricultrual activities might be able to result in the specific set of circumstances described in the particular scenario referenced (see Reference C.1). This hypothetical scenario, set forth by the Nuclear Regulatory Commission for use in evaluating the performance of radioactive waste sites, postulates that all of the buried radioactive material would be available to be mixed into the soil. Several thousand years would be required for any significant fraction of the radioactive material in the thick metal of the reactor pressure vessel and its internal structure to be in a form which could be mixed into the soil used for agricultural purposes.

P.15—Summary of Issue

Appendix C states that the total body dose conversion factor for potassium is given in Appendix I but neither the value nor its source appears to be included in that appendix.

Those Identifying Issue	Identification Number
Governor Joe Frank Harris	340

Response

The K-40 dose conversion factor was not described in Appendix I but in Appendix J, Section I of the DEIS. Appendix C, Section VIII.C of the Final EIS would have been changed to refer to Appendix J but this section was deleted at the suggestion of the Environmental Protection Agency.

P.16—Summary of Issue

The DEIS should indicate in Section VIII.B of Appendix C how conservative the calculation for Americium-241 is. Is there any real basis for comparing the exposure calculations based on Americium-241 and on radioactive material release from land disposal of submarine reactor compartments?

Those Identifying Issue	Identification Number
EPA	694

Response

The exposure estimate for uncontrolled disposal of Americium-241 smoke detectors was obtained from Reference C.8 and was presented in Appendix C merely to provide a check of the results obtained for exposure resulting from land disposal of submarine reactor compartments. Both exposure rate estimates are very small and both are considered to be conservative so it is unnecessary to pursue the question of how conservative the Americium-241 estimate might be.

P.17—Summary of Issue

The EIS should include justification (by reference to appropriate data) of the contention that the effects of land disposal pathways other than those actually calculated in the report would be small in comparison to those for which the calculations were made because the exposure to an individual for these direct intrusion pathways may be of comparable magnitude to exposure from sea disposal.

Those Identifying Issue	Identification Number
NRC	445

Response

The dose commitments presented in Appendix C for the land disposal option were estimated using various calculational techniques. One of these was the NRC model reported in Reference C.1, NUREG-0782, which, for the agriculture intruder, includes the effects of all pathways. The estimated dose commitments associated with this worst case agriculture intruder were reported in Section VIII.A of Appendix C. The land disposal dose commitments reported in Appendix C show that the various calculational procedures all indicate that no significant impacts on man would result from the land disposal of the reactor compartments of defueled nuclear submarines.

P.18—Summary of Issue

Justify the use of 10% as the fraction of the fruits, vegetables, grain, meat, and milk consumed by an average individual which is produced in the region affected by the release of radionuclides from the land disposal site. Was consideration given to the values listed in Table E-4 of Regulatory Guide 1.109 (Reference C.2)?

Those Identifying Issue	Identification Number
NRC	445

Response

The daily intakes for an average individual were obtained from the maximum values reported in Table E-4 of Reference C.2 (NRC Regulatory Guide 1.109). This average individual is representative of the 350,000 people who are assumed to someday live downstream of the land disposal site. Since it was judged that less than half of the current population of 70,000 people who live in this region are supported solely by food which is produced in the region affected by the proposed contaminated water supply and since the land area available to produce this food will not increase, it

(Continued on next page)

was judged reasonable that less than 10% of a population five times as large could be supported solely by food produced in this region. Further it should be noted that even if all the food consumed by this increased population were assumed to be produced in regions affected by releases from the land disposal site, the dose commitment received by an average individual as a result of this ingestion exposure would only be 0.026 mrem per year, which is negligible.

P.19—Summary of Issue

The EIS should explain the use of a water consumption rate of 370 liters per year when defining the dose commitments arising from the land disposal of residential smoke detectors containing Am-241 rather than the 730 liters per year rate used in estimating the dose commitment associated with the land disposal of defueled nuclear submarine reactor compartments.

Those Identifying Issue	Identification Number
NRC	445

Response

Reference C.8 (Appendix C), which defined the effects of land disposal of residential smoke detectors containing Am-241, used a water consumption rate of 370 liters per year for an average individual rather than the 730 liters per year rate used elsewhere in the DEIS. The 370-liter-per-year rate is used here only to reproduce the dose commitment specified in Reference C.8 to define the effect of exposure to Am-241 from the land disposal of residential smoke detectors. Section VIII.B of Appendix C has been modified to ensure that the reader understands that the 370-liter-per-year rate was used in the smoke detector analysis report only and is not used to estimate the dose commitment associated with the land disposal of defueled nuclear submarine reactor compartments.

P.20—Summary of Issue

Section X.A of Appendix C includes a reference to a study involving a 0.1% airborne release. In this location and elsewhere in the DEIS, frequent use is made of references of this type without justification. This makes it difficult to assess the validity of the results and conclusions of the DEIS.

Those Identifying Issue	Identification Number
NRC	445

Response

The specific use in the DEIS of a value of 0.1% of the surface disposal activity immediately released from the reactor compartment following the land disposal accident to define the quantity of activity which is transferred to the atmosphere during the accident is based on the results reported in Appendix C, Reference C.14, as stated in the section identified. An accident scenario was examined in this reference which considered the effect of rupturing a steam generator and exposing its internal surfaces to the atmosphere. Since this scenario is essentially the same as that considered in the EIS for the land disposal accident, the results in Reference C.14 were used to estimate the quantity of activity which might be released into the atmosphere during the hypothetical land disposal accidents.

P.21 — Summary of Issue

The final paragraph in Section XI.B of Appendix C states that "the sequence of events required . . . is extremely unlikely." In order to make this statement, it is presumed that some quantitative estimate of likelihood must be available. Justify this assertion by referring to such a quantitative estimate.

Those Identifying Issue	Identification Number
NRC	445

Response

The actual sentence in this section of the EIS, summarizing the immediate effects resulting from an extreme land disposal accident, is "the sequence of events required to cause these hypothetical dose commitments is considered to be extremely unlikely." This sentence implies that a judgment has been made pertaining to the likelihood of such an accident rather than an unequivocal statement as is implied in the comment.

The events asumed to occur in this hypothetical accident are given in Section III.F.2 of Appendix B. Examination of the specific assumptions and comparison with the methods to be used to prepare and transport the reactor compartments provides a qualitative demonstration of the small probability that the assumed events could occur together at the same time. The assignment of a set of quantitative probabilities to each of the above events is not necessary to conclude that the possibility of this sequence of events actually occurring is extremely unlikely.

P.22 — Summary of Issue

On Page C-4, the size distribution (AMAD) of corrosion products should be given, to support the statement that the corrosion product particle size would prevent air transport.

Those Identifying Issue	Identification Number
EPA	694

Response

The average corrosion product particle size was stated in the DEIS, Section IV.D.5 of Appendix G, to be 1 micron.

SECTION Q

This Section (Q.1—Q.13) contains issues related to Appendix F of the Environmental Impact Statement.

Q.1—Summary of Issue

Were any experiments conducted to evaluate corrosion rates in wet or dry soils?

Those Identifying Issue	Identification Number
EPA	694

Response

The data from corrosion testing in wet or dry soils reported in the literature was found to be sufficient to define conservative values for use in the environmental assessment. As was stated in Appendix F, Section III.D.1, no additional experiment was necessary and none was conducted. The data cited were from testing conducted in soils that were characteristic of the soils at the Savannah River Plant (Table F-3). The soil at the Hanford Site is typically drier and less corrosive than the soil at Savannah River. Using these corrosion rates provided estimates of corrosion rates that would not be likely to be exceeded in land disposal at either site.

Q.2—Summary of Issue

Simple experiments could have been conducted to verify the assumptions related to releases of activities and to provide more realistic estimates of the rates of corrosion by immersing activated materials in water and measuring the release of radionuclides to the water.

Those Identifying Issue	Identification Number
EPA	694a

Response

Experiments were conducted to verify the corrosion release model and the assumptions related to releases of activities, as discussed in Appendix F, Sections III.D.3 and IV.A.7 and Reference F.15. The use of irradiated materials and measuring the release of radionuclides to the water was considered, but atomic absorption spectroscopy was found to be sufficiently sensitive for use as an analysis technique and using it eliminated the need to use radioactive materials.

The rates of corrosion obtained from the literature and used in the assessment were verified by in-situ experiments conducted on the ocean bottom, as discussed in Appendix F, Section III.D.2 and References F.13 and F.14. Simple laboratory experiments would not have provided adequate simulation of actual environmental conditions at the bottom of the deep ocean and their effects on the rates of corrosion.

Q.3—Summary of Issue

How successful are field and lab corrosion studies, such as described in this document, at predicting the actual rate of corrosion of large structures in the marine environment? By what factors, typically, do these small scale studies conform or disagree with actual experience with larger objects?

Those Identifying Issue	Identification Number
EPA	694

Response

Small-scale corrosion experiments suffer from so-called "edge effects" that tend to cause differences in results between small specimens and large structures, even if the environment is the same and there is no galvanic effect involved. The edge effects pertain to three factors that need adequate attention in small-scale studies to obtain valid results:

1. The area of the major surfaces should be large in comparison to the area of the narrow edges. This minimizes the contribution of the edges which might corrode at a different rate due to metallurgical differences that are created naturally during the rolling process. In the deep ocean corrosion experiments, this area ratio exceeded 10.

2. The specimens should be supported by a material that is an electrical insulator to limit the interference of stray currents and potential galvanic effects. Crevice effects might be significant at the contact area and should be allowed for in assessing the data. In the deep ocean experiments, no credit was taken for actual crevice effects due to supports because it was a small effect.

3. The specimens should be separated from each other by a sufficient distance so that corrosion effects due to differences in their electrical potentials are minimized. In seawater, this is especially significant because of its relatively high electrical conductance. In the deep ocean experiments, the specimens were separated by approximately four inches.

Control of these factors is to be expected in a well-designed experiment, and the results would provide valid predictions of the corrosion of such alloys in large structures. Variability between maximum amounts of corrosion and average amounts is typically within a factor of 2, as illustrated in Appendix F, Figure F-1. Larger disagreements between small specimens and large objects would indicate that some other factor (metallurgical, physical, chemical, etc.) had not been adequately simulated in the small-scale study. This is why the in-situ experiments are so useful.

Q.4—Summary of Issue

Actual corrosion data from submarine structures long submerged in the sea should be provided to corroborate the theoretical discussion in Appendix F.

Those Identifying Issue	Identification Number
EPA	694

Response

Actual corrosion data from the USS MONITOR were provided (Appendix F, Section III.D.1), representing 115 years of exposure, and indicating an average corrosion rate of approximately 0.5 mil per year. The corresponding value in the EIS is 2.5 mils per year (Table F-1).

(Continued on next page)

The results from such data typically suffer from three problems:

1. The older the data, the less the metal is likely to resemble the alloys in the submarines, from a metallurgical point of view.

2. Most of such data come from exposures that are in relatively shallow waters having environmental conditions that may differ markedly from the deep ocean.

3. The initial thickness may not be adequately known, and estimated rates would be affected accordingly.

With due consideration of these concerns, the limited data from the USS MONITOR indicate that the corresponding corrosion rate used in the environmental assessment is conservatively faster by a factor of approximately 5.

Q.5—Summary of Issue

The Navy should consider examining the sites of previous sinkings to obtain information on corrosion rates and hull integrity.

Those Identifying Issue	Identification Number
EPA	694

Response

Corrosion rates depend on factors such as material type, water temperature and paint condition. In addition, evaluation of the actual corrosion rate requires an exact knowledge of the original metal thickness and the ability to measure the cleaned, after-corrosion thickness to 0.001 inch (not possible with in-situ measurements on deep wrecks) because corrosion in the deep ocean is such a slow process. Therefore, the corrosion evaluation was based on controlled deep sea measurements and, to be conservative, the measurements were performed on unpainted material. However, for a qualitative evaluation, the THRESHER was examined again in 1983, twenty years after sinking. Because of the low temperatures and the painted surfaces, the THRESHER hull showed very few signs of rusting.

Q.6—Summary of Issue

The use of average corrosion rates and the average pitting factor in "conservative" calculations of penetration times and radionuclide release rates should be clarified with reference to the maximum values that are also available (Appendix F, Section IV.A.3). To be conservative, it would be more proper to use the maximum long-term rates shown in the Table F-1.

Those Identifying Issue	Identification Number
EPA	694

Response

The "average" corrosion rates used in the environmental assessment were developed to be conservatively higher than the adjusted values of the averages reported in the literature, as described in Section III.D.1 of Appendix F and illustrated in Figures F-1 and F-3. The "average" pitting factor was also developed to be conservative, as described below. "Maximum" values were even higher.

The conservative average values were used in scenarios with expected containment, and the conservative maximum values were used in scenarios with minimum containment, as described in Appendix G, Sections II.A and II.B. On this basis, the calculated corrosion effects were stated to be conservative.

Despite the respondent's statement to the contrary, it would not be more proper to use the maximum values shown in Table F-1 just to be more conservative because that would produce inflated estimates of environmental effects without corresponding justification. In the present case, the data from the literature were sufficient to define both a conservative upper bound for averages and a conservative upper bound for maximums. This fulfilled the needs of the two different scenarios. The terms "average" and "maximum" were retained to provide a simple way to identify these two sets of values.

The "average" pitting factor was the average of the five deepest pits on the four faces of two duplicate specimens—a 20-pit average of conservatively-defined values. This conservative average pitting factor was used for scenarios with expected containment. For scenarios with minimum containment, penetration was assumed to occur instantaneously and pitting per se was not a limiting factor in such evaluations.

Q.7—Summary of Issue

It is suggested that higher corrosion rates be used in sea disposal for conservative estimates of penetration times with "expected containment"

Those Identifying Issue	Identification Number
EPA	694

Response

The corrosion rates used in the DEIS were chosen to be conservative representations of the data in the literature (Appendix F, Section III.D.1). Conservative values were chosen so that corrosion effects would not be likely to be underestimated. To use even higher values of corrosion rates would add pessimism without justification, for the values used were well-founded, were interpreted conservatively, and were shown by in-situ ocean-bottom testing to be conservative.

The values suggested by the respondent were not supported by any reference to a source of data, but they correspond essentially to the "maximum" values given in Appendix F, Table F-1 and Section IV.A.2. Such values were used in calculating corrosion effects in accident scenarios and are not considered to be appropriate for cases with expected containment. Furthermore, use of these values would not change the conclusions of the EIS regarding the safety and environmental acceptability of the disposal options.

See also Issue Q.6.

Q.8—Summary of Issue

The statement that corrosion values for the corrosion resistant alloys selected for assessing environmental effects are considered to be conservatively high should be clarified. The extent of conservatism should be identified (Appendix F, Section III.D.1).

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

As discussed in Appendix F, Section III.D, conservatism arises from the temperature difference between the Naval Research Laboratory (NRL) test site (16-32°C) and the study sites (approximately 2°C). Corrosion rates at the study sites would be less than those at the NRL test site because of the temperature difference, and it was the NRL data that defined the corrosion-time behavior of corrosion resistant alloys in Figure F-1. On this basis, the values used in the environmental assessment are conservative.

The degree of conservatism has not been quantified, but it is well supported in theory and by data reported in Reference F.15.

Q.9—**Summary of Issue**

The discussion of crevice corrosion is quite inadequate, and the accompanying diagram, Figure F-5, is actually wrong (DEIS, pp. F-12 and F-14). A far better figure and discussion are given in the book Corrosion Engineering by Fontana and Greene (Second Edition, 1978, McGraw-Hill, pp. 41-43).

Those Identifying Issue	Identification Number
EPA	694

Response

As stated in Section IV.A of Appendix F, many of the fine points that are very significant to the science and technology of corrosion are omitted from the summary of corrosion theory for simplicity and brevity. While the mechanism of crevice corrosion depicted in Figure F-5 of the DEIS was extremely simplified, the shape of the corroded groove shown in Figure F-5 accurately depicts the results obtained with low alloy steels in the Navy's deep ocean corrosion experiments. In the Final EIS, Figure F-5 and the accompanying text have been revised to provide additional details. The assessment of the environmental impacts is not changed by the additional information.

Q.10—**Summary of Issue**

The use of an average pitting factor and a linear model for the variation in depth of penetration with time should be clarified with respect to why the results are considered to be conservative and why the maximum pitting factor was not used (Appendix F, Sections IV.A.2 and IV.A.3).

Those Identifying Issue	Identification Number
EPA	694

Response

Predicted pit depths and penetration times are considered to be conservative: calculated pit depths are deeper and calculated penetration times are sooner than they would be if the most-likely values were used. This was accomplished by using predicted amounts of corrosion and predicted pitting factors that exceeded average values obtained from the literature.

The result was that pit depths were predicted to increase linearly with time after the first few years (Appendix F, Section IV.A.2) even though the pitting data and some pitting theories indicate that pit depths increase with time at a continuously slower rate (the cube-root-of-time model cited by the respondent is an example). Predicted pit depths exceed actual pit depths by continously increasing amounts as time progresses.

The pitting factor is defined by the average of the five deepest pits on each of four tested surfaces (the 20-pit average, Appendix F, Section III.D.1), divided by the corresponding amount of average corrosion. This provides a conservative measure of pitting for estimating approximate penetration times and potential flow areas. The use of the maximum pitting factors would be unnecessarily conservative by at least a factor of four (Appendix F, Section IV.A.2). See also Issue Q.6.

Q.11—Summary of Issue

The "adjusted averages" in Table F-3 should be identified to specify for which site the adjustment has been made (Appendix F).

Those Identifying Issue	Identification Number
EPA	694

Response

The Pacific Ocean study area was chosen as the basis for the adjustments made to the data in Table F-3, as discussed in Appendix F, Section III.D.1.

Q.12—Summary of Issue

The effects of biofouling on the ocean corrosion experiment should be discussed (Appendix F, Section III.D.2).

