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FINAL ENVIRONMENTAL IMPACT STATEMENT

S1C Prototype Reactor Plant Disposal

Volume 1 of 2

November 1996

Prepared by the
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Office of Naval Reactors

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COVER SHEET

PROPOSED ACTION: Determine a disposal strategy for the defueled S1C Prototype reactor plant.

TYPE OF STATEMENT: Final Environmental Impact Statement

RESPONSIBLE AGENCY: U.S. Department of Energy, Office of Naval Reactors

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ABSTRACT: This Final Environmental Impact Statement evaluates in detail three alternatives for the disposal of the S1C Prototype reactor plant. These alternatives include: prompt dismantlement and disposal of the entire S1C Prototype reactor plant; deferred dismantlement, which allows for decay of some radioactivity prior to dismantlement; and "no action," which means continuing surveillance and monitoring for an indefinite period of time.
The evaluations conclude that the environmental and socioeconomic impacts for all of the disposal alternatives would be small.

Naval Reactors received written comments on the Draft Environmental Impact Statement during a 45-day public comment period lasting from July 5, 1996 to August 19, 1996. Oral comments were received during a public hearing held on August 7, 1996. This Final Environmental Impact Statement includes copies of all written and oral comments that Naval Reactors received on the Draft Environmental Impact Statement. All comments were taken into consideration during preparation of this Final Environmental Impact Statement.

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SUMMARY

The U.S. Department of Energy Office of Naval Reactors (Naval Reactors) is currently evaluating alternatives for disposal of the S1C Prototype reactor plant, located at the Knolls Atomic Power Laboratory Windsor Site in Windsor, Connecticut (Windsor Site). A key element of Naval Reactors' decision making is a thorough understanding of the environmental impacts associated with each alternative. The National Environmental Policy Act requires Federal agencies to analyze the potential environmental impacts (both positive and negative) of their proposed actions to assist them in making informed decisions. In following this process, Naval Reactors prepared a Draft Environmental Impact Statement to assess various alternatives and to provide necessary background, data and analysis to help decision makers and the public understand the potential environmental impacts of each alternative. Following consideration of public comments, Naval Reactors prepared this Final Environmental Impact Statement. The Naval Reactors decision will be presented in a Record of Decision to be issued thirty days after publication of the Final Environmental Impact Statement.

National Environmental Policy Act: A Federal law passed in 1969, which requires all Federal agencies to consider in their decision making processes potential environmental effects before implementing any major action, and established the Council on Environmental Quality within the Office of the President.

Alternatives: The range of reasonable options considered in evaluating and selecting an approach to meet the need for agency action.

Environmental Impact Statement: A detailed environmental analysis for a proposed action that could significantly affect the environment. A tool for decision making, it describes the positive and negative environmental effects of the alternatives.

Record of Decision: A concise public record of the agency's decision, which discusses the alternative selected. The discussion will include whether all practicable means to avoid or minimize environmental harm from the selected alternative were adopted (and if not, why they were not).

The S1C Prototype reactor plant was permanently shut down in March 1993, reflecting the end of the Cold War and projected downsizing of the U.S. Naval fleet. All spent nuclear fuel was removed from the S1C Prototype reactor and has been shipped off-site. Management of spent nuclear fuel has been addressed in a separate Department of Energy evaluation, Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement, (Reference 1-1).

The S1C Prototype reactor plant is located within a reactor compartment. The reactor compartment is shielded and serves as a containment structure. All S1C Prototype reactor plant systems have been drained, deenergized and placed in a safe, stable condition. However, the S1C Prototype reactor plant systems still contain radioactive materials such as activated metals and corrosion products.

The disposal alternatives examined in detail include:

(1) **Prompt Dismantlement (Preferred Alternative)** - The S1C Prototype reactor plant would be promptly dismantled and materials would be disposed of or recycled. Low-level radioactive waste would be shipped to the Department of Energy Savannah River Site for disposal. All structures would be removed from the Windsor Site and the Windsor Site would be released for unrestricted use. Under this alternative, the Windsor Site could be made available for other uses as early as possible, currently estimated for the year 2001.

(2) **Deferred Dismantlement** - The S1C Prototype reactor plant would be left in a drained, deenergized, stable condition and monitored for a period of 30 years to allow for radioactive material decay prior to dismantlement. This alternative would not change the amount of material handled as low-level radioactive waste due to the presence of long lived radionuclides. Deferred dismantlement would prevent the release of the Windsor Site for more than 30 years.

(3) **No Action** - The S1C Prototype reactor plant would be left in a drained, deenergized, stable condition and monitored for an indefinite period of time. This alternative would prevent the Windsor Site from being released for unrestricted use for an indefinite period.

The alternative of removing and disposing of the entire S1C Prototype reactor compartment in one piece (analogous to ongoing submarine reactor compartment disposal) was considered but eliminated from detailed analysis as infeasible, due to numerous transportation interferences such as load-limited bridges and width and height restrictions. The alternatives of entombment and on-site disposal were eliminated to avoid creation of a new radioactive and hazardous waste disposal site.

A comparison of the three alternatives examined in detail is provided in Table S-1. No new legislation would be required to implement any of these alternatives. The environmental effects from each alternative are small, as are the health effects and risks. Recycling and volume reduction services of commercial enterprises would be used to minimize the volume of low-level radioactive waste. The cost of the deferred dismantlement alternative is significantly higher than the prompt dismantlement alternative, and the no action alternative also would eventually result in higher costs.

From an environmental perspective, no single alternative stands out in this comparison. Deferred dismantlement has the advantage of minimizing occupational radiation exposure while still providing for eventual unrestricted release of the Windsor Site. Prompt dismantlement has the advantage of not requiring long term commitment of the land for surveillance and maintenance of the S1C Prototype reactor plant. The occupational radiation exposure associated with the prompt dismantlement alternative is comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval prototype reactors. Also, the impacts associated with the prompt dismantlement alternative have a higher degree of certainty than those associated with actions thirty or more years in the future. Because prompt dismantlement would result in unrestricted release of the Windsor Site at the earliest time with little occupational radiation exposure risk to the workers, and given that the impacts associated with prompt dismantlement have a higher degree of certainty, Naval Reactors has identified prompt dismantlement as the preferred alternative.

Table S-1: Comparison of Alternatives

	Prompt Dismantlement Preferred Alternative	Deferred Dismantlement Alternative	No Action Alternative
Timing	Prompt start, 2-year dismantlement duration	30-year deferment, 2-year dismantlement duration	Indefinite deferment, no dismantlement
Number of Radioactive Material Shipments [1]	23	23	0
Number of Nonradioactive Material Shipments [2]	1600	1600	0
Additional Latent Fatal Cancer Risks or Fatal Injury Risks [3]			
Occupational [4] (Radiological)	4.3×10^{-2} to 7.9×10^{-2}	1.7×10^{-3} to 2.4×10^{-3}	8.4×10^{-4}
Occupational [5] (Nonradiological)	6.7×10^{-2}	7.4×10^{-2}	6.9×10^{-3}
Public [6] (Radiological)	9.7×10^{-4} to 2.6×10^{-3}	3.8×10^{-5} to 7.1×10^{-5}	1.6×10^{-5}
Public [7] (Nonradiological)	2.2×10^{-2} to 3.0×10^{-2}	2.2×10^{-2} to 3.0×10^{-2}	0
Estimated Cost [8]	$51,000,000	$64,800,000	$13,800,000 total for 30 years of caretaking

1. Data represents a conservatively high number of radioactive material shipments consisting of 19 miscellaneous waste package shipments and 4 major component package shipments such as the reactor pressure vessel, pressurizer and steam generators. As discussed in Sections 5.1.13 and 5.2.13, approximately 10 of the shipments (approximately 110 cubic meters) would be low-level radioactive waste requiring disposal. The other 13 shipments would be to commercial vendors for recycling and volume reduction processing.

2. Data represents the number of shipments of nonradioactive waste and recyclable materials from S1C Prototype dismantlement and Windsor Site demolition activities. Data also includes deliveries of fill and topsoil for Windsor Site restoration activities.

3. Values listed include latent fatal cancer risks due to incident-free activities and accident scenarios as well as fatal injury risk from accidents. For the public, the numbers provide a range since the value strongly depends on the distance to the disposal site. For the purpose of bounding the transportation related impacts, the disposal site was assumed to be either the Department of Energy Savannah River Site in South Carolina or the Department of Energy Hanford Site in Washington State. The occupational risk values do not strongly depend on distance to the disposal site.

4. Occupational (Radiological) risks apply to the on-site worker and transportation worker population. Occupational latent fatal cancer risks are calculated by multiplying occupational exposure in rem for the total on-site worker and transportation worker population by 0.0004 additional latent fatal cancers per rem. The range provided for the prompt and deferred dismantlement alternatives reflects the uncertainty in occupational exposure estimates during the dismantlement of the reactor plant. Individual worker exposure would be limited to two rem per year. Two rem results in a risk of 0.0008 additional latent fatal cancers.

5. Occupational (Nonradiological) risks result from transportation and industrial worker accidents.

6. Public (Radiological) data accounts for effects on the general public from activities associated with on-site work and transportation of radioactive recyclable material and waste. Public latent fatal cancer risks are calculated by multiplying general population exposure in rem by 0.0005 additional latent fatal cancers per rem.

7. Public (Nonradiological) data accounts for effects on the general public from nonradiological causes related to transportation vehicle exhaust emissions and accidents. The No Action alternative does not involve any transport of materials.

8. Estimated costs are presented in 1996 dollars. Taking into consideration the eventual need for a permanent disposal decision, the no action alternative would ultimately result in a higher figure.

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CHAPTER 1
PURPOSE AND NEED FOR AGENCY ACTION

1.0 PURPOSE AND NEED FOR AGENCY ACTION

Naval Reactors is currently evaluating alternatives for disposal of the S1C Prototype reactor plant, located at the Knolls Atomic Power Laboratory Windsor Site in Windsor, Connecticut. The function of the Windsor Site and the S1C Prototype was to train Navy personnel and test propulsion plant equipment. As a result of the end of the Cold War and the downsizing of the Navy, the S1C Prototype reactor plant was permanently shut down in March 1993. Because the S1C Prototype reactor plant is the only activity at this small site and there is no further need for this plant, a decision is needed on its disposal.

1.1 THE PROPOSED ACTION

Naval Reactors proposes to determine and implement a disposal strategy for the defueled S1C Prototype reactor plant.

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CHAPTER 2
S1C PROTOTYPE AND WINDSOR SITE DESCRIPTION

2.0 S1C PROTOTYPE AND WINDSOR SITE DESCRIPTION

The following sections describe the Windsor Site facilities and characterize the S1C Prototype reactor plant and associated reactor compartment structure.

2.1 Windsor Site - General Description

Owned by the Department of Energy, the Windsor Site was established in 1957. It is situated on 10.8 acres of land, in the Town of Windsor, Hartford County, Connecticut (approximately five miles north of the City of Hartford). See Figures 2-1 and 2-2. The Windsor Site is currently operated by KAPL, Inc., a Lockheed Martin company, under contract with the U.S. Department of Energy.

The Windsor Site mission was to train Navy personnel in the operation and maintenance of Naval nuclear propulsion plants for the Navy fleet and to test Naval nuclear propulsion plant equipment. The Windsor Site includes one pressurized-water Naval nuclear propulsion plant, known as the S1C Prototype, and miscellaneous support facilities. Most of the remaining support facilities are located within a fenced security area as shown in Figure 2-3. Parking lots are located outside the security fence. Historical information regarding the Windsor Site is contained in the Windsor Site Environmental Summary Report (Reference 2-1).

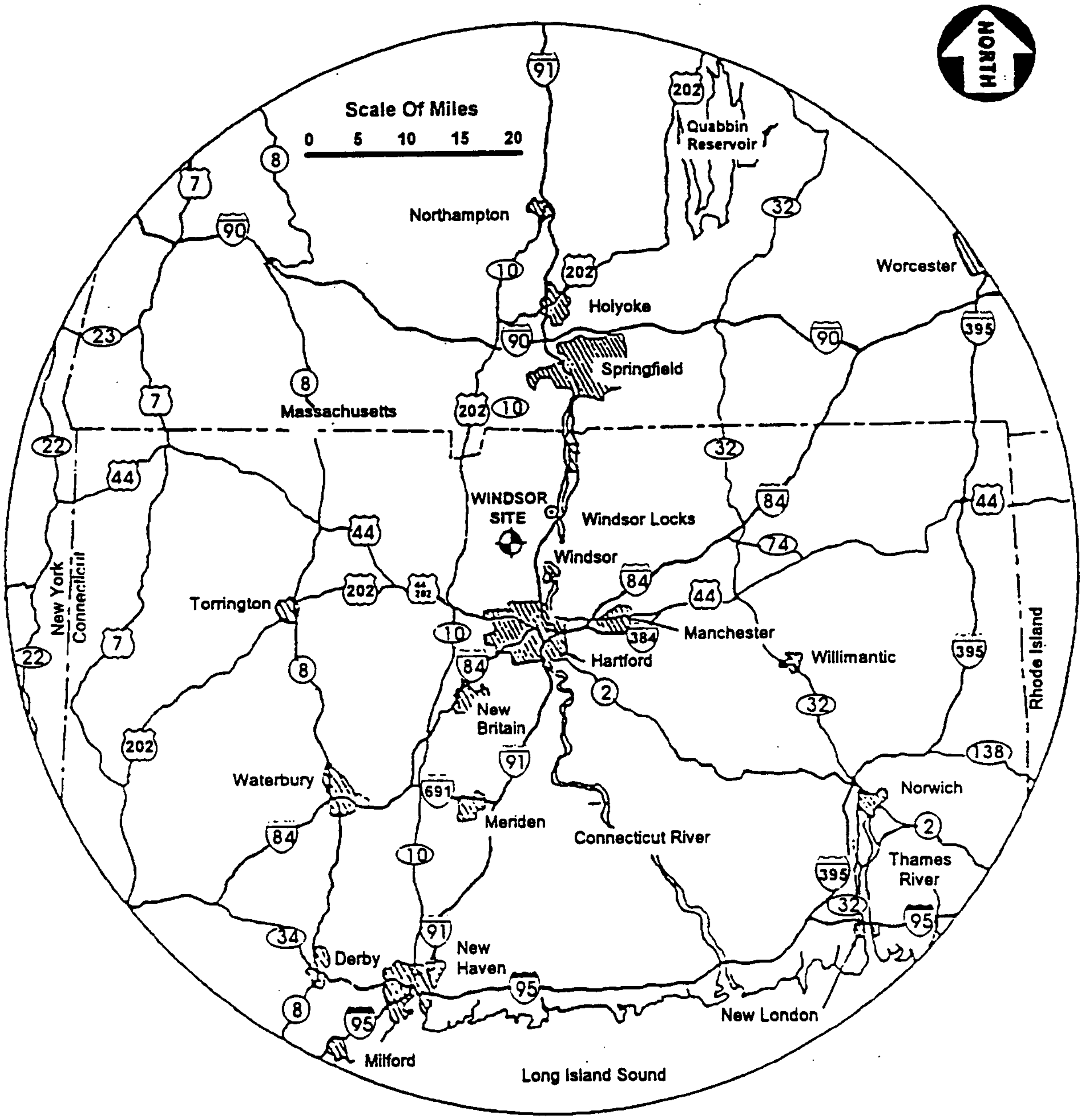


Figure 2-1 Eighty Kilometer (50 Mile) Assessment Area Map for the Windsor Site

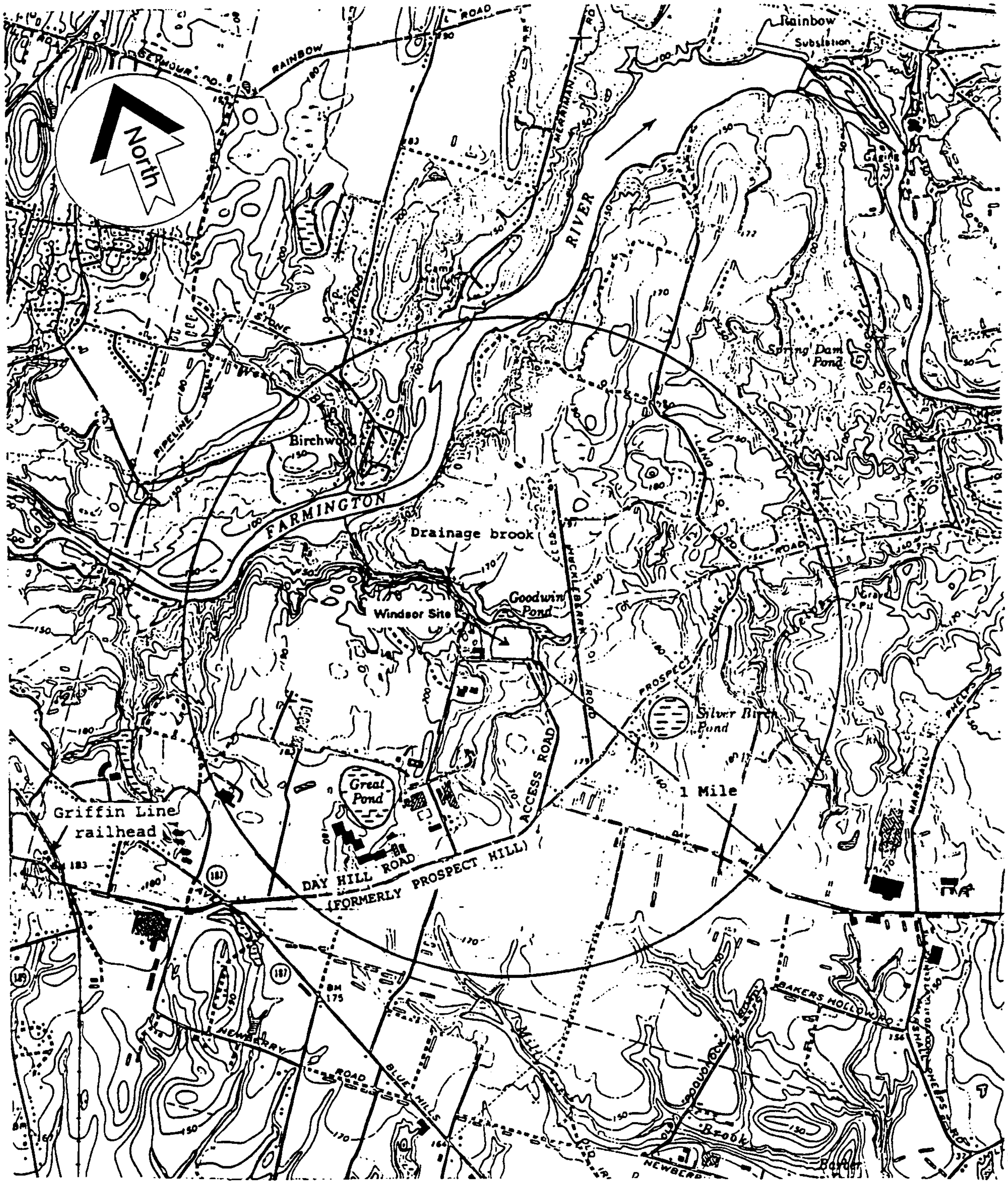
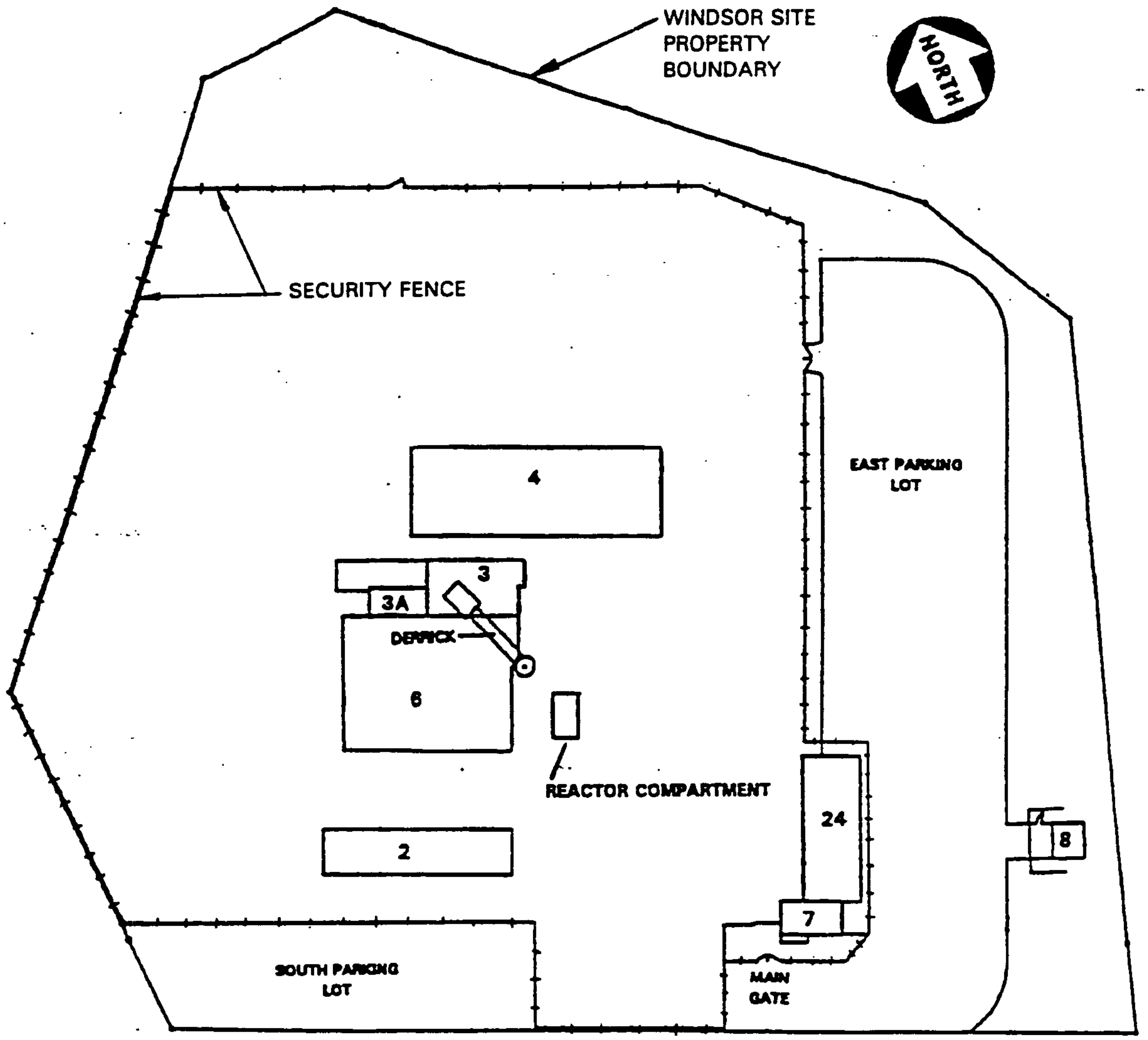


Figure 2-2: Proximity of Windsor Site to the Farmington River



2	Auxiliary Shops	6	Operations Building
3	Power Plant Building	7	Guard House
3A	Battery Room	8	Well Pump House
4	Warehouse	24	Offices

Figure 2-3: Projected Windsor Site Layout at the Start of Each Alternative

2.2 S1C Prototype - General Description

The S1C Prototype was placed in operation in 1959. In addition to its use as a training platform, the S1C Prototype served as a test facility for propulsion plant equipment. Removal of the spent nuclear fuel from the reactor (defueling) was completed in February 1995 and the spent fuel has been removed from the Windsor Site. Management of spent fuel are addressed in a separate Environmental Impact Statement, Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference 1-1).

Defueling removed all of the fuel assemblies which contained uranium and fission products. Defueling removed more than 95% of the radioactive material inventory from the S1C Prototype reactor plant. After defueling, S1C Prototype reactor plant systems were drained and placed in a stable protective storage condition.

Figure 2-4 provides a sketch of the S1C Prototype reactor compartment. The hull construction duplicates as completely as possible the comparable section in a seagoing submarine. The S1C Prototype reactor compartment is a horizontal cylinder (approximately 24 feet diameter by 23 feet long) formed by a section of the prototype's pressure hull and provides the containment structure for the reactor plant. Stiffened steel bulkheads separate the reactor compartment from the remainder of the prototype. The reactor compartment bulkheads are shielded.

Appendix A provides additional general information for a typical Naval prototype reactor compartment.

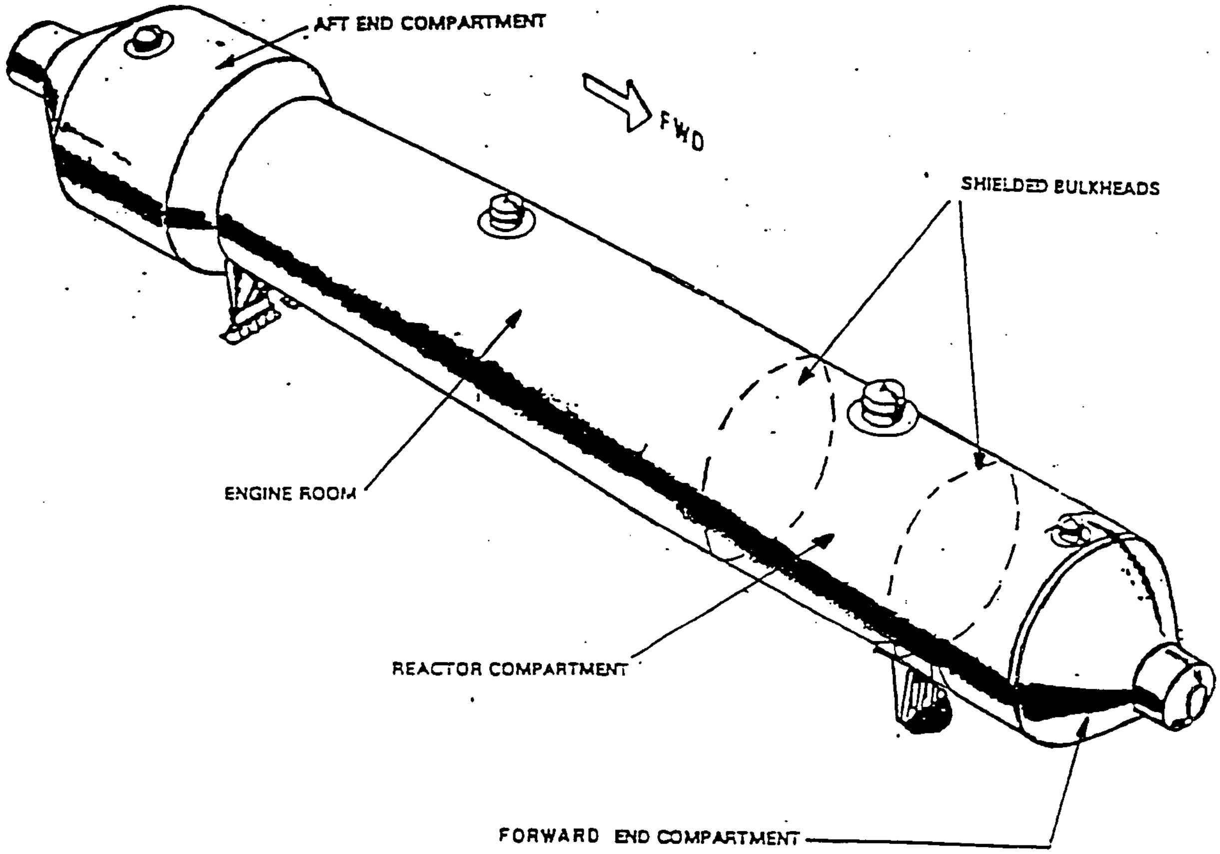


Figure 2-4: S1C Prototype Reactor Compartment

2.3 Radiological Characterization of the S1C Prototype Reactor Plant

Table 2-1 lists the radionuclide inventory that is expected in the defueled S1C Prototype reactor plant at various times after shutdown. Data for four years after shutdown represent the radiological conditions expected for the Prompt Dismantlement Alternative. Data for thirty-four years after shutdown represent radiological conditions expected for the Deferred Dismantlement Alternative.

Cobalt-60 is one of the predominant radionuclides in activated corrosion and wear products within the reactor plant systems. Gamma radiation from cobalt-60 is the major source of radiation exposure in the defueled S1C Prototype reactor plant. Cobalt-60 has a 5.27-year half-life and emits beta and penetrating gamma radiation.

While iron-55 is one of the predominant radionuclides at the time of shutdown in terms of numbers of curies, it is not significant for disposal considerations. Iron-55 has a relatively short half-life of 2.73 years and emits nonpenetrating, low energy x-ray radiation. Iron-55 is not a major source of radiation exposure because the low energy x-rays emitted by iron-55 are stopped within the reactor plant piping and structure.

Some of the radionuclides included in the Table 2-1 list have long half-lives. Examples of long half-life radionuclides include nickel-63 (100 years, beta radiation), carbon-14 (5730 years, beta radiation), niobium-94 (20,000 years, beta and gamma radiation) and nickel-59 (76,000 years, weak x-ray). Nickel-63 and carbon-14 are not major sources of radiation exposure since the beta radiation they emit is stopped within the prototype reactor plant piping. Radiation from nickel-59 is also stopped within the prototype reactor plant piping. Niobium-94 is present in small quantities and would be the only measurable gamma radiation dose emitter after cobalt-60 and all of the other short half-life radionuclides have decayed away.

Appendix A provides additional general information on radioactivity and health effects from radiation exposure.

Table 2-1: Radioactivity by Individual Radionuclide Present in the Defueled S1C Prototype Reactor Plant Four Years and Thirty-Four Years After Final Reactor Shutdown

Radio-nuclide[1]	**Half-life**[2] **(Years)**	**Radiation Emitted**[2]	**Radioactivity Four Years After Reactor Shutdown**[3] **(Curies)**	**Radioactivity 34 Years After Reactor Shutdown**[3] **(Curies)**
Fe-55	2.73	X-ray	9.83 x 10^{+03}	4.86
Co-60	5.27	beta and gamma	4.19 x 10^{+03}	8.14 x 10^{+01}
Ni-63	100	beta	9.16 x 10^{+02}	7.45 x 10^{+02}
Ni-59	76,000	X-ray	7.68	7.68
C-14	5,730	beta	2.26	2.25
H-3	12.3	beta	4.39 x 10^{-01}	8.10 x 10^{-02}
Mn-54	0.85	X-ray and gamma	5.89 x 10^{-02}	0.00
Nb-94	20,000	beta and gamma	3.79 x 10^{-02}	3.79 x 10^{-02}
Mo-93	3,500	X-ray and gamma	3.64 x 10^{-02}	3.62 x 10^{-02}
Tc-99	213,000	beta and gamma	8.91 x 10^{-03}	8.91 x 10^{-03}
Ba-137m[3]	0.000005	gamma	5.50 x 10^{-03}	2.76 x 10^{-03}
Sr-90	29.1	beta	5.50 x 10^{-03}	2.69 x 10^{-03}
Y-90[4]	0.01	beta and gamma	5.48 x 10^{-03}	2.68 x 10^{-03}
Cs-137	30.2	beta and gamma	5.47 x 10^{-03}	2.77 x 10^{-03}
Pu-241	14.4	alpha, beta and gamma	1.23 x 10^{-03}	2.93 x 10^{-04}
Am-241	432.7	alpha and gamma	5.19 x 10^{-05}	4.97 x 10^{-05}
Cm-244	18.1	alpha and gamma	4.48 x 10^{-05}	1.42 x 10^{-05}
Co-58	0.19	X-ray, beta and gamma	3.82 x 10^{-05}	0.00
Pu-238	87.7	alpha and gamma	3.62 x 10^{-05}	2.85 x 10^{-05}
Zr-93	1,500,000	beta and gamma	3.54 x 10^{-05}	3.54 x 10^{-05}
Pu-239	24,100	alpha and gamma	7.76 x 10^{-06}	7.75 x 10^{-06}
		TOTALS:	**1.50 x 10^{+04}**	**8.41 x 10^{+02}**

1. The radionuclides listed were considered in facility and transportation accident evaluations in Appendices B and C, respectively. The amounts of radioactivity for each nuclide represent a combined total from activated metals (inseparable from the base metal) and activated corrosion products (which could potentially be released in the event of an accident). More than 99% of the remaining radioactivity in the defueled S1C Prototype reactor plant is an inseparable part of the metal components.

2. Chart of Nuclides, 14th Ed.

3. Ba-137m exists in equilibrium with its parent Cs-137.

4. Y-90 exists in equilibrium with its parent Sr-90.

2.4 Hazardous Materials Contained in the S1C Prototype Reactor Plant

The S1C Prototype reactor plant contains several types of hazardous materials, with lead being the most significant in quantity. The S1C Prototype reactor plant contains more than 100 tons of lead. Most of the lead is encased with welded steel sheets. The encased lead is permanently installed as radiation shielding in the form of panels. The lead inside the panels is either layered sheets, bricks or poured in place. Although the lead used for permanently installed shielding is highly refined, the lead contains a small amount of impurities. The lead closest to the prototype reactor was exposed to a neutron flux which caused the impurities to become activated, resulting in a mixed hazardous and radioactive material. Approximately 30% of the lead in the S1C Prototype reactor plant is estimated to contain activated impurities. There are a variety of other hazardous materials that may be present in small quantities in the S1C Prototype reactor plant. These hazardous materials are usually elemental metals such as lead, chromium and cadmium. Hazardous elements are sometimes found in equipment construction materials and as constituents in paint, leaded glass, adhesives, and brazing alloys.

—In addition to hazardous materials, some S1C Prototype reactor plant components may contain regulated concentrations of polychlorinated biphenyls (greater than 50 parts per million). Examples of materials that could contain polychlorinated biphenyls as a constituent include paint, adhesives, electrical cable coverings and rubber items manufactured before the mid-1970s. In these examples, polychlorinated biphenyls are usually tightly bound in the composition of the solid material. While the amount of polychlorinated biphenyls is small by weight, its use as a constituent in paint could affect a large number of components. Painted surfaces in the S1C Prototype reactor plant include the hull, decking support structures, pipe hangers, equipment foundations and thermal insulation.

Some items in the S1C Prototype reactor plant are insulated with asbestos-containing materials, typical of piping systems constructed before the mid-1970s. Thermal insulation that contains asbestos is installed on the steam generators, pressurizer and some piping. Miscellaneous items may also include asbestos-containing materials. Examples of miscellaneous items that could contain asbestos include electrical cable insulation, small components in electrical equipment, and gaskets in mechanical systems.

2.5 Applicable Regulatory Considerations

This section provides a general discussion of the environmental statutes and regulations that are applicable to Windsor Site activities.

2.5.1 Federal Environmental Statutes and Regulations

Applicable Federal statutes for the Windsor Site activities include:

National Environmental Policy Act of 1969, as amended (42 USC §4321 et seq.)

The National Environmental Policy Act establishes a national policy promoting awareness of the environmental consequences of human activities and promoting consideration of the environmental impacts during planning and decision making stages of a project. This law requires all Federal agencies to prepare a detailed statement on the environmental effects of proposed major Federal actions that may significantly affect the quality of the human environment. This environmental impact statement has been prepared in accordance with the Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508) and Department of Energy National Environmental Policy Act Implementing Procedures (10 CFR Part 1021).

Atomic Energy Act of 1954, as amended (42 USC §2011 et seq.)

This law authorizes the Department of Energy to establish standards to protect health or minimize dangers to life or property with respect to activities under its jurisdiction. Through a series of Department of Energy orders, an extensive system of standards and requirements has been established to ensure safe operation of facilities.

Clean Air Act, as amended (42 USC §7401, et seq.)

The Clean Air Act is intended to protect and enhance the quality of the Nation's air resources and to promote the public health and welfare and the productive capacity of its population. The Act requires each Federal agency to comply with all Federal, state, interstate, and local requirements with regard to the control and abatement of air pollution to the same extent as any non-governmental entity. The Clean Air Act established the National Ambient Air Quality Standards program for criteria pollutants. Criteria pollutants include sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, ozone and lead. Sources of air pollution are subject to regulation through limitations contained in U.S. Environmental Protection Agency approved State Implementation Plans. The Clean Air Act also addresses specific pollution problems such as hazardous air pollutants and visibility impairment. New and modified sources are regulated to more stringent controls based on available pollution technology.

The State of Connecticut Department of Environmental Protection has been delegated authority to implement and enforce Federal standards and other requirements for some emissions of hazardous air pollutants (such as asbestos) pursuant to Section 112 of the Clean Air Act. Notwithstanding these delegations, the Environmental Protection Agency retains authority for enforcing any rule, standard or requirement established under Section 112.

Clean Water Act, as amended (33 USC §1251 et seq.)

The Clean Water Act was enacted to restore and maintain the chemical, physical and biological integrity of the nation's water. The Act requires each Federal agency to comply with all Federal, state, interstate, and local requirements with regard to any activity that might result in the discharge or runoff of pollutants to surface waters in the same manner and to the same extent as any non-governmental entity. The National Pollutant Discharge Elimination System program is administered by the Water Management Division of the U.S. Environmental Protection Agency. The State of Connecticut Department of Environmental Protection, Water Management Bureau, has regulatory authority for the National Pollution Discharge Elimination System program in the State of Connecticut. Storm water drainage associated with the Windsor Site is also regulated by the State of Connecticut Department of Environmental Protection, Water Management Bureau.

Resource Conservation and Recovery Act, as amended (42 USC §6901 et seq.)

The treatment, storage, or disposal of hazardous and nonhazardous waste is regulated under the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, the Hazardous and Solid Waste Amendments of 1984, and the Federal Facility Compliance Act. The U.S. Environmental Protection Agency regulations implementing the Resource Conservation and Recovery Act are found in 40 CFR Parts 260 - 280. These regulations define hazardous wastes and specify hazardous waste transportation, handling, treatment, storage, and disposal requirements. The regulations imposed on a generator or a treatment, storage and/or disposal facility vary according to the type and quantity of materials or wastes involved. The U.S. Environmental Protection Agency has granted final authorization to the State of Connecticut Department of Environmental Protection to operate its hazardous waste program, subject to the authority retained by the U.S. Environmental Protection Agency in accordance with the Hazardous and Solid Waste Amendments of 1984. As a result, there is a dual State and Federal regulatory program in Connecticut. To the extent the authorized State program is unaffected by the Hazardous and Solid Waste Amendments, the State program operates in lieu of the Federal program. Where Hazardous and Solid Waste Amendments apply, the U.S. Environmental Protection Agency administers and enforces these provisions until the State receives authorization to do so.

Comprehensive Environmental Response, Compensation, and Liability Act (42 USC §9601 et seq.)

This Act provides a statutory framework for the clean up of waste sites containing hazardous substances and - as amended by the Superfund Amendments and Reauthorization Act - provides an emergency response program in the event of a release (or threat of a release) of a hazardous substance to the environment. Using the Hazard Ranking System, Federal and private sites are ranked and may be included on the National Priorities List. The Act requires Federal facilities having such sites to undertake investigations and remediation as necessary. The Act includes requirements for reporting releases of certain hazardous substances in excess of specified amounts to State and Federal agencies. Section 120(h) of the Act establishes Federal Agency notification requirements for selling or transferring Federal property where any hazardous substance was either stored for one year or more, or known to have been released, or known to have been disposed of on the property. The Environmental Protection Agency regulations implementing property transfer requirements are found in 40 CFR Part 373.

An environmental evaluation of conditions at the Windsor Site, called a Preliminary Assessment, was conducted in 1988 in accordance with the Act. As a result of the Preliminary Assessment, the Environmental Protection Agency placed the Windsor Site in 1990 in the category of No Further Remedial Action Planned within the Federal Superfund program.

Toxic Substances Control Act (15 USC §2601 et seq.)

This Act requires that the health and environmental effects of all new chemicals be reviewed before they are manufactured for commercial purposes. The Act authorizes the U.S. Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. Regulated controls include the manufacture, use, distribution in commerce, and disposal of chemical substances, including polychlorinated biphenyls, and abatement of asbestos and lead.

Federal Facility Compliance Act (42 USC §6921 et seq.)

This Act amended the Resource Conservation and Recovery Act and requires the Department of Energy to prepare plans for developing the required treatment capacity for mixed waste stored or generated at each facility. The Site Treatment Plan for Mixed Wastes Generated at the Windsor Site was approved by the U.S. Environmental Protection Agency. The State of Connecticut Department of Environmental Protection reviewed and commented on the Site Treatment Plan and remains an active participant in related matters. The U.S. Environmental Protection

Agency, Region I, issued a Consent Agreement and Order regarding the Site Treatment Plan for Mixed Waste Generated at the Windsor Site that became effective on October 6, 1995.

Endangered Species Act, as amended (16 USC §1531 et seq.)

This Act is intended to prevent the further decline of endangered and threatened species and to restore these species and habitats. The Act is jointly administered by the U.S. Departments of Commerce and the Interior. The Act requires consultation with the U.S. Fish and Wildlife Service to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action, and whether an action will adversely affect listed species or designated critical habitats.

Safe Drinking Water Act, as amended (42 USC §300f et seq.)

The Safe Drinking Water Act (SDWA) was enacted to protect potable water resources and ensure potable water quality. Among other things, the Act requires each Federal agency and department that owns or operates a public water system to comply with all Federal, State and local safe drinking water requirements. The Environmental Protection Agency has promulgated the SDWA regulations at 40 CFR Parts 140 - 149. The State of Connecticut Department of Public Health has primary enforcement responsibility for the regulations implementing the potable water quality requirements. The State of Connecticut Department of Environmental Protection has primary enforcement responsibility for the regulations implementing the protection of potable water resources.

2.5.2 Executive Orders

Executive Order 12344 (Naval Nuclear Propulsion Program)

Executive Order 12344, enacted as permanent law by Public Law 98-525 (42 USC §7158) prescribes the authority and responsibility of the Naval Nuclear Propulsion Program, a joint Navy/Department of Energy organization, for matters pertaining to Naval nuclear propulsion. These responsibilities include all environmental and occupational safety and health aspects of the program.

2.5.3 Department of Energy Regulations and Orders

The Department of Energy regulations are generally found in Title 10 of the Code of Federal Regulations. Department of Energy Orders generally set forth policy and programs and internal procedures for implementing department policies. These regulations address such areas as administrative requirements and procedures, general environmental protection, radiation protection of the public and the environment, radioactive waste management, and occupational health and safety. Department of Energy Orders are implemented by Naval Reactors under authority of Executive Order 12344.

2.5.4 Hazardous and Radioactive Materials Transport Regulations

Transportation of hazardous and radioactive materials, substances, and wastes are governed by the U.S. Department of Transportation, the U.S. Environmental Protection Agency, and the Nuclear Regulatory Commission regulations (49 CFR Parts 171-178 and Parts 383-397, 40 CFR Part 262, and 10 CFR Part 71, respectively).

Department of Transportation regulations contain requirements for identifying a material as hazardous or radioactive. These regulations interface with those of the Nuclear Regulatory Commission or the U.S. Environmental Protection Agency for identifying material, but the Department of Transportation hazardous material regulations govern the hazard communication (such as marking, hazard labeling, vehicle placarding, and emergency response telephone number) and shipping requirements (such as required entries on shipping papers or waste manifests).

Nuclear Regulatory Commission regulations applicable to the transportation of larger quantities of radioactive materials are found in 10 CFR Part 71, which includes detailed packaging design requirements and package certification testing requirements. Complete documentation of design and safety analysis testing results for these shipments is submitted to the Nuclear Regulatory Commission to certify the package for use.