Those Identifying Issue	Identification Number
Mr. Wells Eddleman	20
EPA	694
Dr. Michael J. Herz	37, 37c
Ms. Jane Sharp	14

Response

The ocean corrosion experiments reported in References F.13 and F.14 did not reveal any apparent corrosion effect that was attributed to biofouling. Preliminary results from a three-year experiment at the Pacific Ocean Study Area showed that tube worms, approximately one-inch long, were observed at scattered locations on many surfaces, but after removal there was no visible mark on the surface of the corrosion specimens. The natural presence of potentially biofouling agents would be expected to have some effect on the corrosion processes. The results of in-situ experiments would include these effects in the averages and the ranges of the data even if they produced no visual effect.

Q.13—Summary of Issue

In the area of corrosion and corrosion release, the following factors should be considered:

- Galvanic effects
- Manner and rate of corrosion at external weld locations
- Effect of lattice damage in irradiated stainless steel on corrosion (ionizing radiation could enhance corrosion)
- Bacterial mobilization
- Effects of salt water
- Effects of extreme pressure
- Effects of a sediment environment versus a salt-water environment.

(Continued on next page)

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
S. Andres	365	Ms. Jane Jarrett	245
Mr. Brian N. Baird	55a	Mr. Jim Marotta-Jaenecke	194
Mr. George Balding	77	Ms. Teresa Matta	382
Mr. Nathaniel S. Bingham	78a	Ms. Maxine McCloskey	689
Ms. Elizabeth Bock	692	Mr. Scott McCreary	86
Ms. Anne Bringloe	36	Mr. Thomas D. O'Neil	80
Ms. Gretchen Crosson	408	Mrs. W. R. Phillips	332
Mr. Kevin Crosson	408	Ms. Donna M. Pinkey	360
Mr. Clifton E. Curtis	695	Mr. Christopher D. Roosevelt	695
Ms. Randi Dalton	161	Mr. John Runkle	18 or 468
Honorable Ronald V. Dellums	447	Mr. Robert S. Sanyak	413
Mr. Wells Eddleman	20	Mr. Clifton Troy Toth	659
Mr. Fred Eissler	664	Unkown	213
EPA	694	Dr. Ruth Weiner	39, 39a
Dr. Judith E. Gordon	420	Mr. Ocean Wells	401
Mr. Michael J. Herz	37, 37c	Mr. James Widmeyer	678
Mr. Jeff Hohensee	116	Mr. Charles B. Williams	688
Mr. Thomas C. Jackson	37b		

Response

These comments reflect numerous concerns that were expressed regarding the durability of containment and the adequacy of the assessment of the numerous factors related to corrosion in seawater and the release of radioactive material from the disposed submarines into the ocean's waters. These topics have been discussed in the DEIS, as summarized below.

Galvanic Effects

Galvanic corrosion was recognized and accounted for in the assessment (Appendix F, Section IV.A.2). One respondent cited the lack of quantitative definition for qualitative terms used to identify the proximity of a corrosion region under discussion to the boundary line between dissimilar metals, and discussed effects that occur within a few millimeters and over 50 to 100 feet. In the vicinity of the weld, "near" would be adequately quantitified by distances of a few millimeters, and "remote" would be a few feet. Galvanic effects at 50 to 100 feet away from a bimetallic weld would not be significant in a reactor compartment that is 20 feet long.

Welds

External welds on the reactor compartment are made with similar materials to provide uniform corrosion behavior, or are made with corrosion resistant alloy to provide extra corrosion resistance by taking advantage of the favorable galvanic relationship. (No credit was taken in the assessment for such favorable welds.)

Radiation Damage

Lattice damage ("brittlization") in irradiated stainless steel is not sufficient at the amounts of radiation exposure experienced by the metals in submarine reactors to warrant the use of enhanced corrosion rates or corrosion release rates in the assessment because the rates would not be increased by any significant amounts. Further, any effect would be limited almost entirely to the structures that are inside the reactor vessel. The containment boundaries of the reactor compartment are irradiated to such a slight degree that they would behave as ordinary unirradiated materials in corrosion. Experimental programs cited below (References 1, 2, 3, and 4) have not demonstrated any significant change in post-irradiation corrosion behavior of corrosion resistant alloys.

Bacterial Mobilization

One respondent expressed concern that bacteria in the deep ocean environment may mobilize radionuclides by ingesting them and transporting them away from the local site. This potential effect was accounted for in the assessment by assuming in certain cases that all corrosion products released to the local environment would be transported away as readily as if they were soluble (Appendix G, Section IV.D. 2). Corrosion tests in the deep ocean did not disclose any aggravated corrosion that would be attributable to bacterial mobilization (References F.13 and F.14). On these bases, the assessment is considered to be conservative with respect to the possible role of bacteria in the mobilization of radionuclides. In addition, it should be noted that the bacteria would simultaneously mobilize some non-radioactive nuclides that would exist in the same corrosion products, and that this action would tend to dilute the potential mobilization and accumulation of radionuclides (Chapter 4, Section II.A.3(c)).

Saltwater

The effects of saltwater on corrosion were accounted for in the environmental assessment. Corrosion data for structural alloys in seawater were used in the calculations (Appendix F, Section III.D, and Appendix G, Section II.A.2.a).

Pressure

The effects of very high pressure on corrosion, due to the great depth of the ocean (nearly 6000 psi at a depth of 4000 meters), are not very significant because the steels and water in the corrosion processes and the soluble and insoluble metallic compounds in the corrosion products are not very different under great pressure from what they are at normal pressure. For example, seawater compresses by approximately 2 percent under such pressure, steel even less. Temperature is a more significant factor than pressure and the temperature differences between the ocean surface and the ocean bottom tend to reduce the rates of corrosion substantially because the ocean bottom temperature is so much colder (Appendix F, Section III.D.3, and Table F-4).

Sediment

The effects on corrosion processes of a sediment environment contrasted with a seawater environment can be significant when the sediment is quite low in oxygen content (anoxic). Metal exposed to such different oxygen concentrations would suffer aggravated corrosion in the region of lower oxygen concentration (Appendix F, Section IV.A.4). The undersurface of the hull on the sea floor would be subject to anoxic chemical conditions, whereas the portions exposed to seawater would be subject to the less-aggressive oxic reactions (Appendix E, Section IV.C.6).

The outermost containment would be penetrated first by normal seawater corrosion of the bulkheads because the hull would prevent the bulkheads from contacting the sediment. The hull would be affected by anoxic conditions in the sediment, and would be penetrated eventually by sediment corrosion, but because the hull is so much thicker than the bulkhead, it would last longer in spite of potentially faster corrosion (Appendix F, Section IV.A.4). It is estimated from model tests and prior experience described in Appendix M that the hull would penetrate into the sediment, and the bottom of the hull would be approximately 11 feet below the surface of the sediment.

(Continued on next page)

References

1. Bush, Spencer H., "Irradiation Effects in Cladding and Structural Materials." Rowman and Littlefield, Inc., N.Y., N.Y., 1965

2. Nesternko, V. B., "Corrosion of Structural Materials in N_2O_4 Coolant Under Irradiation." Nauka I Tekhnika, Minsk. 1976 (p. 68)

3. Stobbs, J. J., and A. J. Swallow, "Effects of Radiation on Metallic Corrosion." Metals Review, Vol. 7, No. 25. 1962 (p. 95)

4. Votinov, S. N., et al., "Reactor Irradiation Effect on the Austenitic Steel Susceptibility of Intercrystalline Corrosion." Atomic Energy (U.S.S.R), Vol. 41, No. 6 (In Russian), December 1976, (pp. 405-408)

SECTION R

This Section (R.1—R.24) contains issues related to Appendix G of the Environmental Impact Statement.

R.1—Summary of Issue

The possibility of released radionuclides becoming part of the sediments or entering the water column should be included in the Environmental Impact Statement.

Those Identifying Issue	Identification Number
Mr. Peter Douglas	68a
Ms. Jane Jarrett	245
Ms. Dena Mossar	442

Response

Both possibilities were considered in the DEIS. Refer to Appendix H for transport of radionuclides in the ocean's water column and Appendices G and I for discussion of effects of possible release of radionuclides into the ocean's bottom sediment.

R.2—Summary of Issue

An estimate of curies released for the expected containment with maximum corrosion rates should be included in the EIS.

Those Identifying Issue	Identification Number
Dr. Judith E. Gordon	420

Response

The specific details of the corrosion product release mechanisms were described in the DEIS in Appendix G, Section II, and the resulting release rates into the ocean environment were summarized in Appendix G, Section III. Four cases were described: two levels of containment of the radioactivity (expected and minimum) and two levels of conservatism (best estimate and conservative estimate) in the calculation of the release rates.

Both cases of expected containment used average corrosion rates and pitting factors (Appendix F, Sections III.A. and III.D) to calculate penetration times and corrosion release rates because the average rates represent expected containment. Maximum corrosion rates were used only in the accident case where a conservative estimate of minimum containment was calculated. Maximum corrosion rates were not used with expected containment because an estimate of curies released under such conditions would be unrealistically inflated and would not represent a valid estimate of the environmental impact.

In all cases, the results were estimated conservatively. The average rates were determined by a conservative assessment of published data, so that the calculated amount of corrosion would not be exceeded by the averages from the published data (Appendix F, Section III.D).

In addition, the calculated amounts of corrosion were found to be conservatively greater than the data from the deep-ocean corrosion experiments (Appendix F, Section III.D.2).

R.3—Summary of Issue

Because of the eventual leakage of radionuclides, the Navy program would in one century be the equivalent of annually dumping 40,000 curies of unpackaged radioactive wastes directly into our grandchildren's laps.

Those Identifying Issue	Identification Number
Dr. Jackson Davis	76
Mr. Lewis Seiler	707

Response

This statement is incorrect for two reasons. Virtually all the radioactivity (98%) is contained within the metal of the corrosion resistant alloys inside the reactor pressure vessel, as shown in Table G-1. Activated metal is considered to be contained under DOT and IAEA regulations simply by the fact that the radioactive atoms are embedded in the metal. The rate of release of this radioactivity to the ocean is governed by the very slow rate at which the corrosion resistant alloys corrode, and this release can begin only after the ship's bulkheads and the reactor pressure vessel have corroded enough to provide a path for radioactive particles to escape from the inside of the reactor vessel. As shown in Table G-2 and Figure G-2, the maximum rate of radioactive material release is expected to be 45 curies per year from all 100 ships combined. Even conservative calculations, using unrealistically high corrosion rates, would predict only a little over 700 curies released in the year of greatest release.

Secondly, the small number of curies eventually released would be released in the depths of the ocean, 2 1/2 miles deep, and 100 to 200 miles from the nearest shore.

R.4—Summary of Issue

The discussion of the model used to estimate radioactive releases following disposal at sea, and the justification of its parameter values, were insufficient to evaluate its effectiveness.

Those Identifying Issue	Identification Number
EPA	694

Response

A thorough review of Appendix G of the DEIS, where the model used to estimate radionuclide release rates subsequent to sea disposal actions was described, shows that the nuclide release rate model was presented in sufficient detail to describe the processes by which releases would occur, the equations describing these processes, and the basis for the choice of parameter values to be used in these equations.

R.5—Summary of Issue

It appears that approximations to the basic release rate models presented in Appendix G were made over small intervals by analytical functions. The principal attribute of this procedure is that it is easy to conduct parametric studies for a wide range of model parameters. Apparently, however, this was not done.

Those Identifying Issue	Identification Number
EPA	694

Response

The ability to easily conduct studies over a wide range of model parameters is not the only reason to use analytic solutions to the model equations over small time intervals. One of the basic reasons to use a procedure of this nature is that under a given set of conditions with a particular set of model parameters, this type of solution to a set of equations may represent the simplest and most straightforward procedure. This was the case during the EIS preparation.

Parameter studies of the radionuclide release rate models were performed during the preparation of the EIS, using a wide range of parameter values. The results of these and other parametric studies were represented in the EIS by the presentation of "best" and "conservative" estimates since it was considered that this type of presentation would be most meaningful, and it demonstrates the effects of a wide range of variation in the parameters.

R.6—Summary of Issue

It appears that approximations to the basic release rate models presented in Appendix G were made over small intervals by analytic functions. The disadvantage of this approach is that the solution technique is not especially accurate or even efficient. It is disturbing that no mention is made of this disadvantage or that any rationale is provided for the approach taken. Thus it is important to evaluate the claim that the approximations are "reasonable"

Those Identifying Issue	Identification Number
EPA	694

Response

The accuracy of the technique of solving the release rate equations in Appendix G over small time intervals is solely dependent upon the size of the time interval chosen. Any degree of accuracy desired can be obtained by reducing the size of the time interval considered. The efficiency of such a process is dependent upon how rapidly the various parameters change with time. For systems in which the model parameters are relatively constant and change only slowly with time, as is the case for corrosion of metal in submarines for such relatively unchanging environments, this procedure can be fairly efficient and easily understood. Thus under certain conditions, and in particular those encountered in estimating the radionuclide release rates in the ocean environment from defueled nuclear submarines on the deep ocean floor, the "disadvantage" of such a solution technique may, in fact, be an advantage.

The procedure is clearly described in Appendix G, Sections IV.C.4 and IV.D.3. and is based upon information presented in any standard mathematics text such as *Advanced Calculus*, R. Creighton Buck, McGraw Hill, 1956. The rationale for using this technique is presented in Section IV.B.3 of Appendix G as is the identification of either the slowly varying nature or the actual time independent nature of the parameters which were approximated in the solutions to the nuclide release rate equations.

R.7—Summary of Issue

"Uptake and subsequent remobilization of radionuclides from sediments have not been addressed, except in passing in Appendix H."

Those Identifying Issue	Identification Number
EPA	694

Response

The DEIS conservatively took no credit for the delay in transport and associated radioactive decay provided by adsorption of radionuclides by the sediment, but did consider removal by detritus settling, as discussed in Appendix H, Section IV.A.5 and Table H-1, and coagulation-deposition, in Appendix G, Section IV.D.8. Resuspension of deposited radioactivity was discussed in Appendix G, Sections IV.D.6 and IV.D.7.

R.8—Summary of Issue

No documentation was provided for the way the values of the leakage and coagulation coefficients used in the release rate models were selected.

Those Identifying Issue	Identification Number
EPA	694

Response

Discussions of the manner in which the leakage and coagulation coefficients used in the radionuclide release rate calculations were obtained were presented in Sections IV.D.5 and IV.D.8 of Appendix G of the DEIS.

R.9—Summary of Issue

Some effort should be made to justify the values of the parameters used in Appendix G to obtain the radionuclide release rate estimates and to provide a reasonable range of these parameters.

Those Identifying Issue	Identification Number
EPA	694

Response

The values of the parameters used to estimate the radionuclide release rates to the ocean environment from defueled nuclear submarines on the deep ocean floor and the basis for their choice were presented in Section IV.D of Appendix G of the DEIS. The reasonable range of the values of these parameters which are considered to vary, except for the corrosion release rates, was also given in this section of Appendix G in terms of "best" estimates and "conservative" estimates. The ranges associated with corrosion release rate values were presented in Appendix F.

R.10—Summary of Issue

The discussion of corrosion rates and penetration times for the best estimate of the expected containment in sea disposal (Appendix G, Section II.A.1) should include consideration of the relative areas of the galvanically-different alloys in the hull and reactor plant.

Those Identifying Issue	Identification Number
EPA	694

Response

The outer containment boundary, represented by the hull and bulkheads, is all low alloy steel and there is no galvanic effect that would need to be accounted for in estimating the external penetration rate. The internal penetration rate would not be affected by galvanic effects because the surface area of the low alloy steel is greater than that of the corrosion resistant alloy.

Galvanic corrosion was discussed in Appendix F, Section IV.A.2. Area effects and bimetallic welds are discussed and the basis is described for calculating the penetration time of the piping with a bimetallic weld.

R.11—Summary of Issue

"In Section II.A.2.a of Appendix G, the corrosion of low alloy components is described, but "low alloy" is not defined."

Those Identifying Issue	Identification Number
EPA	694a

Response

Low alloy steel was defined in the Glossary.

R.12—Summary of Issue

Is it reasonable to assume all corrosion products are transportable and no credit taken for settling in the sea disposal system?

Those Identifying Issue	Identification Number
EPA	694

Response

Assuming all corrosion products are transportable and taking no credit for settling in the sea disposal option results in a conservative estimate of the amounts of radionuclides which might reach the locations at or near the shore for transfer to the pathways which lead to people. This is an assumption made to maximize the impacts from such pathways.

R.13—Summary of Issue

Is it realistic to assume a current flow through the reactor vessel in 400 years after submarine emplacement on the deep ocean floor?

Those Identifying Issue	Identification Number
EPA	694

Response

In approximately 400 years the only penetration of the reactor vessel would be relatively small openings in the form of pits in piping which enters high in the reactor vessel. Therefore, it is conservative to assume any significant flow through the reactor vessel at that time.

This subject is addressed on page G-4 with the following words. "In fact, a substantial current through the reactor vessel would not be expected until general surface penetration of the reactor vessel occurs about 1300 years following disposal. However, to be conservative, a substantial current through the reactor vessel was assumed to begin in approximately 400 years."

R.14—Summary of Issue

Describe the composition of crud and its solubility in seawater.

Those Identifying Issue	Identification Number
Honorable Jesse Helms	708

Response

Crud is a mixed oxide, primarily of iron and nickel, with small amounts of other elements such as cobalt and chromium incorporated in the lattice. Chemically, it is known as a "spinel", and is similar to magnetite, the magnetic oxide of iron, which has the formula Fe_3O_4. It is formed in the oxidation of corrosion resistant alloys by the high temperature reactor coolant. Its solubility in pure water is less than 1 part per million; in seawater its solubility would be expected to be about the same, or less. Also, see response to Issue L-22.

R.15—Summary of Issue

Calculated results for pitting penetration by corrosion are presented in Appendix G. Verification of these results by obtaining samples or presenting data from the SEAWOLF, THRESHER and SCORPION would be useful. There is no discussion of this data in comparison to the corrosion rate estimates provided in Appendix F.

Those Identifying Issue	Identification Number
EPA	694

Response

Corrosion resistant metals exhibit pitting penetration. Since these metals are in the interior of the submarines, it was not feasible to collect samples of these materials at the THRESHER and SCORPION wreck sites. However, obtaining samples from these sunken submarines to measure the depth of pitting attack is not necessary since the calculations are based on actual data obtained over a 16-year period by the Naval Civil Engineering Laboratory and the Naval Research Laboratory, and discussed in Appendix F, Section III.D.1.

Since no corrosion or pitting data are available from THRESHER or SCORPION, no comparison to the experimental data reported in Appendix F is possible.

R.16—Summary of Issue

There are substantial differences between the best and conservative estimates in Figures G-2 and G-3. Discussion of these differences is needed.

Those Identifying Issue	Identification Number
EPA	694

Response

The differences between these two figures depict the effects associated with the assumptions made in conjunction with the "best" estimates and the "conservative" estimates of the radionuclides release rates into the ocean environment for an expected containment disposal scenario. A thorough and detailed description of these assumptions and their expected effect upon the nuclide release rates was presented in Section II.A of Appendix G of the DEIS and a summary of the resulting nuclide release rates was provided in Section III.A of Appendix G.

R.17—Summary of Issue

Equation G.2 is misleading in that it indicates that the number of modeled components for each of the barriers is the same. In the subsequent discussion, this does not appear to be true. Therefore each of the sums in this equation should have a different range.

Those Identifying Issue	Identification Number
EPA	694

Response

The introduction to the description of the Release Model (Appendix G, Section IV) clearly stated that the equations in the mathematical model are general to allow a wide application (e.g., expected containment and minimum containment). The discussion subsequent to the equations described how the equations were actually used. This is standard practice in modeling because it allows different cases to be evaluated without a complete redevelopment of the equations and computer program.

R.18—Summary of Issue

The expectation of a uniform release for a fully exposed compartment over a one-year period as identified in Section IV.D of Appendix G is not reasonable.

Those Identifying Issue	Identification Number
NOAA	444

Response

The release of material which has accumulated within containment barriers such as the reactor vessel or the submarine hull prior to the penetration of the barriers is assumed to begin as soon as any breaching of these containment barriers occurs. Since the initial penetration of these barriers would occur over a very small portion of the total barrier surface area, there is virtually no chance that any releases would occur until a much greater portion of the surface area of the containment barriers has been breached. This does not occur for many years. As a result, the assumption that the accumulated material within the containment barriers would be released within the first year subsequent to the barrier penetration at a uniform rate is extremely conservative since the actual release of this material would take place over a much longer period of time. The conservatism of this assumption is supported by the fact that very little radioactivity has been released at the THRESHER and SCORPION sites, where reactor compartment containment has been breached.

R.19—Summary of Issue

Equations G.5 through G.8 in Appendix G include an unnecessary distinction between transportable and non-transportable forms of a nuclide. Since for simplicity all are considered transportable this unneccessary complication should not be included in the equations.

Those Identifying Issue	Identification Number
NOAA	444

Response

The distinction between transportable and non-transportable nuclides was included in the cited equations to provide as much general applicability as possible, but such generality was not required for the DEIS analysis.

R.20—Summary of Issue

The material presented for the models as represented in Equations G.5 through G.8, and G.10 through G.12 is not sufficient to evaluate how effectively they describe the basic processes. More material is needed.

Those Identifying Issue	Identification Number
EPA	694

Response

Each of the terms in the referenced equations was defined in detail in Appendix G of the DEIS and a summary of the specific process which is defined by each of the terms was presented in the material describing each equation.

R.21—Summary of Issue

There is no discussion of the meaning of the β (Beta) and γ (Gamma) terms in Equations G.14 through G.17.

Those Identifying Issue	Identification Number
EPA	694

Response

The symbol Beta was defined directly above Equation G.14.

The symbol Gamma was not used in Equations G.14 through G.17 and, in fact, Gamma was not used in any of the equations in Appendix G. The respondent may have been referring to the symbol Lambda (λ) which was used in Equations G.14 through G.17 and was defined below Equation G.11.

R.22—Summary of Issue

The Draft Environmental Impact Statement should clearly identify whether the use of highest average corrosion rates (Appendix G, Section II.A.2.a) refers to long-term values or to one-year values.

Those Identifying Issue	Identification Number
Dr. Judith E. Gordon	420

Response

The highest average first year corrosion rates presented in Table F-1 were used during the initial year to account for the faster corrosion rates that occur during the initial exposure. The highest average long-term values were used for all years thereafter since the corrosion rate can then be considered constant with time.

R.23—Summary of Issue

In Section II.A.3 of Appendix G what does "unrealistically high" mean in contrast to Section II.A.2 which is also "unrealistic"?

Those Identifying Issue	Identification Number
EPA	694

Response

The word "unrealistic" did not appear in any of the sections of Appendix G dealing with the "best estimate" nuclide release rates of the expected containment sea disposal option. However, the fourth paragraph of Section I (Introduction) of Appendix G presented a clear and concise summary of the differences in scope and intent of the "best estimates" and the "conservative estimates" of the radionuclide release rates for the expected containment scenario during sea disposal actions.

R.24—Summary of Issue

Terminology in describing various scenarios ("worst case", "average case") and calculated exposures is inconsistent and confusing.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692	Mr. Thomas C. Jackson	37b
Mr. Clifton E. Curtis	695	Mr. Scott McCreary	86
Dr. Michael J. Herz	37, 37b, 37c	Mr. Christopher D. Roosevelt	695

Response

The DEIS used consistent terminology throughout to describe the various scenarios and to identify the calculated exposures. Several scenarios were treated and different degrees of conservatism were used in the calculations to demonstrate the range of potential effects. Discussion provided in Appendix G (Releases) described the sea-disposal release scenarios that distinguish between expected containment and the minimum containment that might result from an accident. It also distinguished between the best estimate of the release rates and the conservative estimates (Appendix G, Sections II.A and II.B).

One respondent stated that some persons believe that a portion of the worst case calculations may be off by up to nine orders of magnitude. The respondent did not identify the portion that was suspect. The calculations performed for the environmental assessment were reviewed and the results were verified. A sample dose calculation was provided in the DEIS (Appendix J, Section IV) to illustrate the calculations performed.

SECTION S

This Section (S.1 —S.35) contains issues related to Appendix H of the Environmental Impact Statement.

S.1 —Summary of Issue

The ocean transport model presented in Appendix H is a gross oversimplification of what happens in the ocean.

Those Identifying Issue	Identification Number
EPA	694

Response

The ocean transport model present in Appendix H is, without question, a major simplification of the physical transport of tracers in ocean waters. However, the purpose of this model is not to provide a detailed definition of the nuclide concentrations at every spatial point in the ocean at all times but rather to provide estimates of nuclide concentrations which can be used in the evaluation of the potential impacts from the various general pathways. This was accomplished with the relatively simple but conservative model described in Appendix H.

S.2—Summary of Issue

The greatest deficiency in the ocean transport model presented in Appendix H is the use of single long-term average horizontal velocities.

Those Identifying Issue	Identification Number
EPA	694a

Response

The ocean transport model presented in Appendix H of the EIS uses average horizontal velocities and eddy diffusivities which were judged to be applicable over the times and distances of interest. The analysis in the EIS was intended to estimate the radionuclide concentrations in the ocean waters at the pathway entry points for the nearest human activities; therefore, the horizontal advection and eddy diffusivity values used in the calculations in the EIS were chosen to be representative of the ocean transport which would occur within a few hundred kilometers of the disposal site.

The analysis of the effects associated with various parameters upon the estimated dose commitments (described in Appendix H, Section IV.C) indicated that parameters which affected the vertical transport and mixing (e.g., the assumed height of the pathway entry points, the vertical diffusivity and the boundary layer properties), and the detritus removal coefficient had a greater effect on the estimated dose commitments than the horizontal advection terms. Even the north-south horizontal diffusivity term had a more significant effect than the horizontal advection terms.

S.3—Summary of Issue

The ocean transport model presented in Appendix H represents long term averages and as such used large mixing length scales, presumably because the mean velocities are low and the x, y diffusivities are high.

Those Identifying Issue	Identification Number
EPA	694

Response

The ocean transport model presented in Appendix H was used to estimate nuclide concentrations at relatively large distances (a few hundred kilometers) from the disposal site. This required that the eddy diffusivity and advection terms be chosen such that they would adequately represent the average movement of ocean waters over these distance scales. Information presented in Reference H.4 indicated that the domain of occupation of the released nuclides would be expected to expand to approximately 300 kilometers in diameter in about 100 days. These values were then used to develop the eddy diffusivity values used to estimate the nuclide concentrations at these distance scales. The advection terms were based upon the mean value of 90-day velocity measurements obtained from the current meter data presented in Reference H.7. Thus the ocean transport model presented in Appendix H in conjunction with the specified eddy diffusivity and advection terms is considered to provide an adequate representation of the movement of tracers in ocean waters over the distance scales of interest.

S.4—Summary of Issue

It would be appropriate to calculate nuclide concentrations with the ocean transport model presented in Appendix H for smaller space and time scales, in addition to the longer time and space scales, in both two and three dimensions using more appropriate values for the smaller scales. By that, one could suggest velocities of up to 20 to 30 cm/sec and x, y, diffusivities of 10^3 cm^2/sec rather than 10^7 cm^2/sec.

Those Identifying Issue	Identification Number
EPA	694

Response

The use of the transport model defined in Appendix H with parameters of the magnitude mentioned in the comment would only provide estimates of the average nuclide concentrations in the immediate vicinity of the disposal site. Nuclide concentrations in the vicinity of the disposal site are not those generally needed to obtain estimates of the dose commitments which might be accrued by man due to the disposal of defueled nuclear submarines on the deep ocean floor. Rather, nuclide concentrations at the pathway entry points where the actual items which interact with man pick up their activity from the ocean environment are needed, and these pathway entry points are at distances which are commensurate with the use of parameters based upon large space and time scales. Thus the inclusion of nuclide concentrations using parameters defined for small space and time scales was not considered to be warranted in the EIS.

S.5—Summary of Issue

The purpose of comparing the ocean transport model results with those of Shepherd is questioned since the physical processes are different.

Those Identifying Issue	Identification Number
EPA	694

Response

The basic purpose for comparing the results of the ocean transport model used in the EIS with those obtained from Shepherd's model was to demonstrate that the nuclide concentrations obtained using this ocean transport model would provide a better representation of the movement of nuclides in the deep ocean waters than would be obtained through the use of Shepherd's model. In particular this comparison illustrates the effects on the nuclide concentration distributions associated with permitting variable advection and diffusivity terms in the vertical direction, including the effect of detritus removal and using a release term which can vary with time. Thus, it is precisely to evaluate the differences in the physical processes which can be described by the two models that these comparisons are being made. The comparison was provided for information because many analysts are familiar with Shepherd's model.

S.6—Summary of Issue

The comparison of the ocean transport model results with those of Shepherd is questionable since the Shepherd model has not passed any peer review.

Those Identifying Issue	Identification Number
EPA	694

Response

The Shepherd model is the latest published model presently available to estimate nuclide concentrations in ocean waters at remote distances from a release site and, as such, is the natural choice with which to make a comparison. While the Shepherd model has not been published in a major peer-reviewed journal, it has been subject to extensive review and has been used, in a modified form, by the IAEA in their evaluation of the disposal of radioactive waste at sea.

S.7—Summary of Issue

The ocean transport model is used to predict nuclide concentrations which occur at the edge of a basin of complex geometry, biology, and sediments. Thus as radionuclides are advected or diffuse into progressively more coastal environments, the parameters of the model should change. Terms for advection and eddy diffusion certainly are not conservative at the edge of a continent.

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

The values of the parameters describing the movement of radionuclides in ocean waters do vary in both space and time as is clearly demonstrated by the current meter readings and other experimental data from the ocean study areas. However, the ocean transport model used in the EIS to calculate nuclide concentrations for use in estimating the possible dose commitments due to disposal of defueled nuclear submarines represents most of these parameters as constant over the space and time of interest. These constant parameter values, including the advection and eddy diffusion terms, were deliberately chosen to provide an overestimate of the radionuclide concentrations at the pathway entry points where the radionuclides are transferred from the ocean environment into the pathways which lead to man.

S.8—Summary of Issue

Uncertainties in the vertical diffusivities, vertical velocities in the mid-depth region and settling water provide potential errors in the ocean transport model presented in Appendix H.

Those Identifying Issue	Identification Number
EPA	694a

Response

As discussed in Section IV.C of Appendix H, the values of the parameters used in the model calculations were generally chosen so that they included the end of the uncertainty band which produced the higher estimated exposure. The results of each set of calculations, combined with a comparison of the results for the best estimate, conservative, and worst case calculations demonstrate that it is highly unlikely that ocean disposal would produce any appreciable effect, regardless of the analytical technique or variation in parameter values.

S.9—Summary of Issue

Appendix H does not acknowledge differences in the quality of the estimates that went into the model computations. The reader is simply referred to some referenced literature, often not in a reviewed journal.

Those Identifying Issue	Identification Number
EPA	694

Response

The EIS explicity describes and provides a "conservative estimate" to encompass the differences which might be encountered in dose commitment estimates developed using the "best estimate" parameter values and those obtained using possible variations of these parameter values. This "conservative estimate" was deliberately defined to result in dose commitment estimates which would be extremely unlikely to be exceeded as a result of variations in parameter values.

S.10—Summary of Issue

When dealing with an area the size of the Pacific Ocean, the use of first order estimates or approximations is probably justified. However, on-site predictive capability requires much greater precision. As a result it is doubtful that the estimates in the study area are well-modeled by the approach taken.

Those Identifying Issue	Identification Number
EPA	694

Response

The basic purpose of the sea disposal portion of the EIS was to evaluate the potential hazards to man which might exist due to the disposal of defueled nuclear submarines on the deep ocean floor. The procedures and models used in the EIS demonstrated conclusively that no impacts to man would result from such disposal actions. There is no need to develop significantly more sophisticated and complex models to more accurately represent the physical and biological environment in the ocean at the disposal site because of the large separation of the site and the locations of possible entry points to the pathways leading to man. The model was not intended to predict the detailed distribution of radioactive material in the immediate vicinity of the disposals and was not used for that application.

S.11—Summary of Issue

The model used to estimate the transport of radionuclides in the ocean waters should be tested with an experimental point source release or by detailed studies of accidental point source releases rather than by a diffuse isotope release such as that associated with Rn-222.

Those Identifying Issue	Identification Number
EPA	694

Response

As demonstrated by the extremely small effects predicted for possible submarine disposal, the magnitude of an experimental point source release large enough to test the model used in the EIS to estimate the transport of radionuclides in the ocean waters would be of the same order of magnitude as the disposal of a submarine on the ocean floor. The potential environmental impacts from such an experiment would therefore be as large as those from submarine disposal. Detailed studies of accidental submarine losses to date have produced results illustrating the substantial conservatism of the model used in the EIS, particularly in evaluation of containment effectiveness.

The Rn-222 data were used by oceanographic experts (Reference H.7) to demonstrate the existence of a well-mixed bottom boundary layer along the ocean floor. The model results were then examined and found to reproduce such a layer. This was the only use made of Rn-222 data to provide verification of any aspect of the model used to estimate the movement of radionuclides in the ocean waters.

S.12—Summary of Issue

The ocean transport model presented in Appendix H is used to make assertions that are probably beyond its predictive capabilities. It is not proven that it can accurately predict the nuclide concentrations in a disposal field of 100 submarines, and it is unlikely that it can accurately predict the concentrations at a specific coastal site.

Those Identifying Issue	Identification Number
EPA	694

Response

The ocean transport model described in Appendix H of the EIS is used to provide estimates of the nuclide concentrations at locations in the ocean waters where foodstuffs, such as fish, seaweed, or crustacea, might take up activity from the ocean waters and carry it to man. To ensure that the dose commitments which might be received by man as a result of his interaction with these items would be conservative, the estimates of the nuclide concentrations at the locations where these items take up their activity from the ocean waters were deliberately calculated in a manner to overestimate the actual nuclide concentrations which would be present at these locations. This was accomplished through the use of the ocean transport model in conjunction with conservative parameter values. Thus, the intent of the application of the model was to provide demonstratively conservative (high) estimates of the nuclide concentrations at those locations where activity leaves the ocean waters and enters the pathways which lead to man and not to predict accurate concentrations at specific coastal sites. Further, since these locations at which activity is taken up from the ocean waters into the pathway components are basically at or near the coast, and thus remote from the disposal site, the ocean transport model was never intended to accurately predict the nuclide concentrations in the vicinity of the disposal site.

S.13—Summary of Issue

One of the difficulties associated with the ocean transport model presented in Appendix H deals with the very fundamental issue of how one goes about parametizing horizontal advective and turbulent diffusion effects. Apparently, in the approach taken here, the horizontal advection is treated as a constant for all space and time, as is the horizontal diffusivity.

Those Identifying Issue	Identification Number
EPA	694

Response

It is quite true that the horizontal advection and eddy diffusivity values are not constant in either space or time as is apparent from the current meter measurements reported in Reference H.7. However, the basic purpose of the ocean transport model was not to accurately reproduce the continually fluctuating local nuclide concentrations in all regions of the ocean for all times, but to represent the overall long-term effects. The purpose of the ocean transport model was to provide nuclide concentrations which could be used as representative of the nuclide concentrations over relatively large regions of the ocean waters (such as a major fishing ground) in a given time interval of interest (such as a year) for use in estimating the activity concentrations which might be found in the components of the pathways which lead to man. Thus the use of long-term average values of horizontal advection and eddy diffusivity terms developed specifically to provide adequate representation over the particular time and spatial scales of interest is considered to be a reasonable approach to obtain estimates of the desired nuclide concentrations at locations remote from the disposal site.