2.5.5 State Environmental Statutes and Regulations

State of Connecticut environmental laws which apply to Windsor Site activities are found in Connecticut General Statutes, Title 22a - Environmental Protection. The laws are implemented in accordance with requirements contained in the Regulations of Connecticut State Agencies.

State of Connecticut Air Regulations

Regulations of Connecticut State Agencies, Title 22a, Chapter 174, provides applicable air pollution control standards. Regulated air pollutants include criteria pollutants such as carbon monoxide, sulfur dioxide, oxides of nitrogen, particulate matter, ozone, lead, hazardous air pollutants, odors and volatile organic compounds.

State of Connecticut Water Pollution Control Regulations

Regulations of Connecticut State Agencies, Title 22a, Chapter 430, provides applicable water pollution control standards. The State of Connecticut regulates the discharge of water (including waste water, sanitary system discharges and storm water runoff from industrial facilities), and the discharge of substances or material into the waters of the State. Waters of the State include all surface waters and ground waters. Discharges to waters of the State are regulated by permits.

State of Connecticut Hazardous Waste Regulations

Regulations of Connecticut State Agencies, Title 22a, Chapter 449c, Parts 100 through 110, define the State of Connecticut's hazardous waste management program. These regulations incorporate by reference and adopt Federal regulations pursuant to Subtitle C of the Resource Conservation and Recovery Act, with certain specified differences. Differences occur where the State regulations are more stringent than the Federal regulations. The State regulations include standards applicable to generators of hazardous waste, standards for owners and operators of hazardous waste treatment, storage and disposal facilities, and provide the requirements for applicable permits. Other solid waste management regulations are provided in the Regulations of Connecticut State Agencies, Title 22a, Chapter 209.

State of Connecticut Property Transfer Program

Sections 22a-134 through 22a-134e of the Connecticut General Statutes, as amended by Public Act 95-183, establish the State's property transfer law which must be complied with whenever an establishment is transferred. The program requires disclosure of environmental conditions through the filing of one of four available forms. The form executed and submitted is dependent upon the environmental history and condition of the property. When the transfer involves an establishment where there has been a release of hazardous waste, certification is required that the property has been investigated and cleaned up.

State of Connecticut Water Resources Regulations

Regulations of Connecticut State Agencies, Title 25, Chapter 128, Parts 56 and 57, provide applicable requirements for abandonment (closure) of wells. Requirements include plugging wells to prevent the entrance of surface water or any other process that could contaminate or pollute ground water resources. Regulations require well closure actions to be performed or directed by a registered well drilling contractor.

State of Connecticut Standards for Quality and Adequacy of Public Drinking Water

Regulations of Connecticut State Agencies, Title 19, Chapter 13, Part B102 provides the standards for quality of public drinking water supplies including applicable requirements for protection of public water supplies. Protection of drinking water requirements include a cross-connection control program and the use and maintenance of backflow prevention devices.

CHAPTER 3
ALTERNATIVES

3.0 ALTERNATIVES

The following sections discuss in detail three alternatives for the defueled S1C Prototype reactor plant - Prompt Dismantlement, Deferred Dismantlement and the No Action Alternative. Several other alternatives are also considered in limited detail.

3.1 Prompt Dismantlement Alternative (Preferred Alternative): Promptly Dismantle the S1C Prototype Reactor Plant; Recycle or Dispose of Materials

In this alternative, dismantlement of the defueled and drained S1C Prototype reactor plant would begin promptly after the Record of Decision for this Environmental Impact Statement is issued. The project would be completed as soon as possible. Upon completion of reactor plant dismantlement and shipment of recyclable materials and wastes, the Windsor Site property would be released for unrestricted use in accordance with applicable local, State and Federal regulations. Low-level radioactive waste from dismantlement would be shipped to the Department of Energy Savannah River Site for disposal.

3.1.1 Dismantlement Operations

Dismantlement operations would involve mechanical disassembly of all S1C Prototype reactor plant systems and the reactor compartment structure. In general, dismantlement would be sequenced based on a removal strategy that focuses on major reactor components. Major reactor components include the reactor vessel, steam generators, and pressurizer. Prior to the removal of each major component, interferences would be removed. Examples of typical interferences include electrical cables, reactor system piping, pumps, deckplates, and bulkhead sections. Disassembly techniques would include proven methods such as remote machine cutting of piping, grinding, sawing, flame cutting, and plasma arc cutting. Cutting techniques and radiological controls would vary depending on the application, location and radiological status of the affected component.

Operations on radiologically contaminated piping and components would be performed using appropriate personnel protection equipment and environmental protection measures to prevent the spread of radioactivity. The protective measures would adhere to the same standards and practices that were used to successfully control maintenance evolutions during plant operations. These protective measures include, but are not limited to:

- personnel training on mockups and practice in dismantlement tasks,
- protective clothing,
- radiation shielding,
- remotely operated tools,
- engineered containment enclosures and ventilation systems equipped with high efficiency particulate air filters,
- National Institute for Occupational Safety and Health approved respirators and breathing apparatus,
- personnel barriers around work zones, with radiation monitoring stations at all exits,
- sealing open ends of pipes, tubes and other components immediately upon disassembly,
- monitoring and appropriate sampling during work activities.

Similar techniques would also be applied to protect personnel and prevent the spread of nonradiological, hazardous materials.

The S1C Prototype reactor compartment and reactor plant components are within the reach and load capacity of the Windsor Site derrick crane. The derrick is located above a support building adjacent to the S1C Prototype hull (see Figure 2-3). Other lifting and handling equipment such as mobile cranes, fork lifts, jacking and blocking gear could also be used.

3.1.2 Waste Streams and Recycling

In order to minimize the volume of waste generated from prototype dismantlement, detailed material segregation efforts would occur. Segregation is a process of identifying and separating materials into different categories, known as waste streams. Dismantlement activities would generate the following waste streams:

- recyclable materials,
- nonhazardous and nonradioactive wastes,
- hazardous and/or toxic wastes,
- low-level radioactive wastes, and
- mixed wastes (radioactive and hazardous).

Emphasis would be placed on recycling as much material as practical. Segregating radioactive and hazardous materials increases the options for recycling. Most of the recyclable materials from dismantlement and demolition activities would be concrete, lead, carbon steel, and corrosion resisting metals. These materials would be recycled through various licensed commercial vendors.

Other than recyclable materials, the primary waste streams include low-level radioactive materials and mixed wastes. Estimated waste volumes are discussed in further detail in Chapter 5. Low-level radioactive waste includes solid, nonhazardous material only. Low-level radioactive waste would be disposed of at a Department of Energy disposal facility. The Savannah River Site in Aiken, South Carolina currently receives low-level radioactive waste from Naval Reactors sites in the eastern United States.

Mixed wastes are radioactive materials that include inseparable hazardous constituents, such as lead. Typically, mixed wastes generated would be a homogeneous solid (such as radiologically activated or surface contaminated lead), a nonhomogeneous solid (such as a radioactive item having an inseparable coating that contains a hazardous constituent), or a solidified liquid (such as a solidified solution that contains radioactive chromates). Mixed wastes are regulated by the Resource Conservation and Recovery Act (40 CFR Parts 260-271), Regulations of Connecticut State Agencies (Title 22a, Chapter 449c, Parts 100 - 110), as well as the Atomic Energy Act (42 USC §2011 et seq.). The processing and treatment of mixed wastes would be in accordance with the Site Treatment Plan for Mixed Wastes Generated at the Windsor Site, which was approved by the U.S. Environmental Protection Agency (Reference 3-2). The Site Treatment Plan includes volume projections of the mixed wastes to be generated during the dismantlement activities. Naval Reactors is currently evaluating recycling options to use radioactive lead in shielding applications in other Naval Reactors or Department of Energy facilities to further reduce estimated volumes of mixed waste.

Other nonradioactive, nonhazardous demolition debris from dismantlement activities that could not be recycled would be disposed of in accordance with all applicable Federal, State and local regulations.

3.1.3 Packaging and Transport of Recyclable Material and Waste

All recyclable material and waste shipments would be properly classified, described, packaged, marked and labeled for normal transportation conditions in accordance with all applicable regulations. Applicable regulations include 49 CFR Parts 171-179 (Transportation of Hazardous Materials), 10 CFR Part 71 (Packaging and Transportation of Radioactive Materials), Department of Energy orders and disposal site waste acceptance criteria.

Dismantlement of the S1C Prototype reactor plant would require an estimated 23 shipments of low-level radioactive recyclable material and waste. The largest shipment by weight, size and radioactive content would be the reactor pressure vessel. The reactor pressure vessel contains more than 99% of the total radioactivity in the S1C Prototype reactor plant that remains after defueling. Nearly all of this radioactivity results from neutron activation of the metal structure of the reactor pressure vessel and is therefore not loose. The reactor pressure vessel would be placed in a large, shielded shipping container for transport and disposal. This package would be moved by a heavy haul truck over public roads to the Griffin Line industrial track railhead, located approximately 1.5 miles west of the Windsor Site. The reactor pressure vessel package would then be transported by railroad to the Department of Energy Savannah River disposal site. In addition to the pressure vessel, one additional shipment by railroad may be necessary in order to ship the primary shield tank in a single large package. The Department of Energy Hanford disposal site is also considered in the transport analyses.

Large components, such as the steam generators and pressurizer, would be shipped to a Department of Energy disposal site or to a Nuclear Regulatory Commission licensed commercial recycle facility to reduce the volume of disposed waste. Highway shipments of all components and miscellaneous low-level radioactive recyclable material and waste would comply with Department of Transportation regulations and disposal site waste acceptance criteria.

3.1.4 Windsor Site Restoration and Site Release

The prompt dismantlement alternative would include the following actions to support restoration and site release:

- All Windsor Site systems would be completely removed, including all systems that are located below grade. With the exception of the building that housed the Windsor Site's former water supply well and pump system (Building 8, discussed below), all buildings located within the Windsor Site property boundary will be removed to at least four feet below grade. Paved areas, including the parking lots, and Windsor Site security fencing will be removed. The access roadway leading to the U.S. Government owned property will be left intact.

- Electrical service would be terminated. Light posts and associated wiring leading up to the Windsor Site which are located along the access road would be left in place.

- The municipal water supply to the Windsor Site would be shut off. Building 8 (see Figure 2-3) contains piping and backflow protection for the municipal water supply. This piping would be drained and laid-up and Building 8 would remain.

- A voluntary facility assessment (described in Chapter 4 and Appendix F) addressing the potential for environmental chemical contamination would be completed to support Windsor Site inactivation and future release of the property. Following completion of all sample collecting and analytical work, a report would be prepared and provided to the U.S. Environmental Protection Agency, Region I and the State of Connecticut Department of Environmental Protection. The report would summarize findings and would provide recommendations for any additional investigation or cleanup required to support the goal of unrestricted release of the Windsor Site.

- A final radiological survey of the Windsor Site would be performed to confirm that radioactivity levels in soils are below release criteria for future unrestricted uses of the property. Appendix G provides details on the final radiological survey of the Windsor Site, including the timing for performing the surveys. The action of confirming that applicable release criteria are met ensures that any future occupant at the Windsor Site would receive less radiation exposure than limits specified in Department of Energy Order 5400.5 (Reference 3-3) as well as the draft regulations under consideration by the Nuclear Regulatory Commission (Reference 3-4) and the Environmental Protection Agency (Reference 3-5). Draft regulations include a maximum exposure limit of 15 millirem per year from all sources of which a maximum of 4 millirem per year can be from ingestion of radioactivity in water. The final radiological survey would be conducted following a comprehensive strategy that measures radioactivity levels at the ground surface and takes systematic soil samples for analysis. Final survey results would be documented and reported to appropriate Federal and State regulatory agencies. Federal and State regulators would be invited to comment on the reports and to perform verification surveying and sampling.

Upon completion of reactor plant dismantlement, recyclable material and waste shipments, any necessary cleanup activities, verification sampling, and completion of any required Windsor Site restoration, the Windsor Site property would be released for unrestricted use in accordance with applicable local, State and Federal regulations. If there is no other use for the property by the U.S. Government, the land would be offered for sale. The Windsor Site property deed grants Combustion Engineering, Inc. a first right of refusal to acquire the property through the year 2010.

3.1.5 Cost

The cost of prompt dismantlement is estimated at $51,000,000 (1996 dollars). This estimate is a rough order of magnitude based on experience, engineering concepts, and comparison to similar Department of Energy and commercial projects. The principal dismantlement costs included in this estimate are preparation of engineering procedures, procurement or rental of special equipment, direct labor, support labor, waste disposal, utilities, and the voluntary facility assessment process. The highest single expense is the removal and disposal of the pressure vessel.

3.2 Deferred Dismantlement Alternative: Dismantle the S1C Prototype Reactor Plant After a 30-Year Caretaking Period to Allow Radioactive Decay; Dispose of or Recycle Materials

This alternative postpones S1C Prototype reactor plant dismantlement for a defined period of time (known as a caretaking period) to allow for radioactive decay of radioactive materials. The caretaking period selected for this alternative is 30 years. After completion of deferred reactor plant dismantlement and shipments of recyclable material and waste, the Windsor Site property would be released for unrestricted use as stated under the prompt dismantlement alternative.

Although similar analyses sponsored by the Nuclear Regulatory Commission have considered deferment periods of 50 or 60 years for commercial nuclear power plant dismantlements (Reference 3-6), Naval Reactors considers 30 years is appropriate for the S1C Prototype reactor plant for the reason explained below. Nearly all of the gamma radiation within the defueled S1C Prototype reactor plant comes from cobalt-60, which has an approximately 5.27-year half-life. Deferring dismantlement for 30 years would allow cobalt-60 to decay to less than 2% of the radioactivity levels present in 1997. Unlike the S1C Prototype reactor plant, defueled commercial nuclear power plants have a substantial amount of fission products cesium-137 and strontium-90 which have approximately 30-year half-lives. Due to the high integrity of Naval nuclear fuel assemblies, these fission products are not present in significant quantities after defueling of a Naval plant. Even after a longer deferment period of 60 years, commercial power plants would still contain approximately 25% of the cesium-137 and strontium-90 levels present at shutdown. Because cobalt-60 decays relatively quickly, further deferment beyond 30 years for the S1C Prototype reactor plant would provide little additional benefit in reducing the amount of remaining radioactivity. However, allowing cobalt-60 to decay away would not change the amount of materials handled as low-level radioactive waste, due to the presence of other longer-lived radionuclides.

3.2.1 Caretaking Period Operations

During the caretaking period, the defueled S1C Prototype reactor plant would be periodically monitored. The purpose of this monitoring would be to verify overall physical integrity of the reactor plant and to verify that all radioactivity remains contained.

Periodic radiological surveys of the reactor plant would be performed as part of a comprehensive environmental monitoring program to be maintained during the caretaking period. This monitoring program would be a continuation of the current monitoring program at the Windsor Site and would involve air sampling, the continuous monitoring of radiation levels at Site perimeter locations and at off-site locations, and the routine collection and analysis of water samples, sediment samples, and fish. Details of the current environmental monitoring program at the Windsor Site may be found in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report for calendar year 1994 (Reference 4-10). Monitoring would identify any unexpected changes in radiological conditions in the reactor plant and at the Windsor Site. The only expected change would be decay of residual radioactivity.

During the caretaking period, the reactor compartment would be periodically ventilated. Ventilation system exhaust would pass through high efficiency particulate air filters. The system would be tested to verify that it is at least 99.95% efficient at removing potential airborne particulate radioactivity. The reactor compartment exhaust would be continually sampled with a fixed filter air sampler to verify that applicable environmental standards are met (Reference 3-1).

To preserve overall system and compartment integrity, the reactor compartment would be seasonally heated and dehumidified. In addition, visual inspections would be performed inside and outside of the reactor compartment. These inspections would include verification that known hazardous materials remain stable inside the compartment. Maintenance would be performed as necessary to maintain the physical integrity of the reactor plant.

Under this alternative, several buildings would remain at the Windsor Site in an inactive condition. The buildings would be used to support dismantlement operations after the 30-year caretaking period. These buildings would be seasonally heated and dehumidified and routinely inspected. Maintenance would be performed as necessary to sustain their physical integrity. During the caretaking period, access to fenced areas and buildings at the Windsor Site would be controlled by both a staffed security force and a remote alarm system.

3.2.2 Deferred Dismantlement Operations, Recycling, and Waste Disposal

Following completion of the 30-year caretaking period, reactor plant dismantlement would commence. Deferred dismantlement operations are assumed to be identical to dismantlement operations outlined in the prompt dismantlement alternative discussion, Section 3.1.1.

While the radioactive decay of cobalt-60 would substantially reduce occupational exposure associated with deferred dismantlement operations, many of the materials from reactor systems would still be radioactive due to the longer-lived radionuclides which remain after 30 years. The number and types of radioactive shipments associated with deferred dismantlement would be the same as for the prompt dismantlement alternative. Methods for packaging, transport, disposal and recycling would also be the same as discussed in the prompt dismantlement alternative discussion, Sections 3.1.2 and 3.1.3.

3.2.3 Windsor Site Restoration and Site Release

A voluntary facility assessment (described in Chapter 4 and Appendix F) is in process at the Windsor Site and would not be affected by selection of this alternative. Soil within or adjacent to the Windsor Site boundary that exceeds any applicable cleanup standards would be removed at the earliest time practical, consistent with current schedules. The extent of soil remediation, if required, is expected to be very small.

Under this alternative, the Windsor Site would not be released for unrestricted uses until completion of deferred reactor plant dismantlement. After completion of deferred reactor plant dismantlement activities, unnecessary buildings and utility systems would be removed consistent with discussion in Section 3.1.4. Unrestricted Windsor Site release would not occur before 2031.

3.2.4 Cost

The total cost of deferred dismantlement, including caretaking, is estimated at $64,800,000 (1996 dollars). The average caretaking cost is estimated at $477,000 per year (1996 dollars). The principal caretaking costs included in this estimate are direct labor for routine maintenance of the reactor plant and support buildings, radiological and environmental surveys, surveillance and security of the Windsor Site, utilities, and the voluntary facility assessment process. Over the course of 30 years, caretaking costs would total $14,300,000. Deferred dismantlement cost ($50,500,000) is assumed to be the same as prompt dismantlement cost described in section 3.1.5, except that the voluntary facility assessment process cost is included in the caretaking cost as discussed above.

3.3 No Action Alternative: Maintain the S1C Prototype Reactor Plant In Place and Monitor for an Indefinite Period of Time

The primary goal of this alternative would be to maintain the defueled S1C Prototype reactor plant in a stable condition for an indefinite period of time. This alternative involves no dismantlement operations or waste shipments of any kind. This alternative does not provide permanent disposal of the S1C Prototype reactor plant. Disposal of the S1C Prototype reactor plant would be required at some time in the future.

3.3.1 Caretaking Period Operations

Caretaking period operations for this alternative would be identical to caretaking period operations described in the deferred dismantlement alternative (section 3.2.1), except that the voluntary facility assessment process (described in Chapter 4 and Appendix F) and the radiological survey process (discussed in Appendix G) and any associated remediation activities would not be completed. Also, this alternative would have no defined end date.

3.3.2 Cost

The annual cost of this alternative is estimated at $460,000 (1996 dollars), which is the same as the annual caretaking cost for the deferred dismantlement alternative with the exception of the costs associated with the voluntary facility assessment process, which would not be completed. The total cost over a 30-year period is estimated to be $13,800,000. However, the no action alternative does not provide a permanent solution for S1C Prototype reactor plant disposal. Taking into consideration the eventual need for a permanent disposal decision, the no action alternative would ultimately result in a higher figure.

3.4 Other Alternatives

Other alternatives were also considered for this Environmental Impact Statement, but were eliminated from detailed evaluation for various reasons. These alternatives are described in the following sections.

3.4.1 One-Piece Reactor Plant Disposal Off-Site

This alternative is based on the submarine reactor compartment disposal program currently in use for dismantling decommissioned U.S. Navy submarines. Defueled reactor compartments are packaged in their entirety at the Puget Sound Naval Shipyard. The packaged reactor compartments are then sent by barge and special ground transport for disposal at the Department of Energy Low-Level Waste Burial Grounds, Hanford Site, State of Washington. As a single package, the S1C Prototype reactor compartment would measure approximately 23 feet in length, 24 feet in diameter and would weigh approximately 400 tons.

Unlike Puget Sound Naval Shipyard, the Windsor Site is not located adjacent to navigable water. Transport of the S1C Prototype reactor compartment in its entirety to the nearest barge facility on the Connecticut River is considered impractical due to many highway interferences and load-limiting bridges. Transport of the S1C Prototype reactor compartment in one piece by rail was also ruled out due to load-limiting bridges, interferences with bridge underpasses, and tunnels along routes to navigable water or potential disposal sites.

3.4.2 Entombment Alternative

The entombment alternative involves leaving the S1C Prototype reactor plant permanently at the Windsor Site within a strong, durable structure. There are many possible designs for a suitable entombment structure, ranging from the prototype reactor compartment, that currently contains the reactor plant, to additional massively reinforced concrete enclosures. The entombment structure could be located either above grade or below grade. Entombment structures are typically designed to last between several hundred to thousands of years to ensure containment of very long-lived radionuclides that remain in the reactor plant.

The Windsor Site has never been used for burial or permanent storage of radioactive or hazardous waste materials. In addition to radioactivity, the S1C Prototype reactor compartment contains a significant quantity of lead shielding - a hazardous material. Entombment alternatives would require regulatory approval to change the land use criteria of the Windsor Site property. Entombment alternatives would prevent unrestricted release of the Windsor Site property. Based on the small size of the property, the fact that it has had no historical use as a waste burial site, and given the land disposal restrictions for radioactive materials, entombment alternatives were not examined further.

3.4.3 On-Site Disposal

On-site disposal alternatives involve placing the S1C Prototype reactor compartment and contained reactor plant underground and covering it with a series of impervious materials and earth. Like the entombment alternative, based on the small size of the Windsor Site property, the fact that it has had no historical use as a waste burial site, and land disposal restrictions, on-site disposal was not examined further.

CHAPTER 4
AFFECTED ENVIRONMENT

4.0 AFFECTED ENVIRONMENT

This chapter provides baseline environmental conditions pertaining to the Windsor Site property (described in Chapter 2) and surrounding areas.

4.1 Land Use

There are two categories of industrial use areas established in the Town of Windsor zoning regulations (Reference 4-24). I-1 Industrial Zones allow for low intensity industrial uses and I-2 Industrial Zones provide for general, higher intensity industrial uses. Industrial zoning regulations allow for higher noise generation compared to other zoning categories. The Windsor Site property and the surrounding Combustion Engineering, Inc. property are located within an area classified by the Town of Windsor as an I-2 Industrial Zone (Reference 4-1). Three other small properties that border the east side of the Windsor Site access road are located within an area zoned for I-1 industrial use. Currently, only one small office building is located on the adjacent properties east of the access road.

In general, the broader surrounding area includes a mixture of residential, agricultural and industrial uses. The nearest residential areas are located about 0.25 miles to the northeast and southeast of the Windsor Site, and about 0.6 miles northwest of the Windsor Site, across the Farmington River (see Figure 2-2). Agricultural areas are mixed in with the residential areas, though located mainly along the floodplains of the Farmington River. Agricultural areas in the vicinity of the Windsor Site consist mostly of tobacco and shrub farms, but other crops include sweet corn and potatoes. Land about 0.5 miles north of the Windsor Site is zoned public and quasi-public, and includes the Windsor-Bloomfield Landfill and the recreational Northwest Park. Bradley International Airport is located about three miles north-northeast of the Windsor Site.

4.2 Ecological Resources

4.2.1 Terrestrial Ecology

The Windsor Site is a small, developed area that is located within a broad basin of gently rolling terrain called the Connecticut River Valley. The natural state of the land was changed during S1C Prototype and Windsor Site construction more than thirty years ago. Almost all of the Windsor Site property has been developed and is covered with tarmac, concrete or crushed stone. The area within the Windsor Site property boundary has no ecological resources of significance. Plant and animal species sensitive to disturbance by human activities have not been observed at the Windsor Site. The area surrounding the Windsor Site is covered with vegetation.

4.2.2 Wetlands

A U.S. Department of the Interior National Wetlands Inventory map shows numerous wetlands dotting the region surrounding the Windsor Site (Reference 4-2). However, there are no wetlands located on the Windsor Site property. The wetland nearest the Windsor Site is associated with Goodwin Pond (see Figure 2-2). The access road to the Windsor Site crosses the southern portion of the wetland at one point. The wetland is not being impacted by current activities at the Windsor Site.

4.2.3 Aquatic Ecology

The principal game fishes in the surrounding area are Atlantic salmon, brown trout, northern pike, bass (largemouth and smallmouth), and shad. Shad is an important commercial fish as well. Information on game fish takes in the area is not available. Shad fishing is concentrated between the community of Wilson and the Enfield Dam on the Connecticut River. Some shad are also caught in the Farmington River, between the Interstate 91 crossing and the Connecticut River. The season typically runs from mid-April to early June. The State of Connecticut maintains an active program of fish stocking. Nongame fish found in the Farmington River include perch, catfish, sunfish, carp, herring, shiner, and eel. Fish found in Goodwin Pond include bluegill, perch and bass.

4.2.4 Critical Habitats and Endangered Species

The Windsor Site is located in an ecoregion known as the North-Central Lowlands. The State of Connecticut Department of Environmental Protection lists several significant biological habitats and rare plant species characteristic to this ecoregion (Reference 4-3); however, there are none found on the Windsor Site property. According to a State of Connecticut Department of Environmental Protection review of the Natural Diversity Data Base, there are no known existing populations of Federal or State endangered, threatened or special concern species currently present at or in the vicinity of the Windsor Site (Reference 4-4).

4.3 Water Resources

4.3.1 Surface Water

The Windsor Site property does not include any bodies of open surface water. The nearest body of open surface water, Goodwin Pond, is located immediately north and east of the Windsor Site. The pond is manmade and predates Windsor Site construction. The pond drains northwest about 3600 feet along a drainage brook to the Farmington River (see Figure 2-2). A hydrogeologic evaluation performed in 1982 estimated the mean annual discharge of the brook into the Farmington River at 1.8 cubic feet per second (Reference 4-5). The State of Connecticut Department of Environmental Protection has classified Goodwin Pond and its drainage brook as suitable for "fish and wildlife habitat, recreational use, agricultural use, industrial supply and other legitimate uses including navigation" (References 4-6 and 4-7).

Goodwin Pond currently only serves as a fish and wildlife habitat with no recreational, agricultural, industrial or navigation uses.

The Farmington River is regulated by the Rainbow Reservoir and continues from there to join the Connecticut River. The U.S. Geological Survey has estimated the mean annual flow downstream of the Windsor Site at the Rainbow Reservoir to be about 1,100 cubic feet per second (Reference 4-8). The State of Connecticut Department of Environmental Protection has classified the Farmington River and Rainbow Reservoir as suitable for "fish and wildlife habitat, recreational use, agricultural use, industrial supply, and other legitimate uses including navigation" (Reference 4-6 and 4-7). Principal recreational activities on the Farmington River are swimming, fishing, and boating limited to small boats and canoes.

The Windsor Site is not located in a floodplain. The Flood Insurance Rate Map for the Town of Windsor shows that the Windsor Site property is in an area of minimal flooding and is above the 500-year flood boundary (Reference 4-9). There are no records of flooding on the Windsor Site property.

4.3.2 Ground Water

Geologic and aquifer test data suggest that two overburden aquifer systems underlie the Windsor Site: an upper relatively fine-grained unconfined aquifer and a lower (at least on the east side of the Windsor Site) coarse-grained semi-confined aquifer. Depth to the water table is typically 25 to 30 feet below grade. Ground water within the upper aquifer has been generally interpreted to flow easterly into the southwest portion of the Windsor Site and then more northeasterly and northerly toward Goodwin Pond and the drainage brook. The State of Connecticut Department of Environmental Protection has classified ground water at the Windsor Site as suitable as "industrial process and cooling water," but "presumed not suitable for direct human consumption without treatment" (References 4-6 and 4-7).

The Windsor Site has an ongoing ground water monitoring program that measures a variety of organic and inorganic parameters from four monitoring wells. These wells monitor the upper aquifer in order to determine the impacts from industrial activities. Details of the Windsor Site's ground water monitoring program and sampling results are described in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-10). Samples from the four monitoring wells have been taken by Knolls Atomic Power Laboratory personnel since 1984.

The service water production wells are located at the southeast corner of the Windsor Site. The service water production wells pumped ground water from the lower aquifer. The results of Windsor Site service water samples collected from the production wells met all State of Connecticut public health standards for drinking water (Reference 4-10). The production wells were removed from service in March 1994 when the Windsor Site was connected to the Town of Windsor municipal water supply. Since they are no longer needed, the production wells will be closed in accordance with applicable State of Connecticut regulations.

4.3.3 Existing Radiological Conditions - Water Resources

From 1959 to 1978, water containing low concentrations of radioactivity was discharged from the Windsor Site to the shallow, low flow, drainage brook between Goodwin Pond and the Farmington River (References 2-1 and 4-10). The drainage brook is located on property owned by Combustion Engineering, Inc. and is not readily accessible to the public. The concentration of radioactivity in the Windsor Site water discharges never exceeded applicable Federal standards. Since 1979, only nonradioactive water discharges have been released from the Windsor Site into the drainage brook.

The liquid effluent monitoring program at the Windsor Site consists of radiological monitoring of the drainage brook, Goodwin Pond, and Farmington River water. Aquatic life in the vicinity of the Windsor Site is also monitored. The purpose of the monitoring is to determine the effect from operations on the general public and surrounding environment. Analysis results of water and fish collected from the Farmington River have shown no radioactivity attributable to former operations. Conditions in the brook sediment from these discharges are discussed in Section 4.5.4.2.

4.3.4 Existing Nonradiological Conditions - Water Resources

Nonradiological waste water discharges from the Windsor Site included non-contact cooling water, retention tank liquids, and other Windsor Site process waters. Waste water effluent was released through a section of the storm drain system to the drainage brook that flows into the Farmington River. These waste water discharges were permanently secured in October 1995. In February 1996, the State of Connecticut Department of Environmental Protection acknowledged termination of all process discharges from the Windsor Site. The Windsor Site is no longer authorized to discharge any waste water under the previously issued discharge permit (National Pollutant Discharge Elimination System permit number CT0002020). As discussed in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report, the analytical results for chemical constituents present in the Windsor Site liquid effluents at the Windsor Site outfall have been well within applicable standards (Reference 4-10).

Sanitary waste is discharged to an on-site septic system. The septic system includes an auxiliary clarification chamber and a septic tank for anaerobic treatment of the waste. The resultant discharge is released below ground through a leach field located at the north end of the property.

Storm water drainage from the Windsor Site is monitored for compliance with a State of Connecticut Department of Environmental Protection General Storm water Discharge Permit. Under the permit, the Windsor Site is required to annually sample Storm water drainage for parameters such as copper, lead, zinc, and coliform, among others, and to test the biotoxicity of these constituents on aquatic life.

Windsor Site Storm water drainage analysis results have shown higher levels for copper, lead and zinc than guideline values set at the time for this type of effluent. As a result, additional sampling was performed for the affected discharge points and reported to the State as required by the general Storm water permit. On October 1, 1995, the State of Connecticut modified the General Permit for the Discharge of Storm water Associated with Industrial Activity. This modification changed the comparison value for copper from 0.014 milligrams per liter to the current value of 0.200 milligrams per liter. Windsor Site Storm water sampling results from 1996 ranged from none detectable to 0.130 milligrams of copper per liter.

Prior to 1980, water containing chromate compounds was discharged from the Windsor Site to the drainage brook. Chromate compounds were added to Windsor Site cooling water systems to inhibit corrosion and biological growth. Conditions in the brook sediment from these discharges are discussed further in Section 4.5.5.2.

4.4 Air Resources

4.4.1 Climate and Meteorology

The climate in the region of the Windsor Site is typical for a northern temperate climate zone. The prevailing west to east movement of air in the region carries the majority of weather systems into the Windsor area from the west. The location of the Windsor Site, relative to the continent and ocean is noteworthy in that rapid weather changes can result when storms move northward along the Mid-Atlantic coast. The overland air masses produce a frequent passage of low-pressure systems, punctuated by occasional winds from the ocean. The result is a rather variable climate, with cloudy and clear skies alternating as often as twice a week.

Seasonally, weather characteristics vary from the cold and dry continental-polar air of winter to the warm, maritime air of summer. Typical minimum and maximum temperatures are 19°F and 84°F respectively and the average temperature is approximately 50°F. Annual snowfall is approximately 48 inches per year and snow cover is generally present from late December through early March. Precipitation is fairly uniform throughout the year and averages approximately 43 inches per year. Prevailing winds are north to northwest during the winter and south to southwest during the rest of the year (Reference 4-11). Infrequent winds may attain velocities up to 65 miles per hour and are likely to come from the northwest.

4.4.2 Severe Weather Phenomena

The State of Connecticut is subject to about one tornado per year. In contrast, the neighboring States of Massachusetts and New York average 3 and 4 tornadoes a year, respectively. In the period of 1953-1989, 49 tornadoes were recorded in Connecticut, with eight occurring in 1973 (Reference 4-12). All tornadoes have occurred in the summer months (Reference 4-11).

Storms of tropical origin occasionally affect Connecticut during the summer or fall months, as they move on a path well out over the ocean. However, hurricanes have been known to strike areas of Connecticut full force resulting in substantial property damage and loss of life (Reference 4-11).

4.4.3 Air Quality

Air quality in the Windsor area meets the National Ambient Air Quality Standards established for oxides of nitrogen, sulfur dioxide, carbon monoxide, lead, suspended particles, and particulate matter (PM-10). The region has been designated as a serious ozone nonattainment area and is in the Northeast Ozone Transport Region.

4.4.4 Existing Radiological Conditions - Air Resources

Operations having a potential for the release of airborne particulate radioactivity are serviced by monitored exhaust systems and regulated under the National Emission Standard for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities, 40 CFR Part 61 Subpart H, by the U.S. Environmental Protection Agency. Prior to release, the exhaust air is passed through high efficiency particulate air filters to minimize radioactivity content. As reported in the Knolls Atomic Power Laboratory Environmental Monitoring Report for calendar year 1994 (Reference 4-10), the radioactivity contained in exhaust air during 1994 consisted of less than 1×10^{-3} curie of particulate fission and activation products and approximately 9×10^{-3} curie of tritium. The airborne radioactivity was contained in a total air exhaust volume of approximately 8.5×10^{10} liters. The average radioactivity concentration was well below the applicable standards listed in Reference 3-3. The annual radioactivity concentration at the nearest Windsor Site boundary, allowing for typical diffusion conditions, was less than 0.01 percent of the Department of Energy derived concentration guide for effluent released to unrestricted areas (Reference 3-3). Public radiation exposures from airborne radioactivity are calculated using computer models qualified for this specific task. These models conservatively estimate the radiation exposure to the public through many pathways, including radioactivity in surface soil, vegetation and animal pathways from airborne radioactivity sources. The exposures are calculated using computer models because direct measurements results are indistinguishable from naturally occurring background radioactivity levels.

4.4.5 Existing Nonradiological Conditions - Air Resources

There are no longer any regulated sources of nonradiological pollutant air emissions at the Windsor Site. The principal source of industrial air emissions currently at the Windsor Site is from three liquid propane heating units. Nonradiological pollutant emissions from operation of these propane fired heaters is very low and their operation do not require any regulatory permits.

4.5 Terrestrial Resources

4.5.1 Topography

The Windsor Site property is located in the central Connecticut River Valley. Most areas within two miles of the Windsor Site lie between 150 and 250 feet above sea level. The topography of the Windsor Site is generally flat at an elevation of about 180 feet above sea level.

4.5.2 Geology

The Windsor Site is located within the Central Valley landscape of the Newark Terrain rift basin. Borings taken on and near the Windsor Site identified depths to bedrock ranging from 90 to 145 feet. Bedrock underlying the Windsor Site consists of arkose (sedimentary redbeds) with interlayered basalt and diabase. Successive bedrock formations mapped in the vicinity of the Windsor Site (upper to lower layers) include Portland arkose, the Hampden basalt layer (100 to 150 feet thick), the East Berlin formation (about 500 feet thick), Holyoke basalt (about 300 feet thick), Shuttle Meadow formation (100 to 150 feet thick), Talcott basalt (0 to 150 feet thick), and New Haven arkose (Reference 4-13). The soils at the Windsor Site have been mapped as the Merrimac Series (Reference 4-26). The Merrimac Series formed on deltas and nearly level to undulating glacial stream terraces. This soil has been characterized as a well drained to somewhat excessively drained moderately coarse-textured soil (References 4-26 and 4-27). A typical profile consists of generally brown sandy loam from 0 to 22 inches, yellowish-brown loamy sand from 22 to 26 inches, and various colored coarse sand mixed with 10 to 20 percent fine and medium gravel from 26 to 48 inches. Coarse fragments in the surface soil and subsoil make up 3 to 20 percent of the soil volume. There are no known geologic resources at the Windsor Site having economic value.

4.5.3 Seismology

The Windsor Site is located in a stable geological region with no known active faults. According to the U.S. Geological Survey, a geologic fault known as The Great Fault runs in a generally southwest-to-northeast line across Connecticut about 15 miles east of the Windsor Site (Reference 4-14). A complex system of minor faults exists about 15 miles south of the Windsor Site, between the City of Hartford and Middletown. Some very small faults lie about 2 miles west of the Windsor Site. The faults to the south and east of the Windsor Site generally run southwest to northeast. The faults are very old, dating back about 200 million years or more to the development of the Appalachian Mountains. Many are healed and may be stronger than the original structure. Records dating back to the late 1700s indicate the occurrence of earthquakes capable of damage in the vicinity of the Windsor Site are rare (Reference 4-15).

No voids, either natural or man-excavated, are known to be present in the bedrock beneath the Windsor Site. The Windsor Site is located in an area where there is no hazard of surface faulting, subsidence, solution, uplift, collapse, weathering, landsliding or other hazards resulting from natural causes or from mining activity, petroleum recovering, or ground water extraction.

4.5.4 Existing Radiological Conditions of the Windsor Site and Surrounding Areas

As part of a nationwide program to document baseline conditions surrounding energy-related sites of interest to the Department of Energy, aerial radiological surveys were obtained over Windsor Locks, Connecticut. Figure 4-4 (page 4-22) provides aerial radiological survey results for the area in 1982 that includes the Windsor Site and the adjacent Combustion Engineering, Inc, Site (Reference 4-29, Figure A-1).

4.5.4.1 Existing Radiological Conditions on Windsor Site Property

Radioactive materials attributable to Windsor Site operations have never been disposed of or buried on the Windsor Site property (Reference 2-1). However, small amounts of residual radioactivity remain in localized portions of the Windsor Site discharge system from discharges of water containing low concentrations of radioactivity from 1959 to 1978. The Windsor Site discharge system is located below grade, on the west side of the property.

4.5.4.2 Existing Radiological Conditions in the Surrounding Area Relating to S1C Prototype Operations

Due to discharges of water containing low concentrations of radioactivity between 1959 and 1978 from the Windsor Site to the shallow drainage brook that flows from Goodwin Pond to the Farmington River, small amounts of residual radioactivity are present in the brook sediment. The drainage brook is located on property owned by Combustion Engineering, Inc. and is not readily accessible to the public.

A detailed evaluation of radiological conditions at the Combustion Engineering, Inc. site, including the drainage brook, is being performed under the Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP). The Oak Ridge Institute for Science and Education, under contract with the Formerly Utilized Sites Remedial Action Program, performed investigation sampling at the Combustion Engineering, Inc. site and reported sampling results in Reference 4-28. Reference 4-28 provides the most complete radiological description of the drainage brook currently available. The following discussion incorporates figures and data results contained in Reference 4-28.

The drainage brook measures about 3600 feet long and joins the Farmington River at a location northwest of the Windsor Site. The width of the brook bed varies from approximately 6 to 65 feet. The physical characteristics of the brook sediment bed are not uniform. Sediment depth in the brook varies from 0 feet (no sediment, only rocks) to greater than three feet.

During the third quarter of 1991, an extensive survey of the sediments in the brook was performed. Sediment samples were collected by Knolls Atomic Power Laboratory to study cobalt-60 conditions in the drainage brook. Samples were taken at 108 locations as shown on Figure 4-1 (page 4-12). Samples consisted of the top two inches of sediment at all 108 sampling locations. Deeper samples were taken at locations 6, 11, 24, 63, 71, 81, and 93 and consisted of the top six inches of sediment. Samples at locations 16, 42, and 51 consisted of the top twelve inches of sediment. These twelve-inch deep samples were divided into a top sample and a bottom sample. Naval Reactors provided these 1991 samples to the Oak Ridge Institute for Science and Education to assist in their evaluations of Combustion Engineering, Inc. property (including the drainage brook) adjacent to the Windsor Site.

The Oak Ridge Institute for Science and Education analysis results for these sediment samples are shown in Table 4-1, starting on page 4-13 (Reference 4-28, Table 7). The analyses were performed on dried samples and indicated the presence of cobalt-60 and uranium isotopes above naturally occurring concentrations. The uranium is present in three isotopes: uranium-234, uranium-235, and uranium-238.

The uranium detected in the brook is due to discharges from the Combustion Engineering, Inc. facility adjacent to the Windsor Site and is not attributable to Windsor Site operations. This is clearly shown by the different distributions of uranium and cobalt-60 in the brook. The cobalt-60 is found throughout the entire length of the drainage brook and is found in the highest concentrations close to the Windsor Site outfall and upstream of the Combustion Engineering, Inc. site outfalls into the brook. This is consistent with the cobalt-60 originating from the S1C Prototype reactor plant discharges. The elevated uranium concentrations are found at or downstream of the Combustion Engineering, Inc. site outfalls (and nearby trash piles and a partially buried barrel as discussed later in this section). Uranium concentrations in samples taken upstream of the Combustion Engineering, Inc. site outfalls, but downstream of the Windsor Site outfall, are at natural background levels.

In addition to the clear inference of this physical data, the S1C Prototype reactor plant only handled uranium in the form of high integrity, zirconium alloy clad nuclear fuel. Therefore, there was no dispersible uranium at the S1C Prototype reactor plant which could have been discharged. Combustion Engineering, Inc. on the other hand, manufactured uranium fuel. The Oak Ridge Institute for Science and Education report (Reference 4-28) shows uranium contamination at several locations on the Combustion Engineering, Inc. site and not just at the drainage brook.

Figure 4-2 on page 4-18 shows a map of sampling locations independently selected by the Oak Ridge Institute for Science and Education during their designation survey investigation of the Combustion Engineering, Inc. site (Reference 4-28, Figure 16). Analysis results from these samples are provided in Table 4-2 (Reference 4-28, Table 5). Figure 4-3 on page 4-20 depicts a small area of the Combustion Engineering, Inc. property from which the Oak Ridge Institute for Science and Education collected three soil samples (Reference 4-28, Figure 14). The samples were taken near trash piles and a partially buried barrel located on the drainage brook bank. Analysis results are shown in Table 4-3 (Reference 4-28, Table 6), including one sample result having a total uranium concentration of 24,090 picocuries per gram.

Based on Table 4-1 data, the average cobalt-60 concentration in the drainage brook samples, decay-corrected to the time the samples were collected (September 1991) is approximately 2.2 picocuries per gram. As shown in Table 4-1, the concentrations of cobalt-60 were lower, further from the Windsor Site. Between sampling location 77 and sampling location 108, the average cobalt-60 concentration is less than 0.4 picocuries per gram. Also, the cobalt-60 concentrations are, on average, higher near the top layer of sediment. This conclusion is based on comparison of the deeper six- and twelve-inch deep samples with the two-inch deep samples which were taken at the same locations.