S.14—Summary of Issue

Even if the use of constant advection and diffusivity terms can be justified, their actual applications in the ocean transport model presented in Appendix H are done improperly, since it is physically and mathematically incorrect to specify separate diffusion equations for different geographic and geometric components.

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy does not agree with this statement. The concentration equation presented in Appendix H was obtained by solving an advection-diffusion equation for an instantaneous unit pulse and then integrating this solution over time to obtain the equation for a continuous release. The solution to this advection-diffusion equation for the instantaneous pulse was obtained by assuming that horizontal and vertical components of the resulting nuclide concentration field were independent of each other and can be obtained separately. Therefore, the ocean transport model presented in Appendix H is mathematically correct. This technique is often used in modeling large complex multi-dimensional fields.

Physically, the nuclide concentration field is not truly separable. However, the vertical component of the concentration is relatively insensitive to the horizontal location in the open ocean and separability between the vertical dimension and the horizontal dimensions is an acceptable assumption in the open ocean away from coasts and similar disturbances to the ocean continuity.

S.15—Summary of Issue

The National Ocean Service considers that the "conservative estimate" provides a more stringent estimate of the hazards associated with the sea disposal option and that the "best estimate" may provide a false sense of how precisely the dose commitment estimates can be made.

Those Identifying Issue	Identification Number
NOAA	444

Response

It was considered that both "conservative" calculations and "expected" calculations should be included in the EIS since the presentation of only one would not permit the reader to obtain a valid picture of the effects associated with radionuclide releases from defueled submarines on the deep ocean floor. If only the "conservative" estimates of the dose commitments arising from the disposal actions and from the postulated accident scenarios had been presented, the reader could have no concept of the conservatism inherent in these dose commitments nor of the magnitude of the actual dose commitments which might be received. Conversely if only the "expected" dose commitments had been presented, the reader would be unable to identify the upper bounds of the range over which the dose commitment estimates might extend. Thus the "conservative" estimates demonstrate that no hazard is associated with releases from the deep ocean disposal of defueled submarines while the "expected" values provide a much better estimate of the actual dose commitments which might be accrued because of such disposal actions.

S.16—Summary of Issue

The National Ocean Service questioned the use and purpose of the pathway entry points in their comments on Appendix H and stated that the rationale for their choice was not provided.

Those Identifying Issue	Identification Number
NOAA	444

Response

The use of pathway entry points was discussed and a justification for their location was given in Section III of Appendix J of the DEIS.

S.17—Summary of Issue

It is suggested that a horizontally homogeneous, basin-wide calculation similar to that from a one-dimensional Shepherd calculation be used to obtain the radionuclide activity concentrations for use in estimating dose commitments.

Those Identifying Issue	Identification Number
NOAA	444

Response

The results of the use of such a procedure are strongly dependent upon the choice of the basin. Choosing a basin the size of the Pacific Ocean, or even of a significant fraction of it, would result in concentrations which would be unrealistically low. Conversely, choosing a basin 500 or 600 km on a side would result in concentrations which are unrealistically high, particularly for long-lived radionuclides.

S.18—Summary of Issue

Horizontal diffusivities on the order of 10^7 cm^2/sec are applicable to large scales ($\geq$100 km) and long times ($\geq$1 month) but mixing in small scales and short times is not nearly as rapid. Thus diffusivities of this magnitude should not be used to obtain concentration estimates in the immediate vicinity of the disposal site.

Those Identifying Issue	Identification Number
NOAA	444

Response

The EIS uses diffusivities of this magnitude to calculate the activity concentrations at the pathway entry points for both of the accident scenarios, the "expected" disposal scenario and the "conservative" disposal scenario. However, the disposal site activity concentrations reported in Appendix H were not obtained using these diffusivities. Instead these activity concentrations were defined by uniformly distributing the radionuclides released in one day at the maximum rate into the volume of water which is moved through the source region in one day due to tidal processes. Since the activity concentrations at the disposal site were used only to estimate the hypothetical maximum dose commitment associated with biological transport, it was decided that for purposes of brevity and simplicity, a detailed description of the manner in which these disposal site activity concentrations were obtained did not need to be included in the EIS.

S.19—Summary of Issue

Calculations of the activity concentrations should be made using the IAEA plume model.

Those Identifying Issue	Identification Number
NOAA	444

Response

Calculations using a plume model were performed during the preparation of the EIS. The IAEA plume model is based upon the assumptions that the pathway entry points are 1500 kilometers from the disposal site and that the released activity is advected directly to the pathway entry points. Examination of the submarine disposal scenario indicates that the pathway entry points may be as close as 300 kilometers to the assumed release point (Figure H-2) but that the released activity will not be advected toward these closest pathway entry points. Therefore, the transport model presented in the EIS was used to calculate possible activity concentrations which are more appropriate.

S.20—Summary of Issue

The National Ocean Service identified the need to provide time scale data in Appendix H.

Those Identifying Issue	Identification Number
NOAA	444

Response

These data were obtained during the development of the activity concentrations used in the EIS. In general it was found that the effects associated with a given radionuclide release would be discerned at distances from the disposal site corresponding to the shoreline at times ranging from within a few months for waters on the ocean floor to a few years for waters corresponding to the 2000-meter depth contour along the continental shelf. These time scale data were not included in the EIS since all dose commitment calculations were made at the time when the activity concentrations at the pathway entry points reached a maximum. The times that such maxima occurred were not germane to the dose commitment estimates and the recording of this information in the EIS is considered unnecessary.

S.21—Summary of Issue

The EIS should use the "conservative estimate" approach to calculate the activity concentrations for use in estimating the dose commitments with the parameters defining the removal coefficients, the settling rate and the distance off the ocean floor all set to zero.

Those Identifying Issue	Identification Number
NOAA	444

(Continued on next page)

Response

This is exactly the set of calculations which was performed for the DEIS and reported in Appendix H as the "conservative estimate" activity concentrations.

S.22—Summary of Issue

The DEIS utilized the Shepherd model of dispersion which assumes an equal rate of waste dilution within the ocean. By not taking into account the effect of currents on dilution, the result may be highly inaccurate. Some method of accounting for the effect of the currents must be used.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Ms. Rebecca Matthews	693

Response

The EIS did not use Shepherd's model to estimate the transport of radionuclides in the ocean waters but rather used the model described in Appendix H. This model differed from the Shepherd model in several ways, including permitting the use of a vertical velocity component, the use of both components of the horizontal advection rather than just one as in the Shepherd model, and the ability to provide for a time varying source. Also see Issues S.5, S.6 and S.17.

S.23—Summary of Issue

The choice of single long-term average velocities (Table H-1 in Appendix H) of 0.19 cm/sec to the east and 1.12 cm/sec to the south will result in the case chosen of advecting the released radionuclides out to sea, away from the coastline.

Those Identifying Issue	Identification Number
EPA	694a

Response

The horizontal advection values used in the ocean transport calculations are based on actual observations and correspond to an advective term which is essentially parallel to the West Coast of the United States. However, the specific model used for the coastline of the United States conservatively assumed the coastline was oriented in a north-south direction. Therefore, the advection values used in the ocean transport calculations resulted in the advection of the released radionuclides towards the coast line and not out to sea.

S.24—Summary of Issue

The "best estimate" depth of the benthic boundary layer at the Pacific study area is not documented.

Those Identifying Issue	Identification Number
NOAA	444

Response

The "best estimate" depth of the bottom boundary layer thickness of 170 meters is given in Appendix H, Table H-1. The "best estimate" of the thickness of the benthic boundary layer in the Pacific study area is based upon data obtained from the Pacific Ocean but is not one of the specific thicknesses reported. Data are reported in Reference H.4 (SAND 80-2573), indicating a range of bottom boundary layer thicknesses in the Pacific Ocean between 120 meters and 250 meters while data in Volume II of Reference H.7 (SAND 82-1005) indicate that the bottom boundary layer thickness in the Pacific study area may be between 300 and 400 meters. These data were assumed to have a log-normal distribution with the 120-meter thickness representing the -1σ value, the 250-meter thickness representing the $+1\sigma$ value, and a 350-meter thickness representing the $+2\sigma$ value. This distribution yields a mean value for the bottom boundary layer thickness of 170 meters which was used in the "best estimate" calculations.

S.25—Summary of Issue

None of the measurements reported in the DEIS is accompanied by error terms, making it impossible to determine the level of precision or the range of variability of the data reported.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. Ruthann Corwin	112	Mr. Scott McCreary	86
Mr. Clifton E. Curtis	695	Mr. Daniel F. Read	12
EPA	694	Mr. Christopher D. Roosevelt	695
Dr. Michael J. Herz	37, 37b, 37c	Dr. Ruth Weiner	39c
Mr. Thomas C. Jackson	37b		

Response

In general, the EIS provides ranges of values that reflect different degrees of conservatism in the scenario and in the credible ranges of parameters used in the calculation of the resulting environmental impacts. These ranges of values explicitly demonstrate the range of variability in the calculated results.

Appendices G and J summarize the calculated results for a number of levels of conservatism for the interested reader, and Chapter 4 describes the most pertinent results. The parameters used in the best-estimate and in the conservative calculations of the radionuclide concentrations in the ocean are provided in Appendix H, Table H-1.

The results indicate that none of these doses, even those calculated for extreme scenarios by conservative methods, approached any level of concern, and the best estimate of expected conditions is nearly 12 orders of magnitude less than the most pessimistic results (Appendix J, Section III and Table J-1).

S.26—Summary of Issue

Instead of using radioactivity concentrations in seawater at the "pathway entry points" for fish (Appendix H, Table H-4), a more credible value would be the concentration at the disposal site.

Those Identifying Issue	Identification Number
Dr. Judith E. Gordon	420

(Continued on next page)

Response

The activity concentrations at the disposal site were used in the DEIS to estimate the hypothetical maximum dose commitment which an individual could receive if he consumed fish from the disposal site. This is the method recommended in the issue and it was used to be conservative in spite of the fact that no food chain has been found experimentally which leads directly to man from the ocean floor at 4000 meters or more.

The activity concentrations presented in Appendix H, Table H-4 of the DEIS are used to perform the "best estimate" calculation of the dose commitments to an average individual and to the general population of the West Coast of the United States resulting from the normal disposal of 100 submarines on the ocean floor. These calculations are based upon the activity in an average or representative item in the food supply of man. Since the average individual eats food taken from all regions of the ocean and not just in the vicinity of the disposal, the concentrations used to define the activity in a given sea food should be more representative of the concentration at the locations where the average food item might exist and this was the intent of the pathway entry point actually used.

This use of a sea food from an average location may be more easily understood by considering the quantity of fish consumed by the general population of the West Coast of the United States. If each member of a population eats 15 grams of fish per day on the average, it would be necessary to harvest a total of 4.5×10^5 kilograms (approximately one million pounds) of fish per day to supply a population of 30 million people. It is obvious that this quantity of fish cannot grow or be harvested from the small region in the ocean at the disposal site. Thus, it is apparent that the fish consumed by the average member of this population must come from many locations, most of which would not be in the vicinity of the disposal.

S.27—Summary of Issue

Numerical results of the study referred to at the end of Section IV of Appendix H should be included to demonstrate the sensitivity of the dose commitments to the various parameters and to verify the statement that the disposal of submarines on the deep ocean floor will not produce significant environmental effects even in the vicinity of the disposal.

Those Identifying Issue	Identification Number
EPA	694
NOAA	444

Response

It was considered that the inclusion in the EIS of a "best" and a "conservative" estimate of the dose commitments which might be received by man due to the disposal of defueled nuclear submarines on the deep ocean floor would provide a demonstration of the effects associated with possible parameter variations in a manner more easily understood by the general reader of the EIS than could be accomplished by the detailed presentation of sensitivity results. Further, the presentation of these results would not clarify or simplify either the procedures used to calculate the dose commitment estimates or the description of the parameters used to obtain these estimates.

S.28—Summary of Issue

A reference or discussion to describe how concentration patterns were calculated is needed to verify the statement in Section V.A of Appendix H that "the radionuclide concentrations are predicted, by the calculations, to decrease to less than one percent of the bottom value at about 385 meters above the ocean floor."

Those Identifying Issue	Identification Number
EPA	694

Response

The equations used to calculate the nuclide concentrations in the ocean waters were given in Section IV.A of Appendix H of the DEIS and the parameters used to evaluate these equations were presented in Table H-1. Reference H-17 was identified in Section IV.A.4 as the source of the method by which the solution for the vertical component of the concentration is obtained numerically.

The specific statement to which the issue refers is simply one aspect of the results obtained during the preparation of the EIS. In this case, using the procedures defined in Appendix H, the calculated values of the nuclide concentrations at a distance of 385 meters above the ocean floor were 1% or less of the calculated values at the ocean floor. This particular piece of information was provided as one of the means used in the EIS to define the effect of parameter variations upon the results.

S.29—Summary of Issue

No data or descriptive information on how the values of key parameters in Appendices G and H were obtained is provided except in unpublished or hard-to-obtain technical reports such as SAND82-1005.

Those Identifying Issue	Identification Number
EPA	694

Response

A discussion of each parameter used in Appendices G and H and its source was provided in the DEIS in Section IV.D of Appendix G and Section IV.C of Appendix H. No references were made to unpublished reports in these sections. With one exception all references for the parameter values used in Appendix H are readily available through the National Technical Information Service (NTIS), books published by major publishing houses, or are published in a major journal. The one exception is a United Kingdom government report which was easily obtained by letter request to the author.

S.30—Summary of Issue

Appendix H cites 17 references, of which only six can be considered to be available in the open literature.

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

Of the 17 references in Appendix H, five are books published by major publishing houses, four are available through the National Technical Information Service (NTIS), three are U. S. Government documents, two are published by the International Atomic Energy Agency (IAEA), and one is published in a scientific journal. The two remaining references were United Kingdom Government documents and were obtained by the authors of the DEIS upon letter request. Thus, all of these documents are in the open literature.

S.31 —**Summary of Issue**

Appendix H is vague in its use of multichapter and multiauthor works which are cited without reference to the specific relevant material; such is the case for References H.7, H.8, and H.9.

Those Identifying Issue	Identification Number
EPA	694

Response

It is true that references in the EIS do not cite the specific pages and chapters. It was considered that the specific topics referenced in the EIS were sufficiently concise that a reader interested in pursuing the information further would be able to find the specific passage through the indexes of books, such as References H.8 and H.9, and/or the Table of Contents in reports such as Reference H.7. Citing published works in their entirety and not specific pages in them is a standard practice. The information provided in the EIS reference citations is equivalent to that provided by the EPA in its DEIS for 40CFR191: Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, EPA 520/1 82 025, December 1982.

S.32—**Summary of Issue**

Reference H.10 is cited in support of the contention that sediments in the Pacific site are like Fuller's earth in their adsorptive capabilities (page H-10). Reference H.10 is over 30 years old and does not in any manner address adsorption of radionuclides by natural marine sediments in 4000 meters of water.

Those Identifying Issue	Identification Number
EPA	694

Response

The adsorption properties of various materials are not dependent upon whether the particular nuclides which are being adsorbed are radioactive or not. Reference H.10 was used in Appendix H to demonstrate the similarity of the chemical characterization of the marine sediments which were documented in Reference H.7 to that of Fuller's earth and to establish the adsorption capabilities of Fuller's earth. This similarity of the marine sediment to a known filtering material is then used to support the statement that marine sediments are expected to have excellent adsorption capabilities.

S.33—Summary of Issue

While Appendix G uses conservative as well as "best" values, and includes a discussion of the derivations or assumptions involved, Appendix H is deficient in these aspects.

Those Identifying Issue	Identification Number
EPA	694

Response

Appendix H defined, discussed and used both "conservative" estimates and "best" estimates in describing the overall transport of radionuclides from the deep ocean floor to the entry points of the pathways leading to man. Further, Appendix H presented and discussed the various assumptions used in developing this overall transport procedure and in defining the values of the parameters used in estimating the nuclide concentrations at the pathway entry points.

S.34—Summary of Issue

Examination of the footnote in Table H.6 indicates that the only parameters which are assumed to change near the continent are bottom boundary layer thickness, particle settling velocity, and maximum vertical diffusivity in the bottom boundary layer. Directional components of horizontal diffusivity, horizontal current velocities, vertical velocity, and the coefficient of detrital removal do not change. Realistic use of values would produce markedly different results.

Those Identifying Issue	Identification Number
EPA	694

Response

The nuclide concentrations reported in Table H.6 are for an in-transit accident which is assumed to occur 25 kilometers from the shore in relatively shallow waters of 800 meters depth. The parameter values used in conjunction with the ocean transport model to estimate the nuclide concentrations at the pathway entry points were chosen to provide an overall conservative (high) estimate of these concentrations. It is expected that the use of more representative parameter values would result in greater stirring and therefore lower nuclide concentration estimates and correspondingly lower dose commitment estimates.

The use of large scale horizontal advection and eddy diffusivity terms at this location rather than the smaller scale values actually applicable is considered to overestimate the transport of activity towards the shore regions and the detritus removal coefficient is considered to underestimate the removal of radionuclides from the ocean waters (and thus result in higher nuclide concentrations in the ocean waters) since the detritus flux is expected to be significantly greater in the near shore regions than in the open ocean. On the other hand, using an increased bottom boundary layer thickness and letting the maximum vertical diffusivity extend to the top of this layer not only permit a more rapid upward transfer of activity, but also result in reducing the conservatism associated with the nuclide concentrations used at the pathway entry points by allowing mixing over a greater volume. On balance, the model calculation is judged to provide an estimate of the possible effects which would not be exceeded if other analytical approaches were used.

S.35—Summary of Issue

In the ocean depths storms occur and vast amounts of sediments are circulated.