Taking into account the 5.3-year half-life of cobalt-60 and the time which has passed since these samples were obtained (almost five years), the present activity levels would be about one-half the activity levels indicated in Table 4-1. Therefore, the average cobalt-60 concentration present in 1997 is about 1.1 picocuries per gram.

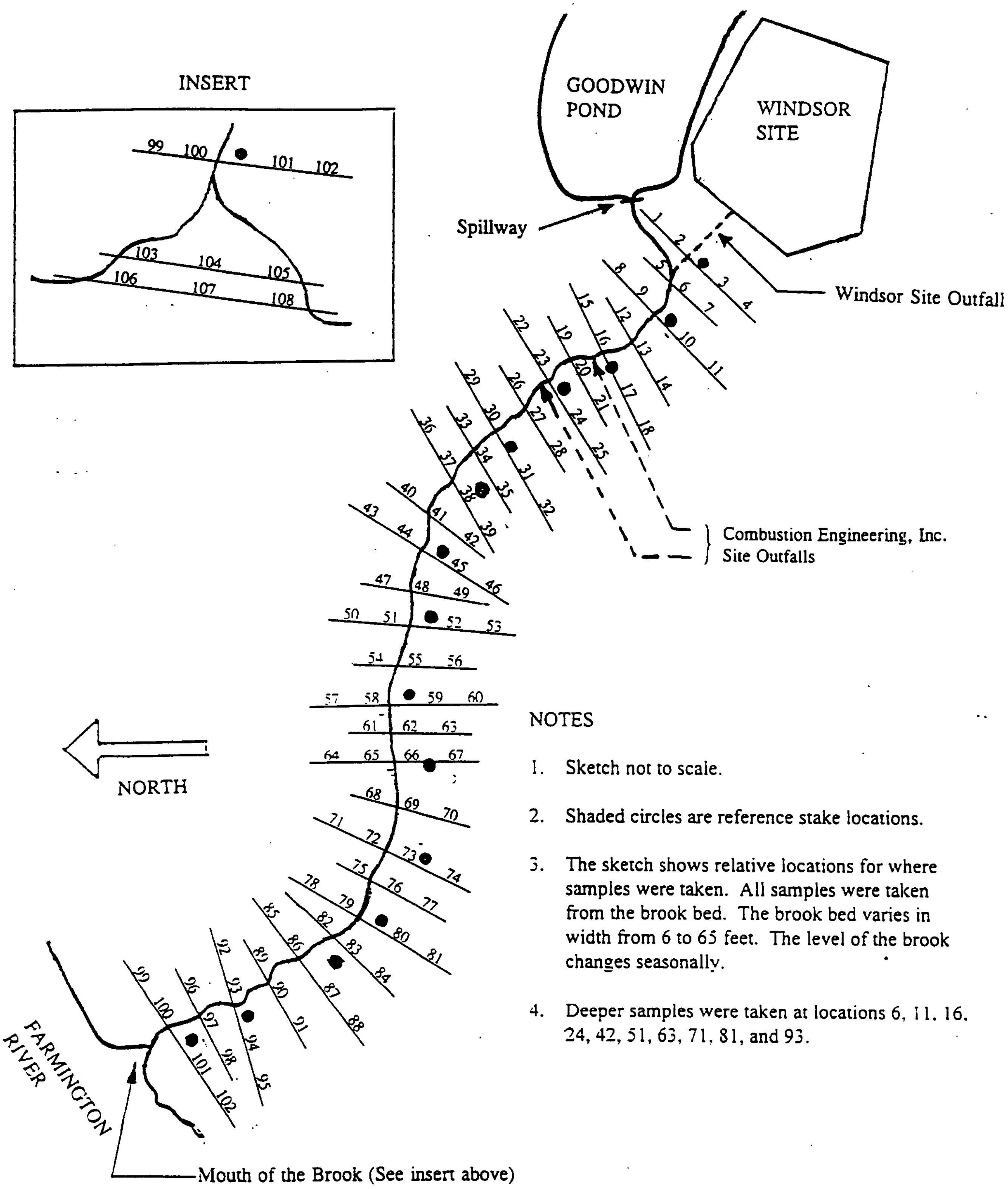
The only other radionuclide from Windsor Site operations that would still be present in the brook sediment is nickel-63 which is a low energy beta emitter and has a half-life of 100 years. Nickel-63 is present in the same insoluble corrosion and wear products as cobalt-60. The Oak Ridge Institute for Science and Education performed nickel-63 analyses on the three samples provided by Naval Reactors which exhibited the highest concentration of cobalt-60. The nickel-63 analysis results were 26.7 ± 1.5 picocuries per gram, 13.2 ± 1.3 picocuries per gram, and 7.2 ± 1.2 picocuries per gram, for samples S7, SC6, and S27, respectively.

The environmental significance of the residual cobalt-60 and nickel-63 in the brook can be evaluated based on a draft report prepared by Argonne National Laboratory and sponsored by the Department of Energy Office of Environmental Restoration (Reference 4-22). The derivation of concentration guideline report is for Combustion Engineering, Inc. property adjacent to the Windsor Site including the drainage brook area. The report describes the derivation of concentration guidelines for both cobalt-60 and nickel-63 which are attributable to Windsor Site operations and uranium isotopes which are not attributable to Windsor Site operations.

Using the conservative assumption that a subsistence farmer moves in and farms the area on top of and immediately surrounding the drainage brook in 1997, an average decay-corrected cobalt-60 concentration of 1.1 picocurie per gram results in a dose of 11 millirem per year to the subsistence farmer. This dose is 3.7% of the dose to an individual from naturally occurring sources. The dose to an industrial worker at a hypothetical industrial facility on top of the brook from a cobalt-60 concentration of 1.1 picocurie per gram is about 3 millirem per year.

The draft concentration guideline for nickel-63 is 3800 times higher than that of cobalt-60. Thus, even though nickel-63 concentration in the brook sediment is higher than the cobalt-60 concentration, the potential dose due to nickel-63 is insignificant.

Additional characterization of the Combustion Engineering, Inc. site adjacent to the Windsor Site will be accomplished as part of the Formerly Utilized Sites Remedial Action Program evaluation of the Combustion Engineering, Inc. Site. Any action taken as a result of the National Environmental Policy Act decision making process for the disposal of the S1C Prototype reactor plant would not affect future evaluation of the drainage brook or any remedial action on the Combustion Engineering, Inc. Site.



NOTES

1. Sketch not to scale.
2. Shaded circles are reference stake locations.
3. The sketch shows relative locations for where samples were taken. All samples were taken from the brook bed. The brook bed varies in width from 6 to 65 feet. The level of the brook changes seasonally.
4. Deeper samples were taken at locations 6, 11, 16, 24, 42, 51, 63, 71, 81, and 93.

Figure 4-1 Drainage Brook Sediment Sample Locations

Table 4-1 Radionuclide Concentrations in the Drainage Brook Sediment Samples Collected by KAPL and Analyzed by the Oak Ridge Institute for Science and Education

KAPL Id[d, e]	ORISE Sample ID	Radionuclide Concentration (pCi/g)					% U-235 Enrichment
		U-235	U-238	Total U[a]	Co-60[b] (1173 keV)	Co-60[b] (1332 keV)	
S1	390S117	0.00	0.73 ± 0.76[c]	0.7	0.11	0.00	0.0
S2	390S001	0.00	0.37 ± 0.78	0.4	0.16	0.00	0.0
S3	390S002	0.00	0.63 ± 0.78	0.6	0.17 ± 0.11	0.17 ± 0.11	0.0
S4	390S003	0.00	0.35 ± 0.86	0.4	0.25	0.00	0.0
S5	390S004	0.00	0.80 ± 0.71	0.8	0.37 ± 0.16	0.49 ± 0.14	0.0
S6	390S005	0.00	1.07 ± 1.74	1.1	5.78 ± 0.73	4.77 ± 0.72	0.0
SC6	390S116	0.00	6.19 ± 1.99	6.2	46.67 ± 1.92	46.90 ± 1.88	0.0
S7	390S006	0.00	0.71 ± 2.15	0.7	29.63 ± 1.53	28.81 ± 1.48	0.0
S8	390S007	0.00	1.33 ± 1.92	1.3	5.33 ± 0.68	5.92 ± 0.69	0.0
S9	390S008	0.00	3.72 ± 2.79	3.7	13.43 ± 1.26	13.02 ± 1.17	0.0
S11	390S009	0.30 ± 0.12	4.36 ± 1.53	11.8	1.81 ± 0.31	1.84 ± 0.33	1.04
SC11	390S102	0.00	0.92 ± 0.92	0.9	0.25	0.00	0.0
S12	390S010	0.00	2.61 ± 1.26	2.6	2.23 ± 0.43	2.44 ± 0.39	0.0
S14	390S011	0.00	1.89 ± 1.29	1.9	1.39 ± 0.33	0.87 ± 0.30	0.0
S15	390S012	0.00	2.79 ± 1.73	2.8	5.09 ± 0.82	5.24 ± 0.70	0.0
S16	390S013	0.00	2.76 ± 1.03	2.8	0.88 ± 0.22	1.02 ± 0.18	0.0
SC16B	390S103	0.72 ± 0.10	11.99 ± 1.37	30.0	0.54 ± 0.31	0.74 ± 0.21	0.92
SC16T	390S104	0.00	5.62 ± 1.54	5.6	2.10 ± 0.45	1.69 ± 0.37	0.0
S17	390S014	0.95 ± 0.22	5.67 ± 2.53	29.4	4.11 ± 0.76	4.44 ± 0.81	2.54
S18	390S015	0.25 ± 0.11	2.97 ± 1.47	9.3	8.70 ± 0.69	7.98 ± 0.68	1.32
S19	390S016	4.97 ± 0.29	15.33 ± 2.61	139.6	13.95 ± 1.12	13.12 ± 1.08	4.80
S20	390S017	0.62 ± 0.08	2.16 ± 1.04	17.7	0.29 ± 0.25	0.12 ± 0.12	4.28
S21	390S018	0.79 ± 0.16	7.63 ± 2.07	27.4	1.78 ± 0.47	1.97 ± 0.56	1.59
S22	390S019	1.76 ± 0.32	11.05 ± 2.73	55.2	2.69 ± 0.74	2.49 ± 0.77	2.42
S23	390S020	2.69 ± 0.18	11.33 ± 1.98	78.5	17.88 ± 0.95	16.36 ± 0.97	3.56
SC24	390S105	0.49 ± 0.07	2.25 ± 0.78	14.5	0.20 ± 0.22	0.41 ± 0.16	3.29
S24	390S021	1.80 ± 0.14	7.54 ± 1.59	52.5	1.76 ± 0.37	1.92 ± 0.36	3.58
S25	390S022	1.45 ± 0.09	1.49 ± 0.82	37.8	0.45 ± 0.18	0.41 ± 0.17	13.14

Footnotes located on page 4-17

Table 4-1 Radionuclide Concentrations in the Drainage Brook Sediment Samples Collected by KAPL and Analyzed by the Oak Ridge Institute for Science and Education, (continued)

KAPL Id[d, e]	ORISE Sample ID	Radionuclide Concentration (pCi/g)					% U-235 Enrichment
		U-235	U-238	Total U[a]	Co-60[b] (1173 keV)	Co-60[b] (1332 keV)	
S26	390S023	7.13 ± 0.50	24.39 ± 4.26	202.7	5.74 ± 1.09	7.35 ± 1.20	4.35
S27	390S118	12.93 ± 0.54	11.82 ± 3.76	335.1	34.38 ± 2.08	33.91 ± 1.98	14.53
S28	390S119	16.48 ± 0.23	1.29 ± 1.40	413.3	0.73 ± 0.15	0.59 ± 0.17	66.12
S29	390S024	4.17 ± 0.19	6.67 ± 1.56	110.9	3.03 ± 0.40	2.36 ± 0.40	8.86
S30	390S025	4.42 ± 0.24	6.77 ± 1.75	117.2	2.44 ± 0.42	2.53 ± 0.39	9.22
S31	390S026	1.02 ± 0.06	0.65 ± 0.62	26.1	0.26 ± 0.12	0.15 ± 0.08	19.63
S32	390S027	14.26 ± 0.60	18.62 ± 4.05	375.1	5.13 ± 0.96	5.47 ± 0.94	10.64
S33	390S120	27.34 ± 0.62	5.36 ± 2.64	688.9	4.66 ± 0.82	4.90 ± 0.67	44.11
S34	390S028	5.04 ± 0.19	2.61 ± 1.22	128.6	0.74 ± 0.31	0.40 ± 0.18	23.04
S35	390S029	7.53 ± 0.33	16.94 ± 2.75	205.2	4.89 ± 0.73	4.97 ± 0.71	6.47
S36	390S030	2.05 ± 0.16	3.69 ± 1.10	54.9	1.28 ± 0.35	1.07 ± 0.27	7.95
S37	390S031	2.44 ± 0.14	3.19 ± 1.02	64.2	0.72 ± 0.25	0.70 ± 0.21	10.61
S38	390S032	4.22 ± 0.26	7.93 ± 1.91	113.3	2.07 ± 0.42	2.30 ± 0.42	7.64
S39	390S033	0.56 ± 0.08	1.76 ± 1.16	15.7	0.24	0.00	4.69
S40	390S034	3.87 ± 0.20	1.34 ± 1.17	7.0	0.29	0.00	2.59
S41	390S035	3.87 ± 0.20	4.01 ± 1.51	100.7	1.93 ± 0.46	2.09 ± 0.39	13.04
S42	390S036	0.96 ± 0.07	2.38 ± 0.97	26.4	0.35 ± 0.16	0.32 ± 0.13	5.90
SC42B	390S106	0.00	0.88 ± 0.62	0.9	0.10	0.00	0.0
SC42T	390S107	0.48 ± 0.08	2.01 ± 0.98	14.0	0.23	0.00	3.57
S43	390S037	8.72 ± 0.41	16.27 ± 3.28	234.3	5.15 ± 0.87	5.17 ± 0.77	7.69
S44	390S038	7.53 ± 0.28	12.64 ± 2.23	200.8	3.47 ± 0.56	3.53 ± 0.46	8.47
S45	390S039	0.31 ± 0.06	0.56 ± 0.71	8.3	0.17	0.00	7.94
S46	390S040	0.51 ± 0.09	1.67 ± 1.10	14.3	0.37 ± 0.21	0.37 ± 0.15	4.51
S47	390S041	0.82 ± 0.06	1.62 ± 0.69	22.2	0.44 ± 0.16	0.38 ± 0.13	7.32
S48	390S042	0.80 ± 0.07	1.11 ± 0.69	21.1	0.73 ± 0.18	0.59 ± 0.17	10.10
S49	390S043	0.36 ± 0.07	1.12 ± 0.93	10.2	0.29	0.00	4.81
S50	390S044	0.24 ± 0.08	1.58 ± 0.75	7.5	0.23	0.00	2.30
S51	390S045	0.21 ± 0.05	1.03 ± 0.82	6.2	0.17	0.00	3.06

Footnotes located on page 4-17

Table 4-1 Radionuclide Concentrations in the Drainage Brook Sediment Samples Collected by KAPL and Analyzed by the Oak Ridge Institute for Science and Education, (continued)

KAPL Id[d,e]	ORISE Sample ID	Radionuclide Concentration (pCi/g)					% U-235 Enrichment
		U-235	U-238	Total U[a]	Co-60[b] (1173 keV)	Co-60[b] (1332 keV)	
SC51B	390S108	0.00	2.57 ± 0.61	2.6	0.09	0.00	0.0
SC51T	390S109	0.00	1.89 ± 0.66	1.9	0.11	0.00	0.0
S52	390S046	5.41 ± 0.26	10.81 ± 2.07	146.1	1.85 ± 0.42	2.12 ± 0.39	7.22
S53	390S047	3.12 ± 0.26	5.18 ± 2.28	83.2	2.01 ± 0.54	1.60 ± 0.42	8.56
S54	390S048	2.85 ± 0.16	1.68 ± 1.14	72.9	1.40 ± 0.29	1.16 ± 0.31	20.85
S55	390S049	0.00	0.67 ± 0.83	0.7	0.30	0.00	0.0
S56	390S050	1.11 ± 0.10	1.73 ± 0.97	29.6	0.63 ± 0.18	0.42 ± 0.25	9.09
S57	390S051	0.85 ± 0.08	1.01 ± 0.93	22.3	0.55 ± 0.22	0.40 ± 0.17	11.55
S58	390S052	0.43 ± 0.06	1.38 ± 0.77	12.1	0.25 ± 0.14	0.46 ± 0.17	4.62
S59	390S053	0.48 ± 0.06	1.42 ± 1.01	13.3	0.24 ± 0.19	0.26 ± 0.15	4.97
S60	390S054	0.26 ± 0.06	0.71 ± 0.67	7.2	0.16	0.00	5.37
S61	390S055	0.41 ± 0.07	1.19 ± 0.97	11.5	0.23 ± 0.15	0.30 ± 0.10	5.11
S62	390S056	0.37 ± 0.07	0.92 ± 0.75	10.1	0.28	0.00	5.89
S63	390S057	0.67 ± 0.08	1.43 ± 1.06	18.3	0.43 ± 0.18	0.41 ± 0.18	6.81
SC63	390S110	0.50 ± 0.07	1.72 ± 0.93	14.2	0.23 ± 0.16	0.20 ± 0.12	4.31
S64	390S058	0.00	0.69 ± 0.77	0.7	0.20	0.00	0.0
S65	390S059	0.28 ± 0.03	0.70 ± 0.46	7.6	0.18 ± 0.07	0.11 ± 0.07	5.77
S66	390S060	0.42 ± 0.04	0.81 ± 0.50	11.3	0.24 ± 0.09	0.20 ± 0.07	7.48
S67	390S061	0.42 ± 0.06	1.18 ± 0.83	11.6	0.17	0.00	5.21
S68	390S062	1.29 ± 0.12	1.44 ± 1.14	33.6	0.69 ± 0.24	0.56 ± 0.19	12.21
S69	390S063	0.44 ± 0.08	1.70 ± 1.00	12.7	0.28	0.00	3.88
S70	390S064	6.56 ± 0.26	9.94 ± 2.05	173.8	4.50 ± 0.52	4.20 ± 0.64	9.30
S71	390S065	0.14 ± 0.03	0.79 ± 0.40	4.4	0.11	0.00	2.73
SC71	390S111	0.00	1.20 ± 0.56	1.2	0.07	0.00	0.0
S72	390S066	0.45 ± 0.04	1.00 ± 0.53	12.3	0.37 ± 0.09	0.28 ± 0.10	6.55
S73	390S067	0.26 ± 0.04	0.78 ± 0.42	7.3	0.18 ± 0.08	0.14 ± 0.06	4.99
S74	390S068	0.57 ± 0.08	0.65 ± 0.82	15.0	0.30	0.00	12.10
S75	390S121	40.07 ± 0.55	7.36 ± 2.59	1009.1	1.71 ± 0.36	1.56 ± 0.35	45.69

Footnotes located on page 4-17

Table 4-1 Radionuclide Concentrations in the Drainage Brook Sediment Samples Collected by KAPL and Analyzed by the Oak Ridge Institute for Science and Education, (continued)

KAPL Id[d,e]	ORISE Sample ID	Radionuclide Concentration (pCi/g)					% U-235 Enrichment
		U-235	U-238	Total U[a]	Co-60[b] (1173 keV)	Co-60[b] (1332 keV)	
S76	390S069	1.03 ± 0.11	1.95 ± 1.25	27.6	0.77 ± 0.26	0.75 ± 0.23	7.56
S77	390S070	0.25 ± 0.08	2.15 ± 1.23	8.4	0.29	0.00	1.76
S78	390S071	0.22 ± 0.06	1.48 ± 0.88	7.0	0.19	0.00	2.26
S79	390S072	0.00	1.26	0.0	0.31	0.00	0.0
S80	390S073	0.23 ± 0.05	1.40 ± 0.69	7.1	0.15 ± 0.15	0.20 ± 0.13	2.49
S81	390S074	0.21 ± 0.07	0.67 ± 1.03	5.8	0.36 ± 0.13	0.31 ± 0.17	4.57
SC81	390S112	0.19 ± 0.05	1.33 ± 0.97	6.0	0.16	0.00	2.14
S82	390S075	0.76 ± 0.09	1.64 ± 0.76	20.6	0.39 ± 0.19	0.25 ± 0.14	6.71
S83	390S076	0.00	0.65 ± 0.85	0.7	0.19	0.00	0.0
SC83	390S113	0.36 ± 0.05	1.22 ± 0.62	10.3	0.24 ± 0.11	0.15 ± 0.09	4.40
S84	390S077	0.12 ± 0.03	0.58 ± 0.37	3.6	0.08	0.00	3.13
S85	390S078	1.78 ± 0.10	1.86 ± 0.77	46.3	0.74 ± 0.19	0.66 ± 0.17	12.97
S86	390S079	0.00	0.32 ± 0.94	0.3	0.24	0.00	0.0
S87	390S080	0.00	0.70 ± 0.51	0.7	0.11	0.00	0.0
S88	390S081	0.20 ± 0.04	1.30 ± 0.70	6.3	0.10	0.00	2.35
S89	390S082	0.23 ± 0.06	1.44 ± 0.97	7.2	0.21 ± 0.11	0.12 ± 0.12	2.41
S90	390S083	0.21 ± 0.04	0.88 ± 0.84	6.2	0.23 ± 0.12	0.11 ± 0.13	3.62
S91	390S084	0.32 ± 0.03	0.80 ± 0.44	8.9	0.15 ± 0.09	0.15 ± 0.06	5.88
S92	390S085	0.46 ± 0.05	0.64 ± 0.58	12.0	0.14	0.00	9.94
S93	390S086	0.25 ± 0.05	1.52 ± 0.84	7.8	0.18 ± 0.12	0.10 ± 0.10	2.52
SC93	390S114	0.31 ± 0.04	1.08 ± 0.62	8.8	0.10	0.00	4.27
S94	390S087	0.00	1.14 ± 0.91	1.1	0.21	0.00	0.0
S95	390S088	0.00	0.70 ± 0.96	0.7	0.22	0.00	0.0
S96	390S089	0.13 ± 0.05	1.23 ± 0.64	4.4	0.14	0.00	1.58
S97	390S090	0.00	0.78 ± 0.85	0.8	0.21	0.00	0.0
S98	390S091	0.24 ± 0.05	1.47 ± 0.86	7.6	0.20 ± 0.12	0.17 ± 0.10	2.51
SC98	390S115	0.23 ± 0.05	1.56 ± 0.91	7.4	0.13	0.00	2.26
S99	390S092	0.00	2.04 ± 1.57	2.0	0.28	0.00	0.0

Footnotes located on page 4-17

Table 4-1 Radionuclide Concentrations in the Drainage Brook Sediment Samples Collected by KAPL and Analyzed by the Oak Ridge Institute for Science and Education, (continued)

KAPL Id[d,e]	ORISE Sample ID	Radionuclide Concentration (pCi/g)					% U-235 Enrichment
		U-235	U-238	Total U[a]	Co-60[b] (1173 keV)	Co-60[b] (1332 keV)	
S100	390S093	0.00	1.47 ± 0.69	1.5	0.15	0.00	0.0
S101	390S094	0.00	1.11 ± 0.75	1.1	0.10	0.00	0.0
S102	390S095	0.00	0.52 ± 0.74	0.5	0.13	0.00	0.0
S103	390S096	0.56 ± 0.10	1.72 ± 1.17	15.6	0.34 ± 0.21	0.28 ± 0.18	4.79
S104	390S097	0.00	1.46 ± 1.14	1.5	0.19	0.00	0.0
S105	390S098	4.34 ± 0.30	6.75 ± 2.46	115.2	3.05 ± 0.69	2.81 ± 0.65	9.09
S106	390S099	2.10 ± 0.14	3.22 ± 1.20	55.6	2.08 ± 0.34	1.77 ± 0.31	9.20
S107	390S100	0.15 ± 0.06	0.28 ± 0.77	4.0	0.22	0.00	7.73
S108	390S101	1.48 ± 0.13	1.96 ± 1.21	38.9	0.88 ± 0.27	0.85 ± 0.23	10.50

[a] Total uranium calculated by multiplying U-235 concentration by 25 (to account for U-234 concentration) and adding U-238 concentration.

[b] All samples were decay-corrected to sample collection date (9/91).

[c] Uncertainties represent the 95% confidence level, based only on counting statistics.

[d] Refer to Figure 4-1.

[e] Samples consisted of the top two inches of sediment. Some deeper samples were collected and are labeled SC. The deeper samples were either six or twelve inches deep. The twelve inch samples were split into a top sample and a bottom sample.

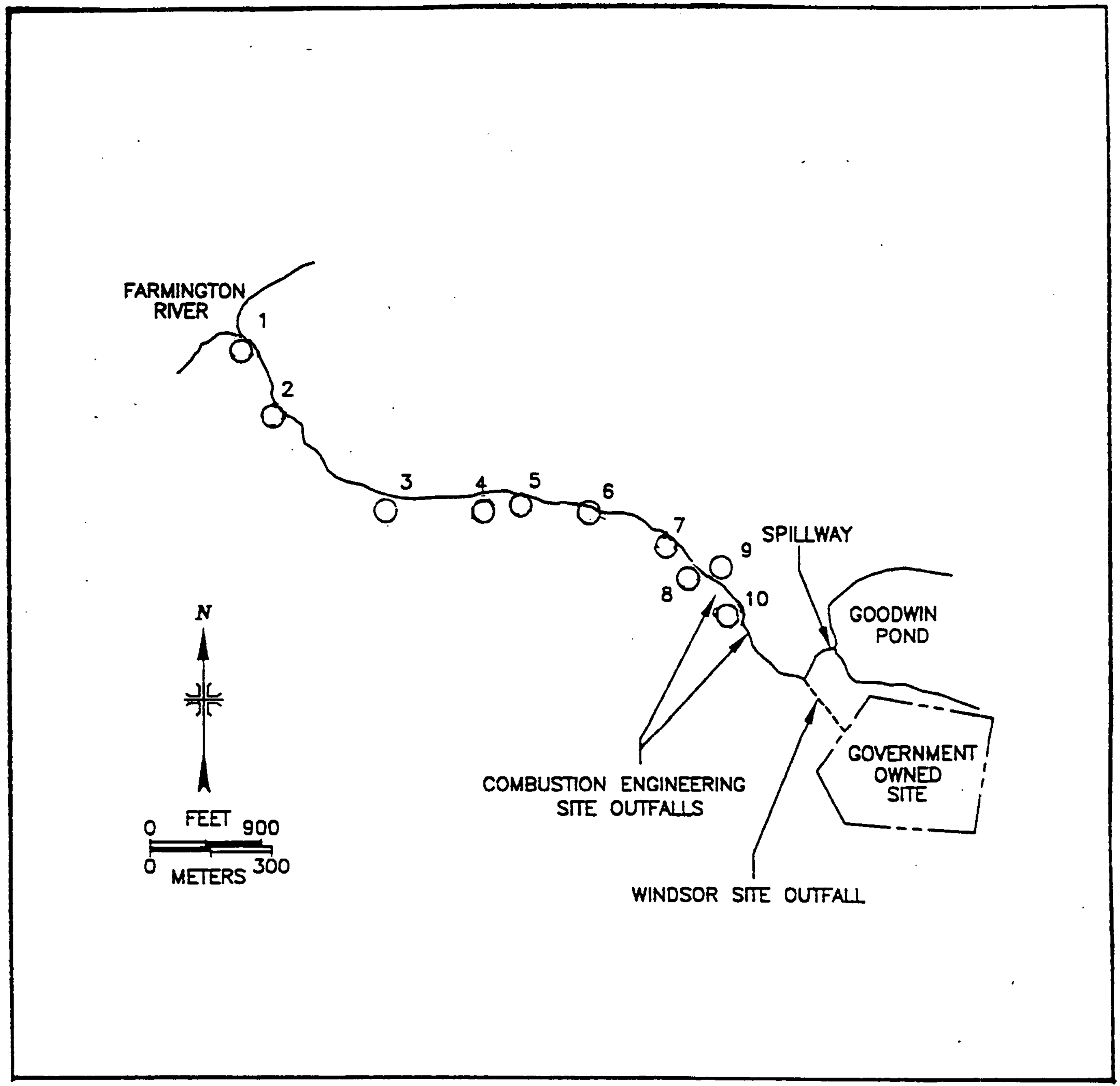


Figure 4-2 Drainage Brook - Oak Ridge Institute for Science and Education Sampled Locations

Table 4-2 Uranium Concentrations in Drainage Brook Sediment Samples Collected by the Oak Ridge Institute for Science and Education

Location [b]	**Uranium Concentrations (pCi/g)**			**% U-235 Enrichment**
	U-235	**U-238**	**Total U** [a]	
1	<0.1	<1.0	3.5	1.5
2	<0.1	1.2±1.1[c]	3.7	1.3
3	<0.1	1.3±0.8	3.8	1.2
4	0.1±0.1	0.5±0.7	3.0	3.0
5	10.9±0.6	11.3±4.8	280	13
— 6	1.5±0.1	3.4±1.2	41	6.4
7	16.7±1.0	21±10	440	11
9	2.3±0.2	8.6±2.9	66	4.0
10	1.0±0.1	2.0±1.7	27	7.2

[a] Total uranium concentration based on assumed U-234 to U-235 ratio of 24.
[b] Refer to Figure 4-2. The results for Location #8 are shown in Table 4-3 (page 4-21).
[c] Uncertainties represent the 95% confidence level, based only on counting statistics.

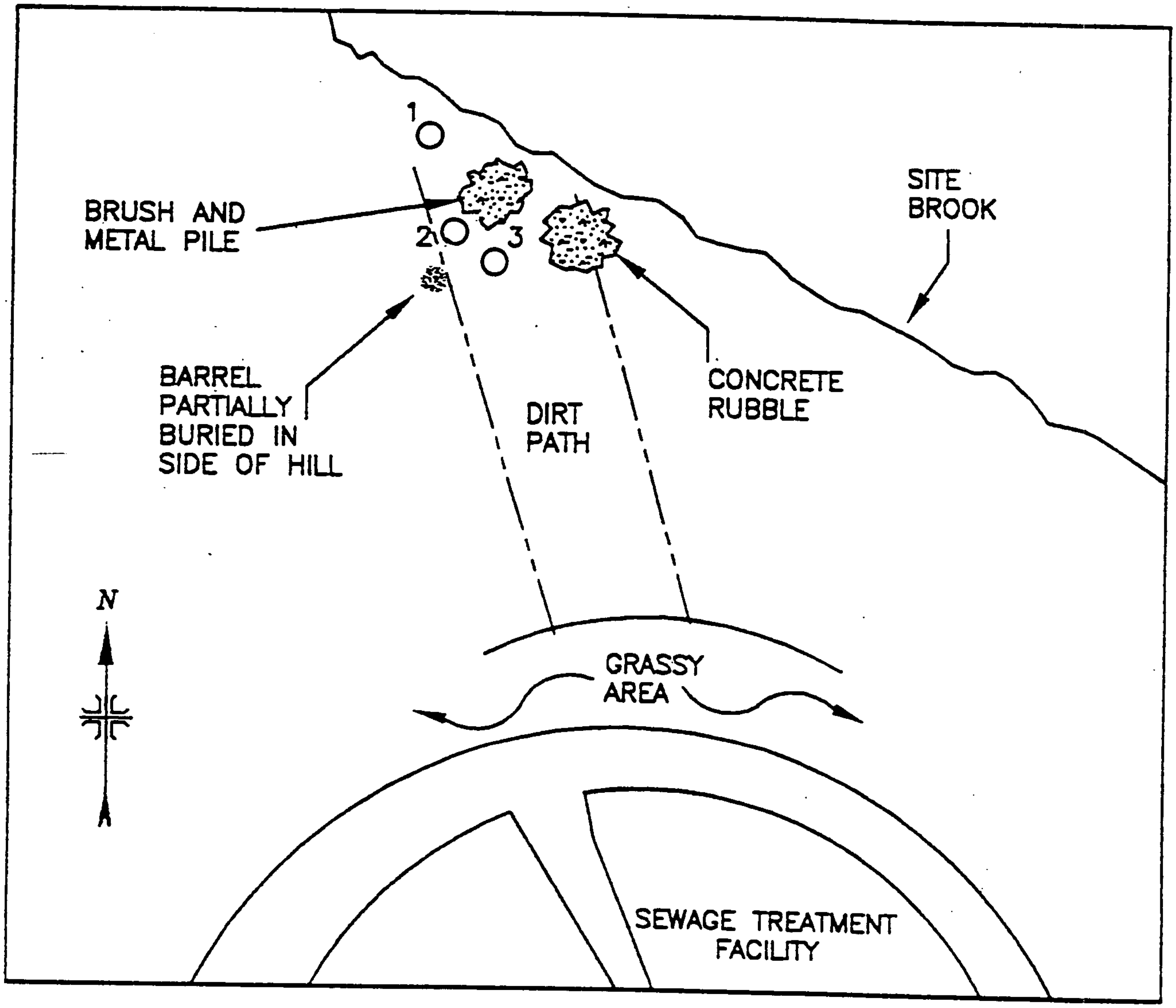


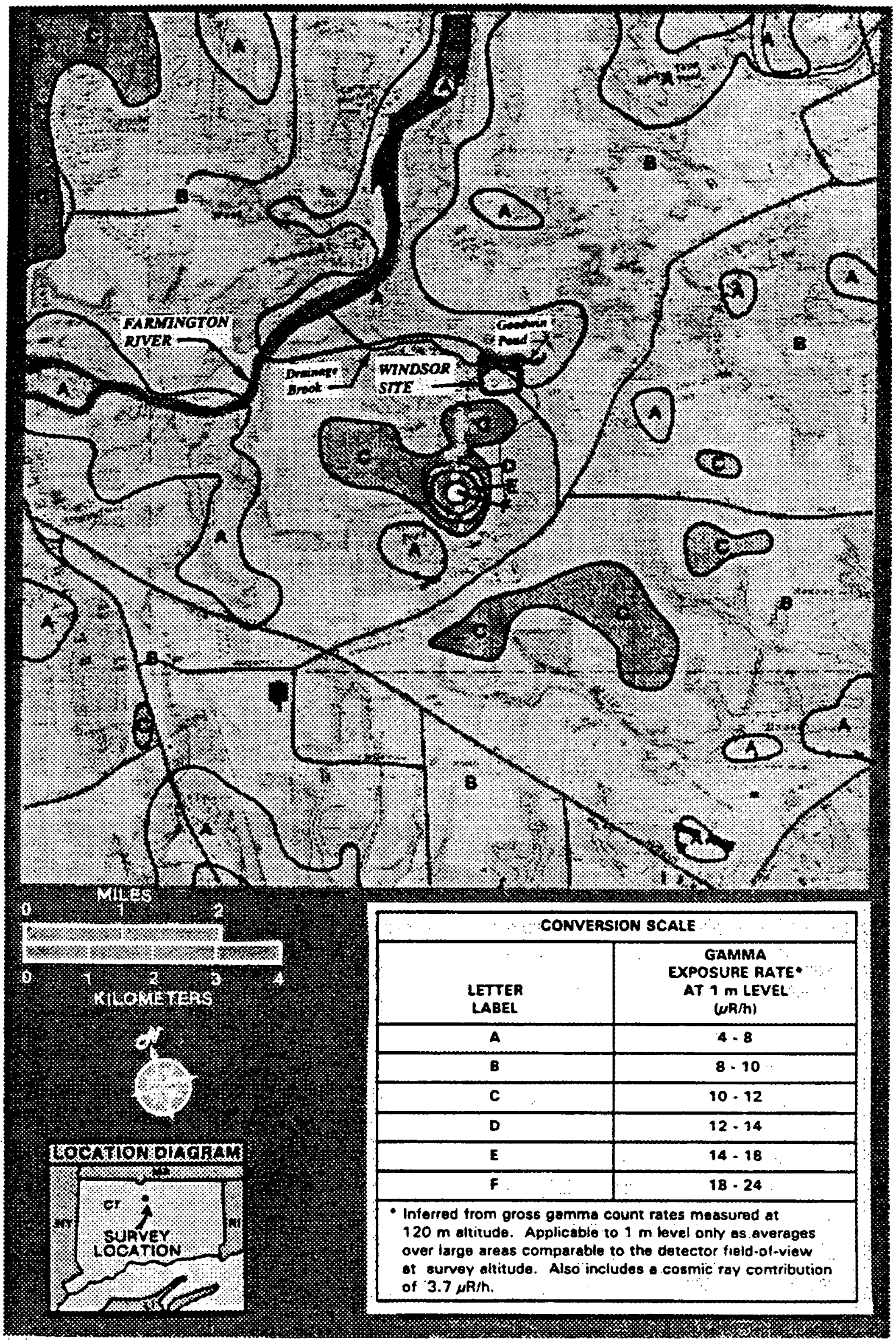
Figure 4-3 Trash Piles on Drainage Brook Bank - Oak Ridge Institute for Science and Education Measurement and Sampling Locations

Table 4-3 Isotopic Uranium Concentrations in Drainage Brook Bank Samples Collected by the Oak Ridge Institute for Science and Education

Location	Figure No.	Uranium Concentration (pCi/g)				%U-235 Enrichment
		U-234	U-235	U-238	Total U[a]	
Site Brook Bank #1	4-3	929±74	37±10	0.9±1.5	967±75	86
Site Brook Bank #2, 0-15 cm	4-3	15,450±320	4,860±200	3,780±160	24,090±410	17
Site Brook Bank #3	4-3	387±33	22.0±3.5	9.1±1.9	418±33	27
Site Brook #8	4-2	16,160±370	525±75	59±22	16,740±380	58

[a] Total uranium concentrations based on the sum of U-234, U-235 and U-238 concentrations.
[b] Uncertainties represent the 95% confidence level, based only on counting statistics.

Map labels have been added and features enhanced for clarity in this Environmental Impact Statement



CONVERSION SCALE	
LETTER LABEL	GAMMA EXPOSURE RATE* AT 1 m LEVEL (μR/h)
A	4 - 8
B	8 - 10
C	10 - 12
D	12 - 14
E	14 - 18
F	18 - 24

* Inferred from gross gamma count rates measured at 120 m altitude. Applicable to 1 m level only as averages over large areas comparable to the detector field-of-view at survey altitude. Also includes a cosmic ray contribution of 3.7 μR/h.

Figure 4-4 Exposure Rate Contour Map for the June 1982 Aerial Survey of the Windsor Locks, Connecticut Area. The elevated levels, D and above, show man-made radiation levels over the Combustion Engineering, Inc. facilities.

4.5.5 Existing Nonradiological Conditions of the Windsor Site and Surrounding Areas

4.5.5.1 Existing Nonradiological Conditions on Windsor Site Property

Only small amounts of chemicals have been disposed of at the Windsor Site. Windsor Site practices have conformed with established rules applicable at the time. These practices included disposal of small amounts of laboratory acids and oxidizers and minute amounts of nonhazardous laboratory analysis chemicals in the Windsor Site septic system. Small amounts of dilute battery acid were disposed of in a dry well and inadvertently into the septic system. At no other time has the Windsor Site been used to bury or otherwise dispose of laboratory or chemical wastes.

As part of ongoing Windsor Site activities, a voluntary facility assessment has been initiated to support Windsor Site inactivation and future release of the property. As a part of the voluntary facility assessment, a work plan for sampling the Windsor Site was developed and provided to the U.S. Environmental Protection Agency and to the State of Connecticut Department of Environmental Protection.

The work plan for sampling was prepared based on interviews with personnel involved in Windsor Site operations over its history, detailed record searches, review of construction drawings, review of historical environmental sampling, hydrogeologic information, published technical literature, and Environmental Protection Agency Resource Conservation and Recovery Act investigation guidance documents. The sampling plan involves investigation of areas within and adjacent to the Windsor Site property to confirm that no significant contamination has occurred resulting from Windsor Site operations. Soil, surface water, ground water and sediment samples will be collected. Samples will be analyzed for specific chemicals of concern based on Windsor Site operating history.

Following completion of all field work, a report will be prepared and provided to the regulatory agencies. The report will summarize findings and will identify the need for any additional investigation or cleanup required to support the goal of unrestricted release of the Windsor Site. Naval Reactors will meet with both regulatory agencies to review report findings and to obtain regulatory agency perspective on achieving the goal of unrestricted release of the Windsor Site.

4.5.5.2 Existing Nonradiological Conditions in the Surrounding Area Relating to S1C Prototype Operations

As discussed in Section 4.3.4, prior to 1980, chromate compounds were added to the Windsor Site cooling water system to inhibit corrosion and biological growth. Samples of Windsor Site discharges, the drainage brook and the Farmington River were taken in 1978. Sample analysis results showed that elevated levels of chromium were present in the brook sediment but indicated that the chromate-containing water discharges from the Windsor Site were not significantly impacting the environment of the Farmington River. Chromium analysis results of twenty sediment samples taken from the brook ranged from 11 to 70 parts per million. Two samples were also taken from Goodwin Pond sediment upstream of the Windsor Site discharge point. Chromium analysis results of the two Goodwin Pond sediment samples were 1.7 and 2.0 parts per million. Subsequent to 1978, a United States Geological Survey reported that chromium levels in soils and other surficial materials in the State of Connecticut range from 30 to 50 parts per million (Reference 4-25).

Although there are no United States Environmental Protection Agency or Connecticut Department of Environmental Protection standards that are directly applicable to sediments, the maximum chromium level detected in the brook sediment (70 parts per million) is less than the most conservative Connecticut Department of Environmental Protection chromium standard (100 parts per million) for direct exposure to residential soils (Regulations of Connecticut State Agencies Section 22a-133k-1 through 22a-133k-3, Remediation Standard, effective January 1996).

The voluntary facility assessment in process includes further investigation of chromium conditions in soils at the Windsor Site and immediately surrounding areas. Surface soil and sediments from the brook and Goodwin Pond will be collected and analyzed for chromium to assess the significance of the 1978 data and the potential for other sources besides the Windsor Site cooling water system.

4.6 Socioeconomics

The population distribution within a 50-mile radius of the Windsor Site, compiled from 1990 Census data, is shown on Figure 4-5. Table 4-4 summarizes the population distribution.

Table 4-4: Population Distribution Within a 50-Mile Radius of the Windsor Site

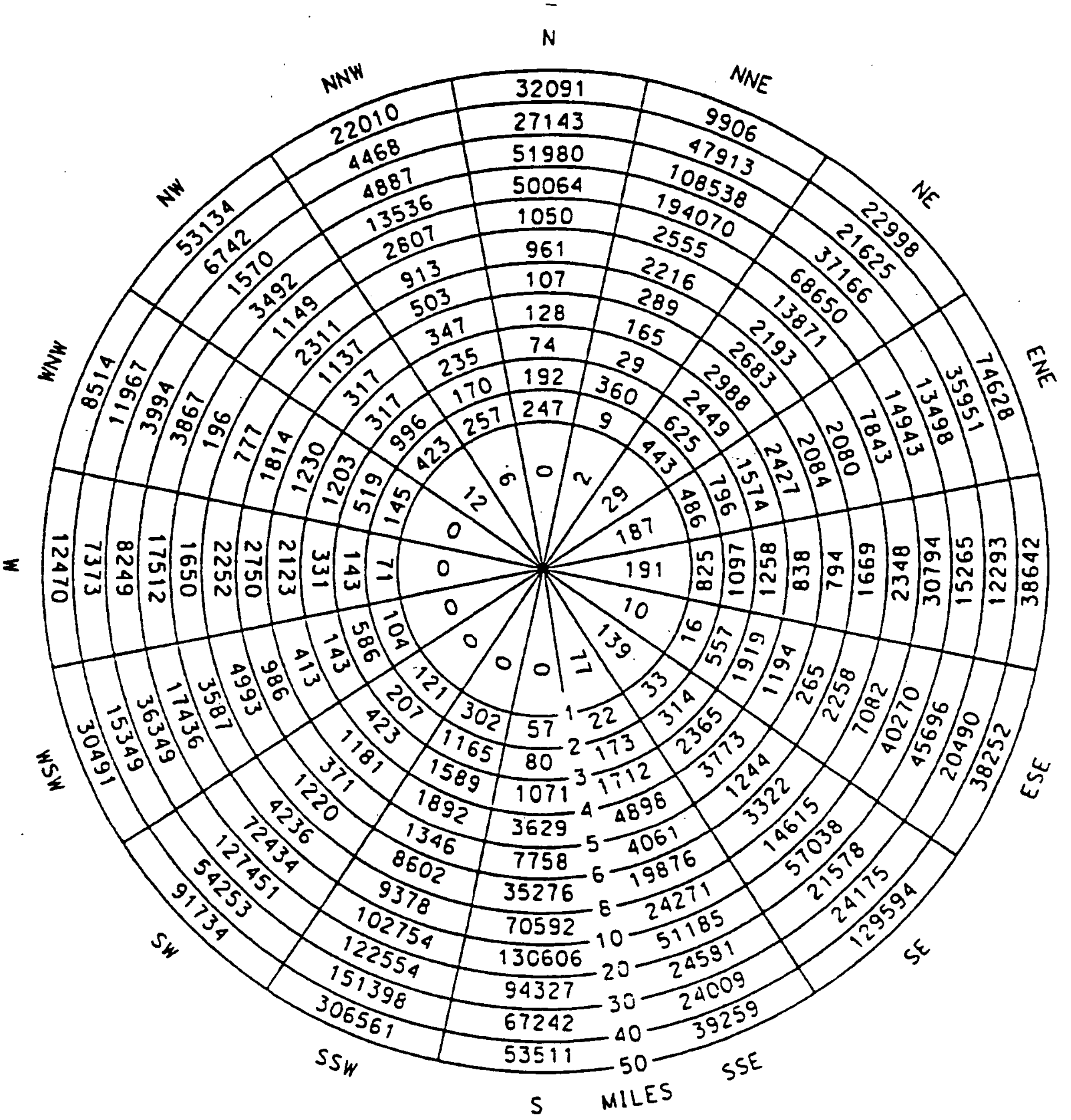
Miles	People	Cumulative People
0 to 5	56,429	56,429
5 to 10	286,341	342,770
10 to 20	868,651	1,211,421
20 to 30	717,683	1,929,104
30 to 40	532,391	2,461,495
40 to 50	963,795	3,425,290

Table 4-5 presents socioeconomic factors for the Capital Region of north-central Connecticut and for the Town of Windsor based on 1990 Census data. The State of Connecticut Capital Region is made up of 29 towns, including the Town of Windsor.

Table 4-5: Socioeconomic Factors for the Town of Windsor and the Capital Region

	Town of Windsor	Capital Region
Population	27,817	709,404
Civilian Labor Force	15,767	387,360
Percent Non-White [a] Population	21 [d]	18
Percent Hispanic Population	3	8
Average Household Income	$50,228	$49,630 [b]
Percent Living In Poverty	2	8 [c]

a. Includes "Black", "Asian or Pacific Islander", "American Indian or Alaska Native."
b. Average for 29 towns comprising the Capital Region.
c. For Hartford County.
d. According to the Town of Windsor, neighborhoods in the northeastern and southern portions of Windsor had 25 to 30% non-white populations while most other neighborhoods, including the area around the Windsor Site, had 3 to 6% (Reference 4-16).



	1	2	3	4	5	6	8	10	20	30	40	50
N	0	247	192	74	128	107	961	1050	50064	51980	27143	32091
NNE	2	9	360	29	165	289	2216	2555	194070	108538	47913	9906
NE	29	443	625	2449	2988	2683	2193	13871	68650	37166	21625	22998
ENE	187	486	796	1574	2427	2084	2080	7843	14943	13498	35951	74628
E	191	825	1097	1258	838	794	1669	2348	30794	15265	12293	38642
ESE	10	16	557	1919	1194	265	2258	7082	40270	45696	20490	38252
SE	139	33	314	2365	3773	1244	3322	14615	57038	21578	24175	129594
SSE	77	22	173	1712	4898	4061	19876	24271	51185	24581	24009	39259
S	0	57	80	1071	3629	7758	35276	70592	130606	94327	67242	53511
SSW	0	302	1165	1589	1892	1346	8602	9378	102754	122554	151398	306561
SW	0	121	207	423	1181	371	1220	4236	72434	127451	54253	91734
WSW	0	104	586	143	413	986	4993	3587	17436	36349	15349	30491
W	0	71	143	331	2123	2750	2252	1650	17512	8249	7373	12470
WNW	0	145	519	1203	1230	1814	777	196	3867	3994	11967	8514
NW	12	423	996	317	317	1137	2311	1149	3492	1570	6742	53134
NNW	6	257	170	235	347	503	913	2807	13536	4887	4468	22010

Figure 4-5: 1990 Population Distribution Within a 50-Mile Radius of the Windsor Site

According to the Town of Windsor Plan of Development, nonagricultural employment in the area totals about 19,500 jobs, divided between manufacturing (39%) and nonmanufacturing (61%) (Reference 4-16). The majority of the manufacturing jobs involve fabricating metals, aircraft and machinery. The majority of the nonmanufacturing jobs involve wholesale trade, retail, financial, insurance, real estate, services and government. Based on Reference 4-16, the diversity of jobs helps to mitigate the impacts of heavy layoffs when any one sector suffers economic setbacks. In 1989, Windsor had a surplus of approximately 2,800 jobs. This surplus was an important factor contributing to Windsor's extremely low unemployment rate of about 4% town wide and about 2% for minority groups. For comparison, overall unemployment in Hartford was about 9%. The Windsor Site currently employs about 150 personnel.

4.7 Cultural Resources

According to the Connecticut Historical Commission (Reference 4-17) and the Connecticut Office of State Archaeology (Reference 4-18), there are no known areas or items of archaeological, historical or cultural significance located at or immediately adjacent to the Windsor Site that predate Windsor Site construction in 1957. There are no Native American rights or interests associated with the Windsor Site property.

A Memorandum of Agreement has been executed between the Department of Energy and the State of Connecticut. The Memorandum of Agreement identifies measures that will be carried out to address issues pertaining to the historical significance of the Windsor Site and the S1C Prototype reactor plant. The Memorandum of Agreement, a copy of which is included in Appendix E of this Environmental Impact Statement, has been accepted by the Advisory Council on Historic Preservation.

4.8 Noise, Aesthetic and Scenic Resources

The Windsor Site property is offset from Day Hill Road (formerly Prospect Hill Road) approximately one-half mile and is not visible from public roadways. The land surrounding the Windsor Site property is mostly commercially-owned woodlands. Thus, the public is not exposed to noise generated by Windsor Site activities, typically equivalent to light industrial activity.

4.9 Traffic and Transportation

Two major interstate highway corridors are located in close proximity to the Windsor Site. Approximately two miles east of the Windsor Site, Interstate 91 serves urban traffic north and south of the Hartford metropolitan area. Approximately eight miles south of the Windsor Site, Interstate 84 serves urban traffic east and west of Hartford. Secondary roads bounding the Windsor Site are used for local residential traffic, commuting and delivery routes by a variety of businesses. Secondary roads include Day Hill Road (approximately one-half mile south of the Windsor Site) and State Routes 187 and 189 (approximately two miles west of the Windsor Site). Traffic associated with Windsor Site activities does not contribute noticeably to overall traffic conditions in the area.

There are two rail lines that pass through the Town of Windsor. The New Haven/Springfield line is located approximately five miles east of the Windsor Site, running north-south, and passing through Hartford. The New Haven/Springfield line provides routine passenger and freight service. The Griffin Line is located approximately 1.5 miles west of the Windsor Site. The Griffin Line is a branch line, approximately eight miles in length, that runs in a north-south direction. The Griffin Line connects to the New Haven/Springfield line in the City of Hartford. The Griffin Line was abandoned in place by commercial railroad companies about ten years ago and except for very infrequent use by Naval Reactors for Windsor Site related shipments, the Griffin Line has been unused during the past ten years. The Griffin Line is currently under the purview of the Connecticut Department of Transportation.

Commercial barge traffic occurs on the Connecticut River up to the city of Hartford. Docking facilities are available in Hartford, and full, seagoing facilities exist on Long Island Sound.

Bradley International Airport, approximately three miles north-northeast of the Windsor Site, is the nearest airport with scheduled flights by commercial jet aircraft. Flights from Bradley International Airport also include air cargo, corporate, private, and military aircraft (Connecticut and Army Air National Guard). The Windsor Site is located within the five nautical mile radius air traffic control boundaries used for aircraft approaches and departures. Regular large and small aircraft flight patterns, including designated Federal Aviation Administration (FAA) instrument approaches, have the potential for flying over the Windsor Site. Simsbury Airport, approximately three miles northwest of the Windsor Site, is a small airport used only by light private aircraft. Other small airports in the greater Hartford area are located more than five miles from the Windsor Site.

There are no public roads, highways, railways, or navigable waterways on the Windsor Site property.

4.10 Nonradiological Occupational Hazards

Naval Reactors policy is to maintain a healthful work environment at all its facilities, and utilize Occupational Safety and Health Administration standards where appropriate for all Windsor Site activities. Engineered systems, administrative controls, and employee training are the primary means employed for minimizing potential employee exposure to occupational hazards. If hazards cannot be controlled with engineering or administrative controls, personal protective equipment is used to provide additional protection.

Impact for workplace hazards other than radiation are measured by reportable injury, illness, and fatality rates in the work force. Injury, illness, and fatality rates for construction (demolition) workers are considered separately because of the more hazardous nature of their work. Table 4-6 provides the reportable injury, illness, and fatality rates for the Department of Energy and its contractors. Reportable injury and illness rates related to Naval Reactors work have been consistently lower than the rates reported by private industry and the Department of Energy. For the purposes of this evaluation, overall Department of Energy statistics provide a more representative baseline for dismantlement work. The average rates for private industry in the United States are also provided for comparison.

According to the U.S. Department of Labor, injuries in the workplace are most likely to be sprains and strains, bruises and contusions, cuts and lacerations, and fractures. Injuries are most likely to occur from contact with equipment and other objects, falls, and overexertion. Generally, fatalities in the workplace (non-violence related) are most likely to result from contact with equipment and other objects, falls, and exposure to harmful substances or environments (Reference 4-19).

Table 4-6: Average Occupational Injury, Illness and Fatality Rates

	All labor categories		**Construction workers**	
	Total injuries and illnesses per worker-year	Fatalities per worker-year	Total injuries and illnesses per worker-year	Fatalities per worker-year
Department of Energy and contractors [a]	3.6×10^{-2}	3.0×10^{-5}	6.6×10^{-2}	1.0×10^{-4}
Private industry [b]	8.9×10^{-2}	5.8×10^{-5}	1.2×10^{-1}	2.2×10^{-4}

a. 1989-1993 averages (Reference 4-20).
b. 1990-1994 averages (Reference 4-21).

4.11 Utilities and Energy

Windsor Site electricity is supplied by Connecticut Light and Power. Since March 1994, the Windsor Site water system is supplied from the Town of Windsor municipal water supply (Metropolitan District Commission). Utility usage by the Windsor Site during 1995 averaged about 7,000 kilowatt-hours per day for electricity and about 34,000 gallons per day for water. Monthly fuel use at the Windsor Site during 1995 averaged 120 gallons of gasoline, 130 gallons of diesel fuel, and 480 gallons of liquid propane.

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CHAPTER 5
ENVIRONMENTAL CONSEQUENCES

5.0 ENVIRONMENTAL CONSEQUENCES

This chapter summarizes a wide variety of potential environmental consequences associated with the Prompt Dismantlement, Deferred Dismantlement, and No Action alternatives for S1C Prototype reactor plant disposal. The environmental consequences are determined by comparing calculated impacts (such as hypothetical health risks) to the baseline environmental conditions described in Chapter 4. Detailed analyses of potential impacts on worker and public health are described in Appendix B for facility activities and Appendix C for transportation of materials off-site. In addition, Appendices B and C discuss potential consequences and risks of various accident scenarios. This chapter provides a brief description of analysis methodology, results, and conclusions. A basic, overall understanding of the environmental consequences can be gained without reading Appendices B and C, however, those appendices are cited numerous times to assist the reader in finding additional information on specific topics.

To further assist the reader and decision makers, this chapter is organized by alternatives. All environmental topics of concern are discussed within a section devoted to each alternative.

Hypothetical health effects are expressed in terms of latent fatal cancer risks. The most significant potential health effect from environmental and occupational radiation exposures is the inducement of latent fatal cancers. This effect is referred to as latent because the cancer may take many years to develop. The health risk conversion factors used in this document are taken from the International Commission on Radiological Protection which specifies 0.0005 latent fatal cancers per person-rem of exposure to the public and 0.0004 latent fatal cancers per person-rem for workers (Reference 5-1). These risk estimates were extrapolated from estimates applicable to high doses and dose rates and probably overstate the true lifetime risk at low doses and dose rates. In an assessment of this uncertainty, the National Academy of Sciences pointed out that "the possibility that there may be no risks from exposures comparable to external natural background radiation cannot be ruled out" (Reference 5-3). Appendix A provides additional information on common sources of radiation and health effects.

Detailed analyses discussed in Appendices B and C support the conclusion that public exposure resulting from any of the reasonable alternatives for disposal of the S1C Prototype reactor plant would be negligible.

5.1 Prompt Dismantlement Alternative

This alternative would dismantle the reactor plant promptly, dispose of waste, and recycle materials. Dismantling the reactor plant would be done by removing components individually. Section 3.1 provides a detailed description of the prompt dismantlement alternative. Environmental impacts are discussed below.

5.1.1 Land Use

Prompt dismantlement of the defueled S1C Prototype reactor plant would have no adverse effect on land use. Prompt dismantlement would actually have a positive impact on land use by making the Windsor Site property available for other uses as soon as practical. Prompt dismantlement could allow for the unrestricted release of the Windsor Site as early as 2001.

Dismantlement activities would be confined within the Windsor Site property boundary which is an already developed area. There would be no impact on present or planned use of the surrounding areas. Materials resulting from dismantlement activities would be recycled as much as practical and any wastes would be disposed of off-site at licensed disposal facilities. No land on-site and no additional land off-site would have to be set aside for waste disposal.

5.1.2 Ecological Resources

Prompt dismantlement of the defueled S1C Prototype reactor plant would not impact ecological resources at the Windsor Site or surrounding areas. Since the Windsor Site property is small and mostly developed, ecological resources are essentially nonexistent. There are no woodlands, wetlands, or other significant biological habitats at the property, so there would be no habitat loss due to dismantlement activities. Plant or animal species sensitive to disturbance by human activities are not expected to be present and have not been observed at the Windsor Site. There are no known populations of Federal or State designated endangered, threatened or special concern species existing at or in the vicinity of the Windsor Site (Reference 4-4). Fish populations in Goodwin Pond and the Farmington River, and small game and deer in the surrounding area would be unaffected.

5.1.3 Water Resources

The Windsor Site is not located in a 100 or 500-year floodplain area. Dismantlement activities would not involve major earth moving work. Consequently, floodplains in the vicinity of the Windsor Site would not be affected by prompt dismantlement activities.

PROMPT DISMANTLEMENT ALTERNATIVE

5.1.3.1 Radiological Consequences for Water Resources

Prompt dismantlement activities would not involve any discharges of radioactive liquid effluents. Ground water under the Windsor Site and surface water in the surrounding environment would not be affected.

5.1.3.2 Nonradiological Consequences for Water Resources

During prompt dismantlement, liquid discharges from the Windsor Site would be limited to Storm water runoff. Approximate flow of this drainage was incorporated in the State of Connecticut Department of Environmental Protection General Storm water Permit application. These effluents would continue to be monitored and results would continue to be reported annually through completion of this alternative. In the event that excavation activities disturb more than five acres of land, a State of Connecticut Department of Environmental Protection General Permit for the Discharge of Stormwater and Dewatering Wastewater from Industrial Activities will also be obtained. Effluent from the sanitary sewer would continue to be treated in the anaerobic septic system and released below ground through the Windsor Site leach field. Ground water under the Windsor Site and surface water in the surrounding environment would not be affected.

5.1.4 Air Resources

5.1.4.1 Radiological Consequences for Air Resources

Dismantlement operations on radiologically contaminated piping and components would be performed using environmental protection measures to minimize the emission of particulate radioactivity to air as discussed in Section 3.1.1. The resulting airborne particulate radioactivity emissions associated with incident-free prompt dismantlement activities were evaluated. The details of the analyses are provided in Appendix B, Section B.2. Analyses for this alternative assumed an airborne particulate radioactivity source term which was derived from radiation levels measured on high efficiency particulate air filters in reactor servicing ventilation systems used during past maintenance activities. The high efficiency particulate air filters have a greater than 99.95% efficiency for removal of airborne particulate radioactivity. It is conservatively estimated that 7.7×10^{-6} curies per year would be discharged during prompt dismantlement (1.5×10^{-5} total curies for the two-year duration of the alternative). As discussed in Chapter 4, Section 4.4.4, and reported in Reference 4-10, the radioactivity contained in exhaust air from calendar year 1994 Windsor Site activities totaled less than 1×10^{-3} curies of particulate fission and activation products and had no environmental impact. Therefore, prompt dismantlement activities would have no significant radiological consequences on air resources.

5.1.4.2 Nonradiological Consequences for Air Resources

Environmental impacts on air resources from nonradiological emissions were evaluated for several sources, including Windsor Site heating furnaces, airborne dust, and vehicle emissions. There are currently no regulated point sources of nonradiological industrial gaseous emissions at the Windsor Site. Windsor Site heating would be provided by several small, liquid propane fueled, forced hot air furnaces.

Prompt dismantlement activities would include cutting, handling and removal of systems and structures. The presence of materials such as asbestos insulation, lead-based paint, and lead shielding introduce the potential for minor emissions of criteria and hazardous air pollutants from these operations. Since detailed plans have not yet been developed, specific analyses of these emissions were not performed. However, such emissions would be controlled in accordance with applicable State and Federal regulations. Furthermore, these emissions would be transitory and would not be expected to result in the classification of the Windsor Site under the Clean Air Act as a major source of air pollutants based on Program experience. Consequently, no discernible effect on air resources is expected.

Facility demolition and miscellaneous earth moving work could affect air quality through emission of pollutants from diesel and gasoline powered equipment and from the spread of dust. As described in Appendix B, Section B.5, the spread of dust was analyzed using a computer model. The analysis focused on the maximally exposed off-site individual located 100 meters from the center of the dismantlement work area. The calculated dust concentration for the maximally exposed off-site individual during Windsor Site restoration activities was 1.7 milligrams per cubic meter. When this airborne concentration is compared to a Threshold Limit Value - Time Weighted Average concentration for inhalable particulates (10 milligram per cubic meter), it is concluded that dust emissions associated with dismantlement activities would not result in any adverse effects. To reduce the generation of dust, control measures such as using an appropriate level of water spray would be used. Pollutants from diesel and gasoline powered equipment and vehicles would be immediately diluted in the air with no discernible effect on-site or off-site.

Nonradiological consequences of vehicle emissions from transport of dismantlement wastes and recyclable materials off-site is discussed in Section 5.1.10.2. The overall discharge of nonradiological air pollutants from prompt dismantlement activities would be very small and would not have a discernible effect on air resources.

5.1.5 Terrestrial Resources

Prompt dismantlement of the defueled S1C Prototype reactor plant would not adversely affect terrestrial resources at the Windsor Site or surrounding areas. Excavation work in support of reactor plant dismantlement activities would be confined within the fenced security boundary of the Windsor Site. Excavation work would be shallow (limited in depth to a few feet) and would not affect the geological character of the Windsor Site.

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As discussed in Section 3.1.4, following prompt dismantlement of the S1C Prototype reactor plant, shipment of recyclable materials, and waste disposal, actions would be taken to remove all unnecessary buildings, systems, and paved areas from the Windsor Site property. Excavation activities required to remove underground systems would be accomplished in small, limited areas and would not have a permanent affect on the terrestrial resources. After completion of Windsor Site dismantlement activities, the land contour would be restored to natural, nominally flat conditions to support natural reforestation.

5.1.5.1 Expected Final Radiological Conditions of the Windsor Site Property After Prompt Dismantlement

As discussed in Section 3.1.4, after removal of all radioactive material from the Windsor Site, actions would be taken to release the Windsor Site property for future unrestricted use. In other Naval Nuclear Propulsion Program Sites which have been released for unrestricted use, a screening limit of 1 picocurie per gram of soil for cobalt-60 was used to confirm that final conditions in soil were acceptable. Typical soils often contain more than 10 picocuries per gram of naturally occurring radionuclides.

The extent of soil remediation, if any, is expected to be small and has been included in the estimation of radioactive waste to be shipped from the Windsor Site discussed in Section 5.1.13. Soil within or immediately adjacent to the Windsor Site boundary that exceeds applicable radioactive guideline values would be removed. A final radiological survey of the Windsor Site would be performed to confirm radioactivity levels in soils are below release criteria for future unrestricted uses of the property. The action of confirming that applicable release criteria are met ensures that any future occupant at the Windsor Site would receive less radiation exposure than limits specified in Department of Energy Order 5400.5 (Reference 3-3) as well as the draft regulations under consideration by the Nuclear Regulatory Commission and the Environmental Protection Agency. Draft regulations include a maximum exposure limit of 15 millirem per year from all sources of which a maximum of 4 millirem per year can be from ingestion of radioactivity in water. The final radiological survey would be conducted following a comprehensive strategy that measures radiation levels at the ground surface and takes systematic soil samples for analysis. Appendix G provides details on the final radiological survey of the Windsor Site, including the timing for performing the surveys. Final survey results would be documented and reported to appropriate Federal and State regulatory agencies. Federal and State regulators would be invited to comment on these reports and perform verification surveying and sampling.

5.1.5.2 Expected Final Nonradiological Conditions of the Windsor Site Property After Prompt Dismantlement

As discussed in Section 3.1.4, all Windsor Site systems would be completely removed including all systems that are located below grade. Buildings, paved areas, and Windsor Site security fencing would be removed. Soil within or adjacent to the Windsor Site boundary that exceeds any applicable cleanup standards would be removed to support unrestricted release of the property. The extent of soil remediation, if required, is expected to be very small.

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As discussed in Section 4.5.5, a voluntary facility assessment has been initiated to support Windsor Site inactivation and future release of the property. Following completion of all sample collecting and analytical work, a report will be prepared and provided to the U.S. Environmental Protection Agency, Region I and the State of Connecticut Department of Environmental Protection. The report will summarize findings and will provide recommendations for any additional investigation or cleanup required to support the goal of unrestricted release of the Windsor Site. Naval Reactors will meet with both regulatory agencies to review report findings.

5.1.6 Socioeconomics

Current Windsor Site staffing is about 150 personnel. Windsor Site staffing through a reactor plant dismantlement period of approximately 2 years is estimated to remain at 150 construction (demolition) and support personnel. Based on current staffing demographics, an estimated 75% of the Windsor Site labor force would be made up of Connecticut state capital region residents, and the rest would commute from longer distances. Reduction in the Windsor Site work force to zero at the end of the dismantlement period would not significantly affect overall unemployment levels in the Windsor area or greater Hartford region.

Since the Windsor Site is currently owned by the U.S. Government, the Site is not taxable. Under the prompt dismantlement alternative, the Windsor Site could be transferred to a taxpaying entity soon after prompt dismantlement is complete. However, considering the small size of the Windsor Site, the impact on the tax base of the town is not expected to be significant. Consequently, prompt dismantlement would not have any discernible socioeconomic impact.

5.1.7 Cultural Resources

Prompt dismantlement of the S1C Prototype reactor plant would not impact any cultural resources predating Windsor Site construction. Measures that will be carried out by the Department of Energy to address the effects of dismantlement activities on the Windsor Site and the S1C prototype reactor plant are identified in the Memorandum of Agreement with the State of Connecticut, as approved by the Advisory Council on Historic Preservation. A copy of this Memorandum of Agreement is included in Appendix E of this Environmental Impact Statement.

5.1.8 Noise, Aesthetic and Scenic Resources

Prompt dismantlement of the S1C Prototype reactor plant would not have noticeable noise, aesthetic or scenic impacts. The Windsor Site is an existing industrial zoned area characterized by noise from truck and automobile traffic, and operating industrial equipment such as diesel-powered engines, air-operated jackhammers, and other similar equipment. Reactor plant dismantlement activities would not result in an increase in ambient noise levels in occupied areas surrounding the Windsor Site above pre-dismantlement levels.

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Since wooded areas surrounding the Windsor Site block any view from the nearest public roadways, dismantlement activities would have no impact on aesthetic and scenic resources in the vicinity of the Windsor Site. Compared to the existing developed conditions at the property, removal of the S1C Prototype reactor plant and various other buildings, structures and pavement would have a positive environmental effect on visual characteristics.

5.1.9 Traffic and Transportation

Prompt dismantlement of the defueled S1C Prototype reactor plant and Windsor Site restoration activities would not have a noticeable impact on regional and local traffic. Traffic related to dismantlement would include commuting personnel, equipment mobilization, waste shipments, and deliveries of fill and topsoil. On average, there would be about three shipments arriving and departing daily. Transport of the pressure vessel (and possibly the primary shield tank) from the Windsor Site to the Griffin Line industrial track railhead, approximately 1.5 miles west of the Windsor Site, would affect traffic on the western portion of Day Hill Road (formerly Prospect Hill Road) for a short period during the day the shipment leaves the site. The transport of such shipments by heavy hauler would be planned for a time that minimizes the impact. Highway shipments of packages of similar size to the reactor pressure vessel package have occurred between the Windsor Site and the Griffin Line industrial track railhead in the past. Based on past experience for these shipments, local police escorts have allowed traffic to pass to reduce congestion.

5.1.10 Occupational and Public Health and Safety

This section summarizes analysis results for expected incident-free conditions during prompt dismantlement. Section 5.1.12 summarizes analysis results for potential accident conditions during prompt dismantlement and transport of materials.

5.1.10.1 Incident-Free Facility Activities

5.1.10.1.1 Incident-Free Facility Activities - Radiological Consequences

The radiological health risks associated with incident-free facility activities during prompt dismantlement are evaluated in Appendix B, Section B.2. Effects from assumed airborne particulate radioactivity releases and direct radiation exposure were assessed for the worker, maximally exposed off-site individual and the general population. Gamma radiation from cobalt-60 contained within the reactor plant systems is the primary source of direct radiation exposure. For the workers, analyses were based on data from detailed radiation surveys of the S1C Prototype reactor compartment, worker staffing levels, and time in or near the reactor compartment. For the general population, analyses were based on the cumulative exposure to all members of the general population living within a 50-mile radius of the Windsor Site and historical radiation data at the Windsor Site boundary.

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Appendix B, Section B.2 discusses assumptions used in calculations for airborne particulate radioactivity releases. Airborne particulate radioactivity can cause exposures via several different pathways. The air resource impact calculations include the external exposure from the ground and surface water deposition (from fallout of airborne radioactivity), air immersion pathways and internal exposure through the ingestion and inhalation pathways.

The combined health risks for direct radiation exposure and radioactive contamination to the air are summarized in Table B-6. It is estimated that the radiation workers would receive between 94 to 188 person-rem (3.8×10^{-2} to 7.5×10^{-2} additional latent fatal cancer risk) during prompt dismantlement. The larger value of the range represents an estimate based on preliminary plans. The lower value of the range reflects experience that detailed work planning typically results in additional exposure reductions. The annual occupational radiation exposure from prompt dismantlement would be comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval nuclear reactor plants. Individual worker exposure would be limited to 2 rem per year even though Federal limits allow exposure up to 5 rem per year. Under the prompt dismantlement alternative, the general population would receive an estimated total of 8.1×10^{-3} person-rem (4.0×10^{-6} additional latent fatal cancer risk) from radiation exposure during prompt dismantlement.

5.1.10.1.2 Incident-Free Facility Activities - Nonradiological Consequences

Naval Reactors policy is to maintain a safe and healthful environment at all facilities, including the Windsor Site. Work practices are designed to minimize exposure to physical and chemical hazards. Employees are routinely monitored during work for exposure to such hazards and, when appropriate, are placed into medical surveillance programs. Dismantlement evolutions requiring the use of specialized equipment or the handling of hazardous materials would only be performed by trained personnel. Personnel exposure to hazardous materials would be maintained within Occupational Safety and Health Administration limits through the use of engineered controls, protective clothing, air supplied respirators, containment tents and filtered ventilation. These controls would also ensure protection of the environment within applicable limits. Nonradiological emissions would be controlled in accordance with applicable State and Federal regulations. Nonradiological effects from facility demolition and miscellaneous earth moving work would be negligible.

5.1.10.2 Incident-Free Transportation Analyses

Appendix C transportation evaluations assumed all shipments originate at the Windsor Site located in Windsor, Connecticut. The analyses assumed that there would be 1,100 shipments of nonradioactive waste and recyclable materials from dismantlement and demolition activities and 500 incoming shipments of materials such as fill and topsoil. These shipments would occur between the Windsor Site and facilities located an average of 200 kilometers from the Site. Analyses assumed that 23 radioactive material shipments would be made from the Windsor Site consisting of 19 shipments of miscellaneous waste packages and 4 individually packaged major components. As discussed in Section 3.1.3, the reactor pressure vessel would be shipped by heavy haul truck to the Griffin Line industrial railhead and the rest of the trip to the disposal site would be made by rail. The other 22 shipments would be made by truck. In addition to the pressure vessel, one additional shipment by railroad may be necessary in order to ship the primary shield tank in a single large package. In the transportation analyses, two Department of Energy destinations were analyzed for shipments of low-level radioactive materials: the Savannah River disposal site in the State of South Carolina and the Hanford disposal site in the State of Washington. The analyses included additional general assumptions to keep the meaning of the results simple and conservative. For example, the Savannah River disposal site and the Hanford disposal site were examined individually as the destination for all radioactive shipments. The Savannah River disposal site represents a reasonable close location and distance for transportation analyses, and the Hanford disposal site represents a reasonable but significantly more distant location. Combinations of shipping destinations, including available recycling facility locations for radioactive materials, are not examined. This is a conservative simplification because the cumulative mileage of any combination of available destinations would be less than the cumulative mileage of all shipments going cross-country to the Hanford disposal site. Actual disposal of dismantlement materials would utilize multiple shipping destinations with emphasis on recycling as much material as practical. The topic of waste management and recycling is discussed in more detail in Section 5.1.13.

5.1.10.2.1 Incident-Free Transportation - Radiological Consequences

Gamma radiation emanating from cobalt-60 contained within reactor components is the primary source of direct radiation exposure from the low-level radioactive recyclable material and waste shipments. All low-level radioactive recyclable material and waste shipments would be packaged to meet Department of Transportation standards for packaging integrity and dose rate limits.

The potential radiological health risks associated with incident-free transportation of reactor plant components were evaluated using the RADTRAN 4 computer code. Health effects were assessed for the general population, transportation crew, hypothetical maximally exposed individuals in the general population and the maximally exposed individual in the transportation crew. As discussed in Appendix C, Section C.2, a conservative simplification was made in the transportation analyses which assumed that all radioactive recyclable material or waste would be shipped to the same location, either the Savannah River disposal site in South Carolina or the Hanford disposal site in Washington State. Details for the technical approach for assessing incident-free radioactive shipments are provided in Appendix C, Section C.4. Computer model variables and assumptions are provided in Appendix C, Section C.5.

The health risks due to low-level radioactive material shipments from the Windsor Site to the Savannah River disposal site for prompt dismantlement are summarized in Table C-12. Analyses indicate that the general population would receive 1.93 person-rem (9.66×10^{-4} additional latent fatal cancer risk) from shipment of low-level radioactive materials from the Windsor Site to the Savannah River Disposal Site. Transportation workers would receive 6.66 person-rem (2.67×10^{-3} additional latent fatal cancer risk) for the same shipments.

The health risks for shipments of the same packages to the Hanford disposal site are summarized in Table C-13 and are slightly higher due to the greater distance traveled. However, the radiological health risks are still very small. For shipment of low-level radiological materials from the Windsor Site to the Hanford disposal site, analyses indicate the general population would receive 5.11 person-rem (2.55×10^{-3} additional latent fatal cancer risk) and the transportation crew would receive 10.3 person-rem (4.11×10^{-3} additional latent fatal cancer risk).

These results represent conservative estimates of the radiological consequences of incident-free transportation, and are higher than past experience shows for typical Naval Reactors waste shipments.

5.1.10.2.2 Incident-Free Transportation - Nonradiological Consequences

The nonradiological health risks associated with incident-free transportation of waste and recyclable materials, fill and topsoil were evaluated based on methods developed at Sandia National Laboratory. Nonradiological health risks for incident-free transportation would result from vehicle exhaust emissions (air pollutants). Health effects were assessed for the general population. All material shipments were evaluated. The radiological shipment evaluations considered shipment to Savannah River and the Hanford disposal sites. The nonradiological shipment evaluations assumed an average transportation distance of 200 kilometers since the final destination for waste and recyclable materials and the points of origin for fill and topsoil shipments could vary depending on the haulers.

Incident-free transportation analyses are discussed in detail in Appendix C, Section C.3. The nonradiological health risks (due primarily to vehicle exhaust emissions) are presented in Tables C-3, C-12, and C-13. Adding the nonradiological-related health risks for all waste shipments from the Windsor Site results in a 1.8×10^{-2} additional fatality risk to the general population. This risk is small and is approximately the same as the radiological risks discussed in Section 5.1.10.2.1.

5.1.11 Utilities and Energy

Prompt dismantlement of the defueled S1C Prototype reactor plant would not result in a large demand on utilities and energy resources. Dismantlement activities would require quantities of fuel, water, and electricity typical of small to medium sized construction or demolition projects. The amount of utilities and energy expected to be consumed would not result in any discernible environmental consequences.

5.1.12 Occupational and Transportation Accidents

Hypothetical accident scenarios were evaluated to estimate the potential for, and effects of, release of radioactive material and toxic chemicals. Appendix B, Section B.3 provides details of hypothetical facility accidents resulting in the release of radioactive materials to the environment. Appendix B, Section B.4 provides analysis of a nonradiological fuel fire. Appendix C, Section C.6 describes the technical approach for assessing radioactive shipment accidents. The results of these analyses are presented in terms of latent fatal cancer risks to facility workers and the public.

5.1.12.1 Facility Accidents

5.1.12.1.1 Radiological Consequences of Facility Accidents

Several hypothetical accident scenarios that would result in uncontrolled release of radioactivity to the environment were evaluated to determine the long-term health risks. The hypothetical releases of airborne radioactivity and exposure to radiation during accident scenarios were assessed for the worker, maximally exposed off-site individual and the general population.

As described in Appendix B, Section B.1.2, accidents were considered if they were expected to contribute substantially to risk. Risk is defined as the product of the probability of occurrence times the consequence of the accident. The four hypothetical accident scenarios evaluated for the dismantlement activities included 1) a large component drop, 2) mechanical damage of a component due to a wind-driven missile, 3) an airplane crash into the reactor plant with damage to several components, 4) and a high efficiency particulate air filter fire. Variables considered in the analyses include source terms, population density, meteorological conditions, affected area and pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation).

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The details of the analysis are provided in Appendix B, Section B.3. As shown in Table B-16, the accident with the greatest risk for dismantlement activities is an airplane crashing into the reactor plant. The annual risk of a member to the general population developing a latent fatal cancer due to an airplane crash accident during prompt dismantlement is 3.8×10^{-7}. This risk is the product of the probability of the accident occurring (6.6×10^{-7} per year) times the consequence of the accident (0.58 latent fatal cancers). Over the two-year duration of prompt dismantlement, the cumulative risk from an airplane crash accident is 7.6×10^{-7}. This is extremely small compared to other incident-free radiological impacts due to the low probability of an airplane crashing directly into the S1C Prototype reactor plant.

5.1.12.1.2 Nonradiological Consequences of Facility Accidents

For the purposes of comparison with other risks associated with dismantlement and caretaking activities, an evaluation of a diesel fuel oil fire was analyzed in detail in Appendix B, Section B.4. This accident was selected based on the potential duration of the accident, the potential size of the affected area, and the combustion products that would result. A hypothetical accident scenario involving a fire in the Windsor Site's hazardous waste container storage area was considered but eliminated from detailed analysis. The quantity of hazardous wastes that would be stored at any time during dismantlement is expected to be maintained small by routine disposal shipments. The Windsor Site's hazardous waste container storage area is constructed and operated such that the overall environmental risks, including risks from accidents, are insignificant.

The airborne concentrations of the combustion products resulting from the fire were evaluated with respect to the maximally exposed off-site individual. The toxic chemicals that would be generated during the fire due to combustion are carbon monoxide, oxides of nitrogen (90% nitric oxide and 10% nitrogen dioxide), lead and sulfur dioxide. In the event of an accidental fire, Windsor Site safety procedures would be immediately followed to protect the workers and the public.

Nonradiological occupational accidents, such as slips and falls, are expected to occur during the dismantlement activities; however, the rate is not expected to be greater than rates for other construction activities (provided in Table 4-6). Projections of the number of fatalities, injuries or illnesses during prompt dismantlement were calculated based on Table 4-6 Department of Energy rates and are summarized in Table 5-1 for the prompt dismantlement alternative. These results indicate that the overall nonradiological occupational risks are small.

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Table 5-1: Estimated Nonradiological, Occupational Impacts for Prompt Dismantlement

Estimated Windsor Site Staffing Level	150
Estimated average injuries/illnesses per year [a]	9.9
Estimated fatalities per year [a]	1.5×10^{-2}
Total estimated injuries/illnesses [b]	19.8
Total estimated number of fatalities [b]	3.0×10^{-2}

a. Calculated by multiplying Windsor Site staffing level times the Department of Energy rates for construction workers provided in Table 4-6.

b. Total values calculated for a two-year duration of prompt dismantlement.

5.1.12.2 Transportation Accidents

There has never been a major accident nor measurable release of radioactivity to the environment during shipment of Naval Reactors program waste or materials, however, hypothetical accidents were evaluated to determine potential environmental effects.

5.1.12.2.1 Radiological Consequences of Transportation Accidents

Appendix C, Section C.6 provides the technical approach used for assessing hypothetical radioactive shipment accidents. Health effects were assessed for the general population and the hypothetical maximally exposed individual. Analyses assumed that the transportation workers would evacuate the scene of an accident within a relatively short time after the accident occurred. Therefore, the risks of transportation accidents on transportation workers are included in the results for the general population.

Radiological health risks from uncontrolled releases of radioactivity to the environment and direct radiation exposure from damaged packages were evaluated using the RADTRAN 4 and RISKIND computer codes. Variables considered in the analyses include affected areas and pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation), weather conditions and accident and package release fractions. The major contributor to radiation exposure would be from the ground contamination pathway (more than 90% of total exposure).

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The health risks associated with transportation accidents for shipments from the Windsor Site to the Savannah River disposal site for prompt dismantlement are summarized in Table C-16. Analyses indicate that the general population would receive 7.74 x 10^{-4} person-rem (3.88 x 10^{-7} additional latent fatal cancer risk) in this scenario.

The health risks associated with transportation accidents for shipments of the same packages from the Windsor Site to the Hanford disposal site for prompt dismantlement are summarized in Table C-17. Analyses indicate that the general population would receive 9.09 x 10^{-4} person-rem (4.55 x 10^{-7} additional latent fatal cancer risk) in this scenario. These results are slightly higher than the Savannah River destination due to the greater distance traveled. However, the radiological health risks are still very small.

When compared to the radiological health risks associated with incident-free radioactive waste shipments (see Section 5.1.10.2) the consequences of hypothetical accidents are less. This is due to the very low probability of a severe accident occurring.

5.1.12.2.2 Nonradiological Consequences of Transportation Accidents

There would be no long-term environmental consequences from an accident in which some waste package containing hazardous or toxic material is breached. Hazardous or toxic constituents such as polychlorinated biphenyls, lead, and chromium would be in a solid (insoluble) state. Asbestos, if present, could be disturbed in an accident and portions of the disturbed asbestos might become airborne or mix with water. Any asbestos would eventually settle out of the air or water and become entrained in soil. Naval Reactors would ensure recovery, as necessary, of any spilled hazardous or toxic materials as part of the accident recovery action.

5.1.13 Waste Management

The S1C Prototype reactor plant is small. The volume of the intact reactor compartment is only approximately 293 cubic meters (10,400 cubic feet); the reactor compartment weighs approximately 400 tons. In comparison, decommissioning of the Shippingport pressurized water reactor plant (a small plant by commercial standards) produced approximately 6,060 cubic meters (214,000 cubic feet) of low-level radioactive waste that weighed approximately 4,200 tons. Even though the S1C Prototype reactor plant is small, emphasis would be placed on recycling as much material as practical. Section 3.1.2 described the various waste streams that would be generated as a result of dismantlement activities.

Waste minimization is achievable through recycling and volume reduction. One existing business in Tennessee recycles low-level radioactive metals by melting them into shield blocks which are then provided to the Department of Energy for reuse in high energy physics applications. Other commercial enterprises are also starting to enter the radioactive metal

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recycling field with alternate recycling uses. Recycling and volume reduction services that would be used in conjunction with this alternative would be selected using the normal competitive bidding process.

Low-level radioactive materials from the S1C Prototype reactor plant that could be recycled include stainless steel piping, pumps, valves, and other components and carbon steel structural materials. Low-level radioactive materials would be candidates for recycling if the radioactivity concentration is less than 2×10^{-3} microcuries per gram. As a rule of thumb, components with radiation levels that measure less than 50 millirem per hour on contact would meet the radioactivity concentration criteria for recycling.

Radioactive components that exceed the criteria for recycling could still be candidates for volume reduction if their radiation levels measure less than 200 millirem per hour on contact. Similar to recycling, S1C Prototype reactor plant materials that would be candidates for volume reduction include stainless steel piping, pumps, valves and other components. Volume reduction savings vary widely depending on component construction. Volume reduction processing of S1C Prototype reactor plant materials could achieve an average volume savings in excess of 40%. It is estimated that thirteen shipments would be required for the removal of low-level radioactive materials that would be recycled or volume reduced and for the removal and treatment of mixed waste (see discussion below).

S1C Prototype reactor plant dismantlement would generate approximately 16.7 cubic meters (approximately 600 cubic feet) of elemental lead weighing more than 100 tons that would require recycling or disposal. Lead that could be released from radiological controls would be recycled; other lead containing radioactive impurities or surface contamination would be treated in accordance with the Site Treatment Plan for Mixed Waste Generated at the Windsor Site (Reference 3-2). The 1996 revision of the Site Treatment Plan estimates that 70% of the lead (approximately 11.7 cubic meters (420 cubic feet)) would be released from radiological controls and recycled. The remaining 30% of the lead (approximately 5.0 cubic meters (180 cubic feet)) would be recycled or treated off-site as mixed waste. Decontamination of the lead containing radioactive impurities may not be practical because the impurity concentrations are very low and essentially inseparable. Naval Reactors is evaluating recycling options to reuse lead containing low levels of radioactive impurities in shielding applications at other Naval Reactors facilities. Decontamination of lead with surface contamination is practical with commercially available technology which would further reduce the volume of mixed waste. Residues from treatment of mixed waste would be disposed of off-site.