Those Identifying Issue	Identification Number
Mr. Ron Good	574

Response

This issue appears to refer to the eddies of various sizes which may be found in ocean waters. The largest of these may be of the order of 100 to 150 km in diameter and have velocities ranging up to a maximum of 30 cm/sec. Some scientists believe that eddies of this nature may be an important mechanism in the mixing and transport of ocean waters. This movement of the ocean waters by eddies and currents is accounted for in the EIS through the use of diffusivities and water velocities as specified in Appendix H.

It is also possible that these eddies may resuspend sediments in regions where the sediments are loose. However, one of the criteria to be met in identifying a potential deep ocean disposal site is that regions where significant sediment suspension could occur are to be avoided. Further, the EIS examines two situations: (1) where all of the released material was assumed to remain suspended in the water column, and (2) where all of the released material was assumed to be incorporated in the sediments in the immediate vicinity of the disposal. Even under these unrealistically adverse conditions, the disposal of defueled nuclear submarines on the deep ocean floor would not result in any hazard to man.

SECTION T

This Section (T.1 —T.34) contains issues related to Appendix I of the Environmental Impact Statement.

T.1 —Summary of Issue

The models used in Appendix I to estimate dose commitments employ estimates made in Appendices G and H for the release and transport of nuclides. It is not clear if dose commitments were estimated assuming a full range of parameter values. In other words, there is no discussion of potential or real compounding of errors which might result from errors of estimation at several steps in the chain of calculations.

Those Identifying Issue	Identification Number
Ms. Elizabeth Bock	692
EPA	694

Response

As is apparent from the equations in Appendix I, the dose commitments are directly dependent upon the values used for the various parameters. Thus the dose commitment estimates will directly reflect a given change in any of these values. As a result it does not appear necessary to discuss the effect upon the dose commitments of changes to the specific terms used to estimate the dose commitments in Appendix I.

The only term used in these equations which is dependent upon the procedures defined in Appendices G and H is the one which represents the nuclide concentrations. Thus it is only through this term that compounding errors could possibly occur. As is pointed out in Appendix H, a parametric study was performed to evaluate such potential effects which might be associated with the uncertainties in the parameters used to obtain the nuclide concentrations. The results of this study basically indicated that the "conservative" nuclide concentration estimates reported in Appendix H were considerably greater than the highest nuclide concentrations obtained by the various combinations of randomly chosen parameter values associated with the study. As a result it is considered that the dose commitments calculated in the EIS are considerable overestimates of the actual dose commitments which might be received by man due to the disposal of defueled submarines on the deep ocean floor.

T.2—Summary of Issue

Dose to man was computed via a chain of models with insufficient use of present-day modeling concepts and data.

Those Identifying Issue	Identification Number
EPA	694

Response

There are currently no published models nor did the respondent suggest any which are more appropriate for estimating release rates at deep ocean disposal sites, estimating ocean transport from the disposal sites to the entry points of pathways leading to man and calculating doses which might be accrued by man via these pathways than the ones developed and used in the EIS. The data used in the EIS were, with some minor exceptions, values taken from the latest available sources and chosen to provide conservative estimates of the calculated dose commitments.

T.3—Summary of Issue

Theoretical calculations are not reliable.

Those Identifying Issue	Identification Number
EPA	694
Mr. Ken Kelley	612
Dr. John W. Harris	85
Mr. Lewis Seiler	707
Mr. Arthur Wang	159

Response

The EIS primarily relies on using simplified conservative models of the complex processes which occur within the ocean environment to obtain upper limit estimates of the impacts which the disposal of defueled nuclear submarines on the ocean floor might have. The development of such simplified models requires that empirical data be provided to serve as the base upon which these models may be formulated. Further, the use of the models is dependent upon having empirical results available to be utilized as input data and to verify the predicted results. As a result, the EIS cannot be considered to even remotely depend upon theoretical calculations alone.

T.4—Summary of Issue

The faunal data presented in the EIS is not sufficient to verify statements, calculations, and model assumptions.

Those Identifying Issue	Identification Number
EPA	694

Response

The dose commitments presented in the EIS for the sea disposal option of defueled nuclear submarines were found to be extremely small based upon extremely conservative scenarios and assumptions concerning the availability of marine life (i.e., it was assumed that unlimited quantities of marine life were available at any location in the ocean as required to meet the needs of man). Thus extensive faunal data to reduce the conservatism in the analysis were not necessary. This conclusion is supported by the lack of adverse environmental consequences at the THRESHER and SCORPION sites.

T.5—Summary of Issue

The EIS uses the important concepts of concentration factors and specific activities uncritically in computing the food chain transfer in Appendix I.

Those Identifying Issue	Identification Number
EPA	694

Response

The Navy does not agree with this statement. The equations used in Appendix I to calculate estimates of possible dose commitments do use the concentration factor concept recommended by international experts and are based upon more detailed information presented in References I.1, I.4, and I.5, as stated in Sections I, II, and III of Appendix I. These sections contain reference to and some discussion of the assumptions associated with the use of the concentration factor concept, but a detailed discussion of the advantages and disadvantages of the concentration factor concept is not presented in the EIS. However, sufficient information to completely define all aspects of the concentration factor concept is presented in other references and incorporation of these detailed discussions in the EIS is not consistent with Council on Environmental Quality directions to reference supporting material to the greatest extent possible. It is considered that concentration factors and specific activities were used properly in the EIS.

T.6—Summary of Issue

There are essentially no data available on uptake, concentration factors, or sensitivity of deep-sea organisms (from depths greater than 1000 meters). As a result, realistic numbers are not available to plug into the models. Without empirically derived data to input, the dosages calculated in the DEIS are not believable, in my opinion, although it is likely that dosages generated from a realistic input will also be low.

Those Identifying Issue	Identification Number
Ms. Camilla Ingram	686

Response

The concentration factors used in the EIS for the foods which are consumed by man were based upon the information developed by the IAEA for use in evaluation of radioactive material at sea and are reported in Appendix I. These values represent the latest conservative data available at the time the EIS was prepared. While these factors may not be specifically derived from deep sea organisms, the IAEA expert group concluded that their use for this purpose should produce overestimates of the potential radiation dose to humans.

Regarding sensitivity to radiation, recent studies to define the radiation regime in the deep ocean have indicated that the dose rates experienced by the fauna from both external and internal sources of naturally occurring radionuclides are of the same order as those experienced by shallow water species. Reference 1, below, reported, "Our data support the conclusions of Pentreath et al. [R. D. Pentreath et al., paper presented at the third OECD/NEA Marine Radioecology Seminar, Tokyo, 1979] that the natural radiation regime for organisms in the deep ocean is not likely to be any lower than that for organisms in coastal waters and is also not likely to be constant." This gives increased confidence in translating our knowledge of radiation effects on shallow water species to the deep-ocean. As reported in Reference 1, a number of deep ocean fish and invertebrates have been collected and analyzed and the most important contributor to the internal dose appears to be the naturally-occurring radionuclide Polonium-210 which accumulates in the tissue of these marine fauna. The ranges of absorbed dose for whole body and specific organs are similar to those observed for coastal water species, and show little change with depth for similar species. The calculated radiation dose increment from the disposal of defueled submarines is far less than that received by marine organisms from natural radionuclides. Such an increment, based upon experimental and field studies in contaminated areas as reported in Reference 2, is unlikely to result in any detectable effects.

(Continued on next page)

References

1. R. D. Cherry & M. Heyraud, Science *218*, 54 (1982)

2. Effects of Ionizing Radiation on Aquatic Organisms and Ecosystems, Technical Reports Series No. 172, IAEA, Vienna (1976)

T.7—Summary of Issue

A reference for the specific nuclides listed in Table I-1 of Appendix I is needed.

Those Identifying Issue	Identification Number
EPA	694a

Response

References for the sources of the half-lives presented in Table I-1 of Appendix I were given at the bottom of the table. The basis for the choice of the specific nuclides included in Table I-1 was given in Section I.A of Chapter 1 of the DEIS.

T.8—Summary of Issue

The equations which appear on Pages I-6 through I-9 and the definitions of the units associated with the various factors appear to have some problem with the dimensions; i.e., they do not appear to yield the dose, D, in rems. Perhaps the difficulty lies in the definition of the units associated with each factor, which are somewhat confusing.

Those Identifying Issue	Identification Number
EPA	694

Response

The units of D in the equations in Sections IV.A through IV.C.4 of Appendix I should be in man-rem instead of rem.

T.9—Summary of Issue

Reference to corrosion products which are "not removable by system flushing" should be explained further (Appendix I, Section V.A). Does this mean that some effort would be made to decontaminate the reactor systems in conjunction with defueling and preparation for disposal?

Those Identifying Issue	Identification Number
EPA	694

Response

The quoted passage describes the adherent nature of the corrosion products (crud) to indicate that they would not be freely dispersible and was not intended to describe a decontamination procedure.

No decontamination effort is planned because such a small fraction (approximately 0.1 percent) of the total amount of radioactive material would be available to removal by decontamination that the effort would not be justified.

T.10—Summary of Issue

Some updating of accumulation factors could be incorporated in the report but the end result, that is the computed dose rates, will probably change very little. The IAEA is in the process of revising the concentration factors shown in Table I-3 of Appendix I. These factors were deemed to be inadequate because they are usually for whole organisms and they do not provide an indication of the range of values that are encountered. The current plans are to update the information by including recent published data for edible and nonedible tissues, and best estimates, maximum and minimum values.

Those Identifying Issue	Identification Number
EPA	694a

Response

The values used are those currently recommended by the IAEA. If updated values had been published in time for inclusion in the EIS, they would have been used to perform the analysis.

T.11—Summary of Issue

The EIS should include a formula to convert fish consumption (in grams per day) into radiation exposure (in millirems per year).

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Michael J. Herz	37b
Mr. Thomas C. Jackson	37b
Mr. Christopher D. Roosevelt	695

Response

Section IV.A of Appendix I of the DEIS included the equation which relates the dose commitments received from the ingestion of radioactivity to the rate at which individuals ingest foods and the time during which these individuals are ingesting these foods. Each term in this equation was fully defined in this section. In addition, a sample dose commitment calculation was presented in Section IV of Appendix J using the same equation specified in Appendix I, including a detailed definition of each of the terms and identification of the values substituted into this equation for the specific terms of the equation, the units of these values and their source.

T.12—Summary of Issue

One hundred and forty-five pounds of fish per year is not a large amount of fish, particularly if this quantity represents raw weight (~40% waste).

Those Identifying Issue	Identification Number
Ms. Carol E. Mone	627

Response

The fish consumption data were obtained from published USDA data for U. S. citizens (Reference I.9). The weight is the actual amount eaten.

T.13—Summary of Issue

The study of freshwater organisms is not applicable to marine biota.

Those Identifying Issue	Identification Number
Dr. Gordon L. Chan	85
Mr. Lewis Seiler	707

Response

The EIS does not propose the use of freshwater organism studies to define parameters describing marine biota. Calculations are reported in the EIS to estimate doses arising from the ingestion of freshwater fish in evaluating the land disposal option and to estimate doses arising from the ingestion of various forms of marine life in the evaluation of the sea disposal option. In both cases the parameters used are applicable to the particular option being examined. For example, the concentration factors used for freshwater fish in the land disposal calculations were obtained from the NRC Reg. Guide 1.109 for freshwater fish and the concentration factors used for the marine life in the sea disposal calculations were developed by the IAEA for use in evaluating radioactivity disposal actions in ocean waters.

T.14—Summary of Issue

Calculated exposure from fish 250 km away from the dumpsite used a recognized concentration factor of 5×10^2 to reflect the tendency of fishes to concentrate Ni from the environment. However, in the calculation of "worst case dose commitment" where fish are theoretically exposed to relatively higher concentrations of isotopes in the sediments, no concentration factor was used. Instead concentrations of isotopes in fish were calculated on the basis of average Ni concentration found in fish tissues (from the literature). Also, Greig et al. (1976) showed that *C. armatus*, (the dominant large fish at the Lower Slope Area) concentrates Ni (0.82 mg/kg) at a level an order of magnitude or more higher than that apparently used in the EIS.

Those Identifying Issue	Identification Number
Mr. J. A. Musick	419
Ms. Sheila M. Prindiville	700

Response

The concentration factors used to calculate the potential exposures from eating fish relate the concentration of a given element in water to the concentration of that element in the fish. These concentration factors were used to relate the concentration in water to the concentration in fish at the disposal site when it was assumed that all radioactive material was soluble in the water and remained concentrated at the disposal site.

However, these concentration factors are not appropriate to relate the concentration of an element in sediment to the concentration of that element in fish living in the water. Therefore, the concentration of radioactive material was based on the concentration of elements in fish that have been reported in the literature (e.g., 0.15 mg/kg for Ni which is approximately the same order of magnitude suggested by the respondent). To maximize the concentration of radioactive material in the fish, it was assumed that the only elements available were the radioactive elements from the submarine and the elements in the top centimeter of sediment (less than 100 years) or the top 10 centimeters of sediment (greater than 100 years). This means that neither the large concentration of stable (non-radioactive) elements in the submarine nor the water was allowed to dilute the concentration of radioactive elements. In addition, it was assumed that there would be enough fauna at the bottom in the relatively small area to provide a person with 145 pounds of this bottom fish per year (see Issue J.12 for a discussion of the concentration of abyssal fish). This direct consumption of disposal site fish also eliminates the reduction of radioactive elements that would take place with each food web transfer. For this conceptual evaluation these conservative assumptions more than compensate for any uncertainties such as the elemental concentration in the fish.

T.15—Summary of Issue

A direct pathway which has been found is from shrimp living in the deep ocean bottom (dump site), which eat food from the bottom (picking up radionuclides), and are then eaten by people.

Those Identifying Issue	Identification Number
Mr. James Widmeyer	678

Response

There has been no direct biological path, including the pathway mentioned in this issue, leading from organisms at disposal sites on the deep ocean floor ($\geq$4000 meters) to man which has been defined and verified by any experimental means to date. Every such pathway which has been mentioned in any context is hypothetical.

T.16—Summary of Issue

No comprehensive food chain analysis was attempted, rather a worst case hypothetical analysis is considered.

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

The purpose of this EIS is to develop information necessary to determine which disposal option should be pursued. A worst case hypothetical treatment was used in evaluating the potential transport of radioactive material by the biota. Even with this worst case evaluation the estimated potential exposure was small in comparison to normal variations in background radiation exposures due to an individual's geographic location and activities.

The fact that there would be no significant environmental impact from ocean disposal, even based on this worst case evaluation, clearly provides the decision-makers with the information they need. To provide additional refinements in the food chain evaluation for this conceptual evaluation would not be necessary.

T.17—Summary of Issue

If the sea disposal option is implemented, radioactivity will eventually reach inland territories in the form of rain.

Those Identifying Issue	Identification Number
Ms. Frances Dollar	562

Response

The possibility that radionuclides from defueled nuclear submarines placed on the deep ocean floor might be deposited in man's environment by means of rainfall is essentially zero. For such an event to occur it would be necessary for any radionuclides which might be released to the ocean environment to be transported to the ocean surfaces or to the sediments at the shoreline. The nuclides would then have to be transferred into the atmosphere by some suspension mechanism associated with wave spray or wind shear because these radionuclides are not carried by the rain water itself, since they remain in the ocean water when water evaporates from the ocean surface. They would then have to be transported in the atmosphere to the inland location where they are to enter man's environment. Finally, these nuclides would have to be removed from the atmosphere and deposited at this location by precipitation scavenging or dry deposition mechanisms. Each of these steps results in a significant dispersion of any radionuclides which might be released from defueled nuclear submarines on the deep ocean floor. As a result even if such an improbable path could be followed, the activity associated with it would not provide any hazard to man or his environment.

T.18—Summary of Issue

Radioactivity in marine waters might affect the fecundity of fish, most especially currently over-exploited fish species.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Dr. Gordon L. Chan	85	Mr. Lewis Seiler	707
Mr. Peter Douglas	68a	Atty. Gen. John K. Van DeKamp	446
Ms. Morere Paradise	85		

Response

Recent studies in the deep ocean have indicated that the dose rates experienced by the fauna from naturally occurring radionuclides are often large. The most important contributor to the internal dose appears to be the naturally-occurring radionuclide Polonium-210 which accumulates in the tissue of these marine fauna. The Polonium-210 in gonads of five species of deep sea fish captured between 1000 m and 4500 m depth produces radiation doses up to 0.3 rem per year to those organs.

The maximum radiation dose of 0.3 rem/year to sea animals calculated for the disposal of defueled submarines would be about the same as that received by the reproductive organ of marine organisms from this one natural radionuclide. Therefore, the fecundity of these animals should not be adversely affected by submarine disposal.

With regard to over-exploited species, one criterion for an ocean disposal area is that the water be at least 4,000 meters deep. At this depth there is no fishing so there are no "over-exploited fish species."

T.19—Summary of Issue

The EIS should discuss the biological pathway associated with grenadier or rattail fish. These fish are commercially important because eighty thousand pounds of these fish were landed in Humboldt Bay last year.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Wesley Chesbro	69	Mr. Christopher D. Roosevelt	695
Mr. Clifton E. Curtis	695	Mr. Gordon K. Van Vleck	715
Mr. Ron Guenther	105a		

Response

There are many species of rattail or grenadier fish, rather than just a single species. The family, macrouridae, to which these fish belong contains about 250 species (Reference 1). This family is distributed worldwide and occurs from continental shelf depths to over 5000 meters (Reference 2). The species referred to in the comment is coryphaenoides acrolepis, a well known benthic species occurring on the continental slope between 450 meters and 2825 meters, but uncommon at the depth extremes (Reference 3). Geographically, it occurs from southern California to Alaska (Reference 4). C. acrolepis is captured incidentally in the Dover Sole fishery off northern California, and is sold locally for human consumption. The greatest depth fished for Dover Sole is about 800 meters, and it is less abundant below that depth (Reference 5). Therefore, the grenadier collected in the Humboldt Bay area are those from only the "shallow" part of the population, although migrations up and down the slope have been suggested for the species (Reference 6). C. acrolepis is unknown at the Pacific Ocean study site and, based on present knowledge, does not occur within 100 nautical miles and 1500 meters of depth of the study site.