In addition to elemental lead, the Site Treatment Plan includes twelve other potential mixed waste streams. The estimated volume of mixed waste that could be generated is 11.9 cubic meters (420 cubic feet). The waste streams that would potentially contribute most of the estimated volume include: inorganic debris and equipment, soils, and sludge. The Site Treatment Plan identifies treatment facilities at the Hanford Site, the Savannah River Site, and

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the Idaho National Engineering Laboratory for off-site treatment of mixed wastes. In the event that identified facilities are not available in time for treatment of mixed wastes generated at the Windsor Site, the Site Treatment Plan states that other options would be evaluated and an Alternate Measures Plan would be submitted to the Environmental Protection Agency, Region I.

After completion of all segregation, recycling, and volume reduction processing initiatives, S1C Prototype reactor plant dismantlement would generate approximately 76 cubic meters (2700 cubic feet) of low-level radioactive waste that would require disposal at a Department of Energy disposal site. This estimate represents approximately 25% of the volume of the intact reactor compartment. Almost half of the low-level radioactive waste volume (35.7 cubic meters, 1262 cubic feet) is due to the reactor pressure vessel package alone (one shipment). In addition to waste from reactor plant dismantlement, Windsor Site dismantlement activities are estimated to generate 30 cubic meters (1040 cubic feet) of low-level radioactive waste mostly originating from the removal of some support systems inside the radiological support facility. Overall, low-level radioactive wastes would include the pressure vessel, steam generator and pressurizer major components, volume reduced-nonrecycled materials, and miscellaneous waste unsuitable for recycling or volume reduction. Low-level radioactive wastes would comprise an estimated ten shipments.

The Savannah River Site has established radioactivity concentration limits for acceptance of waste based upon site specific analysis. In addition, the Savannah River Site Waste Acceptance Criteria prohibits acceptance of waste exceeding the Nuclear Regulatory Commission Class C limits as defined by 10 CFR Part 61 (Licensing Requirements for Land Disposal of Radioactive Waste). Of the total radioactivity remaining in the S1C Prototype reactor plant listed in Table 2-1, more than 95 percent would be in the single package that contains the reactor pressure vessel and its internal structure. This package would be within the limits of the Savannah River Site Waste Acceptance Criteria. The other radioactive waste packages would have much lower radioactivity concentrations.

While the end of the Cold War may result in some increases in radioactive wastes such as S1C Prototype reactor plant dismantlement waste, there has been a larger decrease in radioactive waste generation due to the earlier-than-projected inactivation of nuclear powered ships and prototype reactor plants. As a result, both the volume and the radioactivity content of the S1C low-level waste fall within the projections of Naval Reactor waste provided to the Savannah River Site for disposal. The impacts of Naval Reactor low-level waste disposal activities at the Savannah River Site are analyzed in the recent Savannah River Site Waste Management Final Environmental Impact Statement (Reference 5-2).

Municipal solid waste, nonradioactive hazardous material, and nonradioactive nonhazardous demolition debris from Windsor Site activities would be recycled or disposed of off-site at permitted facilities using licensed haulers. Emphasis would be placed on recycling as much nonradioactive material as practical. Reusable materials such as concrete, lead, carbon steel, and other metals would be reused or recycled through various licensed commercial vendors. Dismantlement and demolition activities would result in approximately 1,100 shipments of nonradioactive waste and recyclable materials from the Windsor Site.

5.1.14 Irreversible and Irretrievable Commitments of Resources

The prompt dismantlement alternative would not involve any irretrievable or irreversible commitment of environmentally sensitive resources. As discussed previously in this section, this alternative would not contribute to any loss of endangered species, critical habitat, or areas of archeological, historical or cultural value. Prompt dismantlement activities would not require any significant demand on consumable resources such as utilities and energy. No additional land at disposal sites would be required to dispose of dismantlement wastes. This alternative would release the Windsor Site land resource for other unrestricted uses in the shortest time.

5.2 Deferred Dismantlement Alternative

This alternative would dismantle the reactor plant, after a 30-year caretaking period, and dispose of waste and recycle materials at that time.

During the caretaking period, the reactor compartment would be seasonally heated and dehumidified to preserve overall system and structure integrity. Radiological work on contaminated systems or opening of contaminated systems in the reactor compartment would not be expected during the caretaking period. To maintain the temperature and humidity, a hull ventilation system would be used. The ventilation system would discharge filtered, monitored air to the environment. Periodic inspections and radiological surveys would be conducted each year during the caretaking period to confirm the continued integrity of the reactor plant systems and reactor compartment structure. The surveys would be performed both inside and outside of the reactor compartment.

Under this alternative, several buildings would remain at the Windsor Site in an inactive condition. The buildings would be used to support dismantlement activities after the thirty-year caretaking period. These buildings would be seasonally heated and dehumidified and routinely inspected. Maintenance would be performed as necessary to sustain their physical integrity. Dismantling the reactor plant plus disposal and recycling of radioactive and nonradioactive materials would be done in the same manner as the prompt dismantlement alternative. Section 3.2 provides a detailed description of the deferred dismantlement alternative. Environmental impacts are discussed below.

5.2.1 Land Use

The deferred dismantlement alternative would not adversely impact area land use but it would prevent unrestricted release of the Windsor Site until at least the year 2031. During the 30-year caretaking period and subsequent dismantlement period, the U.S. Government would maintain ownership of the property. Access to areas inside the Windsor Site's security fence would continue to be controlled during caretaking and deferred dismantlement.

Caretaking activities and dismantlement activities would be confined within the boundary of the Windsor Site property, which is an already developed area. There would be no impact on present or planned use of the surrounding areas. Materials associated with dismantlement activities would be recycled as much as practical and any wastes would be disposed of off-site at licensed disposal facilities. No land on-site and no additional land off-site would have to be set aside for waste disposal.

5.2.2 Ecological Resources

Caretaking activities over a 30-year period, and the subsequent dismantlement of the S1C Prototype reactor plant would not impact ecological resources at the Windsor Site or surrounding areas. Windsor Site caretaking activities would include periodic radiological monitoring, visual inspections and maintenance of the reactor compartment (see Section 3.2.1). Environmental monitoring would be continued throughout this alternative and results would be reported annually. Since deferred dismantlement activities would be similar to prompt dismantlement activities, the discussion on ecological impact in Section 5.1.2 also applies to this alternative.

5.2.3 Water Resources

The Windsor Site is not located in a 100 or 500-year floodplain area. Deferred dismantlement activities would not involve major earth moving work. Consequently, floodplains in the vicinity of the Windsor Site would not be affected by deferred dismantlement activities.

5.2.3.1 Radiological Consequences for Water Resources

Caretaking and deferred dismantlement activities would not involve any discharges of radioactive liquid effluents. Ground water under the Windsor Site and surface water in the surrounding environment would not be affected.

5.2.3.2 Nonradiological Consequences for Water Resources

During the 30-year caretaking period and deferred dismantlement, liquid discharges from the Windsor Site would be limited to Storm water runoff. Approximate flow of this drainage was incorporated in the State of Connecticut Department of Environmental Protection General Stormwater Permit application. In the event that excavation activities disturb more than five acres of land, a State of Connecticut Department of Environmental Protection General Permit for the Discharge of Stormwater and Dewatering Wastewater from Industrial Activities will also be obtained. Effluent from the sanitary sewer would continue to be treated in the anaerobic septic system and released below ground through the existing leach field. No environmental effects would be expected. Liquid effluents would continue to be monitored and results would continue to be reported annually through completion of this alternative.

5.2.4 Air Resources

5.2.4.1 Radiological Consequences for Air Resources

Airborne particulate radioactivity emissions associated with incident-free caretaking and deferred dismantlement activities were evaluated. The details of the analyses are provided in Appendix B, Section B.2. Analyses for this alternative utilized two assumed source terms - one

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for the 30-year caretaking period and a second one for the two-year deferred dismantlement period. For the caretaking period, the release source term was derived using the minimum detectable airborne radioactivity concentration of 2×10^{-14} microcuries per milliliter and the expected volume of ventilation air which would flow through the reactor compartment. For deferred dismantlement activities, the airborne particulate radioactivity source term was derived from radiation levels measured on high efficiency particulate air filters in reactor servicing ventilation systems used during past maintenance activities. The high efficiency particulate air filters have a greater than 99.95% efficiency for removal of airborne particulate radioactivity. It is conservatively estimated that 1.6×10^{-6} curies per year would be discharged during the caretaking period (4.8×10^{-5} total curies over thirty years) and 7.2×10^{-6} would be discharged during deferred dismantlement (1.4×10^{-5} for the two-year dismantlement period). Over the thirty-two year duration of this alternative, it is estimated that 6.2×10^{-5} curies would be cumulatively discharged into the air. As discussed in Chapter 4, Section 4.4.4, and reported in Reference 4-10, the radioactivity contained in exhaust air from calendar year 1994 Windsor Site activities totaled less than 1×10^{-3} curies of particulate fission and activation products and had no environmental impact. Therefore, deferred dismantlement activities would have no significant radiological consequences on air resources.

5.2.4.2 Nonradiological Consequences for Air Resources

During the caretaking period, there would be no regulated point sources of nonradiological industrial gaseous emissions at the Windsor Site. The principal source of nonradiological airborne emissions would be from liquid propane fueled heating units for preservation of remaining Windsor Site buildings. Nonradiological emissions would be approximately the same as current baseline conditions and would have no significant environmental impact. The discussion of nonradiological consequences of prompt dismantlement for air resources in Section 5.1.4.2 applies equally to the deferred dismantlement period.

5.2.5 Terrestrial Resources

Caretaking activities and the subsequent dismantlement of the defueled S1C Prototype reactor plant would not adversely affect terrestrial resources at the Windsor Site or surrounding areas. As discussed in Section 3.2.3, unnecessary buildings, systems, and pavement would be removed early to reduce caretaking and future Windsor Site restoration costs. Excavation activities for system removals would be accomplished in small, limited areas. Windsor Site restoration activities following deferred S1C Prototype reactor plant dismantlement would be the same as described in Section 5.1.5 for prompt dismantlement.

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5.2.5.1 Expected Final Radiological Conditions of the Windsor Site Property After Deferred Dismantlement

After completion of all deferred S1C Prototype dismantlement activities, including final removal of Windsor Site buildings, systems and pavement, the discussion of Section 5.1.5.1 for unrestricted Windsor Site release conditions would apply similarly.

5.2.5.2 Expected Final Nonradiological Conditions of the Windsor Site Property After Deferred Dismantlement

After completion of all deferred dismantlement activities, including final removal of Windsor Site buildings, systems and pavement, the discussion of Section 5.1.5.2 for unrestricted Windsor Site release conditions would apply similarly.

5.2.6 Socioeconomics

Current Windsor Site staffing is about 150 personnel. This alternative results in a staff reduction for the caretaking period. The labor force needed to support caretaking activities at the Windsor Site is estimated at 8 full-time workers. Deferred dismantlement would require rehiring staff for a relatively short (2 year) period. During deferred dismantlement activities, staffing levels and demographics are expected to be similar to those described in the prompt dismantlement alternative (about 150 total personnel). Staff fluctuations associated with deferred dismantlement would not significantly affect regional unemployment levels.

Since the Windsor Site is currently owned by the U.S. Government, the Site is not taxable. Under the deferred dismantlement alternative, the possible transfer of the Windsor Site to a taxpaying entity would be delayed by approximately thirty years. However, considering the small size of the Windsor Site, the impact on the tax base of the town is not expected to be significant. Consequently, deferred dismantlement would not have any discernible socioeconomic impact on the region.

5.2.7 Cultural Resources

Caretaking activities and deferred dismantlement of the S1C Prototype reactor plant would not impact any cultural resources predating Windsor Site construction. Measures that will be carried out by the Department of Energy to address the effects of dismantlement activities on the Windsor Site and the S1C prototype reactor plant are identified in the Memorandum of Agreement with the State of Connecticut, as approved by the Advisory Council on Historic Preservation. A copy of this Memorandum of Agreement is included in Appendix E of this Environmental Impact Statement.

5.2.8 Noise, Aesthetic and Scenic Resources

Caretaking activities and deferred dismantlement of the S1C Prototype reactor plant would not have noticeable noise, aesthetic or scenic impacts. During caretaking, the aesthetic and scenic character of the Windsor Site would be maintained consistent with present conditions. Noise generation above ambient levels would not be expected. Dismantlement activities after the caretaking period would be similar to prompt dismantlement activities. The discussion on noise, aesthetic and scenic impacts in Section 5.1.8 is equally applicable to deferred dismantlement.

5.2.9 Traffic and Transportation

Caretaking activities and deferred dismantlement of the S1C Prototype reactor plant would not have a noticeable impact on regional and local traffic. During caretaking, Windsor Site staffing levels and traffic to and from the Windsor Site would be minimal. After caretaking, Windsor Site staffing and traffic would return to present levels for about a 2-year deferred dismantlement period. Impact on traffic during deferred dismantlement would be similar to that for prompt dismantlement, discussed in Section 5.1.9.

5.2.10 Occupational and Public Health and Safety

This section summarizes analysis results for expected incident-free conditions during a 30-year caretaking period followed by a two-year deferred dismantlement period. Section 5.2.12 summarizes analysis results for potential accident conditions during caretaking, deferred dismantlement and transport of materials.

5.2.10.1 Incident-Free Facility Activities

5.2.10.1.1 Incident-Free Facility Activities - Radiological Consequences

The radiological health risks associated with incident free-facility activities during a 30-year caretaking period and deferred dismantlement of the S1C Prototype reactor plant were evaluated in Appendix B, Section B.2. Effects from assumed airborne particulate radioactivity releases and direct radiation exposure were assessed for the worker, maximally exposed off-site individual and the general population. During a 30-year caretaking period, much of the short half-life radionuclides, primarily cobalt-60, would decay. This decay would result in a reduction factor of 52 for direct radiation exposure to workers compared to the prompt dismantlement alternative.

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Analyses for radiological exposure during the caretaking period and deferred dismantlement were made using a consistent approach as the analyses for prompt dismantlement, discussed in Section 5.1.10.1.1. Occupational exposure over the course of 30-years of caretaking activities would be approximately 2.1 person-rem. This occupational exposure is the same for the 30-year caretaking period of the no action alternative. Occupational exposure from deferred dismantlement activities would be in the range of 1.8 to 3.6 person-rem.

The combined health risks for direct radiation exposure and radioactive contamination to the air are summarized in Table B-6. It is conservatively estimated that the caretaking and dismantlement workers would receive between 3.9 to 5.7 person-rem (1.6×10^{-3} to 2.3×10^{-3} additional latent fatal cancer risk). The general population would receive 3.2×10^{-2} person-rem (1.6×10^{-5} additional latent fatal cancer risk) from exposure during caretaking and dismantlement.

5.2.10.1.2 Incident-Free Facility Activities - Nonradiological Consequences

Naval Reactors policy is to maintain a safe and healthful environment at all facilities, including the Windsor Site. During the caretaking period, no dismantlement activities would occur, no hazardous wastes or bulk supplies of materials would be stored, and facility activities would be limited to surveillance and security tours by a small number of personnel. As a result, incident-free nonradiological consequences would be insignificant. During deferred dismantlement activities, the nonradiological consequences during incident-free facility activities would be the same as the prompt dismantlement alternative, discussed in Section 5.1.10.1.2.

5.2.10.2 Incident-Free Transportation Analyses

The discussion in Section 5.1.10.2 for shipment destinations and transportation analysis assumptions applies equally to the deferred dismantlement alternative.

5.2.10.2.1 Incident-Free Transportation - Radiological Consequences

The radiological consequences associated with incident-free shipment of low-level radiological recyclable material and waste from deferred dismantlement were analyzed using the same approach described in Section 5.1.10.2.1. The potential radiological health risks associated with incident-free transportation of reactor plant components were evaluated using the RADTRAN 4 computer code. Health effects were assessed for the general population, transportation crew, hypothetical maximally exposed individuals in the general population and maximally exposed individual in the transportation crew. As discussed in Appendix C, Section C.2, a conservative simplification was made in the transportation analyses which assumed that all radioactive recyclable material or waste would be shipped to the same location, either the Savannah River disposal site in South Carolina or the Hanford disposal site in Washington State. Details for the technical approach for assessing incident-free radioactive shipments are provided in Appendix C, Section C.4. Computer model variables and assumptions are provided in Appendix C, Section C.5.

Packaging for the reactor pressure vessel shipment would be designed to meet the same transport index for both the deferred and prompt dismantlement alternatives. Analysis results for this one shipment are identical for both the deferred and prompt dismantlement alternatives. The radiological risks for shipment of all other radioactive recyclable materials and wastes under the deferred dismantlement alternative would be lower due to cobalt-60 decay. However, the volume of radioactive waste would not be reduced since the activated and contaminated reactor plant materials would still be radioactive due to long half-life radionuclides such as nickel-63.

The health risks due to low-level radioactive material shipments from the Windsor Site to the Savannah River disposal site for deferred dismantlement are summarized in Table C-14. Analyses indicate that the general population would receive 4.31 x 10^{-2} person-rem (2.15 x 10^{-5} additional latent fatal cancer risk) from shipment of low-level radioactive materials from the Windsor Site to the Savannah River disposal site. Transportation workers would receive 1.40 x 10^{-1} person-rem (5.61 x 10^{-5} additional latent fatal cancer risk) for the same shipments.

The health risks for shipments of the same packages to the Hanford disposal site are summarized in Table C-15 and are slightly higher due to the greater distance traveled. However, the radiological health risks are still very small. Analyses indicate the general population would receive 1.09 x 10^{-1} person-rem (5.46 × 10^{-5} additional latent fatal cancer risk) and the transportation crew would receive 2.18 x 10^{-1} person-rem (8.70 × 10^{-5} additional latent fatal cancer risk).

5.2.10.2.2 Incident-Free Transportation - Nonradiological Consequences

The nonradiological consequences associated with incident-free shipment of low-level radiological recyclable material and waste are identical for the prompt and deferred dismantlement alternatives. The discussion in Section 5.1.10.2.2 is equally applicable for the deferred dismantlement.

5.2.11 Utilities and Energy

Caretaking activities over a 30-year period, and the subsequent dismantlement of the defueled S1C Prototype reactor plant would not place large demands on utilities and energy resources.

Utility and energy usage during the caretaking period, such as seasonal heating and dehumidification of the reactor plant, would be minimal. Dismantlement activities would require quantities of fuel, water, and electricity typical of small to medium-sized construction or demolition projects. The amount of utilities and energy expected to be consumed would not result in any discernible environmental consequences.

5.2.12 Occupational and Transportation Accidents

Hypothetical accident scenarios were evaluated to estimate the potential for, and effects of, release of radioactive material and toxic chemicals. Appendix B, Section B.3 provides details of hypothetical facility accidents resulting in the release of radioactive materials to the environment. Appendix B, Section B.4 provides analysis of a diesel fuel fire. Appendix C, Section C.6 describes the technical approach for assessing radioactive shipment accidents. The result of these analyses are presented in terms of the health risks to facility workers and the public. The overall health risk is a product of the probability that the accident would occur and the consequences resulting from the accident.

5.2.12.1 Facility Accidents

5.2.12.1.1 Radiological Consequences of Facility Accidents

Several hypothetical accident scenarios that would result in uncontrolled release of radioaetivity to the environment were evaluated to determine the long term health risks. The hypothetical release of airborne radioactivity and exposure to direct radiation during accident scenarios were assessed for the worker, maximally exposed off-site individual and the general population.

As described in Appendix B, Section B.1.2, accidents were considered if they were expected to contribute substantially to risk. Risk is defined as the product of the probability of occurrence times the consequence of the accident. The four hypothetical accident scenarios evaluated for the dismantlement activities included 1) a large component drop, 2) mechanical damage of a component due to a wind-driven missile, 3) an airplane crash into the reactor plant with damage to several components, 4) and a high efficiency particulate air filter fire. Variables considered in the analyses include source terms, population density, meteorological conditions, affected area and pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation).

For the caretaking period, a high efficiency particulate air filter fire was evaluated. The other accident scenarios were considered but were not evaluated in detail. A component drop accident was not evaluated since lifting or handling of large components would not occur during the caretaking period. The steel hull of the reactor compartment would absorb most of the energy from any airplane crashes or wind-driven missiles and would limit any release of radioactive materials to the environment. All four accident scenarios were considered for the two-year deferred dismantlement period following the thirty-year caretaking period.

The details of the analysis are provided in Appendix B, Section B.3. As shown in Appendix B, Table B-16, during the caretaking period, the cumulative risk of a member of the general population developing a latent fatal cancer from a high efficiency particulate air filter fire accident is 2.6×10^{-8}. This risk is the product of the probability of the accident occurring

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(5×10^{-4} per year) times the consequence of the accident (1.7×10^{-6} latent fatal cancers) times 30 years. During deferred dismantlement activities, the accident with the greatest annual risk is an airplane crashing into the reactor plant. The annual risk of a member of the general population developing a latent fatal cancer due to an airplane crash accident is 1.1×10^{-8}. This risk is a product of the probability of the accident occurring (6.6×10^{-7} per year) times the consequence of the accident (1.7×10^{-2} latent fatal cancers). The cumulative risk during the thirty-year caretaking period combined with the cumulative risk during the two-year deferred dismantlement period yields a total cumulative risk of 4.8×10^{-8} for the entire duration of the deferred dismantlement alternative. This is an extremely small risk compared to other incident-free risks due to the low probability of the accidents occurring.

5.2.12.1.2 Nonradiological Consequences of Facility Accidents

The nonradiological consequences associated with the caretaking and dismantlement activities are the same as the prompt dismantlement alternative. The discussion of Section 5.1.12.1.2 is applicable for the deferred dismantlement alternative. During the caretaking period, no dismantlement activities would occur, no hazardous wastes would be stored, and no bulk supplies of materials would be stored.

Nonradiological occupational accidents, such as slips and falls could occur during the caretaking period and deferred reactor plant dismantlement. However, the rate is not expected to be greater than rates for other construction activities (provided in Table 4-6). Projections of the number of fatalities, injuries or illnesses were calculated based on Table 4-6 Department of Energy rates and are summarized in Table 5-2 for the deferred dismantlement alternative. These results indicate that the overall nonradiological occupational risks are small.

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Table 5-2: Estimated Nonradiological, Occupational Impacts for Deferred Dismantlement

	Caretaking	Dismantlement
Estimated Windsor Site Staffing Level	8	150
Estimated average injuries/illnesses per year [a]	2.9×10^{-1}	9.9
Estimated fatalities per year [a]	2.4×10^{-4}	1.5×10^{-2}
Total estimated number of injuries/illnesses [b]	8.7	19.8
Combined totals	28.5	
Total estimated number of fatalities [b]	7.2×10^{-3}	3.0×10^{-2}
Combined totals	3.7×10^{-2}	

a. Calculated by multiplying Windsor Site staffing levels times the Department of Energy rates provided in Table 4-6. Rates for construction workers were used for dismantlement activities and rates for all labor categories were used for caretaking activities.

b. Total values calculated for a 30-year caretaking period and two-year dismantlement period.

5.2.12.2 Transportation Accidents

There has never been a major accident nor measurable release of radioactivity to the environment during shipment of Naval Reactors program waste or materials, however, hypothetical accidents were evaluated to determine potential environmental effects.

5.2.12.2.1 Radiological Consequences of Transportation Accidents

Appendix C, Section C.6 provides the technical approach used for assessing hypothetical radioactive shipment accidents. Health effects were assessed for the general population and the hypothetical maximally exposed individual. Analyses assumed that the transportation workers would evacuate the scene of an accident within a relatively short time after the accident occurred. Therefore, the risks of transportation accidents on transportation workers are included in the results for the general population.

Radiological health risks from uncontrolled releases of radioactivity to the environment and direct radiation exposure from damaged packages were evaluated using the RADTRAN 4 and RISKIND computer codes. Variables considered in the analyses include affected areas and pathways for exposure to radiation (such as external direct exposure and internal exposure from inhalation), weather conditions and accident and package release fractions. The major contributor to radiation exposure would be from the ground contamination pathway (more than 90% of total exposure).

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The health risks associated with transportation accidents for shipments from the Windsor Site to the Savannah River disposal site for deferred dismantlement are summarized in Table C-18. Analyses indicate that the general population would receive 1.75×10^{-5} person-rem (8.75×10^{-9} additional latent fatal cancer risk) in this scenario.

The health risks associated with transportation accidents for shipments of the same packages from the Windsor Site to the Hanford disposal site for prompt dismantlement are summarized in Table C-19. Analyses indicate that the general population would receive 2.08×10^{-5} person-rem (1.04×10^{-8} additional latent fatal cancer risk) in this scenario. These results are slightly higher than the Savannah River destination due to the greater distance traveled. However, the radiological health risks are still very small.

When compared to the radiological health risks associated with incident-free radioactive recyclable material and waste shipments (see Section 5.2.10.2) the consequences of hypothetical accidents are less. This is due to the very low probability of a severe accident occurring.

5.2.12.2.2 Nonradiological Consequences of Transportation Accidents

The nonradiological consequences associated with the transportation accidents for the prompt dismantlement alternative, Section 5.1.12.2.2, are the same for the deferred dismantlement alternative.

5.2.13 Waste Management

As discussed in Section 3.2.2, deferred dismantlement activities would be similar to prompt dismantlement activities. Deferred dismantlement would not result in any reduction in the estimated radioactive material volume. Although cobalt-60 will decay to less than 2% of the levels at the start of a 30-year caretaking period, other long half-life radionuclides such as nickel-63 will remain. Nickel-63 has a half-life of approximately 100 years and will decay to only 81% of its initial levels after 30 years.

Deferred dismantlement would result in the same number of shipments of recyclable materials and wastes as the prompt dismantlement alternative. Low-level radioactive waste from deferred dismantlement would meet the same disposal site requirements as discussed in Section 5.1.13. Decay of radioactivity in the S1C Prototype reactor plant could allow for a greater percentage of radioactive metals to be candidates for recycling or volume reduction than the percentages discussed in Section 5.1.13. However, considering that the estimated volume and curie content of low-level radioactive wastes associated with prompt dismantlement falls within ranges currently experienced within the Department of Energy, deferred dismantlement would have an even lower environmental effect. The volume of mixed waste resulting from deferred dismantlement is estimated to be the same as discussed in Section 5.1.13.

During caretaking, waste generated would consist mainly of municipal trash, and disposal would be consistent with state and local regulations.

5.2.14 Irreversible and Irretrievable Commitments of Resources

The deferred dismantlement alternative would not involve any irretrievable or irreversible commitment of environmentally sensitive resources. As discussed previously in this section, this alternative would not contribute to any loss of endangered species, critical habitat, or areas of archeological, historical or cultural value. Deferred dismantlement activities would not require any significant demand on consumable resources such as utilities and energy. No additional land at disposal sites would be required to dispose of dismantlement wastes. This alternative delays release of the Windsor Site land resource for other unrestricted uses for at least thirty-two years.

5.3 No Action Alternative

This alternative would maintain the defueled and drained reactor plant in a protected condition for an indefinite period of time. Caretaking period operations for this alternative would be identical to caretaking period operations described in the deferred dismantlement alternative (section 3.2.1), except that the voluntary facility assessment process (described in Chapter 4 and Appendix F) and the radiological survey process (discussed in Appendix G) and any associated remediation activities would not be completed. Periodic inspections, radiological surveys, and reactor compartment ventilation systems would be the same. For the purposes of comparison to the other alternatives, a 30-year time frame was assumed in analyses that evaluate the environmental effects of this alternative. Section 3.3 provides a detailed description of the no action alternative. Environmental impacts are discussed below.

5.3.1 Land Use

While the no action alternative would not adversely impact area land use compared to present conditions, the alternative prevents the possibility of unrestricted release of the Windsor Site property. Caretaking activities would be confined within the Windsor Site property boundary which is an already developed area. There would be no interference with present or planned use of the surrounding areas. The U.S. government would maintain ownership of the Windsor Site property. Access to areas inside the Windsor Site's security fence would continue to be controlled for as long as the defueled S1C Prototype reactor plant remains on-site.

5.3.2 Ecological Resources

Caretaking activities over an indefinite period would not impact ecological resources at the Windsor Site or surrounding areas. Windsor Site caretaking activities would include periodic radiological monitoring, visual inspections, and maintenance of the reactor compartment (see Section 3.2.1). Environmental monitoring would be continued and results would be reported annually.

5.3.3 Water Resources

The Windsor Site is not located in a 100 or 500-year floodplain area. Caretaking activities would not involve any earth moving work. Flood plains in the vicinity of the Windsor Site would not be affected by caretaking activities.

5.3.3.1 Radiological Consequences for Water Resources

Caretaking activities would not result in any discharges of radioactive liquid effluents. Ground water under the Windsor Site and surface water in the surrounding environment would not be affected.

5.3.3.2 Nonradiological Consequences for Water Resources

During caretaking activities, liquid discharges from the Windsor Site would be limited to Storm water runoff. Approximate flow of this drainage was incorporated in the State of Connecticut Department of Environmental Protection General Storm water Permit application. Liquid effluents would continue to be monitored and results would continue to be reported annually.

5.3.4 Air Resources

5.3.4.1 Radiological Consequences for Air Resources

Airborne particulate radioactivity emissions associated with the no action alternative were evaluated. The details of the analyses are provided in Appendix B, Section B.2. Analyses for this alternative assumed an airborne particulate radioactivity source term which was derived using the minimum detectable airborne radioactivity concentration of 2×10^{-14} microcuries per milliliter and the expected volume of ventilation air which would flow through the reactor compartment. It is conservatively estimated that 1.6×10^{-6} curies per year would be discharged during the caretaking period (4.8×10^{-5} total curies over thirty years). As discussed in the deferred dismantlement alternative, Section 5.2.4.1, caretaking activities would have no significant radiological consequences on air resources.

5.3.4.2 Nonradiological Consequences for Air Resources

During the no action alternative, there would be no regulated point sources of nonradiological industrial gaseous emissions at the Windsor Site. The principal source of nonradiological airborne emissions would be from liquid propane fueled heating units for preservation of remaining Windsor Site buildings. Nonradiological emissions would be approximately the same as current baseline conditions and would have no significant environmental impact.

5.3.5 Terrestrial Resources

Caretaking activities over an indefinite period would not impact terrestrial resources on or surrounding the Windsor Site.

5.3.5.1 Expected Radiological Conditions of the Windsor Site Property During the No Action Alternative

The radiological conditions would remain essentially as they are today, as described in Section 4.5.4.1. Since there is no significant adverse radiological effect caused by the current condition, no significant adverse environmental impact would be expected in the future other than the need to restrict access to the actual prototype plant.

5.3.5.2 Expected Nonradiological Conditions of the Windsor Site Property During the No Action Alternative

The nonradiological conditions would remain as they are today, as described in Section 4.5.5.1. Since the voluntary facility assessment process (described in Chapter 4) would not be completed, a small amount of chemically contaminated soil might remain on the Windsor Site. Since no adverse environmental impacts associated with these conditions have been noted, no adverse impacts would be expected in the future, other than the remaining presence of this material on the Windsor Site.

5.3.6 Socioeconomics

Current Windsor Site staffing is about 150 personnel. The no action alternative would result in a staff reduction for the caretaking period. The labor force needed to support caretaking activities would be 7.7 equivalent full-time workers. Staff reductions associated with the no action alternative would not significantly affect regional unemployment levels.

Since the Windsor Site is currently owned by the U.S. Government, the Site is not taxable. Under the no action alternative, the possible transfer of the Windsor Site to a taxpaying entity would be delayed indefinitely. However, considering the small size of the Windsor Site, the impact on the tax base of the town is not expected to be significant. Consequently, the no action alternative would not have any discernible socioeconomic impact on the region.

5.3.7 Cultural Resources

Caretaking activities over an indefinite period would not impact any cultural resources predating Windsor Site construction.

5.3.8 Noise, Aesthetic and Scenic Resources

Caretaking activities over an indefinite period would not have any noise, aesthetic or scenic impacts. During caretaking, the aesthetic and scenic character of the Windsor Site would be maintained consistent with present conditions. Noise generation above ambient levels would not be expected.

5.3.9 Traffic and Transportation

Caretaking activities over an indefinite period would not impact regional and local traffic since the Windsor Site staffing level and associated traffic would be minimal.

5.3.10 Occupational and Public Health and Safety

Detailed analyses of potential impacts on worker and public health are described in Appendix B for facility activities. This section summarizes analysis results for expected incident-free conditions during a 30-year caretaking period for the no action alternative. There would be no off-site transport of materials during this alternative, hence, Appendix C analyses do not apply to this alternative. Section 5.3.12 summarizes the analyses results associated with potential accident scenarios during the caretaking period.

5.3.10.1 Incident-Free Facility Activities - Radiological Consequences

The radiological health risks associated with incident-free facility activities during a 30-year caretaking period were evaluated in Appendix B, Section B.2, for the no action alternative. Effects from assumed airborne particulate radioactivity releases and exposure to direct radiation were assessed for the worker, maximally exposed off-site individual and the general population.

Caretaking activities during the no action alternative and the deferred alternative are the same. The discussions in Section 5.2.10.1.1, relative to caretaking, are applicable to the no action alternative.

The details of the analyses are provided in Appendix B, Section B.2. The combined health risks for direct radiation exposure and radioactive exposure to the air have been summarized in Table B-6. It is conservatively estimated that the radiation workers would receive 2.1 person-rem (8.4×10^{-4} additional latent fatal cancer risk) and the general population would receive 3.2×10^{-2} person-rem (1.6×10^{-5} additional latent fatal cancer risk) from exposure during caretaking.

5.3.10.2 Incident-Free Facility Activities - Nonradiological Consequences

Naval Reactors policy is to maintain a safe and healthful environment at all facilities, including the Windsor Site. During this alternative, no dismantlement activities would occur, no hazardous wastes or bulk supplies of materials would be stored, and facility activities would be limited to surveillance and security tours by a small number of personnel. As a result, incident-free nonradiological consequences would be insignificant.

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5.3.11 Utilities and Energy

Caretaking activities over an indefinite period would not place a large demand on utilities and energy resources. Usage during the caretaking period, such as for seasonal heating and dehumidification of the reactor plant, would be very small.

5.3.12 Facility Accidents

Hypothetical accident scenarios were evaluated to estimate the potential for, and effects of, release of radioactive material and toxic chemicals. Appendix B, Section B.3 provides details of hypothetical facility accidents resulting in the release of radioactive materials to the environment. Appendix B, Section B.4 provides analysis of a nonradiological fuel fire. The result of these analyses are presented in terms of the health risks to facility workers and the public. The overall health risk is a product of the probability that the accident would occur and the consequences resulting from the accident.

5.3.12.1 Radiological Consequences of Facility Accidents

For the no action alternative, only a high efficiency particulate air filter fire was evaluated in detail. The other accident scenarios were considered but were not evaluated in detail. A component drop accident was not evaluated since lifting or handling of large components would not occur during the caretaking period. The steel hull of the reactor compartment would absorb most of the energy from any airplane crashes or wind-driven missiles and would limit any release of radioactive materials to the environment.

The details of the analysis are provided in Appendix B, Section B.3. As shown in Table B-16, the annual risk of a member of the general population developing a latent fatal cancer due to a high efficiency air filter fire during a caretaking period is 8.5×10^{-10}. This risk is a product of the probability of the accident occurring (5×10^{-4} per year) times the consequence of the accident (1.7×10^{-6} latent fatal cancers). Over the thirty-year duration considered for the no action alternative, the cumulative risk to the general population from a high efficiency particulate air filter fire is 2.6×10^{-8}. This is extremely small compared to other incident-free radiological impacts.

5.3.12.2 Nonradiological Consequences of Facility Accidents

During the caretaking period, there would be no hazardous waste or bulk storage quantities of other products at the Windsor Site. Therefore, the only type of nonradiological accident that was considered for the no action alternative was worker accidents. Projections of the number of fatalities, injuries or illnesses were calculated based on Table 4-6 Department of Energy rates and results are summarized in Table 5-3 for the no action alternative. These results indicate that the overall nonradiological occupational risks are small.

Table 5-3: Estimated Nonradiological, Occupational Impacts for No Action

Estimated Windsor Site Staffing Level (equivalent full-time workers)	7.7
Estimated average injuries/illnesses per year [a]	2.8×10^{-1}
Estimated fatalities per year [a]	2.3×10^{-4}
Total estimated injuries/illnesses [b]	8.4
Total estimated number of fatalities [b]	6.9×10^{-3}

a. Calculated by multiplying Windsor Site staffing level times the Department of Energy rates for all labor categories provided in Table 4-6.

b. Total values calculated for a 30-year caretaking period.

5.3.13 Waste Management

Caretaking activities over an indefinite period would generate only very small volumes of waste. Waste generated would consist mainly of municipal trash, and disposal would be consistent with state and local regulations.

5.3.14 Irreversible and Irretrievable Commitments of Resources

The no action alternative would not involve any irretrievable or irreversible commitment of environmentally sensitive resources. As discussed previously in this section, this alternative does not impact any endangered species, critical habitat, or areas of archeological, historical or cultural value. Demand on consumable resources such as utilities and energy for caretaking of the S1C Prototype reactor plant and remaining Windsor Site buildings would be negligible. Under this alternative, the Windsor Site land resource would continue to be unavailable for other uses indefinitely.

5.4 Cumulative Impacts and Comparison of Alternatives

A summary of cumulative impacts associated with the different alternatives is provided in the following sections. There are no significant cumulative impacts specifically associated with any of the three reasonable alternatives for disposal of the S1C Prototype reactor plant. Because the health risks to the public from transportation of recyclable materials and wastes would be extremely small and indistinguishable from other unrelated health risks, there would be no cumulative transportation related impacts.

5.4.1 Land Use

There are no cumulative land use impacts specifically associated with any of the alternatives considered. The existing land of the entire Windsor Site, 10.8 acres, has already been disturbed from its natural state. The alternatives would not disturb any additional undeveloped land or add land to the Windsor Site. The Windsor Site and the surrounding land are both zoned for industrial use. The alternatives would not affect the current and future use of land surrounding the Windsor Site. Prompt dismantlement could allow for the unrestricted release of the Windsor Site property for other uses, consistent with the existing zoning, as early as 2001. Deferred dismantlement would postpone the unrestricted release of the Windsor Site property until 2031 at the earliest. Similarly, the no action alternative would postpone unrestricted release indefinitely while the S1C Prototype reactor compartment remains in place.

Low-level radioactive waste would meet the disposal site requirements discussed in Section 5.1.13. For the deferred dismantlement alternative, decay of radioactivity in the S1C Prototype reactor plant could allow for a greater percentage of the radioactive metals to be candidates for recycling or volume reduction than the percentages discussed in Section 5.1.13 for prompt dismantlement. However, the estimated volume and curie content of the low-level radioactive wastes associated with prompt dismantlement falls within ranges currently experienced within the Department of Energy. Deferred dismantlement would have an even lower environmental effect. The volume of mixed waste resulting from both the prompt and deferred dismantlement is estimated to be the same as discussed in Section 5.1.13.

5.4.2 Water Resources

There are no cumulative water resource impacts specifically associated with any of the alternatives. The Windsor Site property does not include any bodies of open surface water. An overview of historical impacts from liquid effluents discharged at the Windsor Site is discussed in detail in Section 4.3.

Since 1979, only nonradioactive water discharges have been released from the Windsor Site. As discussed in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-10), there was no significant impact from radiological discharges during former Windsor Site operations on the environment or adverse effect on the community or the public. None of the alternatives would result in the discharge of radiological effluents.

As discussed in Section 4.3.4, nonradiological discharges have included process water and storm water runoff. None of the alternatives would result in discharges other than storm water runoff. The storm water runoff that would occur during the alternatives would not add any cumulative effects from the existing conditions.

5.4.3 Air Resources

There are no cumulative air resource impacts specifically associated with any of the alternatives considered. Existing operations having a potential for the release of airborne particulate radioactivity are serviced by monitored exhaust systems. Prior to release, the exhaust air is passed through high efficiency particulate air filters to minimize radioactivity content. As reported in Section 4.4.4, the radioactivity contained in exhaust air for 1994 consisted of less than 1×10^{-3} curies of particulate fission and activation products and approximately 9×10^{-3} curies of tritium. The average radioactivity concentration was well below applicable standards (Reference 3-3). The annual radioactivity concentration at the nearest Windsor Site boundary, allowing for typical diffusion conditions, was less than 0.01 percent of the Department of Energy derived concentration guide for air released to unrestricted areas (Reference 3-3). Public radiation exposures from airborne radioactivity are calculated using computer models qualified for this specific task. These models conservatively estimate the radiation exposure to the public through many pathways, including radioactivity in surface soil, vegetation and animal pathways from airborne radioactivity sources. The exposures are calculated using computer models because direct measurement results are indistinguishable from naturally occurring background radioactivity levels.

As discussed in Sections 5.1.4.1, 5.2.4.1, 5.3.4.1, and Appendix B, Section B.2, radiological airborne emissions associated with incident-free activities under the three alternatives have been estimated from 1.5×10^{-5} to 6.2×10^{-5} curies. These emissions would not have a discernible effect on the existing Windsor Site discharge of airborne radioactivity. Therefore, none of the alternatives would have a cumulative impact on the existing radiological air emissions.

The existing nonradiological air emissions from the Windsor Site are from three liquid propane heating units. There are no longer any regulated sources of nonradiological pollutant air emissions at the Windsor Site. During the dismantlement activities of the prompt and deferred alternatives, dust from demolition work and vehicle exhaust emissions would result in a small incremental addition to the Windsor Site nonradiological air emissions. Cumulative air emissions would not threaten to exceed any applicable Federal, State, or local air quality requirement or regulation.

5.4.4 Transportation

The cumulative transportation impacts associated with the dismantlement activities of the prompt and deferred alternatives would be small. The estimated total of twenty-three radioactive material shipments from the Windsor Site would be a small part of the more than two million shipments of radioactive materials made annually in the United States (Reference 5-4). Since deferred dismantlement would not reduce the volume of radioactive waste generated compared to prompt dismantlement, due to long-lived radionuclides, the cumulative transportation impacts would be the same for both alternatives.

5.5 Unavoidable Adverse Effects

There are no discernible unavoidable adverse effects associated with the implementation of any of the alternatives and none which would help to choose among the alternatives. The prompt dismantlement alternative would result in a greater occupational dose during dismantlement, and would cause the public to be exposed to small amounts of radiation during transportation of radioactive recyclable materials and waste. However, associated health effects would be very low, with much less than one latent fatal cancer expected. There would be no changes to the ecological, cultural, geological, and aesthetic resources due to the implementation of any of the alternatives.

5.6 Preventive and Mitigative Measures

The ALARA concept (As Low As Reasonably Achievable) would be applied to work at the Windsor Site to minimize radiological exposure to the work force and to the general public. Workers would be trained to perform their assigned tasks using approved procedures in a safe, efficient manner to reduce the likelihood of personal injury, equipment or facility damage and environmental consequences.

The question of what remediation of the brook, if any, may be required is a subject that is under the purview of the property owner and appropriate regulatory agencies. Since this Environmental Impact Statement is intended to arrive at a decision on alternatives for dismantling the S1C Prototype reactor plant and releasing the Government-owned Windsor Site for unrestricted use, and since the brook is not on the Windsor Site property, specific alternatives for potential remedial actions for the brook are beyond the scope of this Environmental Impact Statement.