At present time there is no experimental evidence that the rattail fish which may be found in 4000-meter deep water feed at these depths and then migrate to the surface waters where they may be caught by man. Thus there is no basis to assume that the grenadier or any other fish taken by the fishing industry might be the terminus of a food chain which incoporated radionuclides from a deep ocean disposal site.

(Continued on next page)

However, to verify that man could not be harmed by any fish caught for consumption by the general population, the EIS examined the impossible situation where it was assumed that all fish consumed had lived in the deep ocean waters prior to being caught. These fish were assumed to be restricted to the ocean environment in which any radionuclides released from defueled nuclear submarines would attain their highest concentrations. The results of these extremely conservative calculations are reported as the "conservative" dose commitment estimates in the EIS and indicate that man would not be subjected to any hazard due to the disposal of defueled nuclear submarines on the deep ocean floor.

References

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2. Marshall, N. B. and T. Iwamoto, Family Macrouridae Fishes of the Western North Atlantic, Sears Foundation for Marine Research, Memoir Number I, Vol. 6, 1973.

3. Pearcy, W. G., D. L. Stein, and R. S. Carney, "The Deep Sea Benthic Fish Fauna of the Northeastern Pacific Ocean on Cascadia and Tufts Abyssal Plains and Adjoining Continental Slopes," Biological Oceanography, Vol. 1, Number 4:375-428, 1982.

4. Iwamoto, T. and D. L. Stein, "A Systematic Review of the Rattail Fishes (Macrouridae: Gadiformes) from Oregon and Adjacent Waters," Occasional Papers of the California Academy of Sciences, Number 111:1-79, 1974.

5. Alton, M. S., "Characteristics of the Demersal Fish Fauna Inhabiting the Outer Continental Shelf and Slope Off the Northern Oregon Coast," The Columbia River Estuary and Adjacent Ocean Waters, A. T. Pruter and D. L. Alverson (eds) University of Washington Press, Seattle, pp. 503-634, 1972.

6. "Midwater and Benthic Fish Report of Marine Life Research Group," Scripps Institution of Oceanography, California Cooperative Fisheries Investigation, Vol. 17:15, 1974.

T.20—Summary of Issue

While albacore themselves are surface feeding pelagic fish, they are in fact dependent upon smaller fish, such as needle and seriola, which in turn feed on plankton which is feeding on upwelling of inorganic and organic materials which come from deep within the water.

Those Identifying Issue	Identification Number
Mr. Wesley Chesbro	69

Response

The upwelling along the Northern California coast comes from depths of 300 meters or less below the ocean surface, and any material which might be in the vicinity of the ocean floor at depths of 4000 meters would be isolated from the surface waters above it. Thus any radionuclides which might be released from a deep ocean disposal site would have no effect in the surface waters above the site.

However, calculations were performed in the EIS to examine the effects which might be encountered if somehow radionuclides from the ocean floor did reach the surface waters where major fishing occurred. This was accomplished by essentially assuming that the edible species of surface fish, such as albacore, derive all their food from food chains originating in the deep ocean waters (4,000 m) where any radionuclides which might be released from a deep ocean disposal site would be concentrated, without the diluting effect of food from other unperturbed areas. These results, which represent, in effect, a biological shortcut from the bottom to the surface, are reported in the EIS. Even under these extremely conservative conditions, there would be no hazard to man associated with the ingestion of fish due to the deep ocean disposal of defueled nuclear submarines.

T.21 —Summary of Issue

The ecology of deep-ocean habitats at or near the bottom remains unknown.

Those Identifying Issue	Identification Number
EPA	694
Mr. Gordon K. Van Vleck	715

Response

While it is true that much remains to be learned about the ecology of the deep ocean bottom, it is not correct to say that this area is unknown. Lack of specific knowledge does not prevent the calculation of conservative, bounding estimates of the effects of sea disposal on humans. First, using the accepted "concentration factor" approach, the possible concentrations of the various radioactivities in sea food and sea plant were calculated, which produced the possible radiation exposure to people who might regularly consume average, or higher than average, amounts of each. The concentration factor method implicitly accounts for the possible effects of all steps in a food chain between the radioactive material concentration in the environment and the end-product actually consumed by man. The concentration factors used in the EIS are generally believed to overestimate the actual concentration factors for biological processes in the deep ocean.

Further, although there are no known pathways by which radioactivity could be carried from bottom-dwelling creatures to people, the DEIS postulated that a so-called "biological shortcut" existed, in which people might directly consume unusually high amounts of seafood that was in equilibrium with either the water or the sediment at the disposal site. Even these hypothetical, grossly conservative assumptions would result in a whole body radiation exposure of only 0.2 to 3 mrem per year. Thus, even though sea bottom ecology has not been fully described, the EIS has shown that the possible radiation exposure to people, even under the most pessimistic assumptions, would be negligible.

T.22—Summary of Issue

No data exist on concentration factors for deep sea organisms.

Those Identifying Issue	Identification Number
EPA	694

Response

The concentration factors used in the EIS for the foods which are consumed by man were based upon the information developed by the IAEA for use in evaluation of radioactive material at sea and are reported in Appendix I. Although these factors were not specifically derived from deep sea organisms, the IAEA concluded that their use to estimate doses to man would be acceptable (IAEA-211).

T.23—Summary of Issue

The expressions for D_s, D_e, and D_v in Section IV.C of Appendix I give collective dose equivalents rather than collective dose equivalent commitments.

Those Identifying Issue	Identification Number
EPA	694a

Response

Since the total dose an individual may incur due to exposure for a given period to an external source is received entirely during the exposure period, the dose commitment an individual receives due to exposure to an external source for a given period of time is the same as the dose received from that external source during the period of exposure. Since the expressions for D_s, D_e, and D_v in Section IV.C of Appendix I were all for external sources, these terms can be referred to as dose commitments.

T.24—Summary of Issue

The EIS does not mention the effect of sea disposal upon the marine bacteria in the immediate vicinity of the ocean floor.

Those Identifying Issue	Identification Number
Mr. Eric Simmons	59

Response

Possible effects of the deep ocean disposal of defueled nuclear submarines on marine bacteria are not specifically described in the EIS. However, the maximum activity concentrations estimated for radionuclides released from the submarines at the disposal site are of the same order of magnitude as the concentrations of radionuclides such as Thorium-232, Protactinium-234, Potassium-40, and Rubidium-87 which occur naturally in the ocean waters. Thus, the disposal of defueled submarines in the ocean floor would not significantly alter the radiation field in which these bacteria are normally immersed and would therefore not present a new hazard to those marine bacteria.

Further, the actual area of the ocean bottom and the number of marine bacteria where these maximum disposal site concentrations occur would represent a highly localized, very small portion of the ocean floor and of the population of such bacteria. In addition, the marine bacteria are distributed over the ocean floor in proportion to the available food which is much greater in the relatively shallow shelf and slope water regions than in the deep open ocean waters. Since any effect on the marine bacteria by disposal actions would be small and restricted to a very small area, no significant impact on marine bacteria would be expected.

T.25—Summary of Issue

The value chosen for the density of the shore sediments in Section IV.C.3 of Appendix I, 2.65 × 10^6 grams per cubic meter, is not necessarily conservative. The last paragraph of Section IV.C.3 of Appendix I describing the expression defining the exposure to shore sediments is not clear leading to the thought that there may be a more appropriate approach to calculate external exposures to the shore line.

Those Identifying Issue	Identification Number
EPA	694a

Response

The value chosen for the density of the shore sediments, 2.65 × 10^6 grams per cubic meter (approximately 165 pounds per cubic foot), is significantly higher than most shore sediments or soils and, thus, conservative. This value was obtained from Reference I-6 and is based upon the density of SiO_2 which is the major constituent of sand.

T.26—Summary of Issue

It is not clear where the biomass is supposed to be coming from in the dose calculations of Appendix I.

Those Identifying Issue	Identification Number
EPA	694

Response

Appendix I presents the equations used in the EIS to calculate dose commitment estimates. Of these equations only those which pertain to ingestion dose commitments have any reference to biomass. This biomass is the food which is consumed by people who might receive dose commitments as a result of eating this food so the biomass referred to in the comment is the sea food eaten by the general population of the West Coast and is obtained by the normal harvesting of sea life through fishing, shrimping, etc.

As is pointed out in Appendix J, Section III.D, and in the response to Issue J.1, only a small amount of biomass could be supported by the energy available at a depth of 4000 meters. Thus the "conservative" and "biological shortcut" calculations, which ensure that the biomass lives at a 4000 meter depth and is exposed to radionuclide concentrations existing at that depth, are very conservative because the available biomass could support only a limited population.

T.27—Summary of Issue

The presentation in Section III.A of Appendix I, Ingestion Pathways, is very naive, illustrating that very little knowledge exists of what lives in the sites or what potential pathways might be. Some pathways are quite plausible (albacore in the Pacific site), others are next to impossible (molluscs in the Atlantic sites).

Those Identifying Issue	Identification Number
EPA	694

(Continued on next page)

Response

Section III.A of Appendix I defines all the various pathways by which radionuclides released from defueled nuclear submarines on the deep ocean floor might reach man including pathways originating near the surface or shore. As such, they are to be representative pathways and, as a group, they are to be sufficiently broad that any particular pathway which might be associated with a specific disposal site-population member scenario can be incorporated into one of these pathways. Careful reading of Appendix H and Appendix I shows that by the nature and purpose of these pathways, they cannot and should not be restricted to site specific situations. It should be noted that the purpose of the EIS is to examine the overall effects which might be encountered due to the deep ocean disposal of defueled nuclear submarines and is not to specifically evaluate particular disposal sites.

The EIS explicitly states in appropriate sections that no pathways from the bottom in locations typical of those likely to be selected for disposal to man have been found.

Furthermore, the Navy's hypothetical shortcut calculations and results of analysis of fish and other marine life captured at the THRESHER and SCORPION sites show that even if people could eat seafood from the actual disposal site, there would be no significant radiation exposure.

T.28—Summary of Issue

The assertion that the maximum usages are mutually exclusive which is made in Section V.B of Appendix I and in Section III.A.2 of Appendix J is not entirely true. The maximally exposed individual may consume the maximum amount of fish, and drink the maximum amount of desalinated seawater, and spend the maximum amount of time exposed to shore sediments, etc.

Those Identifying Issue	Identification Number
NRC	445

Response

The DEIS did not state that maximum usages are mutually exclusive but rather stated in Section V.B of Appendix I and in Section III.A.2 of Appendix J that no one individual can be exposed at all of the maximum consumptions rates or occupancy factors for all of the possible exposure pathways. While it may be possible that one individual could be exposed to perhaps two or even three pathways at the maximum rate, it is considered to be inconceivable that a single individual would be exposed to all the pathways at the maximum rate.

T.29—Summary of Issue

Although the dose commitment factors in Table I.4 through Table I.8 are stated to be 70 years dose commitment factors, data taken from References I.5 and I.14 would be only 50 year dose commitment factors, and, if used, should be so indicated.

Those Identifying Issue	Identification Number
EPA	694

Response

Dose commitment conversion factors specified for ingestion and inhalation in Tables I.4 and I.5 respectively of Appendix I should, in the strictest sense, differentiate between 70-year and 50-year dose commitment factors. However, the biological half-lives for all of the nuclides in all of the organs specified in these tables are quite short ($\leq$3 years with the exception of iron which in bone is approximately 4.5 years and in the lung due to ingestion is approximately 9 years). Thus there is no practical difference between 50-year and 70-year dose commitment factors since all of the nuclides would be removed from the organ of concern in less than a 50-year period.

T.30—Summary of Issue

The dose rate conversion factors presented in Tables I-6, I-7, and I-8 of Appendix I for Ni-59 and Hf-181 should not be zero (0.0). They (or daughters) emit photons. (See D. C. Kocher, 1979; NUREG/CR-0494).

Those Identifying Issue	Identification Number
EPA	694a

Response

Dose rate conversion factors for Ni-59, Tc-99, and Hf-181 from D. C. Köcher, 1981, NUREG/CR-1918 have been included in Tables I-6, I-7, and I-8 of Appendix I of the Final EIS. The total dose commitment estimates for air immersion, water immersion, and shore sediment pathways are not significantly affected by these modifications.

T.31—Summary of Issue

The entries in Tables I-3, I-4, and I-5 do not take into account the dilution factors due to the corrosion release of stable elements (as discussed in Chapter 4, Section II.A.3(c)). For example, the entries for Ni-59 and Ni-63 might be reduced by a factor of 700,000 and Co-60 by a factor of 25,000.

Those Identifying Issue	Identification Number
EPA	694

Response

It is true that, throughout the EIS, credit has not been taken for the beneficial effects associated with the dilution of active nuclides by the stable nuclides released simultaneously during corrosion processes with the exception of the calculation of the hypothetical maximum dose commitments associated with biological transport. This only highlights the inherent high degree of conservatism included in even the very low dose commitments estimated using the concentration factor method and thus further demonstrates that these disposal actions would present no hazard to man.

T.32—Summary of Issue

A more thorough breakdown of each nuclide's effect in place of the current general comment on radioactivity and a discussion concerning tendencies of relevant long-lived radionucides to concentrate in marine creatures should be included in the Final Environmental Impact Statement.

Those Identifying Issue	Identification Number
Ms. Jane O. Ballus	19
Mr. Dwight Donovan	228

Response

The use of concentration factors to describe the possible accumulation of each radionuclide in marine creatures and other pathways to humans is described in Appendix I, Section III and the theory of this approach can be found in References I.1 and I.13. This method for calculating the effects of possible bioaccumulation within a food chain is widely used and accepted.

T.33—Summary of Issue

It would be worthwhile to compare or take into account the ingestion and inhalation dose factors available in International Commission on Radiological Protection (ICRP) Publication 30.

Those Identifying Issue	Identification Number
EPA	694a

Response

A comparison of the ingestion and inhalation dose commitment conversion factors used in the EIS with those defined by ICRP Publication #30 was made for the two major contributing radionuclides in the EIS for ingestion and inhalation paths (Ni-63, Ni-59). The results of this comparison indicated that the conversion factors used in the EIS were higher (more conservative) than those obtained from ICRP Publication #30. Since the total dose commitment values reported in the EIS are higher than would be obtained by using the ICRP Publication #30 dose commitment conversion factors, it was not considered to be warranted to make such changes.

T.34—Summary of Issue

The EIS should contain some discussions of the path of potential contaminants away from the disposal site. For example, if the deep currents measured at the Pacific study area are assumed to continue to flow at the same speed all the way to the Antarctic, then a "contaminated parcel" of water would take about 30 to 40 years to get there. However, when it did the contaminants would be so diffuse that they probably would not be detected.

Those Identifying Issue	Identification Number
NOAA	444

Response

The 30- to 40-year estimate of the time necessary for releases from the Pacific study area to reach the Antarctic and the observation that the actual activity concentrations would be exremely diffuse when they arrived are consistent with the analyses performed for the EIS. However, in actuality, any releases from such an area would be expected to take longer and the activity concentrations would be expected to be even less since the probability of a direct current from a given area to the Antarctic is essentially zero.

There are two basic reasons why discussions pertaining to locations more than 500 km from the hypothetical disposal site were not incorporated in the EIS. First, as pointed out in the comment letter, deep ocean circulation pattern data describing the movement over such great distances are sparse and the description of such transport paths is rather speculative. Second, and more compelling, regardless of the path by which these remote locations could be reached, the activity concentrations at these remote locations will be significantly less than the concentrations within 500 km or less of the disposal site. Thus the possible hazards which might be encountered at these remote locations are less than those reported in the EIS. Since the potential effects of releases from defueled nuclear submarines on the deep ocean floor in this near region would not be significant, it does not appear necessary to provide additional discussions pertaining to regions where the possible effects would be even smaller. (Also, see Issue S.23.)

SECTION U

This Section (U.1—U.24) contains issues related to Appendix J of the Environmental Impact Statement.

U.1—Summary of Issue

There may be undiscovered links (or potential shortcuts) between abyssal biota and species utilized by man. More work is needed to be able to evaluate transfer of radionuclides within food chains.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identificaton Number
Mr. Emmett Carson	415	Mr. Ron Guenther	105a
Mr. Clifton E. Curtis	695	Arthur J. Rocque, Jr.	697
EPA	694	Mr. Christopher D. Roosevelt	695

Response

Although no such links are known, the DEIS presented calculations in Chapter 4, Section II.A.3.(d)(4), of what the radiation exposure might be for a hypothetical biological shortcut, where humans were assumed to consume unusually large annual amounts of seafood which was assumed to live directly adjacent to the disposal site, continuously exposed to the highest concentrations of radioactivity in water or in sediment. In this situation, which would represent the worst case postulated by the commenters, the calculated radiation exposure would be 3 mrem per year, which is less than the normal variation in background radiation exposure. The details of these calculations are presented in Appendix J, Section III.D, where the point is made that the upper limit mass of fish which live in the area adjacent to one submarine would be less than the assumed annual consumption by one such hypothetical person. More recent published calculations (Reference 1) indicate that the area adjacent to all 100 submarines would be insufficient to support a fishery of one 400 gram (live weight) fish per day, which is the assumed consumption of this hypothetical person.

Since conservative calculations indicate no significant environmental impact, detailed data on food chains and ecological information would be useful only to demonstrate that the true effects would be even less significant. While this might be desirable research, it is not needed to assess the environmental impact of ocean disposal.

Reference

1. IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
Joint Group of Experts on the Scientific Aspects of Marine Pollution—GESAMP—, Reports and Studies No. 19, An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea, Vienna, June 1983

U.2—Summary of Issue

"The assumption or conclusion that there is no known link between abyssal sediments and upper water food chains leading to living marine resources is not completely correct. There is circumstantial evidence to suggest that deep sea fishes may have reproductive strategies that involve the mesopelagic zone and thus could enter the food chain."

Those Identifying Issue	Identification Number
NOAA	444
Ms. Camilla Ingram	686
Mr. Jonathan McHugh	87

Response

The statements in the EIS pertaining to no known biological links between the deep ocean floor and the surface waters of the open ocean pertain to pathways for which there are experimental data demonstrating the existence of such a path. To date, no such path has been observed or supported by experimental data. There have been, of course, speculations concerning mechanisms by which such hypothetical biological paths between the deep ocean floor and the surface waters might occur and which are currently being examined to determine their validity.

Since such pathways have been postulated, the EIS examined the possible effects such a pathway might have. These effects are included in the "conservative" dose commitment calculations reported in the EIS. These "conservative" dose commitment estimates were obtained by assuming that all pathways which lead to man should be evaluated using the radionuclide concentrations calculated on the ocean floor where any radionuclides which might be released from the defueled submarines would have the highest concentrations. These highly conservative calculations yielded results which indicate that no hazard to man would result from the disposal of defueled nuclear submarines on the deep ocean floor even if the activity concentrations on the ocean floor are assumed to exist in the surface water.

Also direct hypothetical maximum biological shortcuts were assumed, as is reported in Section III.D of Appendix J, and again the results indicated that deep ocean disposals of defueled submarines would not significantly affect man.

U.3—Summary of Issue

More work is needed to be able to evaluate transfer of radionuclides within food chains.

Those Identifying Issue	Identification Number
EPA	694

Response

The basic purpose of the portion of the EIS related to sea disposal was to evaluate the impacts on man which might occur due to the disposal of defueled nuclear submarines on the deep ocean floor. Since this evaluation clearly demonstrated that there were no significant impacts on man resulting from sea disposal actions on a very conservative basis using overall food chain concentration factors, removing the need to examine detailed food web transport mechanisms, it is apparent that additional work to define radionuclide transfer via food chains would not aid the evaluations performed in the EIS.

U.4—Summary of Issue

The EIS claims that physical mechanisms are more important than biological mechanisms for moving radionuclides from the bottom to the surface (Section III.D of Appendix J) and gives a reference citation instead of a discussion of this claim. However, without at least a summary from the cited reference, we think this claim is poorly supported.

Those Identifying Issue	Identification Number
Mr. Gordon K. Van Vleck	715

Response

A brief summary of the results reported in the cited reference was presented in Appendix J. Since these conclusions provided the relevant material pertaining to the EIS, it was considered that the incorporation of additional material from the reference was not warranted. It should be noted that these conclusions identifying the relative unimportance of biological processes as a means of transporting nuclides from the deep ocean floor to the ocean surfaces are supported by others such as the National Marine Fisheries Service (see comment letter #444).

U.5—Summary of Issue

The possibility of radioactive material entering the food chain through benthic pathways should be given fuller treatment in the EIS.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identificaton Number
Mr. George Balding	77	Mr. Jonathan McHugh	87
Ms. Barbara Connelly	143	Mr. J. A. Musick	419
Mr. Clifton E. Curtis	695	Ms. Sheila M. Prindiville	700
Mr. Warren Detriedt	282	Mr. Christopher D. Roosevelt	695
Mr. Dan Hamburg et al.	72b	Mr. James F. Ross	486
Dr. Michael J. Herz	37, 37c		

Response

A significant effort has been expended to identify any possible mechanism by which radionuclides released at a deep ocean disposal site might enter man's food chain through benthic pathways. There have been a few speculative concepts presented postulating such mechanisms which are being evaluated, but to date, there is no known, experimentally confirmed, pathway leading from the benthic regions to the marine foods available for man's ingestion.

However, the EIS has evaluated the effects which might result if such a pathway were ever identified. This is accomplished in the EIS through the "conservative estimate" of the dose commitments which might result from deep ocean disposal of defueled nuclear submarines. The dose commitments associated with the "conservative" approach use activity concentrations along the ocean bottom to define the activity in the marine foods ingested by man. This procedure assumes that man's food chain originates and is contained completely in the benthic region with the associated high radioactivity concentrations levels. The results of this analysis (Chapter 4 and Appendix J) indicate that, even if man's entire food chain were in the benthic regions of the ocean, the dose commitments received by an average individual due to the ingestion of marine foods would be negligible (0.0002 mrem per year) in comparison to his natural background exposure (100 mrem per year).

U.6—Summary of Issue

The EIS should include "specific activity" assessments to complement the "critical pathways" approach.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695	Mr. Thomas C. Jackson	37b
EPA	694	Mr. Christopher D. Roosevelt	695
Dr. Michael J. Herz	37b	Dr. Ruth Weiner	39

Response

The DEIS did include a "specific activity" assessment. Hypothetical biological transport calculations were made using a specific activity approach (Section III.D of Appendix J) to estimate the activity which might be transferred to man from a deep ocean disposal site.

U.7—Summary of Issue

The rate of exchange between the abyssal waters and surface waters was questioned.

Those Identifying Issue	Identification Number
Mrs. Jaman	453
Mr. Heyward G. Shealy	236
Mr. Gordon K. Van Vleck	715

Response

There are no mechanisms by which ocean waters at depths of 4000 meters or greater may be directly exchanged with surface waters at the same location. However, there are physical oceanographic mechanisms by which waters originally at these depths may eventually reach surface waters. The quickest of these would be associated with transport of bottom waters along constant density contours from the original site to Antarctic Ocean regions where these waters could surface and then be introduced into the Pacific, Indian, and Atlantic Oceans at some later time (Reference 1). It is anticipated that this type of movement would require a minimum of 100 or more years to transfer water from a deep ocean site in the Northern Hemisphere to the surface waters of the world's oceans. Further, these waters would be greatly diluted in the process of being distributed throughout the world's oceans and any activity carried by them would also be diluted by the same amount.

It may also be possible for 4000-meter deep water to reach the surface regions by means of a slow material transport through the water column which would take on the order of a thousand years. During this period, the waters would be dispersed into at least the volume of the ocean in which the disposal occurred and any activity concentrations would be reduced accordingly. Another possible mechanism by which deep ocean waters might eventually move to the surface regions would be by horizontal transport to the continental rise regions along the coasts and then by a slow upward movement towards the surface in the boundary layer. Again this process would result in extensive dilution prior to any of the deep ocean waters reaching the surface regions.

Reference

1. Marrietta, M. C. Ed, "Proceedings of a Workshop in Physical Oceanography Related to the Subseabed Disposal of High-Level Nuclear Waste", Big Sky, Montana. Jan. 14-16, 1980, SAND80-1776, April 1981.

U.8—Summary of Issue

The EIS devotes insufficient attention to the possibility that biological processes might transport radionuclides to the surface waters where seabirds and other organisms might come in contact with marine organisms containing radionuclides picked up in deep waters and transported to the surface.

Those Identifying Issue	Identification Number
Mr. Craig S. Harrison	527
Mr. Gordon K. Van Vleck	715

Response

During the development of the DEIS, significant effort was expended to determine the probable mechanisms by which radionuclides might be transported from a disposal site on the deep ocean floor (4,000 or more meters deep) to shallower depths or the surface. However, no overall biological path from the deep ocean floor to the surface waters has been identified and confirmed by experimental data. Further, the National Marine Fisheries Service agrees with the position taken in the EIS that biological transport mechanisms cannot move significant quantities of radionuclides from the deep ocean to surface waters (see Comment Letter #444).

The EIS does include (Section III.D of Appendix J) the analysis of a hypothetical case which postulates that biomass from the bottom waters at a disposal site are brought to the surface where they may be ingested. Even in this virtually impossible scenario, man and animal life at the surface would not be significantly affected by the corrosion products released at a deep ocean submarine disposal site.

U.9—Summary of Issue

The Environmental Impact Statement does not consider the research done by William K. Schell which indicates that Americium-241 from a deep ocean disposal site can enter a food chain culminating in edible rattail fish. This contradicts the statement in Appendix J, Section III.D that no biological pathways are known linking deep ocean organisms to man.

Those Identifying Issue	Identification Number
Ms. Janet P. Brooks	693
Mr. Wesley Chesbro	69
Ms. Deborah L. Clifford	498
Mr. Clifton E. Curtis	695
Mr. Robert Eidus	23
Ms. Judith Evered	71
Dr. Judith E. Gordon	420
Dr. Michael J. Herz	37, 37b, 37c
Mr. Thomas C. Jackson	37b
Ms. Rebecca Matthews	693
Mr. Scott McCreary	86
Ms. Janet T. Orselli	593
Mr. James Puckett	38
Ms. Beverly Roberts	32
Mr. Christopher D. Roosevelt	695
Ms. Joyce Rosenthal	13b
Ms. Cathy Ryan	99
Mr. Stuart Robert Smith	54

Response

Dr. Schell reported the presence of Am-241 in six rattails which were collected by trawl from the 3800-meter Hudson Canyon nuclear waste disposal site. He theorized that this activity had come from the leakage of Am-241 from canisters at the disposal site into the sediments and from there into the infaunal population, then into the food chain and finally to the rattails. However, as was reported in the Second International Ocean Disposal Symposium held in Woods Hole, Mass. in April of 1980, no evidence of any leakage from the canisters was found in either the water or the sediments for any nuclide even when samples were taken by the deep submersible ALVIN immediately adjacent to the disposal canisters. Also, there was no indication of any activity from the containers in any other element of the food chain nor was Am-241 activity found in any other biological sample including other fish taken from the same area although fallout plutonium was found in all such samples. Thus, there is no evidence that the reported Am-241 in the rattails came from the disposal site nor that it entered the rattails through their food chain.

The preceding statement is supported by the following testimony of David Hawkins of the EPA at a hearing of a subcommittee of the House of Representatives Committee on Government Operations on October 7, 1980.

> "In the case of americium, which is a decay product of Plutonium-241, one researcher reported very high levels in the edible muscle of one kind of fish—the rattail—taken in the vicinity of the Atlantic 3,800-meter site.
>
> The rattail is a bottom feeder which is not fished commercially in this country and which, to the best of our knowledge, is not being fished at all in the area of the dumpsite, but which is apparently harvested commercially in other parts of the world.
>
> The data in this case is complicated by several technical factors:
>
> One, the researcher who discovered the high levels of americium in bottom fish samples was not testing specifically for americium at the time of his work and was, therefore, not using state of the art techniques for this radionuclide;
>
> Two, although high concentrations of americium were detected, no plutonium was found in the fish, despite the fact that americium is a decay product of plutonium;
>
> Three, the levels reported were so high that they would be difficult to explain on the basis of fish feeding in the vicinity of a leakage waste canister."

Dr. Schell's research is not discussed in the EIS because defueled, decommissioned submarines contain less than 0.001 curies of Am-241 or any other transuranic radionuclide.

U.10—Summary of Issue

If the fish at the disposal sites are sediment feeders and the clays absorb extensive amounts of particulate radionuclides, they could build up high body burdens. What happens if one feeds directly on them? What happens to whales that ingest these fish?

Those Identifying Issue	Identification Number
EPA	694

Response

The question pertaining to the dose commitments associated with the direct ingestion of fish which might build up high body burdens because of contact with sediments containing the released radionuclides is specifically answered in Section III.D of Appendix J (Hypothetical Maximum Dose Commitments for Biological Transport).

There are no whales at the depths associated with deep ocean disposal sites ($\geq$ 4000 meters), thus the only way for whales to ingest fish from the disposal sites is for these fish to migrate to the depths at which whales may feed and there become intermixed with all other fish which may serve as food for whales. Since only a small portion of a whale's diet could possibly come from a disposal site, the overall effect of the ingestion of such fish on whales would be negligible.

(Continued on next page)

It should also be noted, as is pointed out in Section III.D of Appendix J, that the scenario defined in the above comment does not represent anything resembling a possible realistic situation since the released radionuclides can actually be dispersed by the ocean waters and there is no fishing at 4000 meter depths now or in the foreseeable future.

U.11—Summary of Issue

What is meant by the statement that dose commitment estimates associated with biological transport would be expected to be "significantly less" than the estimates provided in Section III.D of Appendix J?

Those Identifying Issue	Identification Number
EPA	694

Response

The basis for this statement was explicitly discussed in the introductory paragraphs of Section III.D of Appendix J of the DEIS.

U.12—Summary of Issue

Since the dose commitments were based on maximum calculated radionuclide concentrations for the critical (maximum exposed) groups of people, the whole concept of "average" individual loses meaning and at best is a misnomer.

Those Identifying Issue	Identification Number
EPA	694

Response

As is defined in Section I of Appendix J, the EIS uses the term "average" individual only to denote an individual whose consumption rates, breathing rates and occupancy factors represent the typical individual of the West Coast of the United States. This definition does not include the use of an average nuclide concentration in the food and environment of the individual. Similarly the term "maximum" individual is used in the EIS to define an individual whose consumption rates, breathing rates and occupancy factors reflect the maximum values of these parameters which are attained for any of a variety of reasons by a few individuals of the West Coast population. Again, the use of a maximum nuclide concentration in the food and environment of this individual is not included in the definition. Thus the EIS uses the dose commitment estimates associated with the "average" individual and the "maximum" individual to define the large differences in dose commitments which may be associated solely with the differences in the intake and occupancy parameters among various members of a population.

These definitions of the "average" and "maximum" individual are spelled out in detail in the EIS (Appendix J, Section I) and are defined in the Glossary. Thus it is concluded that the meaning of these terms as used in the EIS is adequately documented and their use in this manner is acceptable.

U.13—Summary of Issue

It is misleading to label conditions as "best estimates" when they are conservative and unrealistic. The footnotes to Table J-1 highlight the continuing contradiction in terms. "Best estimate" dose commitments were calculated using "conservative" assumptions, so they are higher than would be expected. Meanwhile, the "conservative" dose commitments were calculated to be "extremely conservative". What is presented in reality is a "conservative" dose and a "very conservative" dose, neither of which has any relation to "best estimate" or reality.

Those Identifying Issue	Identification Number
EPA	694

Response

It is agreed that the EIS basically provides "conservative" dose commitment estimates and "very conservative" dose commitment estimates and that these estimates are considered to be significantly larger than the actual dose commitments which might be received by man due to the disposal of defueled nuclear submarines on the deep ocean floor.

It is considered that the objections to the labels attached to the various dose commitment estimates are associated more with semantics rather than with technical deficiencies in the EIS. One of the primary purposes of the EIS is to define any hazards to man which might result from the deep ocean floor disposal of defueled nuclear submarines. It is apparent from these dose commitment estimates associated with the sea disposal option, that there is no hazard to man due to the presence of radionuclides in these defueled submarines. The labels associated with the various dose commitment estimates are used to identify that in one case, the conditions and assumptions used to obtain these estimates were based on current scientific judgment of the parameter values and process effects or were based on taking the most adverse values and effects.

These conditions and assumptions along with their identifying labels are judged to be adequately documented in Appendices G, H, I, and J of the EIS. This is demonstrated by the fact that the respondent was clearly able to identify the conservative nature of these estimates. Thus it is considered that the use of these terms to identify the various dose commitment estimates in the EIS is understandable and acceptable.

U.14—Summary of Issue

Pathway evaluations in Appendix J use adult intake parameters which are stated to yield dose commitments within a factor of 2 for those using teen, child, or infant parameters. There is no indication of whether the factor of 2 is positive, negative or a combination of both for various age groups. Further, dose commitments may be more crucial to children than to adults, thus, comparative calculations for children should be included.

Those Identifying Issue	Identification Number
EPA	694

Response

As stated in the introduction to Appendix J, dose commitment calculations were performed for four different age groups—adults ($\geq$ 19 years), teens (12-18) children (1-11), and infants (< 1 year) and the dose commitment results were all within a factor of two of the estimates for adults. These results indicated that the dose commitments estimated for children were the largest, approximately a factor of 1.7 greater than those calculated for adults, while those estimated for infants were the lowest, approximately a factor of 2 less than the adults. The dose commitments estimated for teens were about a factor of 1.5 less than those calculated for the adults.

Consideration was initially given to reporting the dose commitment estimates for all four age groups, but for simplicity of presentation and ease of understanding, it was decided to report the dose commitment estimates for only one of the age groups. Since the dose commitment estimates for all four age groups fall within a factor of two of the adult value, the supporting data are better established for adults than for other groups, and since none of the doses would result in any hazard to man, it was judged that the adult dose commitment estimates should be presented in the EIS.

U.15—Summary of Issue

With respect to Section III.E.3 of Appendix J "The wisdom of calculating a collective dose that is based on a population and a conservative dose estimate is questioned. Fundamentally the collective dose can be estimated as the product of the population and the (realistic) average dose to an individual within the population. In any event there is no further reference to the population dose estimates that are reported here and elsewhere in Appendix J. Clarification is needed."

Those Identifying Issue	Identification Number
EPA	694a

Response

Calculations of population dose commitments were made using a conservative estimate of the dose received by an average individual of a population to demonstrate that, even under the unrealistic conditions associated with this conservative scenario, the disposal of defueled nuclear submarines on the deep ocean floor has no significant impact upon man. The population dose commitment, based upon conservative dose estimates, reported in Section III.E.1 of Appendix J was used to define the population dose commitments specified in Section II.H.3.d.4 of Chapter 4 of the EIS. The use of conservative radiation exposure estimates to calculate population dose commitments is consistent with the EPA's approach to calculating population dose commitments from high level waste repositories in the EPA Draft EIS for 40CFR191.

U.16—Summary of Issue

Were the physical transport mechanism parameters used in obtaining the dose commitments reported in Section III.A through Section III.C of Appendix J chosen to "best" represent the transport of radionuclides or to "maximize" the transport?