CHAPTER 6
ENVIRONMENTAL JUSTICE

6.0 ENVIRONMENTAL JUSTICE

6.1 Introduction

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (*Federal Register* 59 FR 32, page 7629, dated February 16, 1994) directs Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies and activities on minority or low-income populations. A disproportionately high and adverse human health or environmental effect occurs when there is a high adverse effect that occurs for minority or low-income populations at an appreciably higher rate than occurs for the general population.

6.2 Community Characteristics

The Capital (north central) Region of Connecticut was selected as a reasonable area for consideration of environmental justice impacts analysis. The region is made up of 29 municipalities, including the Town of Windsor. According to the 1990 Census, the region population is about 18% minority and about 8% at or below poverty level.

Definitions for minority and low-income populations are based on definitions used in the Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement, (Reference 1-1). For this assessment, minority populations are identified as those municipalities within the region for which the percent minority population exceeds the average for the region. There are three minority populations in the region: the Towns of Bloomfield and Windsor, and the City of Hartford. Of the three minority populations in the region, the largest percentage of minorities is in the City of Hartford. Low-income populations are identified as those municipalities within the region for which the percent of the population living in poverty exceeds 25%. The U. S. Census Bureau characterizes persons in poverty as those whose income is less than a "statistical poverty threshold." For the 1990 census, this threshold was based on a 1989 income of $12,500 per household. The only low-income population in the region is the City of Hartford.

6.3 Environmental Justice Assessment

In Chapter 5 of this Environmental Impact Statement, a review was made of human health effects and environmental impacts associated with the three alternatives under consideration. Caretaking and dismantlement activities present no significant health effects and do not constitute reasonably foreseeable adverse impacts to the regional population. The largest potential health effect, while still small, results from occupational radiation exposure to the dismantlement workers, who do not, for purposes of Executive Order 12898, comprise a low-income or minority community.

The number of potential injuries and fatalities as a result of transportation and/or occupational accidents is very small for any of the alternatives. The latent fatal cancer risk for workers and the public resulting from caretaking/dismantlement activities and from the transportation of radioactive materials off-site is very small. The prompt dismantlement and the deferred dismantlement alternatives could allow for the eventual unrestricted release of the Windsor Site. The latent fatal cancer risk from exposure to residual radioactivity levels in the soil below the established release limit is very small.

Socioeconomic impact, in terms of jobs lost to the region, would not be distinguishable for any of the alternatives. The prompt dismantlement alternative would maintain Windsor Site staffing at current level (about 150) for a period of approximately two years, after which it would be further reduced. The no action alternative would result in a more immediate staffing reduction. The deferred dismantlement alternative would also result in an immediate staffing reduction, but with a temporary rehiring after the caretaking period. For any of the alternatives, the job reductions should be absorbed readily into the regional economy.

None of the alternatives would result in the disturbance of undeveloped land or the addition of land to the Windsor Site. Caretaking and S1C Prototype reactor plant dismantlement activities would be confined within the Windsor Site property boundary and would not adversely impact any subsistence consumption of fish, game, or native plants in the region. Liquid and gaseous discharges resulting from caretaking and dismantlement activities would be controlled to maintain water quality and air quality. The aesthetic character of the area surrounding the Windsor Site would remain unchanged.

6.4 Conclusion

None of the alternatives analyzed would result in disproportionately high and adverse environmental or health effects on any particular segment of the population, including minority and low-income populations. Accordingly, none of the alternatives for disposal of the S1C Prototype reactor plant present an environmental justice concern.

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REFERENCES

1-1 Department of Energy, DOE/EIS-0203-F, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, April 1995

2-1 Knolls Atomic Power Laboratory, KAPL-4753, *Windsor Site Environmental Summary Report*, June 1993.

3-1 Code of Federal Regulations, Title 40, Part 61, Subpart H. *National Emission Standards for Emission of Radionuclides Other than Radon from Department of Energy Facilities*

3-2 Welt Katzen, A. U.S. Environmental Protection Agency, Consent Agreement and Order Regarding Site Treatment Plan for Mixed Waste Generated at Knolls Atomic Power Laboratory in Windsor, Connecticut, Letter dated October 12, 1995 to A.R.Seepo, Schenectady Naval Reactors Office.

3-3 U.S. Department of Energy Order 5400.5, *Radiation Protection of the Public and the Environment.*

3-4 Nuclear Regulatory Commission, *Radiological Criteria for Decommissioning; Proposed Rule*, Federal Register Volume 59, Number 161, Pages 43200 - 43232.

3-5 Environmental Protection Agency, *Radiation Site Cleanup Regulation*, preliminary working draft for staff and public comment, dated March 16, 1995.

3-6 Nuclear Regulatory Commission, NUREG/CR-5884, *Revised Analyses of Decommissioning for the Reference Pressurized Water Reactor Power Station*, October 1993.

4-1 Town of Windsor Planning Department, Town of Windsor Zoning Map, 1993.

4-2 U.S. Department of the Interior, National Wetlands Inventory, Windsor Locks, Connecticut. 1980

4-3 Dowhan, J.J. and Craig, R.J., *Rare and Endangered Species of Connecticut and Their Habitats. Connecticut Department of Environmental Protection*, Natural Resources Center, Report of Investigations No. 6., 1976.

4-4 McKay, Dawn M., Connecticut Department of Environmental Protection, Natural Resources Center, Letter dated April 11, 1994 to John J. Minno (Knolls Atomic Power Laboratory).

4-5 Fuss & O'Neill, Inc., *Hydrogeologic Assessment Combustion Engineering, Inc. Process Development Unit*, September 1982.

4-6 Connecticut Department of Environmental Protection, *Water Quality Classifications Map of Connecticut*, compiled by James E. Murphy, Water Compliance Unit, CTDEP, Connecticut Natural Resources Atlas Series, 1987.

4-7 Connecticut Department of Environmental Protection, Water Management Bureau, Water Quality Standards. 1992.

4-8 Ryder, R.B., Thomas, M.P. and Weiss L.A., USGS, *Water Resource Inventory of Connecticut, Part 7, Upper Connecticut River Basin*, Connecticut Water Resources Bulletin No. 24. 1981.

4-9 Federal Emergency Management Agency, National Flood Insurance Program, Flood Insurance Rate Map, Town of Windsor Connecticut - Hartford County, Panel 5 of 10; Rev. September 29, 1986.

4-10 Knolls Atomic Power Laboratory, *Environmental Monitoring Report*, calendar year 1994, KAPL-4812.

4-11 *Climates of the States*, Gale Research Co., Detroit, Michigan, 1985.

4-12 *1992 Weather Almanac*, Gale Research Co., Detroit, Michigan.

4-13 Schnabel, R.W. and Eric, J.H., USGS, *Bedrock Geologic Map of the Windsor Locks Quadrangle, Hartford County, Connecticut*, USGS Map GQ-388, 1964.

4-14 U.S. Department of the Interior, *Engineering Geology of the Northeast Corridor, Bedrock Geology*, U.S. Geological Survey, Washington, D.C., 1967.

4-15 U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Interior, Geological Service *Earthquake History of the United States*, Boulder, Colorado, 1982.

4-16 Town of Windsor Plan of Development, 1991.

4-17 Maddox, D., Connecticut Historical Commission, Letter dated July 19, 1995 to S. C. Gonzalez, Knolls Atomic Power Laboratory

4-18 Bellantoni, N.F., Office of State Archaeology, Connecticut State Museum of Natural History, University of Connecticut, Letter dated May 24, 1995 to S. C. Gonzalez, Knolls Atomic Power Laboratory.

4-19 1995 World Almanac. Occupational Illnesses, by Industry and Type of Illness; Fatal Occupational Injuries.

4-20 Department of Energy, DOE/EH-0507, Occupational Injury and Property Damage Summary, January - December 1994.

4-21 National Safety Council, Accident Facts, 1995 Edition.

4-22 Argonne National Laboratory, *Derivation of Guidelines for Cobalt-60, Nickel-63, and Uranium Residual Radioactive Material in Soil at the Combustion Engineering Site, Windsor, Connecticut*, March 1996 (Draft).

4-23 Connecticut Department of Environmental Protection, Letter dated October 3, 1995, from the Bureau of Water Management to Storm Water Permittees.

4-24 Town of Windsor Zoning Regulations. Effective November 8, 1985, as amended through October 19, 1995.

4-25 Shacklette, H.T. and J.G. Boergen, *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States,* United States Geological Survey Professional Paper 1270, 1984.

4-26 United States Department of Agriculture, Soil Conservation Service, Soil Survey Series 1958, No. 14, *Soil Survey, Hartford County, Connecticut*, Sheet Number 20, February 1962.

4-27 Metzler, K.J. and K. Rozsa, Connecticut Department of Environmental Protection, *Soil Catenas of Connecticut*, Hartford, Connecticut, April 1986.

4-28 Abelquist, E.W., Oak Ridge Institute for Science and Education, *Designation Survey Addendum Report, Combustion Engineering Site, Windsor Connecticut*, Oak Ridge, Tennessee, July 1996

4-29 Department of Energy, DOE/NR-8303, *An Aerial Radiological Survey of the Natural Background Radiation Over Windsor Locks, Connecticut and Surrounding Area*, and Survey Report Addendum, October 1983.

5-1 International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Annals of the ICRP, Vol. 21, No. 1-3, New York: Pergamon Press. 1991.

5-2 Department of Energy, DOE/EIS-0217, *Savannah River Site Waste Management Final Environmental Impact Statement*, July 1995.

5-3 National Academy of Sciences - National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BIER V*, Report of the Committee on the Biological Effects of Ionizing Radiations, 1990.

5-4 U.S. Nuclear Regulatory Commission, *Final Environmental Statement on the Transportation of Material by Air and Other Modes*, NUREG-0170, December 1977.

GLOSSARY

Defueling	The complete removal of all nuclear fuel from the reactor plant.
Dose	The amount of radiation received (in Rem or millirem).
Dose Rate	The radiation dose per unit time (in Rem per hour or millirem per hour).
Half-life	The time required for a radioactive substance to lose 50 percent of its activity by decay.
Hazardous Waste	The Resource Conservation and Recovery Act (40 CFR Part 261) defines Hazardous Waste as a waste that is listed on one of Environmental Protection Agency's hazardous waste lists or meets one of four hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity.
Long-Lived Isotope	A radionuclide with a long half-life.
Particulate Matter	Any material, except water in uncombined form, that is or has been airborne and exists as a liquid or a solid at standard conditions.
Person-Rem	The total radiation dose received by all of the individuals in a specific group over a specific period of time or during a specified work effort.
PM-10	Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers as measured by a reference method based on 40 CFR Part 50 Appendix J (Reference Method for Determination of PM 10 in the Atmosphere) and designated in accordance with 40 CFR Part 53 (Ambient Air Monitoring Reference and Equivalent Methods).
Radiation	Radiation is energy in the form of waves (rays) or particles that is emitted by unstable atoms during disintegration.
Radioactivity	The process of spontaneous decay or disintegration of an unstable nucleus of an atom; usually accompanied by the emission of ionizing radiation.

Radiological Exposure	Refer to "Dose."
Radionuclide	Atoms that exhibit radioactive properties. Standard practice for naming radionuclides is to use the name or atomic symbol of an element followed by its atomic weight (for example, cobalt-60, a radionuclide of cobalt).
Record of Decision	A public document that records the final decision(s) concerning a proposed action. The Record of Decision is based on information and technical analysis generated during the decision making process, which takes into consideration public comments and community concerns.
Rem	Rem (Roentgen Equivalent Man) is a unit of radiation that relates energy deposited to biological damage. (1 Rem = 1000 millirem).
Shielding	Materials, usually concrete, water, and lead, placed around radioactive material to protect personnel from radiation exposure.
Type B Shipping Container	A container designed to retain its containment and shielding integrity under both normal transportation conditions and the hypothetical accident test conditions of 10 CFR Part 71 (Packaging and Transportation of Radioactive Material).

APPENDIX A

RADIOACTIVE SOURCES AND HEALTH EFFECTS

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APPENDIX A

RADIOACTIVE SOURCES AND HEALTH EFFECTS

This appendix describes the sources and types of radiation encountered in the Naval Reactors program. Health effects resulting from radiation exposure are also presented.

A.1 Background Radiation

People have always lived in a sea of natural background radiation. Background radiation is as much a part of the earth's environment as the light and heat from the sun's rays. There are four principal sources of natural background radiation:

- cosmic radiation from the sun and outer space,
- terrestrial radiation from the natural radioactivity in soil and rocks,
- radiation from radon and its decay products, and
- internal radiation from the naturally radioactive elements that are part of our bodies.

The unit of effective dose equivalent is the rem. The rem is relatively large compared with the level of doses received from natural background radiation or projected as a result of releases of radioactivity to the environment. The millirem, which is one thousandth of a rem, is frequently used instead of the rem. The National Council on Radiation Protection and Measurements estimates that the average member of the population of the United States receives an annual effective dose equivalent of approximately 300 millirem from natural background radiation (Reference A-1). This is composed of approximately 28 millirem from cosmic radiation, 28 millirem from terrestrial radiation, 39 millirem from radioactivity within the body and 200 millirem from inhaled radon and its decay products. The cosmic radiation component varies from 26 millirem at sea level to 50 millirem in Denver (at 1600 meters). The terrestrial component varies from 16 millirem on the Atlantic and Gulf coastal plain to 63 millirem in the Rocky Mountains. The dose from inhaled radon and its decay products is the most variable. The average cosmic and terrestrial natural background radiation level measured in the vicinity of the Windsor Site is approximately 70 millirem per year.

In addition to natural background radiation, people are also exposed to manmade sources of radiation, such as medical and dental x-rays. The average radiation dose from these sources is about 53 millirem per year. Other manmade sources include consumer products, such as color television sets. An individual's radiation exposure from color television averages 0.3 millirem per year. An airplane trip results in increased radiation exposure. A round-trip flight between Los Angeles and New York results in a dose of about 5 millirem.

Background fission-product radioactivity also exists in the environment, primarily due to atmospheric nuclear weapons testing. Although the level is very low, these fission products are routinely detected in air, food and water when analyzed with extremely sensitive instruments and techniques.

A.2 Uranium Fission

A brief description of how the reactor plant produces energy will help explain the origins of its radioactivity. The fuel in a reactor contains enriched uranium sealed within a metal cladding. Uranium is one of the few materials capable of producing heat in a self-sustaining chain reaction. When a neutron causes a uranium atom to fission, the uranium nucleus is split apart producing atoms of lower atomic number called fission products. See Figure A-1. Some of the fission products produced by the nuclear reaction in the fuel are highly radioactive. When formed, the fission products initially move apart at very high speeds. However, fission products only travel a few thousandths of an inch before they are stopped within the fuel cladding. As the fission product movement is stopped, the kinetic energy of the fission products is converted to heat. The heat from the fuel is transferred via the reactor coolant into a steam generator which generates non-radioactive steam. The steam is used to drive propulsion plant equipment. Figure A-2 shows a simplified schematic of the reactor plant.

Naval fuel is designed, constructed and tested to ensure it will contain the radioactive fission products within the fuel itself. The materials used in Naval nuclear fuel assemblies are highly corrosion-resistant and highly radiation-resistant. As a result, the fuel assemblies are very strong and have a very high integrity. During normal reactor operation, there is no fission product release from the fuel.

Besides fission products, the nuclear reaction in the fuel also produces neutrons. During reactor operation, most of the neutrons produced are absorbed within the fuel and continue the chain reaction. However, some of the neutrons escape from the fuel. Most of the neutrons which escape from the fuel are absorbed in the walls of the reactor pressure vessel or the shielding immediately surrounding it. The remaining neutrons which escape from the fuel interact with other materials within the reactor compartment, which become activated, or radioactive.

Reactor plant components are constructed from many different materials. During normal reactor operations, trace amounts of corrosion and wear products are generated from piping system components and carried in the reactor coolant. As the reactor coolant circulates past the fuel, some of the corrosion and wear products also can absorb neutrons and become radioactive materials. A portion of the corrosion and wear products is removed from the coolant by a purification system. The portion that is not filtered out redeposits throughout the reactor piping systems or stays in the coolant.

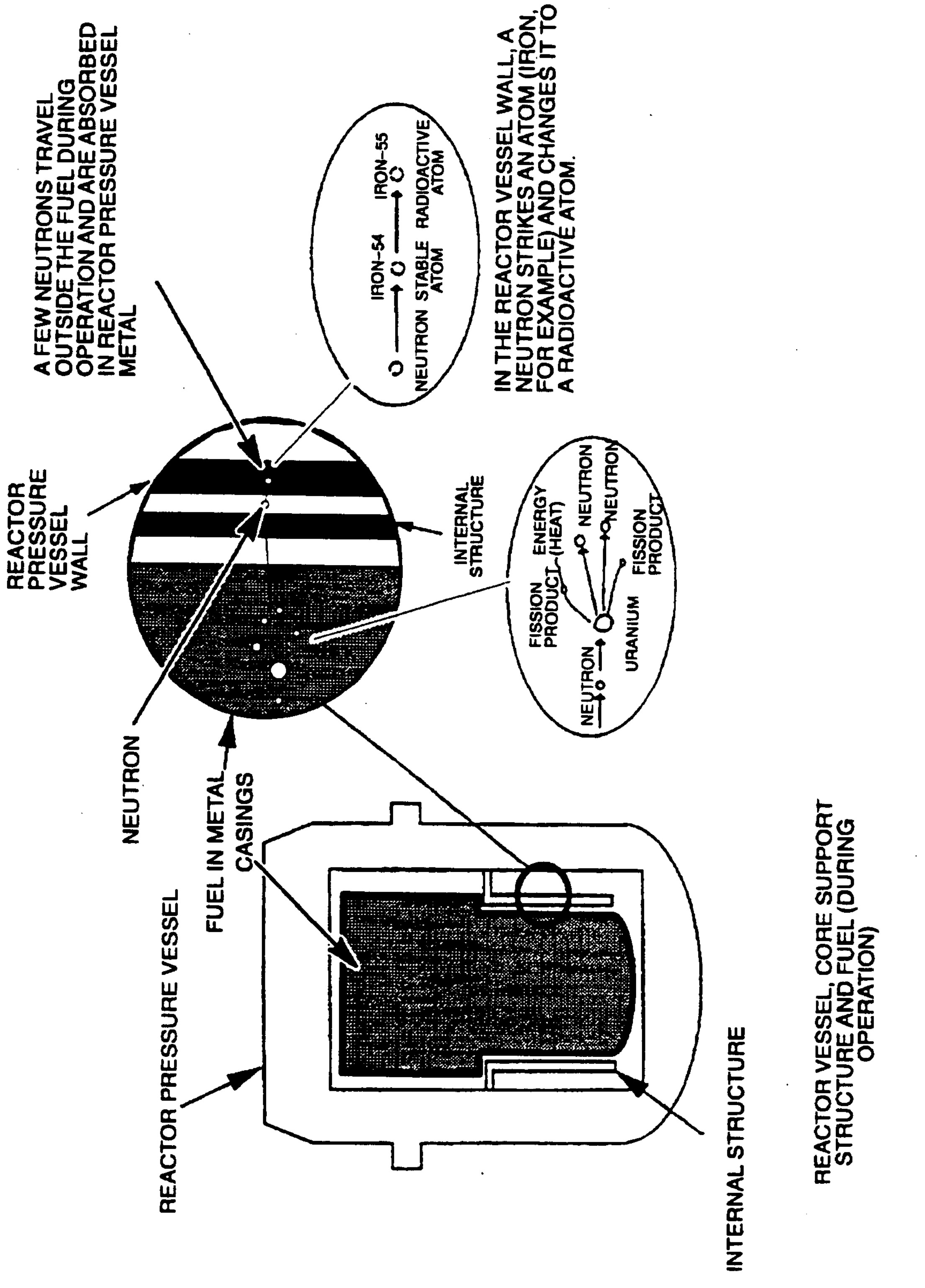

Figure A-1: Neutron and Fission Products From Uranium Fission

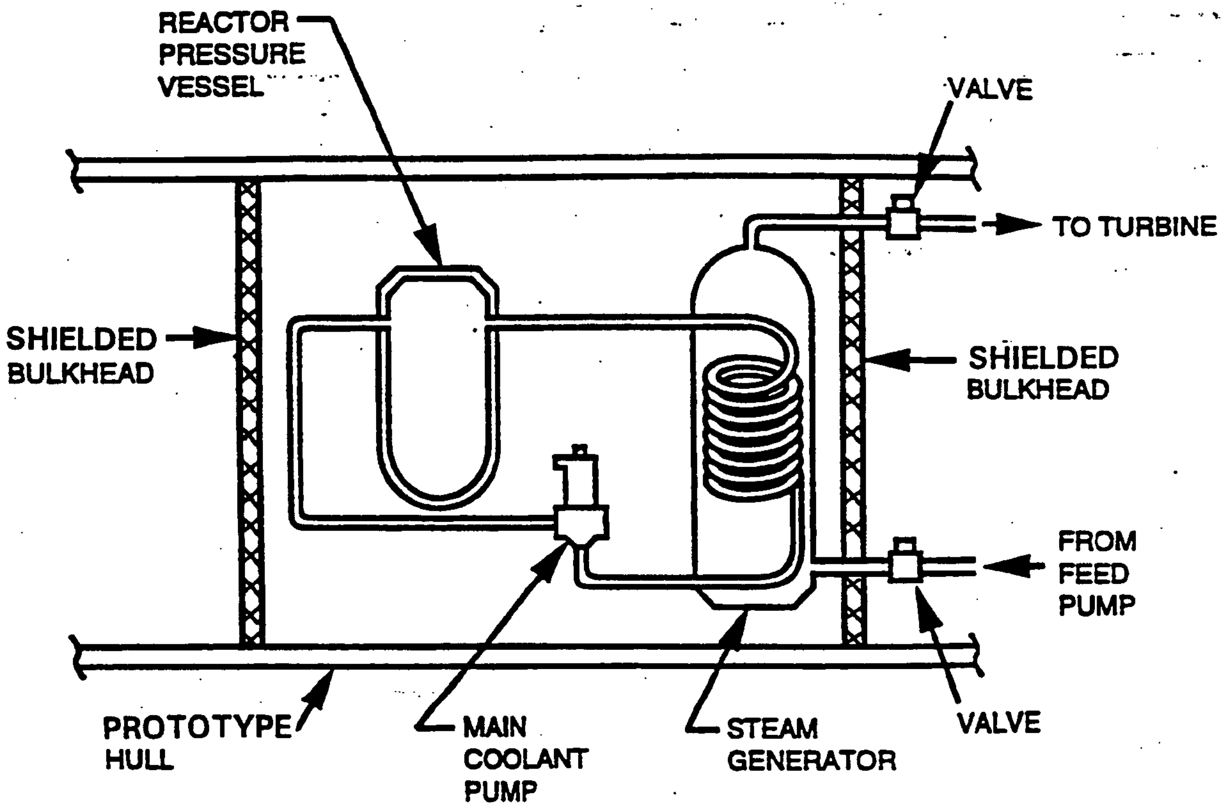

Figure A-2: Schematic of Nuclear Propulsion Plant

A.3 Radioactivation and Decay

Absorption of a neutron in the nucleus of a non-radioactive atom can produce a chemically identical radioactive atom (radionuclide). The process by which a material becomes radioactive from exposure to nuclear particles, such as neutrons, is known as activation or radioactivation. A large percentage of the radioactivity present in a defueled nuclear reactor is from activated metal. More than 99% of the remaining radioactivity in the defueled S1C Prototype reactor plant is an inseparable part of the metal components. Radioactive atoms in activated metal can only be released from the base material by the slow process of corrosion. The remaining radioactivity is comprised of the activated corrosion and wear products left from reactor operations. Release of the activated corrosion and wear products to the environment is prevented by maintaining the reactor compartment and reactor systems sealed.

The process by which radioactive atoms transform into non-radioactive atoms is known as radioactive decay. Typical particles and rays emitted during decay include alpha and beta particles, and gamma rays. Alpha radiation consists of small, positively charged particles of low penetrating power that can be stopped by a sheet of paper. Beta radiation consists of negatively charged particles that are smaller than alpha particles but are generally more penetrating and may require up to an inch of wood or other light material to be stopped. The gamma ray is an energy emission like an x-ray. Gamma rays have great penetrating power but are stopped by up to several feet of concrete or several inches of lead. In the defueled reactor plant, the most prevalent types of radiation are beta particles and gamma radiation.

Alpha particles, beta particles, and gamma rays are emitted in various combinations and energies. Each radionuclide emits a unique combination of radiations. Radionuclides may be identified by measuring the type, relative amounts, and energy of the radiations emitted. Measurement of half-life and chemical properties may also be used to help identify radionuclides. Half-life is a measure of the rate of radioactive decay. It is the time required for one-half of the atoms of a radioactive material to decay to another nuclear form.

Figure A-3 illustrates an example of the activation and radioactive decay processes. The nucleus of a non-radioactive (stable) iron atom contains a total of 54 particles, iron-54. When a non-radioactive iron atom absorbs a neutron, the nucleus contains 55 particles and is transformed to the iron-55 isotope. Iron-55 is radioactive. By releasing energy in the form of radiation, iron-55 eventually decays into manganese-55, which is non-radioactive.

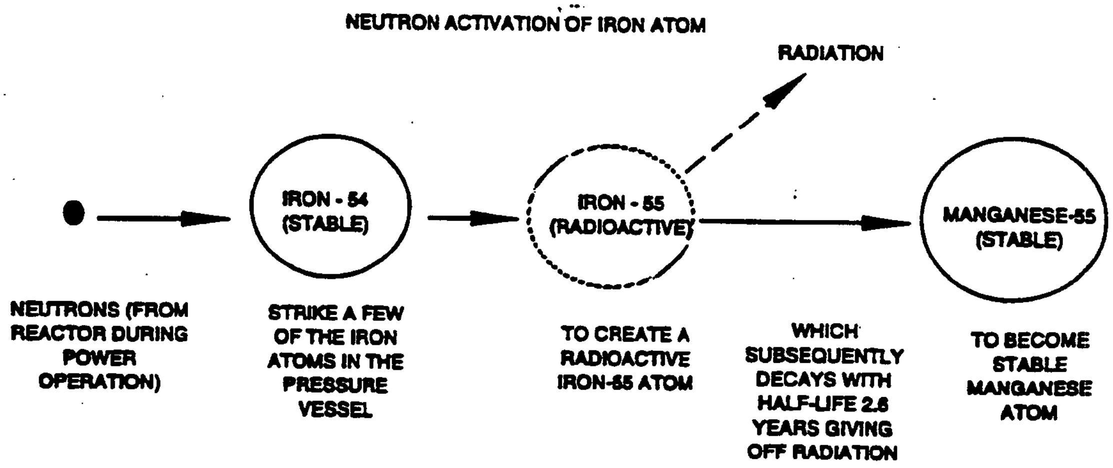

Figure A-3: Capture Neutrons in Iron of Pressure Vessel Walls

The curie (Ci) is the common unit used for expressing the magnitude of radioactive decay in a sample containing radioactive material. Specifically, the curie is that amount of radioactivity equal to 3.7 x 10^{10} (37 billion) disintegrations per second. For environmental monitoring purposes, the curie is usually too large a unit to work with conveniently and is broken down into smaller values such as the microcurie (μCi), which is one millionth of a curie (10^{-6} curie) and the picocurie (pCi), which is one trillionth of a curie (10^{12} curie). The typical radium dial wrist watch has about one microcurie of radium on the dial. The average person has about 100,000 picocuries of naturally occurring potassium-40 in his body. Typical soil and sediment samples contain about one picocurie of natural uranium per gram.

A.4 Health Effects

Body tissue can be damaged if enough energy from radiation is absorbed. The amount of energy absorbed by body tissue during radiation exposure is called absorbed dose. Studies of populations exposed to radiation have been performed to develop numerical estimates of the risk of radiation exposure. These risk estimates are useful in addressing the question of how hazardous radiation exposure is, and evaluating and setting radiation protection standards.

The most recent risk estimates were prepared in 1988 and 1990 by the United Nations Scientific Committee on the Effects of Atomic Radiation (Reference A-2), and the National Academy of Sciences - National Research Council Advisory Committee on the Biological Effects of Ionizing-Radiation (Reference A-3), respectively. These estimates were based on the use of new models for predicting risk, revised dose estimates for survivors of the Hiroshima and Nagasaki atomic bombs, and additional data on the cancer experience by both atomic bomb survivors and persons exposed to radiation for medical purposes. The risk estimate for radiation-induced cancer derived from these most recent analyses can be briefly summarized as follows:

In a group of 10,000 workers in the U.S., a total of about 2,000 (20 percent) will normally die of cancer. If each of the 10,000 received over his or her career an additional one rem of radiation exposure, an estimated 4 additional cancer deaths (0.04 percent) might occur. Therefore, the average worker's lifetime risk of cancer has been increased nominally from 20 percent to 20.04 percent. This risk estimate was extrapolated from estimates applicable to high doses and dose rates, and probably overstates the true lifetime risk at low doses and dose rates. In an assessment of this uncertainty, the National Academy of Sciences pointed out that "the possibility that there may be no risks from exposures comparable to external natural background radiation cannot be ruled out" (Reference A-3).

The health risk conversion factors used in this evaluation are taken from the International Commission on Radiation Protection, Reference A-4, which specifies 0.0005 latent fatal cancers per person-rem of exposure to the general public and 0.0004 latent fatal cancers per person-rem to workers. Risk factors are lower for workers than for the general public because occupational exposures do not have to account for children. These risk factors are consistent with the most recent risk estimates for radiation exposure (References A-2 and A-3).

A.5 References

A-1 National Council on Radiation Protection and Measurements Report 93, *Ionizing Radiation Exposure of the Population of the United States*, September 1987

A-2 United Nations Scientific Committee on the Effects of Atomic Radiation, *Sources, Effects and Risks of Ionizing Radiation*, 1988

A-3 National Academy of Sciences-National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V*, Report of the Committee on the Biological Effects of Ionizing Radiations, 1990

A-4 International Commission on Radiological Protection (ICRP), *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Annals of the ICRP, Vol. 21, No. 1-3, New York: Pergamon Press, 1991

APPENDIX B

ANALYSIS OF NON-TRANSPORTATION RELATED IMPACTS

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APPENDIX B

ANALYSIS OF NON-TRANSPORTATION RELATED IMPACTS

This appendix presents estimated environmental consequences, event probabilities, and risk (a product of probability and consequence) for both facility activities and postulated accident scenarios related to the disposal of the S1C Prototype reactor plant. Facility activities and accident scenarios are evaluated to estimate the effects of potential releases of radioactive material and toxic chemicals to the environment. The results of these analyses are presented in terms of predicted health effects to facility workers and to the general population. Effects on the environment are also presented, based on the amount of land which could be impacted due to postulated accidents. Analysis results are presented for each of the three alternatives being considered for the disposal of the S1C Prototype reactor plant - Prompt Dismantlement, Deferred Dismantlement, and No Action.

B.1 Basis of Radiological Impact Analyses for Facility Activities

B.1.1 Reactor Plant Conditions

The S1C Prototype reactor plant is defueled, however, the remaining reactor plant piping systems and components are still radioactive. The S1C Prototype hull provides a shielded, containment structure for the reactor plant. The reactor plant systems and components are in a safe, stable condition (de-energized and drained) within the hull structure.

B.1.1.1 Caretaking Activities

The No Action and the Deferred Dismantlement alternatives include a 30-year caretaking period. During the caretaking period, the S1C Prototype reactor plant would be periodically monitored. Periodic radiological surveys of the reactor plant would be performed as part of a comprehensive environmental monitoring program to be maintained during the caretaking period. This monitoring program would be a continuation of the current monitoring program at the Windsor Site and would involve air sampling, the continuous monitoring of radiation levels at Site perimeter locations and at off-site locations, and the routine collection and analysis of water samples, sediment samples, and fish. Periodic monitoring would verify reactor plant integrity and expected radiological conditions. To further ensure that reactor plant system and component integrities are maintained, a heating and dehumidifying system would be installed. Airflow from the reactor compartment would be exhausted through a controlled exhaust system containing high efficiency particulate air filters to the environment. This analysis evaluates the radiological impacts of direct radiation exposure to workers and the general population during the caretaking period. In addition, radiological impacts from potential airborne releases during the caretaking period, including potential accidents, are estimated.

B.1.1.2 Dismantlement Activities

Dismantlement activities for the Prompt and Deferred Dismantlement alternatives are similar. The dismantlement work includes removal of reactor plant piping systems and components, disassembly of the prototype hull and preparations for shipment. Dismantlement activities would be performed using proven radiological control methods to prevent the spread of any contamination. The radiological exposures associated with dismantlement work will be significantly lower for the Deferred Dismantlement alternative due primarily to cobalt-60 radioactivity decay. Evaluations of the impacts associated with transportation of dismantled materials from the reactor plant are discussed in Appendix C. This analysis evaluates the radiological impacts of direct radiation exposure to workers and the general population during dismantlement activities. Radiological impacts from potential releases to the atmosphere during dismantlement activities, including potential accidents, are also estimated.

B.1.2 Selection of Facility Accidents for Detailed Evaluation

In selecting accidents to include in detailed analyses, several variables were considered. Variables included risk of an accident, probability of occurrence and consequences. Risk is defined as the product of the probability of occurrence of the accident multiplied by the consequence of the accident. This analysis only evaluates accidents that contribute substantially to risk.

B.1.2.1 Accident Probability Considerations

Accidents were categorized into three types as either Abnormal Events, Design Basis Accidents, or Beyond Design Basis Accidents. These categories are characterized by their probability of occurrence as described below.

Abnormal Events

Abnormal Events are unplanned or improper events which result in little or no consequence. Abnormal events include industrial accidents and accidents during facility activities such as spills of radioactive liquids, or exposure to direct radiation due to improper placement of shielding. The occurrence of these unplanned events has been anticipated and mitigative procedures are in place which immediately detect and eliminate the events and limit the effects of these events on individuals. As a result, there is little hazard to the general population from these events. Such events are considered to occur in the probability range of 1 to 10^{-3} per year. The probability referred to here includes the probability the event occurs multiplied by other probabilities required for the consequences. For accidents included in this range, results are presented for the 95% meteorological condition.

Design Basis Accident Range

Accidents which have a probability of occurrence in the range of 10^{-3} to 10^{-6} per year are included in the range called the Design Basis Accident Range. The terminology "design basis accident," which normally refers to facilities to be constructed, also includes the "evaluation" basis accident which applies to existing facilities. For accidents included in this range, results are presented for the 95% meteorological condition.

Beyond Design Basis Accidents

This range includes accidents which are less likely to occur than the design basis accidents but which may have very large or catastrophic consequences. Accidents included in this range typically have a total probability of occurrence in the range of 10^{-6} to 10^{-7} per year. For accidents included in this range, results are presented for the 95% meteorological condition. Accidents which are less likely than 10^{-7} per year typically are not discussed since it is expected they would not contribute in any substantial way to the risk.

B.1.2.2 Accident Consequence Considerations

Only accidents which could reasonably be assumed to result in severe consequences were evaluated. Severe consequences include a significant release of radioactive material to the environment or a significant increase in radiation levels. Variables affecting accident severity include: dispersibility of the radioactive materials involved, the mechanism that causes the release of radioactive materials from the facility, and the conditions affecting off-site dispersion of the released materials. Initiating events for severe consequence accidents can include natural phenomena (earthquakes, volcanic activity, tornadoes, hurricanes, and other natural events) and human induced events (human error, equipment failures, fires, explosions, plane crashes, transportation accidents, and terrorism). The resulting exposure pathways from accidental releases of radioactive materials include direct exposure to radiation, inhalation of radioactive materials, or ingestion of radioactive materials.

Most accident events, such as procedure violations, equipment failures, and spills affect very limited areas and the environmental consequences are insignificant. For example, such events may not involve enough radioactive material or radiation to result in a significant release to the environment or result in a meaningful increase in radiation levels. Despite the higher frequency of occurrence, the very low severity of these events results in very low risk. Accidents involving small releases and affecting small areas were eliminated from further evaluation.

B.1.2.3 Accidents Selected for S1C Prototype Dismantlement Evaluation

Based on the selection process described above, several accident scenarios were developed for further detailed analysis. The following four hypothetical accident scenarios are considered to be more severe than all other reasonably foreseeable accidents.

- A large component drop, resulting in a breach of the component,
- mechanical damage of a component due to a wind-driven missile,
- an airplane crash into the reactor plant, resulting in the breach of several components,
- and a high efficiency particulate air filter fire.

B.1.3 Analysis Methods for Evaluation of Radiation Exposure

B.1.3.1 Computer Programs and Meteorological Modeling

The radiation exposures to the general population, dismantlement workers and specific individuals were calculated using the following computer programs and meteorological modeling. Radiation exposures were calculated for incident-free facility activities and for hypothetical accidents conditions. The calculation methods are consistent with similar evaluations by the International Commission on Radiological Protection (References B-1 and B-2).

GENII

GENII (Reference B-4) was used in the facility activity evaluations of long-term exposure to released radioactive contaminants. This program was developed at Pacific Northwest Laboratory by Battelle Memorial Institute. The program incorporates internal dosimetry models recommended by the International Commission on Radiological Protection in Publication 26 (Reference B-1) and Publication 30 (Reference B-2). The code uses averaged meteorological conditions to evaluate long-term effects of airborne releases.

RSAC-5

The Radiological Safety Analysis Computer Program, RSAC-5 (Reference B-5), was used to calculate the consequences of the release of radionuclides to the atmosphere. Calculations include potential radiation exposures to maximally exposed individuals or population groups via inhalation, ingestion, exposure to radionuclides deposited on the ground surface, immersion in airborne radioactive material, and radiation from a cloud of radioactive material. This program was developed by Westinghouse Idaho Nuclear Co., Inc., for the Department of Energy - Idaho Operations Office. RSAC-5 meteorological modeling capabilities include Gaussian plume dispersion for Pascal-Gifford conditions. RSAC-5 release scenario modeling allows reduction of radionuclides by chemical group or element and calculates decay and buildup during transport through operations, facilities, and the environment. It allows the amount of each nuclide from a nuclear event to be designated individually or to be calculated internally by the code. It also models the effect of filters or other cleanup systems.

SPAN4

SPAN4 (Reference B-6) was used to calculate the direct radiation levels. The computer code was developed by the Bettis Atomic Power Laboratory for use in Naval Nuclear Propulsion Program work. The SPAN 4 program models the effects of distance from a radiation source on resulting radiation exposure. Estimated exposures are derived by mathematical integration over specified areas.

WATER RELEASE

WATER RELEASE, an unpublished computer code developed by the Bettis Atomic Power Laboratory, was used to calculate exposures to humans arising from radionuclides which have been introduced into water in the vicinity of the radiological facilities. There are two processes by which radionuclides might enter water - via liquid discharge or via airborne discharges. The WATER RELEASE computer code models the resulting effects on humans from exposure to the assumed released radioactivity. Exposure to such releases can be received in several different pathways. Examples of pathways that the program can analyze include consumption of affected water, consumption of affected foods, and immersion (for example, swimming). The total exposure to the general population or individual is the resultant sum of the exposures from each pathway analyzed.

Meteorological Modeling

Meteorological data used in the analyses were obtained from the Support Center for Regulatory Air Models bulletin board system. The Support Center for Regulatory Air Models is an organization within the Environmental Protection Agency, Office of Air Quality Planning and Standards. Bulletin board data files for surface meteorological conditions consist of data acquired from the National Climatic Data Center. Meteorological data from the Bradley International Airport, for the years 1988 - 1992, were used in this evaluation.

Data and computer programs from the Support Center for Regulatory Air Models were used to develop meteorological data in the Stability Array format. The Stability Array format is a joint frequency distribution of six wind speed intervals, 16 wind directions, and six stability categories. The Stability Array meteorology data were used to calculate the 95% meteorological conditions for the accident analyses. The 95% condition represents the meteorological conditions which could produce the highest calculated exposures. This is defined as that condition which is not exceeded more than

5% of the time or is the worst combination of weather stability class and wind speed. Each of these conditions is evaluated for 16 wind directions. The Stability Array data were also reformatted for use in the GENII program calculations.

B.1.3.2 Radiation Exposure Categories

Radiation exposures were calculated for the following categories of individuals for the three disposal alternatives and hypothetical accidents:

Workers

Workers are individuals who would be directly involved in performing the actual dismantlement or caretaking activities. The occupational exposures were calculated based on actual radiation survey data obtained after the reactor plant was defueled and drained. Occupational exposures in person-rem were estimated for specific dismantlement and packaging tasks. Similar estimates were calculated for workers who would perform surveillance tours or security duties during a caretaking period.

Maximally Exposed Off-Site Individual

The maximally exposed off-site individual is a hypothetical individual living at the Windsor Site boundary receiving the maximum exposure. No evacuation of this individual is assumed to occur.

Population

The population consists of the actual number of people, based on 1990 United States Census data, living within a 50-mile radius of the Windsor Site. The total number of people living within a 50-mile radius of the Windsor Site is 3,425,290. The population distribution in 16 compass directions, and various radial intervals from the prototype location is included in Chapter 4, Table 4-3, of the Environmental Impact Statement.

B.1.3.3 Health Effect Evaluations

Table B-1 lists the health risk conversion factors used in this appendix. Health effects are calculated based on the radiation exposure results from incident-free facility activities and hypothetical accidents. The risk factors used for calculations of health effects are taken from Publication 60 of the International Commission on Radiological Protection (Reference B-3). Health risk conversion factors are weighted higher for the general population to account for longer life expectancies of children compared to adult workers.

Table B-1: Health Risk Conversion Factors for Ionizing Radiation Exposure

Effect	Nuclide	Risk Factor (probability per Rem)	
		Worker	General Population
Fatal cancer (all organs)	All	4.0×10^{-4}	5.0×10^{-4}
Weighted non-fatal cancer [1]	All	8.0×10^{-5}	1.0×10^{-4}
Weighted genetic effects [1]	All	8.0×10^{-5}	1.3×10^{-4}
Weighted total effects [1]	All	5.6×10^{-4}	7.3×10^{-4}

1. In determining a means of assessing health effects from radiation exposure, the International Commission on Radiological Protection has developed a weighting method for non-fatal cancers and genetic effects to obtain a total weighted effect, or "health detriment."

B.1.3.4 Evaluation of Impacted Areas for Hypothetical Accident Analyses

The impacted area following a facility accident was determined for each accident scenario. The impacted area was defined as that area in which the plume deposited radioactive material to such a degree that an individual standing on the boundary of the fallout area would receive approximately 0.01 millirem per hour of exposure above background. If this individual spends 24 hours a day at this location, that person would receive an additional 88 millirem per year from direct radiation from radioactivity deposited on the ground. This is within the Nuclear Regulatory Commission dose limit of 100 millirem per year for individual members of the general population (10 CFR Part 20, Standards for Protection Against Radiation).

To best characterize the affected areas for each casualty, a typical 50% meteorology (Pasquill-Gifford Class D, wind speed 10 mph) was chosen. The 95% worst case meteorology was used when calculating exposure and risk to workers and the general population. Computer modeling results (RSAC-5) for ground surface dose were interpolated to determine the distance downwind where the centerline dose had dropped to approximately 88 millirem per year based on 24 hours per day exposure. For the wind class chosen, the plume remains within a single 22.5-degree sector. The area affected by the plume is conservatively assumed to be the entire sector contaminated to the calculated downwind distance rather than the narrower plume profile. Use of a typical 50% meteorology is also a conservative assumption for the footprint evaluation of a tornado generated wind-driven missile accident. Stormy, windy conditions would disperse any release sufficiently such that no location would have a dose greater than 88 millirem per year.