Those Identifying Issue	Identification Number
EPA	694

Response

The dose commitments estimated for the expected disposal conditions (Section III.A) and the accident at the disposal site (Section III.B) used radionuclide concentrations based upon the best available estimates of physical transport properties of the ocean defined in Table H-1 of Appendix H. In general, the model describing physical transport of radioactive material from the disposal site to the vicinity of the continental shelf and the properties used to estimate the dose commitments for the expected disposal conditions and the accident at the disposal site are intended to result in somewhat conservative estimates of these dose commitments but are not considered to "maximize" results.

The dose commitments for the in-transit accident scenario (Section III.C) were also based upon the physical transport properties of the open ocean given in the "best estimate" column of Table H-1 with the exception that the boundary layer parameters and the settling parameters were modified. Since this accident is assumed to occur 25 kilometers offshore, these parameters were selected to produce a considerable overestimate of the actual transport and thus, in essence, "maximize" the transport.

The result of a set of conservative calculations which were specifically designed to significantly overestimate, and thus "maximize", the nuclide concentrations and the corresponding dose commitments are presented in Sections III.D and III.E of Appendix J.

U.17—Summary of Issue

It might be preferable to compile cumulative doses along with dose rates since these only relate to the mrem/70 year per pCi ingested in the first or maximum year of exposure.

Those Identifying Issue	Identification Number
EPA	694a

Response

A conservative estimate of the upper limit of the 70-year cumulative exposure could be simply obtained by multiplying the reported maximum single year exposure estimated by 70 years. The resulting exposure would have the same relation to natural background or limits, since they would similarly be multiplied by 70, and be no more significant than the single highest year estimates.

U.18—Summary of Issue

The fourth sentence of the sixth paragraph of Section I of Appendix J is not clear at all. What the author is trying to say is that the dose commitment (70 year via ingestion or inhalation) that results from an exposure to the maximum concentration for a year is equal to the dose received in the 70th year following continuous exposure to the maximum concentration for 70 years.

Those Identifying Issue	Identification Number
EPA	694a

Response

The meaning of this segment in the EIS has been properly interpreted by the statement in the above issue and is an accurate paraphrasing of the information in the EIS except that it omits the important restrictions identified in the original statement that are necessary to make the statement valid.

U.19—Summary of Issue

Use of the EPA standard for drinking water is misleading and inappropriate, especially since correct calculations using the Navy's data come to within 0.1 mrem per year of that standard.

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Michael J. Herz	37, 37b, 37c
Mr. Thomas C. Jackson	37b
Mr. Christopher D. Roosevelt	695

Response

The EPA standard for drinking water (4 mrem per year) was cited in the DEIS (Appendix J, Section III.C.1) along with three other reference values to indicate that the maximum exposed individual (following an accident during transit to the sea disposal site) would not be exposed to an excessive amount of radiation, as indicated by comparison with any of these dose values. The results

(Continued on next page)

of the comparison indicated that a postulated maximum individual total body dose would be approximately 0.9 mrem per year, in contrast to the 500 mrem per year established by the NRC for an uncontrolled area, approximately 100 mrem per year from natural background, and approximately 20 mrem per year from natural radioactivity in fish. The maximum individual's exposure can be seen to be a small fraction of any of these reference values.

The respondent did not describe the alternate calculation to which he alluded, so it cannot be evaluated.

U.20—**Summary of Issue**

The EIS should acknowledge the amount of concentrated radioactive material, that is now showing up in the larger fish we eat, resulting from activity transfer through the food chain from the prior ocean radioactive dumpsites.

Those Identifying Issue	Identification Number
Ms. Sherry Pimsler	680

Response

To date there has been no radioactivity found in any of the fish taken from commercial fishing grounds which can be traced to activity released at any ocean disposal site. Further, there is no expectation that any such radioactivity will ever be found in the future.

U.21—**Summary of Issue**

Sea disposal "worst case" calculations are confused and appear to be off by nine orders of magnitude. (No page or section identified.)

Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695
Dr. Michael Herz	37, 37b, 37c
Mr. Thomas C. Jackson	37b
Mr. Christopher D. Roosevelt	695

Response

The details of the worst case calculations are provided in Appendix J, Sections III.C and III.E and a treatment of a hypothetical "biological shortcut" from the bottom to humans is provided in detail in Section III.D of Appendix J. The respondent did not identify a specific source of error, and checks of the calculations did not uncover any errors of the sort described.

U.22—**Summary of Issue**

Uniform mixing of nuclides in the sediment is estimated inconsistently, with mixing in 1 or 10 cm (Appendix J, Section III.D.2) and 15 cm (Chapter 4, Section II.A.3(a)). More realistic calculations could be based on deep ocean bioturbation coefficients.

Those Identifying Issue	Identification Number
Ms. Camilla Ingram	686
NOAA	444

Response

The use of bioturbation coefficients would provide a more realistic estimate of the activity distribution in the sediments than an assumed uniform distribution. However, in the three situations in the EIS where uniform mixing was assumed, calculations of hypothetical scenarios were being performed to demonstrate that even under "worst case conditions" no adverse effects would be encountered.

In Chapter 4, all of the 120 Ci of Ni-59 activity from a submarine was assumed to be uniformly distributed in the top 15 cm of the sediments of an area limited to that affected by one day's tidal movement. Since it takes over 4000 years for this amount of activity to be released, the choice of a layer no more than 15 cm thick in which all of this activity is assumed to be constrained was judged to be conservative in light of plutonium distribution measurements which indicate that biological mixing to 12 cm has been attained in the few decades over which this element has been available for deposition on the deep ocean floor.

In Appendix J the maximum amount of activity of each of the radionuclides in the environment at any time is used to estimate the hypothetical maximum effect associated with biological transport. In this case, if the maximum amount of a radionuclide in the environment would occur prior to 100 years after disposal, the uniform mixing depth was assumed to be 1 cm and if the maximum occurred subsequent to 100 years after the releases start, a mixing depth of 10 cm was assumed. These values were used to provide conservative estimates of the activity concentrations encountered in the sediments which might be available for biological transport by using the minimum volume of sediment for the period of interest.

U.23—Summary of Issue

The cultivation of plants on contaminated silt that accumulates in tidal areas that are later reclaimed, represents an "indirect" pathway that is subject to a concentrating process rather than a dispersion process (as far as the soil is concerned).

Those Identifying Issue	Identification Number
EPA	694a

Response

The scenario proposed in the above issue does represent one of the "indirect" ingestion pathways which might possibly lead to man. All such pathways which might reach man through the soil result in some deposition and, thus, accumulation of nuclides in the soil. However, the concentrations of these nuclides in the soil and the subsequent transfer of some of these nuclides into the food which man might eat are significantly less than the concentrations of these nuclides in the sea food which might be ingested by man. Since radiation exposures from the evaluated direct pathways were shown to be negligible, this path and other such indirect pathways were not examined in detail in the EIS.

U.24—Summary of Issue

The apparent importance of C-14 via biological transport from sediments is doubtful. This result is a consequence of the specific activity approach that was used for the calculations. Marine fish derive their carbon from the food web (and water) rather than from sediments. (Ultimately the origin of the carbon is atmospheric CO_2.) Some of the carbon of marine fish may be derived from sediments, but it could be from carbon from the organic matter that settles out from the water column.

(Continued on next page)

Those Identifying Issue	Identification Number
EPA	694a

Response

The Navy agrees with this statement. However, C-14 was included in the calculation of the hypothetical maximum dose commitments which might result from biological transport to ensure that the results were conservative.

SECTION V

This Section (V.1) contains an issue related to Appendix L of the Environmental Impact Statement.

V.1 —Summary of Issue

Appendix L should positively state which endangered species are in the area of the Savannah River proposed off-loading site (Appendix L, Section III.C)

Those Identifying Issue	Identification Number
Mr. Martin F. Golden	634

Response

Of the more than 300 species which are protected by state or federal laws, there are four that occur at the Savannah River Plant. The DEIS discussed three of these and stated that these species do not inhabit the Ellenton Landing Site. Since the DEIS was issued, an additional endangered species, the short nose sturgeon, has been found in the vicinity of the Savannah River Plant. The short nose sturgeon is discussed in Appendix L, Section III.C.

SECTION W

This Section (W.1) contains an issue related to Appendix M of the Environmental Impact Statement.

W.1 — Summary of Issue

Sea disposed radioactive material would be impossible, or extremely costly, to retrieve.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mrs. R. Albertson	633	Honorable Ronald V. Dellums	447
Mr. Alfred W. Anderson	493	Ms. Dobie Dolphin et al.	131b
Ms. Karen Ankersmit	539	Mr. John R. Donaldson	461
Ms. Natasha Atkins	167	Mr. Dwight Donovan	228
Mr. Brian N. Baird	55, 55a	Mr. Peter Douglas	68, 68a
Mr. George Balding	77	Mr. Wells Eddleman	20
Ms. Jane O. Ballus	19	Mr. Robert Eidus	23
Mr. Bill Barlow	17	Mr. Fred Eissler	664
Ms. Jeannie Barnhardt et al.	240	Ms. Katherine Emerson	370
Ms. Ann Bauer	5	EPA	694
Dr. H. Wayne Beam	339 or 339a	Ms. Judith Evered	71
Ms. Alice Berg	203	Mr. Herb Everett	371
Mr. John K. Bermel	227	Ms. Louise Ewens	573
Mr. James F. Berry	22	Ms. Donna Feiner	280
Mr. & Mrs. Warren Beth	189	Mr. James Arthur Ferrara	665
Ms. Elizabeth Bock	692	Ms. Lydia Raas Ford	326
Honorable Barbara Boxer	66	Ms. Melissa Gehrman	16
Ms. Ann Bringloe	36	Ms. Virginia Gibson	522
Ms. Janet P. Brooks	693	Ms. Cecilia J. Gregori	298
Mr. Daniel Brown	243	Mr. Gilbert J. Gregori	298
Mr. Thomas D. Brown	178	Mr. Ron Guenther	105
Mr. Michael Carney	660	Mr. Dan Hamburg et al.	72a, 72b
Mr. Greg Carr	672	Mr. Doug Hansen	536
Mr. Wesley Chesbro	69	Mr. John P. Harville	290
Ms. Carolyn J. Christman	200	Ms. Nancy Haskins	244
Mr. Edgar D. Christman	572	Mr. Dan Hauser	67a
Ms. Jean Christman	572	Ms. Jeane L. Heard	209
Ms. Kimberly J. Christman	671	Ms. Beverly Heisner	540
Mr. Paul Clemmons	387	Dr. Larry Heiss	248
Ms. Deborah L. Clifford	498	Ms. Liz Helenchild	132
Ms. Majorie Cofer	635	Dr. Michael J. Herz	37, 37b, 37c
Ms. Rainbow Trout Cornelia	308	E. Hodges	497
Dr. Ruthann Corwin	112	Mr. Jeff Hohensee	116
Ms. Nancy Cragin	137a	Mr. Keith Houck	301
Ms. Janet Crone	113	Mr. Laurence D. Houlgate	295
Ms. M. R. Crook	230	Ms. Karin Humphrey	402
Mr. Robert Crook	230	Ms. Marcia Jackson	174 or 597
Ms. Gretchen Crosson	408	Mr. Thomas C. Jackson	15 or 37b
Mr. Kevin Crosson	408	Mr. Gary E. James	584
Mrs. Jim Culberson	457	Ms. Jane Jarrett	245
Mr. Clifton E. Curtis	695	Mrs. Brenda S. Johnson	422
Ms. Randi Dalton	161	Honorable Walter B. Jones	9

Those Identifying Issue	Identification Number
Dr. Robert Kay	373
Honorable Barry Keene	67 or 67a
Mr. Ken Kelley	612
Dr. Mary T. Kelly	30
Ms. Maxine King	465
Ms. Mamie Lee Kiyohara	542
Mr. Kingsley H. Klarer	378
Mr. Mike Landen	569
Ms. Patrice Larkins	632
Mr. Jim LeCuyer	84
Ms. Eleanor K. Leek	284
Ms. Jeanie Lopez	235
Mr. Doug Lowe	21
Mr. Edward Luben	197
Mr. Dennis L. Lundblad	372
Ms. Laura Maguire	524
Mr. Jim Marotta-Jaenecke	194
Mr. Ronald E. Martin	219
Ms. Karen A. Massey	674
Ms. Laure Mastrella	637
Ms. Teresa Matta	382
Mr. Michael Matthay	398
Ms. Rebecca Matthews	693
Lt. Governor Leo McCarthy	65
Ms. Maxine McCloskey	689
Ms. Ellen McCord	274
Mr. Scott McCreary	86
Ms. Linda Miller	682
Ms. Carol E. Mone	627
Ms. Susan Moretta	328
Ms. Janet Morrison	341
Ms. Dani S. Moyer et al.	180
Ms. Estelle V. Mueller	212
Mr. Donald S. Muir	604
NOAA	444
Mr. George D. Noble	333
Ms. Julie Kay Norman	709
Mr. Thomas D. O'Neil	80
Ms. Janet T. Orselli	593
Mr. Charles Orth	88
Ms. Janet M. Orth	396
Ms. Rebecca Paterson et al.	631
Ms. Jane Smith Patterson	8
Ms. Linda Peters	97
Ms. Mary T. Phillips	207
Ms. Jane Plankinton	313
Ms. Sheila M. Prindiville	700
Mr. James Puckett	38
Mr. Robert E. Ragland	315

Those Identifying Issue	Identificaton Number
Ms. Karen Rakofsky	272
Ms. Molly Randall	570
Mr. Daniel F. Read	12
Ms. Judith Redwing	96
Ms. Arlene Reeves	487
Mr. Kendall Reid	479
Ms. Arlene Reiss	344
Ms. Beverly Roberts	32
Ms. Dan Roberts	126
Mr. Arthur J. Rocque, Jr.	697
Mr. Christopher D. Roosevelt	695
Ms. Joyce Rosenthal	13a
Ms. Sally Rulison	666
Mr. John Runkle	18 or 468
L. S. Russell	435
Ms. Cathy Ryan	99
Mr. John Schubert	53
Ms. Janet Seaforth	134, 134a
Mr. Ron Shehee	407
Mr. Thomas H. Slone	552
Ms. Polly Smith	366
Mr. Stuart Robert Smith	54
Mr. Randall Stemler	348
Mr. David B. Swoap	721
Mr. Victor G. Taylor	221
Ms. Jo Ann Thomas	646
Mr. Clifton Troy Toth	659
Ms. Sheila Tracy	129
Mr. Michael Tuck	411
Unknown	213
Ms. Kay H. Upchurch	334
Atty. Gen. John K. Van DeKamp	446
Mr. Gordon K. Van Vleck	715
Ms. A. E. Wasserbach	703
Ms. Nancy M. Wassmuth	641
Ms. Edith Webber	211
Mr. Don Weber	231
Mr. Don R. Weber	242
Ms. Linda Weber	231
Dr. Ruth F. Weiner	39a, 39b
Mr. Greg Wellish	103
Mr. Ocean Wells	401
Ms. Emily F. Whittlesey	358
Mr. James Widmeyer	678
Mr. Charles B. Williams	688
Mr. Michael Winks	701
Ms. Sharon Winters	479
Mr. G. Nelson Wolfe	104

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Response

Although there is no technical basis for expecting that retrieval would ever become necessary, the large number of people expressing concern over this issue indicates a widely held belief that nothing could be done to correct any problem which might occur following disposal at sea. The technical assessment in the DEIS concluded that disposal by land or by sea could be accomplished in a safe and environmentally acceptable manner and that radiation dose commitments to affected populations would not approach levels of concern. The technical assessment also examined the potential impacts of credible accidents and of conservative interpretations of the various uncertainties that existed in the dose predictions and concluded that safety and environmental impacts would be satisfactory. Furthermore, the difference between conservative predictions of environmental impacts and levels of concern was sufficiently large that there was no technical reason to anticipate a need for retrievability.

Although the DEIS stated that retrievability would not be feasible with current technology (Chapter 2, Section II.E), reasonable extensions of proven technology could be used after disposal at sea for retrieval or further containment of the submarine reactor plants. Technical assessment shows that retrieval of the entire submarine should be possible for at least 50 years after disposal because of the strength and thickness of the structures, and that containment of the residual radioactive material in concrete could be accomplished at any time. The costs of implementing such actions have been estimated and, while quite large, are not prohibitive.

One respondent stated that retrieval would be of doubtful value and that it is questionable that retrieval is not feasible. Another cited capabilities characteristic of the Glomar Explorer and stated that it is incorrect to say that it would not be feasible. Another respondent requested information on cost probability analysis regarding retrieval. Cost details are provided in Appendix M. The probability that retrieval would be needed is indeed quite low and not significant, as shown by the technical assessment.

A detailed description of the methods which could be used for retrieval or containment has been added to the Environmental Impact Statement in a new Appendix M. This information is summarized in Chapter 4 and included in the Summary. The estimated costs are discussed in Appendix A (Section III.D.2) and in Appendix M.

SECTION X

This Section (X.1 and X.2) contains issues related to Editorial Comments on the Environmental Impact Statement.

X.1 — Summary of Issue

The following commenters made editorial suggestions. The Navy considers these recommendations would improve the Environmental Impact Statement.

Those Identifying Issue	Identification Number	Those Identifying Issue	Identification Number
Mr. Clifton E. Curtis	695	Dr. Robert Kay	373
EPA	694, 694a	NRC	445a
Governor Joe Frank Harris	340	Mr. James Puckett	38
Dr. Michael J. Herz	37b	Mr. Christopher D. Roosevelt	695
Mr. Thomas C. Jackson	37b	Mr. Stuart Smith	54

Response

These editorial comments have been incorporated into the Final Environmental Impact Statement.

X.2 — Summary of Issue

The following commenters made editorial suggestions which the Navy considers would not significantly improve the Environmental Impact Statement.

Those Identifying Issue	Identification Number
EPA	694, 694a
Mr. Martin Golden	634
Mr. Harold Rogers	662

Response

No change to the Environmental Impact Statement was necessary.

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