Table B-2 shows impacted area dimensions (footprints) for each hypothetical accident scenario. Although the radioactive plume resulting from an accident would be contained within a single wind chart sector, the direction of the wind is unknown. Since the accidents occur over a short duration of time, calculations assumed no changes in the general wind direction. Impacts were evaluated in each of the sixteen directions around the facility out to a distance equaling the footprint length. Table B-3 describes secondary effects of hypothetical facility accidents.

Table B-2: Footprint Estimates for Hypothetical Facility Accidents

Accident Scenario	Footprint Length (meters)	Footprint Area (acres)
Airplane Crash (Prompt Dismantlement)	170	1.4
All Other Accidents for All Alternatives	<100	<1.0

Table B-3: Secondary Impacts of Hypothetical Facility Accidents

Topic	**Impact**
Surrounding Environment	Due to the small size of the Windsor Site, contamination would extend beyond the Windsor Site boundary.
Biotic Resources Including Endangered Species	Plants and animals on the Windsor Site and around the Windsor Site will experience no long-term impacts. An accident would not result in the extinction or adversely affect potential for survival of any endangered species.
Water Resources	The water used for drinking and industrial purposes is monitored and use may be temporarily suspended during cleanup operations. Some recreational activities may also be temporarily suspended. No enduring impacts are expected.
Economic Impacts	A small number of individuals may experience temporary job loss due to temporary restrictions on farming, fishing and other support activities near the facility during cleanup operations. Some costs would also be incurred for the actual cleanup operation.
Land Use	Access to some areas may be temporarily restricted until cleanup is completed. The total area restricted would be no greater than the areas identified in Table B-2.

B.1.3.5 Estimated Exposure Times and Mitigative Measures Following Hypothetical Facility Accidents

Accident analysis calculations take no credit for any preventive or mitigative actions that would limit exposure to members of the general population who are assumed to reside in close proximity to the Windsor Site. Radiation dose calculations for the maximally exposed off-site individual (individual who lives nearest the Windsor Site boundary) assume exposure to the entire contaminated plume as it travels downwind from the accident site. Calculations assume no action is taken to prevent these people from continuing their normal day-to-day routines or changing their food sources. The general population is assumed to spend approximately 30% of the day within their homes or other buildings. Since buildings and homes provide shielding, general population annual exposure to ground surface radiation was reduced by 30%.

Facility workers all undergo training to take quick, decisive action during a casualty. In the event of an accident, workers would quickly evacuate the affected area and assemble in an area upwind of the affected area. Analyses assumed that workers would move to an area 100 meters from the affected area. Analyses conservatively assumed that workers would receive exposure to the released radioactivity for a total of five minutes. Worker exposures were calculated for the direct radiation and inhalation pathways. Exposures due to ingestion of contaminated food were not specifically calculated for workers since workers would not eat following the accident.

Table B-4 provides the individual exposure times utilized in the hypothetical facility accident analyses.

Table B-4: Estimated Exposure Times Following a Hypothetical Facility Accident

Exposure Pathway	Worker	Maximally Exposed Off-Site Individual
Plume	5 minutes	100% of release time
Fallout on Ground Surface	5 minutes	0.7 year
Food Ingestion	None	1 year

B.1.3.6 Modeling Assumptions for Hypothetical Facility Accident Evaluations

Unless stated otherwise, the following post-accident modeling assumptions were used when performing airborne radioactivity release calculations with the RSAC-5 computer program. In most cases, these conditions are the default conditions in the computer program.

Meteorological Data

- Wind speed, direction, and Pasquill stability are taken from 95% meteorology.
- The release is calculated as occurring at ground level (0 meters).
- Mixing layer height is 400 meters (1320 feet). Airborne materials freely diffuse in the atmosphere near ground level in what is known as the mixing depth. A stable layer exists above the mixing depth which restricts vertical diffusion.
- Wet deposition is zero (no rain occurs to accelerate deposition and reduce the area affected).
- Dry deposition of the cloud is modeled. During movement of the radioactive plume, a fraction of the plume is deposited on the ground due to gravitational forces and becomes available for exposure by ground surface radiation and ingestion.
- The quantity of deposited radioactive material is proportional to the material size and speed. The following dry deposition velocities (meters per second) were used:
  solids = 0.001   halogens = 0.01   noble gases = 0.0   cesium = 0.001
- If radioactive releases occur through a stack, then additional plume dispersion can be accounted for by calculating a jet plume rise. In this analysis, jet plume rise is ignored.
- When released gases have a heat content, the plume can disperse more quickly. In this calculation, buoyant plume effects are ignored.

Inhalation Data

- Breathing rates are 3.33×10^{-4} cubic meters per second for workers and 2.66×10^{-4} cubic meters per second for people at the site boundary and beyond.
- Particle size is 1.0 micron.
- The internal exposure period is 50 years for individual organs and tissues which have radionuclides committed.
- Exposure to the entire plume for the general population. Exposure to the plume for workers is discussed in Section B.1.3.5.
- Inhalation exposure factors based on Reference B-2.

Ground Surface Exposure

- Exposed to contaminated soil for one year for the general population.
- Building shielding factor is 0.7 which exposes the individual to contaminated soil for 16 hours a day.

Ingestion Data

- The following dietary consumption rates were used:
    - 177 kilograms of stored vegetables (produce) per year
    - 18.3 kilograms of fresh (leafy) vegetables per year
    - 94 kilograms of meat per year
    - 112 liters of milk per year
- 10% of the food consumed is assumed to be locally grown (such as in a person's garden) and contaminated by the accident.

B.2 Radiological Analysis Results - Incident-Free Facility Activities

B.2.1 Facility Activities

The purpose of this analysis is to determine the hypothetical health effects on workers and the general population due to incident-free facility activities associated with disposal of the S1C Prototype reactor plant. Unique source terms were used for each alternative for the evaluation of facility activities. Windsor Site-specific meteorological and population data were used. For facility activities, the radiation dose evaluation addresses workers, the maximally exposed off-site individual, and the general population.

B.2.1.1 Source Terms

The radioactive material release source terms for the analysis are based on conservative calculations of expected releases. For the no action alternative and the first 30 years of the deferred dismantlement alternative, the S1C Prototype reactor compartment will be maintained in a heated and dry condition. The systems and components will be closed and sealed such that none of the contamination will be available for release to the environment. None of the contaminated plant systems will be vented. Therefore, the routine airborne release was calculated based on a minimum detectable airborne activity level of 2×10^{-14} microcuries per milliliter and the expected volume of air which would flow through the reactor compartment. For both dismantlement alternatives, the airborne release source term was selected based on data from typical reactor servicing ventilation systems. The ventilation systems have high efficiency particulate air filters installed and have a 99.95% efficiency for removal of potential airborne particulate radioactivity. The source term was derived from the radiation levels measured on typical air filters installed in ventilation systems used during maintenance work on radioactive systems.

Table B-5 lists the radioactive nuclides and the estimated amounts of radioactivity that result in at least 99% of the possible exposure due to airborne releases to the environment.

Table B-5: Source Terms for Facility Activities Releases

NUCLIDE	RADIOACTIVITY DISCHARGED (Curies per year) [1]		
	No Action	Prompt Dismantlement	Deferred Dismantlement [2]
Co-60	4.5×10^{-8}	2.1×10^{-7}	4.1×10^{-9}
C-14	1.5×10^{-6}	7.1×10^{-6}	7.1×10^{-6}
Fe-55	5.5×10^{-8}	2.6×10^{-7}	1.3×10^{-10}
Ni-63	2.2×10^{-8}	1.0×10^{-7}	8.4×10^{-8}
Sr-90	2.8×10^{-11}	1.3×10^{-10}	6.3×10^{-11}
Nb-93M	9.6×10^{-10}	4.5×10^{-9}	1.2×10^{-9}
Nb-94	1.5×10^{-11}	7.1×10^{-11}	7.1×10^{-11}
Cs-137	2.8×10^{-11}	1.3×10^{-10}	6.5×10^{-11}
Pu-238	1.8×10^{-13}	8.6×10^{-13}	6.8×10^{-13}
Pu-239	3.0×10^{-14}	1.4×10^{-13}	1.4×10^{-13}
Pu-240	1.9×10^{-14}	8.9×10^{-14}	8.9×10^{-14}
Pu-241	6.3×10^{-12}	2.9×10^{-11}	6.9×10^{-12}
Am-241	2.6×10^{-13}	1.2×10^{-12}	1.2×10^{-12}

1. Ventilation system discharges are estimated for the first year of the prompt and no action alternatives and the thirty-first year of the deferred dismantlement alternative (first year of deferred dismantlement operations). The no action source term is used for the 30-year caretaking period prior to deferred dismantlement. Listed radionuclides are from activated corrosion products which could be released.

2. The radionuclides listed for deferred dismantlement were derived based on prompt dismantlement data and individual nuclide decay rates.

B.2.1.2 Facility Activities Analysis Results

Table B-6 contains the detailed analysis results for radiation exposure from facility activities, through various pathways, assuming no accidents occur. Since each of the alternatives represent different lengths of time, the results presented are cumulative exposures and effects. For the no action alternative, the exposures represent the total received over a 30-year caretaking period. For the deferred dismantlement alternative, the exposures represent the total received over the 30-year caretaking period plus the expected exposures during the 2-year dismantlement period. For the prompt dismantlement alternative, the exposures represent the total received during the 2-year dismantlement period. The health effects represent those expected based on the total radiation exposure received over the period of interest.

For occupational exposure to workers, the largest doses result from the prompt dismantlement alternative. The deferred dismantlement dose reflects the radioactive decay of cobalt-60 over a 30-year period and also includes exposure received by workers during the 30-year caretaking period.

Exposure to the general population is essentially the same for the no action and deferred dismantlement alternatives because the time durations are approximately the same. The radiation dose from facility activities to the general population during the prompt dismantlement alternative is significantly lower because of the short two-year duration.

Table B-6: Exposure Results for Incident-Free Facility Activities

		No Action	**Deferred Dismantlement**	**Prompt Dismantlement**
Workers (Occupational Exposure) [1]	Collective Dose (person-rem)	2.1	3.9 to 5.7	94 to 188
	Risk of Latent Fatal Cancers	8.4×10^{-4}	1.6×10^{-3} to 2.3×10^{-3}	3.8×10^{-2} to 7.5×10^{-2}
Maximally Exposed Off-Site Individual [2]	Dose (rem)	1.0×10^{-2}	1.0×10^{-2}	2.6×10^{-3}
	Risk of Latent Fatal Cancer	5.1×10^{-6}	5.2×10^{-6}	1.3×10^{-6}
Population [3]	Collective Dose (person-rem)	3.2×10^{-2}	3.2×10^{-2}	8.1×10^{-3}
	Risk of Latent Fatal Cancers	1.6×10^{-5}	1.6×10^{-5}	4.0×10^{-6}

1. The collective dose values for workers represent the occupational exposure for each alternative based on estimates of worker staffing levels, time in or near the reactor compartment, and general area dose rates. General area dose rates were based on actual radiation survey data measured after the reactor plant was defueled and drained. The larger values for the prompt and deferred dismantlement ranges represent estimates based on preliminary plans. The lower values for the prompt and deferred dismantlement ranges reflect experience that detailed work planning typically results in additional exposure reductions. Individual worker exposure would be limited to 2 rem per year.

2. The dose values for the Maximally Exposed Off-Site Individual represent conservative estimates for a hypothetical individual who resides at the boundary of the Windsor Site for the duration of the respective alternative.

3. The collective dose values for the Population represent conservative estimates of cumulative exposure to all members of the general population living within a 50-mile radius of the Windsor Site.

B.3 Radiological Analysis Results - Hypothetical Facility Accidents

B.3.1 Component Drop Accident

B.3.1.1 Description of Conditions

During dismantlement of the S1C Prototype reactor plant, many large components and portions of piping systems will be disassembled and removed from the facility. Because of strict verbatim procedure compliance rules, proven safe rigging practices, and required crane maintenance, coupled with independent oversight, a drop of one of these large components at a Naval nuclear facility is not considered a credible accident. However, a drop accident of one of these components will be considered based on using commercial industry failure probabilities (References B-9, B-10, and B-11). Since these components contain some radioactive materials in the form of corrosion products, it is postulated that some portion of these corrosion products could become released into the environment.

B.3.1.2 Source Term

The source term for the component drop accident is based on the following considerations. The corrosion product activity on the component is the best estimate deposition on non-reactor core wetted surfaces. The steam generator is the component with the most corrosion deposits since it has the largest internal surface area. The impact associated with the component drop accident is assumed to loosen 33% of the corrosion products adhering to the steam generator surfaces. Of this loose activity, 10% is assumed to be released to the environment as an airborne contaminant. Thus, a total release of 3.3% of the corrosion products from the steam generator is assumed in the airborne dose analysis.

The following amounts of radionuclides from activated corrosion products could be released into the environment. This listing includes radionuclides that result in at least 99% of the possible exposure.

Nuclide	Deferred Dismantlement (Curies)	Prompt Dismantlement (Curies)
Co-60	1.1×10^{-3}	5.7×10^{-2}
C-14	9.7×10^{-4}	9.7×10^{-4}
Fe-55	3.5×10^{-5}	7.0×10^{-2}
Ni-63	2.3×10^{-2}	2.8×10^{-2}
Sr-90	1.7×10^{-5}	3.5×10^{-5}
Nb-93M	3.4×10^{-4}	1.2×10^{-3}
Nb-94	1.9×10^{-5}	1.9×10^{-5}
Cs-137	1.8×10^{-5}	3.5×10^{-5}
Pu-238	1.9×10^{-7}	2.4×10^{-7}
Pu-239	3.9×10^{-8}	3.9×10^{-8}
Pu-240	2.4×10^{-8}	2.4×10^{-8}
Pu-241	1.9×10^{-6}	8.0×10^{-6}
Am-241	3.2×10^{-7}	3.4×10^{-7}

B.3.1.3 Radiological Analysis Results - Component Drop Accident

Tables B-7 and B-8 summarize the health risks to individuals and the general population that might result from the hypothetical drop of a component during dismantlement activities. The number of fatal cancers would be expected to occur over a 50-year period. "Risk" is defined as the number of fatal cancers times the probability of occurrence. The results are presented for the design basis accident with 95% meteorology. Section B.1.3.4 discussed the affected area size. The probability of crane failure is in the range of 1 x 10^{-5} to 1.5 x 10^{-4} per operation (References B-10 and B-11). For this evaluation, a probability of 1 x 10^{-4} per operation was used. The probability of failure leading to an uncontrolled lowering of a component due to failure of either electrical or mechanical backups, given the initial crane failure, is in the range of 10^{-2} to 10^{-1} per failure (Reference B-12). For this evaluation, the smaller probability of 1 x 10^{-2} per failure was used since it is already conservatively assumed that any uncontrolled lowering would result in component damage and a release to the environment. This results in a probability of dropping a single component of 1 x 10^{-6} per operation. Since there will be about four lifts per year during the dismantlement period, a probability of 4 x 10^{-6} per year was used in the risk assessment.

Table B-7: Individual Exposure Results - Hypothetical Component Drop Accident

	Deferred Dismantlement		Prompt Dismantlement	
	Dose (rem)	Risk of Latent Fatal Cancer	Dose (rem)	Risk of Latent Fatal Cancer
Individual Worker	1.8 x 10^{-3}	7.3 x 10^{-7}	3.4 x 10^{-2}	1.4 x 10^{-5}
Maximally Exposed Off-Site Individual	1.2 x 10^{-2}	6.2 x 10^{-6}	4.4 x 10^{-1}	2.2 x 10^{-4}

Table B-8: General Population Exposure Results for Hypothetical Component Drop Accident

	Deferred Dismantlement	Prompt Dismantlement
Collective Dose Within 50-Mile Radius (person-rem)	3.0	110
Number of Fatal Cancers	1.5 x 10^{-3}	5.4 x 10^{-2}
Probability per Year of Accident Occurring	4.0 x 10^{-6}	4.0 x 10^{-6}
Risk per Year of Single Latent Fatal Cancer	6.0 x 10^{-9}	2.2 x 10^{-7}

B.3.2 Wind-Driven Missile Accident

B.3.2.1 Description of Conditions

During dismantlement activities, portions of the plant and large components will be vulnerable to wind-driven missiles while being prepared for shipment off-site. There is a small probability that one of these large components could be damaged during this period. Since these components contain some radioactive materials in the form of corrosion products, it is postulated that some portion of these particles could become released into the environment. During the caretaking period, the thick steel hull of the reactor compartment will provide protection from any naturally caused wind-driven missiles.

B.3.2.2 Source Term

The source term for the wind-driven missile accident is based on the following considerations. The best estimate corrosion product activity is used as the basis of the source term. The steam generator is assumed to be the component which is hit by the wind-driven missile because it has the highest inventory of activity. The impact associated with the missile strike is assumed to loosen 33% of the corrosion products adhering to the steam generator surfaces. Of this loose activity, 1% is assumed to be released to the environment as an airborne contaminant. Thus, a total release of 0.33% of the corrosion products from the steam generator is assumed in the airborne dose analysis.

The following amounts of radionuclides from activated corrosion products could be released into the environment. This listing includes radionuclides that result in at least 99% of the possible exposure.

Nuclide	Deferred Dismantlement (Curies)	Prompt Dismantlement (Curies)
Co-60	1.1 x 10^{-4}	5.7 x 10^{-3}
C-14	9.7 x 10^{-5}	9.7 x 10^{-5}
Fe-55	3.5 x 10^{-6}	7.0 x 10^{-3}
Ni-63	2.3 x 10^{-3}	2.8 x 10^{-3}
Sr-90	1.7 x 10^{-6}	3.5 x 10^{-6}
Nb-93M	3.4 x 10^{-5}	1.2 x 10^{-4}
Nb-94	1.9 x 10^{-6}	1.9 x 10^{-6}
Cs-137	1.8 x 10^{-6}	3.5 x 10^{-6}
Pu-238	1.9 x 10^{-8}	2.4 x 10^{-8}
Pu-239	3.9 x 10^{-9}	3.9 x 10^{-9}
Pu-240	2.4 x 10^{-9}	2.4 x 10^{-9}
Pu-241	1.9 x 10^{-7}	8.0 x 10^{-7}
Am-241	3.2 x 10^{-8}	3.4 x 10^{-8}

B.3.2.3 Radiological Analysis Results - Wind-Driven Missile Accident

Tables B-9 and B-10 summarize the health risks to individuals and the general population that might result from the hypothetical wind-driven missile accident. The number of fatal cancers would be expected to occur over a 50-year period. "Risk" is defined as the number of fatal cancers times the probability of occurrence. The results are presented for the design basis accident with 95% meteorology. Section B.1.3.4 discussed the affected area size. The probability of occurrence of a tornado was obtained using the data in the Atomic Energy Commission document WASH-1300 (Reference B-13). These analyses assumed the probability of a tornado occurrence in the continental United States is 10^{-3} per year per square mile. The probability of generation of a missile sufficient to cause a release of radioactive material is assumed to be 1.0. The probability of the missile hitting the target component was assumed to be 10^{-2}. This is considered to be very conservative due to the small size of the component and the limited amount of time it is in a vulnerable position. Thus, the probability of a wind-driven missile accident occurrence of 1×10^{-5} per year was used in the risk assessment.

Table B-9: Individual Exposure Results - Hypothetical Wind-Driven Missile Accident

	Deferred Dismantlement		Prompt Dismantlement	
	Dose (rem)	Risk of Latent Fatal Cancer	Dose (rem)	Risk of Latent Fatal Cancer
Individual Worker	1.8×10^{-4}	7.3×10^{-8}	3.4×10^{-3}	1.4×10^{-6}
Maximally Exposed Off-Site Individual	1.2×10^{-3}	6.2×10^{-7}	4.4×10^{-2}	2.2×10^{-5}

Table B-10: General Population Exposure Results for Hypothetical Wind-Driven Missile Accident

	Deferred Dismantlement	Prompt Dismantlement
Collective Dose Within 50-mile Radius (person-rem)	3.0×10^{-1}	11
Number of Fatal Cancers	1.5×10^{-4}	5.4×10^{-3}
Probability per Year of Accident Occurring	1.0×10^{-5}	1.0×10^{-5}
Risk per Year of Single Latent Fatal Cancer	1.5×10^{-9}	5.4×10^{-8}

B.3.3 Airplane Crash Accident

B.3.3.1 Description of Conditions

During the dismantlement of the S1C Prototype reactor plant, the components and piping systems could be damaged if a large airplane crashed into the facility while the reactor compartment is partly removed for the dismantlement work. Due to component damage and a subsequent fire, the corrosion products in several components could be released into the environment. It is expected that during any caretaking period, the thick steel hull of the S1C Prototype reactor plant will absorb most of the energy from a plane crash; therefore, the consequences and risks will be smaller than the values shown below for the prompt dismantlement alternative.

B.3.3.2 Source Term

The source term for the airplane crash accident is based on the following considerations. The best estimate corrosion product activity in the reactor plant is used as the basis of the source term. A combination of the three components having the highest corrosion product inventory is assumed to be damaged by the plane crash. The impact of the crash is assumed to loosen 33% of the corrosion products adhering to major component surfaces. Of this loose activity, 50% is assumed to be released to the environment as an airborne contaminant. Thus, a total release of 16.5% of the corrosion product activity in the damaged components is assumed in the airborne dose analysis.

The following amounts of radionuclides from activated corrosion products could be released into the environment. This listing includes radionuclides that result in at least 99% of the possible exposure.

Nuclide	Deferred Dismantlement (Curies)	Prompt Dismantlement (Curies)
Co-60	1.2×10^{-2}	6.2×10^{-1}
C-14	1.1×10^{-2}	1.1×10^{-2}
Fe-55	3.8×10^{-4}	7.6×10^{-1}
Ni-63	2.5×10^{-1}	3.1×10^{-1}
Sr-90	1.9×10^{-4}	3.8×10^{-4}
Nb-93M	3.7×10^{-3}	1.3×10^{-2}
Nb-94	2.1×10^{-4}	2.1×10^{-4}
Cs-137	1.9×10^{-4}	3.9×10^{-4}
Pu-238	2.0×10^{-6}	2.6×10^{-6}
Pu-239	4.2×10^{-7}	4.2×10^{-7}
Pu-240	2.6×10^{-7}	2.6×10^{-7}
Pu-241	2.1×10^{-5}	8.7×10^{-5}
Am-241	3.5×10^{-6}	3.7×10^{-6}

B.3.3.3 Airplane Crash Probability

The probability of an airplane crashing into the S1C Prototype reactor plant was evaluated. The method outlined in the U.S. Nuclear Regulatory Commission Standard Review Plan for Aircraft Hazards (Reference B-8) was used to predict the crash probability.

The aircraft crash probability analysis was based on three major aircraft categories - commercial, military, and general aviation. Two general types of flight sources were addressed in this crash probability - operations at nearby airports (such as landings and takeoffs), and operations in nearby airways (in-flight travel). Airports which met one of the following criteria were considered:

- has a runway used by commercial or military flights that is at least partially located within ten miles of the S1C Prototype,
- has a runway used for general aviation that is at least partially located within five miles of the S1C Prototype, or
- the centerline of the defined airway is located within ten miles of the S1C Prototype.

The probability per year for an airplane crash into the S1C Prototype was calculated by adding the individual crash scenario probabilities for the flight sources listed above (combined takeoff, landing, and in-flight crash probabilities). The airport operation crash probability was determined by multiplying the probability per square mile of a crash for each aircraft by the number of landings and takeoffs for each aircraft along each runway, and by the effective target area for each type of aircraft. The airway crash probability was calculated by multiplying the in-flight crash rate per mile by the number of flights per year along the airway by the effective target area (S1C Prototype reactor compartment) divided by the width of the airway.

The Windsor Site is located approximately 3.5 miles from Bradley International Airport and approximately four miles from a grass runway at the Simsbury Airport. Table B-11 summarizes the airport traffic information. The Windsor Site is located approximately two miles from a high altitude route between Boston and New York which has 21,535 large commercial and large military aircraft flights per year.

Table B-11: Airport Landings and Takeoffs per Year

Airport	Large Civilian Aircraft Landings and Takeoffs	Military A-10 Aircraft Landings and Takeoffs	General Aviation Landings and Takeoffs	Air Taxi Landings and Takeoffs
Bradley International	60,042	5,894	45,804	50,116
Simsbury	0	0	1,094	0

Results of this calculation indicate the probability of an airplane crashing into the S1C Prototype reactor compartment is 6.6×10^{-7} per year.

B.3.3.4 Radiological Analysis Results - Airplane Crash Accident

Tables B-12 and B-13 summarize the health risk to individuals and the general population that might result from the hypothetical airplane crash accident. The number of fatal cancers would be expected to occur over a 50-year period. "Risk" is defined as the number of fatal cancers times the probability of occurrence. The results are presented for the design basis accident with 95% meteorology. Section B.1.3.4 discussed the affected area size.

Table B-12: Individual Exposure Results for Hypothetical Airplane Crash

	Deferred Dismantlement		Prompt Dismantlement	
	Dose (rem)	Risk of Latent Fatal Cancer	Dose (rem)	Risk of Latent Fatal Cancer
Individual Worker	2.0×10^{-2}	7.9×10^{-6}	3.7×10^{-1}	1.5×10^{-4}
Maximally Exposed Off-Site Individual	1.3×10^{-1}	6.7×10^{-5}	4.8	2.4×10^{-3}

Table B-13: General Population Exposure Results for Hypothetical Airplane Crash

	Deferred Dismantlement	Prompt Dismantlement
Collective Dose Within 50-mile Radius (person-rem)	33	1200
Number of Fatal Cancers	1.7×10^{-2}	5.8×10^{-1}
Probability per Year of Accident Occurring	6.6×10^{-7}	6.6×10^{-7}
Risk per Year of Single Latent Fatal Cancer	1.1×10^{-8}	3.8×10^{-7}

B.3.4 High Efficiency Particulate Air Filter Fire Accident

B.3.4.1 Description of Conditions

In this hypothetical accident scenario, a fire in a bank of high efficiency particulate air filters is postulated. This accident could be initiated by the ignition of a flammable mixture released upstream of the system by an external, unrelated fire that spreads to the system. Although the risks associated with this accident are relatively minor, it was analyzed to bound the higher-probability, lower-consequence type accident category. The airborne release fractions associated with this accident were conservatively chosen so that a high efficiency particulate air filter failure by crushing or impact was also bounded.

B.3.4.2 Source Term

A maximum inventory of activity in a high efficiency particulate air filter bank is assumed to be present in the filters at the time of the fire. This activity will only occur after an extended period of operation and is based on previous experience during reactor plant maintenance which included work on the open reactor plant and the release of corrosion products during operations. For the caretaking period, the activity in the filters is based on the minimum detectable activity being released. The hypothetical fire is assumed to spread to the filters from another source and is assumed to release 1% of the radioactive materials from the filter to the environment. The release is relatively small because the filters are constructed of material containing glass fibers which would melt during a fire and trap the radioactive particles in the medium. Measurements from experiments show that 0.01% of the material in the filter could be released during a fire (Reference B-15). The use of 1% is conservatively selected for this analysis.

The following amounts of radionuclides from activated corrosion products could be released into the environment. This listing includes radionuclides that result in at least 99% of the possible exposure. For the no action and prompt dismantlement alternatives, the fire is assumed to occur at the end of the first year. For the deferred dismantlement alternative, the fire is assumed to occur at the end of the thirty-first year (the end of the first year of the dismantlement period after a thirty-year caretaking period). The cumulative impact from the deferred dismantlement alternative incorporates the 30-year caretaking period which is represented by the no action values listed below.

Nuclide	Deferred Dismantlement (Curies)	Prompt Dismantlement (Curies)	No Action (Curies)
Co-60	1.6×10^{-7}	8.4×10^{-6}	1.8×10^{-6}
C-14	1.4×10^{-7}	1.4×10^{-7}	3.0×10^{-8}
Fe-55	5.1×10^{-9}	1.0×10^{-5}	2.2×10^{-6}
Ni-63	3.4×10^{-6}	4.1×10^{-6}	8.9×10^{-7}
Sr-90	2.5×10^{-9}	5.2×10^{-9}	1.1×10^{-9}
Nb-93M	4.9×10^{-8}	1.8×10^{-7}	3.8×10^{-8}
Nb-94	2.8×10^{-9}	2.8×10^{-9}	6.1×10^{-10}
Cs-137	2.6×10^{-9}	5.2×10^{-9}	1.1×10^{-9}
Pu-238	2.7×10^{-11}	3.4×10^{-11}	7.4×10^{-12}
Pu-239	5.7×10^{-12}	5.7×10^{-12}	1.2×10^{-12}
Pu-240	3.5×10^{-12}	3.6×10^{-12}	7.6×10^{-13}
Pu-241	2.8×10^{-10}	1.2×10^{-9}	2.5×10^{-10}
Am-241	4.7×10^{-11}	4.9×10^{-11}	1.1×10^{-11}

B.3.4.3 Radiological Analysis Results - High Efficiency Particulate Air Filter Fire Accident

Tables B-14 and B-15 summarize the health risks to individuals and the general population that might result from the hypothetical high efficiency particulate air filter fire accident. The number of fatal cancers would be expected to occur over a 50-year period. "Risk" is defined as the number of fatal cancers times the probability of occurrence. The results are presented for the design basis accident with 95% meteorology. Section B.1.3.4 discussed the affected area size. The probability of a chemical fire is 5×10^{-3} per year (Reference B-14). The probability of high efficiency particulate air filter fires is considered to be less than a chemical fire since chemicals would not be stored in the immediate vicinity of the high efficiency particulate air filter system and high efficiency particulate air filters are not volatile or explosive. It is estimated that the probability for an existing fire to spread to the high efficiency particulate air filters is less than 10^{-1}. Thus, the probability of occurrence of an event leading to a high efficiency particulate air filter fire is estimated at 5×10^{-4} per year. This probability is applied to all alternatives but is very conservative for the no action alternative because no flammable materials will be stored in the reactor plant.

Table B-14: Individual Exposure Results - Hypothetical High Efficiency Particulate Air Filter Fire Accident

	Prompt Dismantlement	Deferred Dismantlement	No Action
Individual Worker Dose (Rem)	5.0×10^{-6}	2.7×10^{-7}	1.1×10^{-6}
Risk of Latent Fatal Cancer	2.0×10^{-9}	1.1×10^{-10}	4.3×10^{-10}
Maximally Exposed Off-Site Individual Dose (Rem)	6.5×10^{-5}	1.8×10^{-6}	1.4×10^{-5}
Risk of Latent Fatal Cancer	3.2×10^{-8}	9.0×10^{-10}	6.9×10^{-9}

Table B-15: General Population Exposure Results - Hypothetical High Efficiency Particulate Air Filter Fire Accident

	Prompt Dismantlement	Deferred Dismantlement	No Action
Collective Dose Within 50-Mile Radius (person-rem)	1.6×10^{-2}	4.4×10^{-4}	3.4×10^{-3}
Number of Fatal Cancers	7.9×10^{-6}	2.2×10^{-7}	1.7×10^{-6}
Probability per Year of Accident Occurring	5.0×10^{-4}	5.0×10^{-4}	5.0×10^{-4}
Risk per Year of Single Latent Fatal Cancer	4.0×10^{-9}	1.1×10^{-10}	8.5×10^{-10}

B.3.5 Cumulative Radiological Impacts to the General Population from Hypothetical Facility Accidents

Table B-16 presents cumulative risk results to the general population living within a 50-mile radius of the Windsor Site for the specific hypothetical accidents that were evaluated in this analysis. For each accident type, the cumulative results are based on the annual risk multiplied by the duration of the alternative.

Table B-16: Cumulative Radiological Impacts Risk to the General Population from Hypothetical Accidents

	Prompt Dismantlement (risk of latent fatal cancer)	Deferred Dismantlement (risk of latent fatal cancer)	No Action (risk of latent fatal cancer)
Component Drop [3]			
Annual Risk (Table B-8)	2.2×10^{-7}	6.0×10^{-9}	not applicable [1]
Cumulative Risk	4.4×10^{-7}	1.2×10^{-8}	
Wind-Driven Missile [3]			
Annual Risk (Table B-10)	5.4×10^{-8}	1.5×10^{-9}	not analyzed in detail [2]
Cumulative Risk	1.1×10^{-7}	3.0×10^{-9}	
Airplane Crash [3]			
Annual Risk (Table B-13)	3.8×10^{-7}	1.1×10^{-8}	not analyzed in detail [2]
Cumulative Risk	7.6×10^{-7}	2.2×10^{-8}	
High Efficiency Particulate Air Filter Fire [4]			
Annual Risk (Table B-15)	4.0×10^{-9}	1.1×10^{-10}	8.5×10^{-10}
Cumulative Risk [5]	8.0×10^{-9}	2.6×10^{-8}	2.6×10^{-8}

1. Lifting of components would not occur during the no action alternative. The thick steel hull of the reactor compartment would remain in place during the caretaking period.

2. The steel hull would absorb most of the energy from any airplane crashes or wind-driven missiles. No radiological releases to the environment would be expected for the hypothetical wind-driven missile accident. Potential consequences and risks would be smaller than the values shown for the hypothetical airplane crash accident - prompt dismantlement.

3. The cumulative risks associated with the component drop, wind-driven missile and airplane crash accidents are based on a two-year period for the dismantlement activities during the prompt and deferred alternatives.

4. The cumulative risks associated with the high efficiency particulate air filter fire accident is based on a two-year period for prompt dismantlement, thirty-two-year period (caretaking and dismantlement) for deferred dismantlement, and for a thirty-year period for the no action alternative.

5. The cumulative risks from a high efficiency particulate air filter fire are essentially the same for the deferred dismantlement and the no action alternatives. The annual risk for deferred dismantlement activities commence after a thirty-year caretaking period. The cumulative risk during the two-year deferred dismantlement period are small and do not add significantly to the cumulative risk during the caretaking period.

B.3.6 Summary of Analysis Uncertainties

The calculations in this Environmental Impact Statement have generally been performed in such a way that the estimates of risk provided are unlikely to be exceeded during dismantlement activities, caretaking activities, or in the event of an accident. For dismantlement activities, the results of radiation surveys and monitoring of similar operations provide realistic source terms, which, when combined with conservative estimates of the effects of radiation, produce estimates of risk which are very unlikely to be exceeded.

The analyses of hypothetical accidents provide more opportunities for uncertainty, primarily because the calculations must be based on sequences of events and models of effects which have not occurred. The models have attempted to provide estimates of the probabilities, source terms, pathways for dispersion and exposure, and the effects on human health and the environment which are as realistic as possible. However, in many cases, the very low probability of the accidents postulated has required the use of models or values for input which produce estimates of consequences and risks which are higher than would actually occur because of the desire to provide results which will not be exceeded. The risks presented in this appendix are believed to be at least 10 to 100 times larger than what would actually occur. Despite the use of conservative analytical methods, the risks for all of the alternatives are very small. Since the resulting risks are so small, the significance of any uncertainty in analysis parameters is greatly reduced.

The use of conservative analyses does not create a bias in this Environmental Impact Statement since all of the alternatives have been evaluated using the same methods and data. The potential impacts of each alternative can be fairly compared on the same basis.

B.4 Nonradiological Analysis Results - Hypothetical Facility Accidents

For the purposes of comparison with other risks associated with dismantlement and caretaking activities, an evaluation of a diesel fuel oil fire was analyzed in detail. This accident was selected based on the potential duration of the accident, the potential size of the affected area, and the combustion products that would result. A hypothetical accident scenario involving a fire in the Windsor Site's hazardous waste container storage area was considered but eliminated from detailed analysis. No hazardous waste would be left at Windsor Site during a caretaking period. The quantity of hazardous waste which would be stored at any time during dismantlement is expected to be maintained small by routine disposal shipments. The Windsor Site's hazardous waste container storage area is constructed and operated such that the overall environmental risks, including risks from accidents, are insignificant.

B.4.1 Fire Involving Diesel Fuel

B.4.1.1 Accident Description

This analysis assumed that during dismantlement operations, a diesel fuel oil storage tank could be temporarily located near a work area for refueling power equipment and on-site vehicles. A catastrophic failure of a temporarily located diesel fuel storage tank was postulated to occur. This could result in the spilling of the entire quantity of diesel fuel (500 gallons) and a subsequent fire. The airborne release of toxic chemicals resulting from the fire was evaluated with respect to the maximally exposed off-site individual. The maximally exposed off-site individual is assumed to be an individual located 100 meters from the fire.

B.4.1.2 Computer Model Used to Estimate Toxic Chemical Exposures

The Emergency Prediction Information Computer Code (EPIcode™) was used for estimating airborne concentrations resulting from most releases of toxic chemicals (Reference B-16). The computer code uses the well-established Gaussian Plume Model to calculate the airborne toxic chemical concentrations. The computer code database contains information on over 600 toxic substances listed by the American Conference of Governmental Industrial Hygienists. Factors such as locations of affected persons, terrain, meteorological conditions, release conditions, and characteristics of the chemical inventory are required as input parameters for calculations to determine human exposure from airborne releases of toxic chemicals.

B.4.1.3 Source Term

The material involved in this accident was diesel fuel with the fire generating the following toxic chemicals due to combustion:

- Carbon monoxide
- Oxides of nitrogen (90% nitric oxide and 10% nitrogen dioxide)
- Lead
- Sulfur dioxide.

B.4.1.4 Conditions and Key Parameters

- A 500-gallon capacity fuel oil storage tank would spill all its contents into a welded revetment made from 1/4 inch steel plate with dimensions of approximately 8 feet by 8 feet by 1 foot deep. The entire amount of diesel fuel is consumed by the fire in about 2 hours.

- The releases per gallon of fuel burned are as follows:

  Carbon monoxide = 0.34 pound
  Oxides of nitrogen = 1.58 pound
  Lead = 4.2 x 10^{-6} pound
  Sulfur dioxide = 0.105 pound

- The airborne release of toxic chemicals occurs at ground level.

- Standard rural terrain is used and building wake effects are not considered.

- Wind speeds and atmospheric stability classifications are based on 95% meteorology.

- The estimated concentrations are compared against the Emergency Response Planning Guideline levels 1, 2, and 3 concentration limits or alternates to determine the health impacts. Emergency Response Planning Guideline values are estimates of airborne concentration thresholds above which one can reasonably anticipate observing adverse effects (Reference B-17).

B.4.1.5 Results

The airborne concentrations, averaged over the duration of each exposure, were calculated using the Emergency Prediction Information computer program for the combustion products resulting from the fire for the maximally exposed off-site individual under 95% meteorology. Table B-17 lists the downwind concentrations and corresponding Emergency Response Planning Guideline (or equivalent) values. The significance of the Emergency Response Planning Guideline (or equivalent) is explained in the footnotes to the table. Results for the diesel fuel fire indicate that the toxic chemical concentration for lead concentrations were well below Emergency Response Planning Guideline level 1 values. Carbon monoxide may exceed Emergency Response Planning Guideline level 2 value. Sulfur dioxide and oxides of nitrogen may exceed Emergency Response Planning Guideline level 3 values for the maximally exposed off-site individual.

For the on-site workers and any member of the general population that could be exposed to toxic chemicals at above Emergency Response Planning Guideline level 3 values, it is expected that actual toxic chemical exposures would be much less due to the mitigative measures that would be implemented. During dismantlement operations employees would quickly move out of the smoke from the fire. Since the area immediately surrounding the Windsor Site is uninhabited, it is unlikely that a member of the general population would be standing at the Windsor Site boundary and very unlikely that a person would remain in the smoke plume from a fire (as assumed in the analysis).

Additional information on the toxic properties for the chemicals that dominate the toxic effects is provided below.

Sulfur dioxide is a colorless and toxic gas with a pungent odor. Sulfur dioxide is an eye, skin, and mucous membrane irritant. It chiefly affects the upper respiratory tract and bronchi and at higher concentrations, sulfur dioxide causes respiratory paralysis (Reference B-18).

Nitric oxide and **nitrogen dioxide** occur together in dynamic equilibrium. Nitric oxide is a colorless gas, and nitrogen dioxide is a reddish brown gas. Both chemicals are eye, skin, and mucous membrane irritants and primarily affect the respiratory system. Exposure to 47 milligrams per cubic meter of nitrogen dioxide can cause respiratory irritation and chest pain, 93 milligrams per cubic meter can cause lung injuries, and 187 milligrams per cubic meter can be fatal (Reference B-18).

Carbon Monoxide is a colorless, odorless and toxic gas which is a product of incomplete combustion. It is a potent chemical asphyxiant capable of causing headache, nausea, fatigue, confusion, and coma when present in high concentrations.

Table B-17: Typical Chemical Concentrations of a Diesel Fuel Fire

	CHEMICAL CONCENTRATIONS (milligrams per cubic meter) - 95% METEOROLOGY				
	Sulfur Dioxide ERPG-1 0.79 ERPG-2 7.9 ERPG-3 39	Carbon Monoxide TWA 29 .1(IDLH) 172 IDLH 1720	Nitric Oxide TWA 31 .1(IDLH) * IDLH 123	Nitrogen Dioxide TWA 5.6 .1(IDLH) 9.4 IDLH 94	Lead TWA 0.15 .1(IDLH) 70 IDLH 700
Maximally exposed off-site individual (located 100 meters from the fire)	130	430	1800	200	1.6×10^{-3}

ERPG = Emergency Response Planning Guidelines

ERPG-1 = The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.

ERPG-2 = The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

ERPG-3 = The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life - threatening health effects.

Where ERPG values have not been derived for a toxic substance, other chemical toxicity values are substituted, as follows:

For ERPG-1, Threshold Limit Value, Time-Weighted Average (TLV-TWA) values (Reference B-19) are substituted: The TWA is the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

For ERPG-2, Level of Concern values (equal to 0.1 of Immediately Dangerous to Life or Health) are substituted: Level of Concern is defined as the concentration of a hazardous substance in air, above which there may be serious irreversible health effects or death as a result of a single exposure for a relatively short period of time (Reference B-20).

For ERPG-3, Immediately Dangerous to Life or Health (IDLH) values are substituted: IDLH is defined as the maximum concentration from which a person could escape within 30 minutes without a respirator and without experiencing any effects which would impair the ability to escape or irreversible side effects (Reference B-7).

* The .1(IDLH) level not assigned since the value (12.3) would be less than the TWA level.

B.5 Analysis of Dust Emissions

This section provides the results of an evaluation of dust emissions that could be generated during dismantlement of the defueled S1C Prototype reactor plant. None of the S1C Prototype reactor plant dismantlement activities would be expected to generate nuisance dust emissions. Examples of other Windsor Site dismantlement activities that could generate some dust emissions include demolition of buildings (generally concrete and cinder block construction), and earth moving activities (such as backfilling and surface grading for establishing a smooth final contour for the Windsor Site property).

B.5.1 Computer Modeling to Estimate Dust Emissions

Factors such as locations of affected persons, terrain, meteorological conditions, release conditions, and grain size distributions are required as input parameters for calculations to determine particulate concentrations from dust emissions during dismantlement activities. This section describes the computer model used to perform dust concentration estimates. Specific input parameters used in this analysis are summarized in Section B.5.2.

The Fugitive Dust Model computer code was used to evaluate dust emissions from dismantlement activities of the S1C Prototype reactor plant. The computer model was specifically designed for estimating dust emissions from point, line, or area sources in support of air quality evaluations (Reference B-9).

The computer model for dust is designed to work with properly prepared meteorological data in either hourly or Stability Array format. The computer model is based on the well-known Gaussian plume formulation for computing concentrations, but the model has been specifically adapted to incorporate an improved gradient transfer deposition algorithm. Emissions for each source are apportioned by the user into a series of particle size classes. A gravitational settling velocity and a deposition velocity are subsequently calculated in the computer model for each class, and dust concentrations and depositions are then calculated for locations selected by the user.

B.5.2 Conditions and Key Parameters

- Restoration area is 8.8 acres.
- An emission factor of 2.0 tons per acre-month is used.
- Grain sizes used are as follows:

Average Diameter (microns)	% of Total
1.25	3
3.75	5
7.5	15
12.5	10
20.0	67

- Meteorological conditions used are the 5-year average Stability Array data sets.
- Roughness height is 30 centimeters.
- The maximally exposed off-site individual is located 100 meters from the center of the restoration area due to the small area of the Windsor Site.

B.5.3 Results

Dust concentration was calculated for the maximally exposed off-site individual located 100 meters from the center of the restoration area. The calculated dust concentration for the maximally exposed off-site individual during dismantlement of the S1C Prototype reactor plant was 1.7 milligrams per cubic meter. When this airborne concentration is compared against the Threshold Limit Value - Time Weighted Average concentration for inhalable particulates (10 milligrams per cubic meter), it is concluded that dust emissions associated with dismantlement activities would not result in any adverse effects. The estimated levels of dust generation would not require regulation under the Clean Air Act.

REFERENCES

B-1 ICRP (International Commission on Radiological Protection), 1977, *Report of the Task Group on Reference Man,* ICRP Publication 26, International Commission on Radiological Protection, Oxford, Great Britain: Pergamon Press.

B-2 ICRP (International Commission on Radiological Protection), 1979, *Limits for Intakes of Radionuclides by Workers,* Part 1, ICRP Publication 30, International Commission on Radiological Protection, Oxford, Great Britain: Pergamon Press.

B-3 ICRP (International Commission on Radiological Protection), 1991, *The 1990 Recommendations of the ICRP,* ICRP Publication 60, Annals of the ICRP, Volume 21 (1-3), International Commission on Radiological Protection, Elmsford, New York: Pergamon Press.

B-4 Napier, B. A., R. A. Peloquin, D. L. Strenge, J. V. Ramsdell, 1988, *GENII The Hanford Environmental Radiation Dosimetry Software System*, PNL-6584, UC-600, November.

B-5 Wenzel, D. R., 1993, *The Radiological Safety Analysis Computer Program (RSAC-5),* U.S. Department of Energy Report WINCO-1123, Westinghouse Idaho Nuclear Company, Inc., Idaho Falls, Idaho, October.

B-6 Wallace, O. J., 1972, *SPAN4 A Point Kernel Computer Program for Shielding,* WAPD-TM-809(L),Volumes I and II, October.

B-7 NIOSH (National Institute for Occupational Safety and Health), 1990, *Pocket Guide to Chemical Hazards,* June.

B-8 NRC (U.S. Nuclear Regulatory Commission), 1981, Standard Review Plan 3.5.1.6, "Aircraft Hazards," NUREG-0800, July.

B-9 EPA (U.S. Environmental Protection Agency), 1992, *Users Guide for the Fugitive Dust Model (FDM),* EPA-910/9-88-202R.

B-10 EPRI (Electric Power Research Institute), 1984a, *Review of Proposed Dry-Storage Concepts Using Probabilistic Risk Assessment,* EPRI NP-3365, Palo Alto, California, February.

B-11 EPRI (Electric Power Research Institute), 1984b, *Surveillance of LWR Spent Fuel in Wet Storage,* EPRI NP-3765, Palo Alto, California, October.

B-12 NRC (U.S. Nuclear Regulatory Commission), 1975, *Reactor Safety Study - An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants,* WASH - 1400 (NUREG-75/014), Washington, D.C.

B-13 AEC (Atomic Energy Commission), 1974, *Technical Basis for Interim Regional Tornado Criteria,* WASH 1300, U.S. Atomic Energy Commission Office of Regulation, May.

B-14 Ganti, C.S. and L.M. Krasner, 1984, *Navy Fire Risk Management: A Methodology for Prioritizing Fire Protection Recommendations,* Factory Mutual Research, Norwood, Massachusetts, September.

B-15 DOE (U.S. Department of Energy), 1993, *DOE HANDBOOK: Recommended Values and Technical Bases for Airborne Release Fractions, Airborne Release Rates, and Respirable Fractions at DOE Non-Reactor Nuclear Facilities,* DOE-STD-0013-93.

B-16 Homan (Homan Associates, Inc.), 1988, *Emergency Prediction Information Computer Code (EPIcode™) Manual*, Fremont, California.

B-17 Rusch, G. M., 1993, "The History and Development of Emergency Response Planning Guidelines," *Journal of Hazardous Materials,* Volume 33, Amsterdam: Elsevier Publishers, pp. 193-202.

B-18 TOXnet, 1993, Toxicology Data Network, National Library of Medicine, U.S. Department of Health and Human Services, Bethesda, Maryland.

B-19 ACGIH (American Conference of Governmental Industrial Hygienists), 1993, *Threshold Limit Values and Biological Exposure Indices for 1993-1994.*

B-20 EPA (U.S. Environmental Protection Agency), 1987, *Technical Guidance for Hazards Analysis,* Federal Emergency Management Agency, U.S. Department of Transportation, December.

APPENDIX C

ANALYSIS OF TRANSPORTATION RELATED IMPACTS

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APPENDIX C

ANALYSIS OF TRANSPORTATION RELATED IMPACTS

C.1 Background

This appendix presents an evaluation of the health risks to the public and workers from the shipment of all materials and components that would result from dismantlement of the defueled S1C Prototype reactor plant. These analyses cover the prompt and deferred dismantlement alternatives. Transportation analyses for the no action alternative are not required because there would be no dismantlement wastes generated or shipments made. Analyses were performed consistent with the methods and computer models used in the development of the Department of Energy's Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference C-1) and the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants (Reference C-2).

C.2 Shipments Evaluated

This evaluation assumes all shipments originate at the Windsor Site located in Windsor, Connecticut. The analyses assume that nonradioactive materials would be recycled or disposed of at facilities located within an average distance of 200 kilometers from the Windsor Site. The analyses evaluated two Department of Energy destinations for low level radioactive materials - the Savannah River disposal site in the State of South Carolina and the Hanford disposal site in the State of Washington. These analyses include additional general assumptions to keep the meaning of the results simple and conservative. For example, the Savannah River disposal site and the Hanford disposal site are examined individually as the destination for all radioactive shipments. The Savannah River disposal site represents a reasonable close location and distance for transportation analyses, and the Hanford disposal site represents a reasonable but significantly more distant location. Combinations of shipping destinations, including available recycling facility locations for radioactive materials, are not examined. This is a conservative simplification because the cumulative mileage of any combination of available destinations would be less than the cumulative mileage of all shipments going cross-country to the Hanford disposal site. Actual disposal of dismantlement materials would utilize multiple shipping destinations with emphasis on recycling as much material as practical. The topic of waste management and recycling is discussed in detail in the environmental impact statement text. Table C-1 summarizes the types of packages, the transportation modes, the origin and the destinations that are analyzed for shipments of low level radioactive materials from S1C Prototype dismantlement.

Table C-1: Summary of Package Type, Transportation Mode, Origin, and Destination

PACKAGE TYPE	TRANSPORTATION MODE	ORIGIN	DESTINATION
Miscellaneous Components	Truck	Windsor Site	Savannah River Site
			Hanford Site
Pressure Vessel	Heavy Hauler	Windsor Site	Griffin Line Railhead [1]
	Rail	Griffin Line Railhead [1]	Savannah River Site
			Hanford Site
Steam Generator	Truck	Windsor Site	Savannah River Site
			Hanford Site
Pressurizer	Truck	Windsor Site	Savannah River Site
			Hanford Site

1. Alternate transportation modes that would eliminate the use of the Griffin Line railhead for shipment of the reactor pressure vessel package were also considered but eliminated from detailed evaluation. As a single package, the pressure vessel shipping package would measure approximately 18.5 feet in length and 10.5 feet in diameter and would weigh approximately 160 tons. Due to load limiting bridges and speed limitations that would result in traffic disruptions, transport of the pressure vessel package for long distances over highways was considered impractical.

Analyses assumed there would be a total of 19 shipments of miscellaneous component packages. The major components would be shipped as whole units in four individual shipments. All shipments were assumed to occur over a two-year period. In addition to the reactor pressure vessel, one additional shipment by rail may be necessary in order to ship the primary shield tank in a single large package.

C.3 General Technical Approach for Calculating Health Risks

This section describes the general approach taken to evaluate the health risks associated with the shipment of dismantled S1C Prototype reactor plant materials. First, the radiological health risks to the general population, to the transport crew and to hypothetical maximally exposed individuals are evaluated for gamma radiation emanating directly from the packages during normal (incident-free) transport conditions. Radiological health risks are reported in terms of latent fatal cancers. Next, the radiological health risks to the general population for accident scenarios are evaluated. Accidents are evaluated based on corrosion product (crud) release to the atmosphere, probability for occurrence, and accident severity. To upper bound the significance of an accident, the radiological consequences are also evaluated for hypothetical maximally exposed individuals and the general population. In conjunction with these radiological evaluations, nonradiological risks to the population are also evaluated for vehicular exhaust emissions and transportation accidents.

C.3.1 Computer Codes

Several computer codes were used in the analysis of transportation related impacts. General analyses used the RADTRAN 4 and RISKIND computer codes. Several other computer programs, such as INTERLINE, HIGHWAY, and SPAN4, were used to provide input for the RADTRAN 4 and RISKIND computer codes. Due to the simplicity of variables for calculating the risks to the maximally exposed individual in the general population during incident-free conditions, simple equations without computer modeling were sufficient for the analysis.

RADTRAN 4

The RADTRAN 4 computer code was developed by Sandia National Laboratories (References C-3 and C-4). RADTRAN 4 was used to calculate radiological risks for the general population and transportation crew for incident-free and accident risk scenarios. RADTRAN 4 was also used to calculate radiological risks for the maximally exposed individual worker for incident-free scenarios.

RISKIND

The RISKIND computer code was developed by Argonne National Laboratory (Reference C-5). RISKIND was used to calculate the maximum radiological consequences to the general population and the maximally exposed individual in the general population for postulated accident conditions.

INTERLINE

The INTERLINE computer program was developed at Oak Ridge National Laboratory (Reference C-6). The latest available version of INTERLINE was used to model conditions in the vicinity of railroad routes. The INTERLINE database consists of networks representing various competing railroad companies in the United States. The routes used in this study use the standard assumptions in the INTERLINE model which simulate the selection process that railroads would use to direct shipments of Naval reactor plant components. The code is updated periodically to reflect current track conditions and has been benchmarked against reported mileage and observations. INTERLINE also provides the weighted population densities for rural, suburban, and urban populations averaged over all states along the shipment route and the percentage of mileage traveled in each population density. The version of INTERLINE used in these analyses contains 1990 census data. The distance traveled, weighted population density, and percentage of distance in each population density are input variables in the RADTRAN 4 computer code.

HIGHWAY

The HIGHWAY computer program was developed at Oak Ridge National Laboratory (Reference C-7). The latest available version of HIGHWAY was used to model conditions in the vicinity of highway routes. The code is updated periodically as new roads are added. The routes used for this study use the standard assumptions in the highway model. Similar to the INTERLINE computer code, HIGHWAY provides the distance between the origin and destination, the weighted population densities along the route and the percentage of distance traveled in each population density, which are all input variables for the RADTRAN 4 computer code.

SPAN4

The SPAN4 computer code was developed by the Bettis Atomic Power Laboratory for use in Naval Nuclear Propulsion Program work (Reference C-8). SPAN4 was used to model the effect of distance from a radiation source on the resulting radiation exposure. Estimated exposures are derived by mathematical integration over specified areas.

C.3.2 Radiological and Nonradiological Fatality Rates

The health risk conversion factors used in this evaluation are taken from the International Commission on Radiological Protection (Reference C-9) which specified 0.0005 latent fatal cancers per person-rem for members of the public and 0.0004 latent fatal cancers per person-rem for workers. Risk factors are lower for workers than for the general population because occupational exposures do not have to account for children. These risk estimates were extrapolated from estimates applicable to high doses and dose rates and probably overstate the true lifetime risk at low doses and dose rates. In an assessment of this uncertainty, the National Academy of Sciences pointed out that "the possibility that there may be no risks from exposures comparable to external natural background radiation cannot be ruled out" (Reference C-14).

In these analyses, the radiological impacts are first expressed as the calculated total effective exposure. Exposures to the general population and transportation crew are reported as person-rem and exposures to maximally exposed individuals are reported as rem. The appropriate health risk conversion factor, above, is then applied to the calculated total exposure in order to estimate the health risks in terms of latent fatal cancers. When interpreting the results of these analyses, the health risk per person-rem of exposure to the general population is equivalent to the health risk per rem of exposure to an individual. For example, ten people in the general population receiving 0.1 rem exposure each yields the same health risk as one individual who receives one rem of exposure (10 people x 0.1 rem each = 1.0 person-rem = 1 person x 1 rem).

Nonradiological risks related to the transportation of waste and recyclable materials from dismantlement and demolition activities and from the transportation of associated materials such as fill and topsoil are also evaluated. The nonradiological risks are those resulting from vehicle exhaust emissions for incident-free transportation and fatalities resulting from transportation accidents for accident risk assessment. The nonradiological risks associated with return of transport vehicles to their points of origin are also included. Risk factors for exhaust emissions and fatality rates used in these analyses were obtained from References C-10, C-11, and C-12 and are provided in Table C-2.

Table C-2: Fatality Rates for Nonradiological Risks

	RAIL	**TRUCK**
Fatalities per Kilometer Due to Pollutants	1.3×10^{-7}	1.0×10^{-7}
Fatalities per Kilometer Due to Accidents	2.82×10^{-8}	5.82×10^{-8}

C.3.3 Formulas Used for Nonradiological Shipment Health Risk Calculations

The estimated fatalities during incident-free transportation of nonradiological materials are determined according to the following formula:

$$F_1 = D \times U \times R_1 \times N \times 2$$

where:

F_1 = Estimated fatalities for the total number of shipments.

D = Average distance traveled (kilometers), per package.

U = Percent of the distance traveled through urban areas, which has been conservatively estimated to be 27 percent for nonradiological shipments. (This estimate was used since the destination for all nonradiological shipments is not precisely known).

R_1 = Fatalities per kilometer due to pollutants based on Reference C-10.

N = Number of shipments.

2 = Factor which is applied for the return of the transport vehicle to its point of origin.

A summary of the variables and the estimated fatalities due to incident-free shipment of the nonradiological materials is provided in Table C-3.

Table C-3: Variables and Fatalities for Incident-Free Shipment of Nonradiological Materials

D	U	R_1	N	F_1
200 kilometers	27%	1.0×10^{-7} fatalities per kilometer	1600 shipments	1.7×10^{-2} estimated fatalities

For the shipments of nonradiological materials involving an accident, the estimated fatalities are determined according to the following formula:

$$F_2 = D \times R_2 \times N \times 2$$

where:

F_2 = Estimated fatalities for the total number of shipments.

D = Average distance traveled (kilometer), per package.

R_2 = National average truck accident fatality rate (per kilometer) based on Reference C-11.

N = Number of shipments.

2 = Factor which is applied for the return of the transport vehicle to its point of origin.

A summary of the variables and the estimated fatalities due to accidents involving shipment of the nonradiological materials is provided in Table C-4.

Table C-4: Variables and Fatalities Due to Accidents Involving Shipments of Nonradiological Materials

D	R_2	N	F_2
200 kilometers	5.82×10^{-8} fatalities per kilometer	1600 shipments	3.7×10^{-2} estimated fatalities

C.4 Technical Approach for Assessing Incident-Free Radioactive Shipments

C.4.1 General Population Exposure and Transportation Crew Exposure

The RADTRAN 4 computer code includes models for calculating incident-free risks for shipment of radioactive packages. For shipments of S1C Prototype related radioactive materials, RADTRAN 4 models were used to estimate: (1) exposure to persons within about one-half mile of each side of the transport route (off-link exposures), (2) exposures to persons sharing the transport route (such as passengers on passing trains or vehicles, known as on-link exposures), (3) exposures to persons at stops (such as residents or workers not directly involved with the shipment), and (4) exposures to transportation crew members. The exposures calculated for the first three groups were added together to obtain the general population exposure estimates. The exposure calculated for the transportation crew was designated as the occupational exposure. The impacts of exposure to the S1C Prototype package handlers are included in the facility activities analyses in Appendix B, Section B.2.

Highway shipments of packages similar in size to the pressure vessel package have occurred between the Windsor Site and the Griffin Line railhead in the past. Based on past experience for these shipments, local police escorts have allowed traffic to pass to reduce congestion. Related analyses assumed that limited traffic would pass the slow moving heavy hauler portion of the pressure vessel shipment.

The transportation crew would receive radiation exposure directly from radioactive packages during transit and/or inspection periods. For truck and heavy hauler shipments, RADTRAN 4 assumes crew exposure is only received during the transit period and no inspections occur. For rail shipments, RADTRAN 4 assumes crew exposure is only received during periods of package inspections. Crew exposure is assumed to be negligible during transit due to the relatively long separation distance between the crew and the package and massive shielding of intervening structures. Therefore, for rail shipments, RADTRAN 4 assigns crew exposure to one individual, the inspector.

C.4.2 Maximally Exposed Individuals

To estimate the maximum radiological exposure to an individual member of the transportation crew and an individual in the general public during incident-free radioactive shipments, various hypothetical scenarios were evaluated. Four scenarios were evaluated for individuals in the general population during rail shipments: 1) a rail yard worker working at a distance of ten meters from the radioactive package for two hours, 2) a resident living 30 meters from a rail line used to ship a radioactive package with the package in transit, 3) a resident living 200 meters from a rail line used to ship a radioactive package and the shipment is stopped for 20 hours, and 4) a person standing still for one hour at a distance of six meters from a radioactive package loaded on a railcar. Since the inspector is the only transportation crew member exposed during rail shipments, he is also the maximally exposed individual worker.

Three hypothetical scenarios were evaluated for individuals in the general population during highway shipments: 1) a person who is caught in traffic at a distance of one meter from the radioactive package for one half hour, 2) a resident living 30 meters from a highway used to ship a radioactive package with the package in transit, and 3) a service station worker working at a distance of 20 meters from the package for two hours. The maximally exposed individual worker for highway shipments is the truck driver.

The following formula was used to calculate the radiological exposures to individuals at a fixed distance from a radioactive package during a stop:

$$E = (T \times K \times TI) / D^2$$

where:

E = Exposure (Rem).

T = Total exposure time (hours).

K = Point source conversion factor (meters squared).

TI = Transport Index (equal to the radiation level at one meter from the package surface, Rem per hour).

D = Average distance from centerline of container to exposed person (meters).

Exposure to individuals at a fixed distance from the route along which the shipment is being transported was calculated using the following formula for a moving radiation source traveling with a fixed velocity, V, in meters per hour. All other terms are the same as described for the previous formula.

$$E = (\pi \times K \times TI) / (V \times D)$$

C.5 Computer Model Variables and Assumptions

This section highlights various assumptions and specific variables that were used in transportation related analyses for S1C Prototype related shipments. Table C-5 provides the RADTRAN 4 computer program default values and also identifies different values used in analyses when a default value did not reflect the best estimate of current conditions.

Table C-5: Values for RADTRAN 4 Key Input Parameters

RADTRAN 4 Input Parameter	Default Value		Value Used in Analyses			
			Hanford		Savannah River	
	Truck	Rail	Truck	Rail	Truck	Rail
1) Fraction of Travel in Rural Zone	0.90	0.90	0.79 a,d	0.78 a	0.51 a,d	0.53 a
2) Fraction of Travel in Suburban Zone	0.05	0.05	0.18 a,d	0.18 a	0.42 a,d	0.35 a
3) Fraction of Travel in Urban Zone	0.05	0.05	0.03 a	0.04 a	0.07 a	0.12 a
4) Velocity in Rural Zone (kilometers per hour)	88.49	64.37	= d	=	= d	=
5) Velocity in Suburban Zone (kilometers per hour)	40.25	40.25	= d	=	= d	=
6) Velocity in Urban Zone (kilometers per hour)	24.16	24.16	=	=	=	=
7) Number of Crew Members Exposed on a Shipment	2	5	c	1.00 b	c	1.00 b
8) Average Distance from Radiation Source to Crew During Shipment (meters)	3.10	152.40	e	=	e	=
9) Number of Handlings per Shipment	0.0	2.00	=	=	=	=
10) Stop Time for Shipment (hours per kilometer)	0.011	0.033	0.005 b	=	0.005 b	=
11) Minimum Stop Time per Trip (hours)	0.0	10	=	=	=	=
12) Distance-Independent Stop Time per Trip (hours)	0.0	60	=	=	=	=
13) Minimum Number of Rail Inspections or Classifications	0.0	2	=	=	=	=
14) Number of Persons Exposed During Stop	50	100	=	=	=	=
15) Average Exposure Distance When Stopped (meters)	20	20	=	=	=	=
16) Storage Time per Shipment (hours)	0.0	4.0	=	0.0 b	=	0.0 b
17) Number of Persons Exposed During Storage	100	100	0.0 b	0.0 b	0.0 b	0.0 b
18) Average Exposure Distance During Storage (meters)	100	100	0.0 b	0.0 b	0.0 b	0.0 b
19) Number of Persons per Vehicle Sharing the Transport Link	2	3	=	=	=	=
20) Fraction of Urban Travel During Rush Hour	0.08	0.0	=	=	=	=
21) Fraction of Urban Travel on City Streets	0.05	1.0	=	=	=	=
22) Fraction of Rural and Suburban Travel on Freeways	0.85	0.0	=	=	=	=
23) One-way Traffic Count in Rural Zones	470	1	=	=	=	=
24) One-way Traffic Count in Suburban Zones	780	5	=	=	=	=
25) One-way Traffic Count in Urban Zone	2800	5	=	=	=	=

= RADTRAN 4 default value was assumed.

a. RADTRAN 4 default value not used. Data obtained from INTERLINE and HIGHWAY computer programs.

b. RADTRAN 4 default value not used. Data based on historical information.

c. RADTRAN 4 default value used for normal truck highway shipment. Crew size of 4 assumed for heavy hauler shipment.

d. Transportation analysis of the pressure vessel package by heavy hauler from the Windsor Site to the Griffin Line Railhead used the following values: parameter 1) fraction of travel in a rural zone = 0.999, parameter 2) fraction of travel in a suburban zone = 0.001, and parameters 4) and 5) velocity = 3.2 kilometers per hour.

e. The following average distances from radiation source to the transportation crew were used for highway shipments: 4.02 meters for miscellaneous packages, 5.95 meters for the pressure vessel package, 5.02 meters for the steam generator packages, and 4.66 meters for the pressurizer package.

C.5.1 Planned Number of Shipments and Package Sizes

Table C-6 defines the assumed size of each radioactive package that would be shipped from the Windsor Site. Analyses assume there would be six miscellaneous waste packages per truck shipment and a total of 19 miscellaneous shipments. The major components would be shipped as whole units in 4 individual shipments. The SPAN4 computer code used all of the package dimensions shown in Table C-6. The RADTRAN 4 computer code used an effective package size based on the length dimension only.

Table C-6: Package Data for the S1C Prototype Reactor Plant Components

Package Type	External Package Dimensions
Miscellaneous components via truck	72 inches wide x 48 inches tall x 48 inches deep
Pressure Vessel via heavy hauler and rail	224 inches long x 127 inches diameter
Steam Generator via truck	151 inches long x 49 inches diameter
Pressurizer via truck	123 inches long x 35 inches diameter

C.5.2 Transport Indexes

Transport index values represent the radiation levels at one meter from the package surface of radiological shipments. The transport index values used in the transportation analyses, listed in Table C-7, are based on records of similar low level radioactive waste shipments. The transport index values for the steam generator, pressurizer, and miscellaneous shipments conservatively assume that the components would be shipped without shielding and in standardized disposal containers. As a result of cobalt-60 radioactive decay during the 30-year caretaking period, the transport index values for deferred dismantlement reflect a 98% reduction when compared to prompt dismantlement.

For the pressure vessel shipment, a large shielded disposal container would be required. It was assumed that the large shielded disposal container would be designed to meet a desired transport index at the time of shipment. As a result, the same transport index value was used in the transportation analyses of the pressure vessel shipments for the prompt and deferred dismantlement alternatives.

Table C-7: Transport Indexes [1, 2]

Package Type	Prompt Dismantlement	Deferred Dismantlement
Pressure Vessel	1.5	1.5
Steam Generator	14.4	0.3
Pressurizer	15.4	0.3
Miscellaneous (6 boxes per shipment)	13.9	0.3

1. The Transport Index is a dimensionless number (rounded to the first decimal place) that represents the radiation level at one meter from the package surface in millirem per hour.

2. All packages would be designed and prepared for shipment to meet Department of Transportation requirements, 49 CFR Part 173.

C.5.3 Transportation Distances and Population Densities

As discussed in Section C.3.1, the HIGHWAY and INTERLINE computer codes were used for determining transportation distances and the population densities along the transportation routes. Based on historical data from similar radioactive material shipments, and for added conservatism, the total distances used for pressure vessel rail shipment analysis were increased by approximately 11% above the distances predicted by the INTERLINE computer program. Similarly, the total distances used for highway shipment analyses were increased by approximately 3% above the distances predicted by HIGHWAY computer program. The increased distance factors were applied equally for each population density area.

C.5.4 Shipment Storage Time

Shipments made under the cognizance of Naval Reactors are made in an efficient and safe manner. Shipments of radioactive material are not stored while in the process of being shipped; therefore, there was no shipment storage time associated with any of the shipments.

C.5.5 Rail Shipment Variables

Train Velocity: The RADTRAN 4 computer code provides different default values for train velocity that correspond to travel in the various population density areas. These analyses used the default values for train velocity. The RADTRAN 4 computer code also provides standard values for train stop times that were used in this study.

Crew Size: The RADTRAN 4 computer code default value for the number of personnel that accompany a special radioactive shipment is five, which includes three crew members plus two courier escorts. Although the reactor pressure vessel is radioactive, it does not contain spent fuel and would not be considered to be a special shipment; therefore, couriers would not be required. For this analysis, the train crew size was assumed to be three. RADTRAN 4 assumes crew exposure is received during routine package inspections while the train is stopped. During transit, crew exposure is assumed to be negligible due to the relatively long separation distance between the crew and the package and the shielding effects of intervening structures. Therefore, crew exposure is assigned to only one individual, the inspector.

Shielding Factor: For train stops, the standard RADTRAN 4 computer code gamma shield factor default value is 0.1. This value assumes the presence of substantial rail yard structures equivalent to approximately four inches of steel. Four inches of steel reduces gamma radiation exposure by more than a factor of 10. Therefore, a shield factor of 0.1 was considered to be reasonable.

Distance to the Package: The RADTRAN 4 default value of 152.4 meters was used for the distance between the pressure vessel package and the transportation crew during transit.

C.5.6 Truck and Heavy Hauler Shipment Variables

Truck Velocity: For truck shipment of smaller packages, the RADTRAN 4 defaults were used in all three population density zones. For the heavy hauler segment of the pressure vessel shipment, the velocity was assumed to be 3.2 kilometers per hour.

Crew Size: The RADTRAN 4 computer code default values for the truck crew were used for the truck shipments for the smaller packages. For the reactor pressure vessel, the number of persons assumed to be in the heavy hauler transportation crew was four.

Number of Truck Inspections: Radioactive package shipments would be inspected prior to leaving the Windsor Site. Analyses assumed that there would be no inspections during transport.

Truck Stop Time: A calculated stop time of 0.005 hours per kilometer was used for all highway and heavy hauler shipments. This is based on historical data from other low level radioactive waste shipments that originated at the Windsor Site.

Distance to the Package: The crew was assumed to be located 3.1 meters from the outside of the package for the truck and the heavy hauler shipments.

C.6 Technical Approach for Assessing Radioactive Shipment Accidents

Health risks from hypothetical accidents involving radioactive shipments were evaluated for the general population only. Risk is the product of an event probability and consequence. Analyses assumed that the transportation workers would evacuate the scene of an accident within a relatively short time after the accident occurred. Therefore, the risks of transportation accidents on transportation workers are included in the results for the general population.

C.6.1 General Population and Risk

The RADTRAN 4 computer code was used to calculate the radiological risk to the general population under accident conditions. The RADTRAN 4 computer code evaluates six pathways for radiation exposures resulting from an accident. The six pathways are:

- Direct radiation exposure from the damaged package.
- Inhalation exposure from the plume of radioactive material released from the damaged package.
- Direct radiation exposure from immersion in the plume of radioactive material released from the damaged package.
- Direct radiation exposure from ground deposition of the radioactive material released from the damaged package.
- Inhalation exposure from resuspension of the radioactive material deposited on the ground.
- Ingestion exposure from food products grown on the soil contaminated by ground deposition of radioactive material released from the damaged package.

A specific formula is used to estimate the radiological exposure from each pathway. The formula accounts for the probability of an accident occurring and the severity. The internal pathways (inhalation and ingestion) exposures are based on exposure to the body over a 50-year period. The total radiation exposure resulting from the hypothetical accident equals the sum of the exposures from each pathway. The general equation for the radiation exposure to the general population from all pathways is:

$$D_R = \sum_{c,r} L_C \, P_r \times \sum_{i,j,k} (P_j \times RF_j \times D_{i,j,k})$$

where: D_R = Total radiation exposure risk to the general population from the accident.

L_C = Shipment distance.

P_r = Probability of traffic accidents per unit distance (Accident Probabilities, Table C-8).

P_j = Probability that an accident of a specific severity category occurs. Section C.6.3 provides further discussion.

RF_j = Fraction of curies released from shipping container after a severe accident (Corrosion Product Release Fractions, Table C-11).

$D_{i,j,k}$ = Radiation exposure commitment resulting from a accident of a specific severity category (j), received through a specific pathway (I) in a specific population density zone (k).

Because it is impossible to predict the specific location of a transportation accident, neutral weather conditions were assumed (Pasquill Stability Class D as defined in Reference C-13). Since neutral meteorological conditions are the most frequently occurring atmospheric conditions in the United States, these conditions are most likely to be present in the event of a transportation accident.

C.6.2 Accident Probability

The average probability of an accident in the United States by transportation mode was obtained from Reference C-11. The probabilities used in transportation accident analyses are presented in Table C-8. These probabilities represent all categories of accidents. Rail accident rates are the same for rural, suburban, and urban areas.

Table C-8: Accident Probabilities

Transport Mode	Accidents per Kilometer in Rural Zones (National Average)	Accidents per Kilometer in Urban and Suburban Zones (National Average)
Truck	2.03×10^{-7}	3.58×10^{-7}
Rail	5.57×10^{-8}	5.57×10^{-8}

C.6.3 Severe Accident Probability

The severe accident probability for S1C-related shipments was based on the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference C-1). That study conservatively estimated that 99.4% of truck and rail accidents involving Type B packages would not result in any release of package contents to the environment. The study estimated that 0.6% of truck and rail accidents involving Type B packages would be severe enough to cause a breach in the container and would result in a release of loose corrosion products to the environment. A severe accident probability of 0.6% was assumed in analyses of all S1C-related truck and rail shipments. Further discussion of package types is provided in Section C.6.5.

C.6.4 Corrosion Product Activity

Analyses assumed that the amount of corrosion product activity in each package type was equally distributed. The amount of activated corrosion products was derived based on formulas that correlate reactor plant pipewall dose rate measurements with calculated wetted surface areas and corrosion product deposition levels. The radioactivity amounts used in the transportation accident analyses were based on actual end-of-life data decay corrected to the time of dismantlement. Values for prompt dismantlement are decay corrected for four years and values for deferred dismantlement were decay corrected for 34 years. As discussed in Section C.5.2 for transport indexes, nearly all of the gamma emitting radioactive material in the reactor plant comes from cobalt-60. Cobalt-60 contributes more than 99% to the total exposure levels in the accident analyses for the prompt dismantlement alternative and approximately 85% for the deferred dismantlement alternative. Table C-9 provides the total amount of corrosion product radioactivity assumed in transportation analyses for the package types. Table C-10 lists the radionuclides that result in at least 99% of the possible exposure for the deferred dismantlement alternative.

Table C-9: Corrosion Product Radioactivity Content of Package Types, Decay Corrected

Package Type	Prompt Dismantlement [1] (Curies)	Deferred Dismantlement [2] (Curies)
Miscellaneous	0.59	0.10
Steam Generator	4.85	0.79
Reactor Vessel	2.91	0.47
Pressurizer	0.83	0.13

1. Values decay corrected for four years after final S1C Prototype reactor plant shutdown.
2. Values decay corrected for 34 years after final S1C Prototype reactor plant shutdown.

Table C-10: Radionuclides Included in S1C Prototype Corrosion Product Calculations

Co-60	Ni-63
Sr-90	Pu-239
Nb-94	Pu-241
Cs-137	Am-241
Pu-238	Cm-244

C.6.5 Package Categorization

All reactor plant components would be shipped as packages meeting Department of Transportation regulations 49 CFR Part 173 (Shippers - General Requirements for Shipments and Packagings). The regulations include requirements for several types of packaging. Transportation risk analyses assumed that the reactor pressure vessel would be shipped in a single package meeting Type B criteria. Type B packaging is designed and tested to rigorous standards to prevent any release of contents under most accident conditions. Type B packaging design and testing standards are defined in Nuclear Regulatory Commission regulations 10 CFR Part 71 (Packaging and Transportation of Radioactive Material). The steam generator, pressurizer, and miscellaneous components would be shipped as packages meeting the Department of Transportation criteria for either Low Specific Activity materials or Surface Contaminated Objects. The design and performance standards for these packages are not required to be as rigorous as Type B packaging criteria.

C.6.5.1 Package Release Fractions

The package release fraction represents the percentage of radioactive material in the shipment that would be released to the environment following a severe accident. The amount of radioactivity that could be released from each package was derived based on historical activated corrosion product models. The corrosion product model accounts for all activated corrosion products which adhered to all wetted surfaces inside the reactor vessel and coolant system over plant life. Most of the radioactive corrosion products contained in reactor plant materials are strongly adhering to the inside surfaces. Based on conservative results of laboratory testing, transportation accident analyses for each package type assumed that 33% of corrosion product radioactivity would be loosened from the impact of a hypothetical accident.

As discussed in Section C.6.3 for severe accident probability, only severe accidents would result in a release of radioactivity to the environment. Although the same severe accident probability was assumed in the accident analyses for all packages, the Type B reactor pressure vessel package would be much less susceptible to damage or breaching. Consistent with the Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference C-1), transportation risk analysis of the Type B reactor pressure vessel package assumed that 10% of its loose corrosion products would be released following a severe accident. Since 33% is a conservative prediction of the available corrosion products which could be loosened, as discussed above, the severe accident analysis of the reactor pressure vessel package applied a package release fraction of 0.033 (33% of the total available corrosion product radioactivity in the package × 10% release = 3.3% = 0.033).

| Since the steam generator, pressurizer, and miscellaneous materials would be shipped in packages other than Type B, transportation risk analyses conservatively assumed that all (100%) of the loose corrosion products could be released following a severe accident. Severe accident analyses of these package types applied a package release fraction of 0.33 (33% of the total available corrosion product radioactivity × 100% release = 33% = 0.33). Table C-11 summarizes the release fractions used in transportation risk analyses.

Table C-11: Package Release Fractions for Severe Accident Conditions

Package Type	Release Fraction
Pressure Vessel	0.033
Steam Generator	0.33
Pressurizer	0.33
Miscellaneous	0.33

C.6.6 Maximum Consequence to Individual and Population

Maximum consequences were evaluated for the steam generator, pressurizer, and miscellaneous packages assuming that a hypothetical accident occurs. For the reactor pressure vessel shipment, maximum consequences were evaluated for very severe accidents having a low probability of occurrence. For all package types, radiological exposures were calculated for the maximally exposed individual and the general population. Because it is impossible to predict the specific location of a transportation accident, exposures to the general population were calculated for each of the three population density regions (rural, suburban and urban) over a 50-mile radius. The RISKIND computer code was used to calculate the maximum consequence exposures.

The exposure pathways evaluated by RISKIND are identical to those used in the RADTRAN 4 computer code for exposures to the general population as discussed in Section C.6.1. However, the analyses for the maximum consequence exposure to an individual considered acute doses only. Because the food ingestion pathway does not result in an acute dose, this pathway was not included in the maximum consequence analyses for individuals. Analyses assumed that the maximally exposed individual would be exposed unshielded during the passage of the radioactive plume released from the accident under worst (stable) atmosphere conditions.

Remedial actions following an accident would significantly reduce the consequences of the accident; however, analyses conservatively assume no cleanup actions.

C.6.6.1 Probability Cutoff Criterion

Consistent with Reference C-1, maximum consequence analyses applied a cutoff criterion of one in ten-million (1.0×10^{-7}) chance of occurrence per year for excluding improbable accidents from detailed evaluation. Severe accident probability calculations considered variables such as the probability of an accident occurring (Section C.6.2), the severe accident probability (Section C.6.3), the fraction of travel in each population area, the number of shipments, and the probability of meteorological conditions that would lead to the higher consequences.

C.6.7 Plume Release Height Following an Accident

For the accident risk assessment, a ground level release was used in the RADTRAN 4 model. For the maximum consequence assessment, a plume release height of ten meters was used in the RISKIND model.

C.6.8 Direct Exposure from a Damaged Package

The radiation level following an accident was assumed to be at the Nuclear Regulatory Commission limit in 10 CFR Part 71 of one rem per hour at one meter from the component surface. Analyses concluded that the total direct exposure to the general population or maximally exposed individual from the damaged package is negligible.

C.6.9 Food Transfer Factors

These transportation analyses used the same food transfer factors as similar analyses in the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Reference C-1).

C.6.10 Distance from the Accident Scene to the Maximally Exposed Individual

Analyses assumed that the maximally exposed individual would remain in one location, unshielded, during the time that a radioactive plume passed by following a hypothetical accident. The location of maximum exposure was also assumed to be within the range of 100 meters to 400 meters from the accident site. This location was determined using RISKIND based on the assumed atmospheric stability and plume release height.

C.6.11 Population Density in the Vicinity of a Hypothetical Accident

The standard national average for each population density from the RADTRAN 4 computer code was used for the RISKIND maximum consequence assessment. The assessment considers the population within 80 kilometers (50 miles) of the hypothetical accident site under both neutral and stable weather conditions. The population ranged from 2.6 thousand in rural areas to 1.5 million in urban areas.

C.7 Summary of Analysis Results

This section provides the results of all transportation-related analyses performed for radioactive packages that would be shipped as a result of S1C Prototype reactor plant dismantlement.

C.7.1 Incident-Free Risk

Incident-free transportation analysis results are provided in the following tables:

Destination	Prompt Dismantlement	Deferred Dismantlement
Savannah River Site	Table C-12	Table C-14
Hanford Site	Table C-13	Table C-15

Radiological exposure and latent fatal cancers are provided for the general population, for the transportation crew and for the maximally exposed individual. The predicted numbers of fatalities from nonradiological sources (pollutants) are provided for comparison purposes. The results show the nonradiological risks are comparable to the radiological risks.

C.7.2 Accident Risk

Transportation accident analysis results are provided in the following tables:

Destination	Prompt Dismantlement	Deferred Dismantlement
Savannah River Site	Table C-16	Table C-18
Hanford Site	Table C-17	Table C-19

Tables C-16 through C-19 represent the risks of accidents that would involve a release of radioactivity to the environment and the probabilities of occurrence. Radiological exposure and latent fatal cancer risks are provided for the general population. The predicted numbers of fatalities from nonradiological sources (traffic accidents) are included for comparison purposes. The major contributor is the ground contamination pathway (more than 90% of the total exposure). The ingestion pathway is the next important pathway. The analyses indicate that the nonradiological risks from accidents exceed the radiological risks for both the prompt and deferred alternatives.

C.7.3 Accident Maximum Consequences

Analysis results that estimate the maximum consequences from a severe accident are provided in Table C-20 for the prompt dismantlement alternative and Table C-21 for the deferred dismantlement alternative. These results apply to shipments to either the Savannah River Site or to the Hanford Site. The accident with the highest maximum consequences involves the steam generator shipment because the steam generators have the highest corrosion product radioactivity content.

Table C-12: Incident-Free Transportation Risks, Windsor Site to Savannah River Disposal Site, Prompt Dismantlement Alternative

	General Population		Transportation Crew		Maximally Exposed Individual in the General Population [1]		Maximally Exposed Worker [1]		Non-Radiological Fatality Risk
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	
Misc.	1.42×10^{0}	7.10×10^{-4}	5.85×10^{0}	2.34×10^{-3}	1.31×10^{-1}	6.55×10^{-5}	2.92×10^{0}	1.17×10^{-3}	3.71×10^{-4}
Pressure Vessel	4.52×10^{-3}	2.26×10^{-6}	7.03×10^{-3}	2.81×10^{-6}	6.16×10^{-4}	3.08×10^{-7}	5.43×10^{-3}	2.17×10^{-6}	5.67×10^{-5}
Steam Generator	3.60×10^{-1}	1.80×10^{-4}	5.47×10^{-1}	2.19×10^{-4}	1.44×10^{-2}	7.20×10^{-6}	2.73×10^{-1}	1.09×10^{-4}	3.90×10^{-5}
Pressurizer	1.48×10^{-1}	7.42×10^{-5}	2.61×10^{-1}	1.05×10^{-4}	7.73×10^{-3}	3.87×10^{-6}	1.31×10^{-1}	5.23×10^{-5}	1.95×10^{-5}
TOTAL	1.93×10^{0}	9.66×10^{-4}	6.66×10^{0}	2.67×10^{-3}	1.54×10^{-1}	7.69×10^{-5}	3.33×10^{0}	1.33×10^{-3}	4.86×10^{-4}

1. Data for the maximally exposed individual are conservatively assumed to apply to the same person for all shipments.

Table C-13: Incident-Free Transportation Risks, Windsor Site to Hanford Disposal Site, Prompt Dismantlement Alternative

	General Population		Transportation Crew		Maximally Exposed Individual in the General Population [1]		Maximally Exposed Worker [1]		Non-Radiological Fatality Risk
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	
Misc.	3.75×10^{0}	1.88×10^{-3}	8.27×10^{0}	3.31×10^{-3}	1.31×10^{-1}	6.55×10^{-5}	4.13×10^{0}	1.65×10^{-3}	4.35×10^{-4}
Pressure Vessel	7.28×10^{-3}	3.64×10^{-6}	1.22×10^{-2}	4.90×10^{-6}	6.16×10^{-4}	3.08×10^{-7}	1.06×10^{-2}	4.25×10^{-6}	4.90×10^{-5}
Steam Generator	9.53×10^{-1}	4.76×10^{-4}	1.35×10^{0}	5.39×10^{-4}	1.44×10^{-2}	7.20×10^{-6}	6.74×10^{-1}	2.70×10^{-4}	4.58×10^{-5}
Pressurizer	3.94×10^{-1}	1.97×10^{-4}	6.45×10^{-1}	2.58×10^{-4}	7.73×10^{-3}	3.87×10^{-6}	3.23×10^{-1}	1.29×10^{-4}	2.29×10^{-5}
TOTAL	5.11×10^{0}	2.55×10^{-3}	1.03×10^{1}	4.11×10^{-3}	1.54×10^{-1}	7.69×10^{-5}	5.14×10^{0}	2.06×10^{-3}	5.53×10^{-4}

1. Data for the maximally exposed individual are conservatively assumed to apply to the same person for all shipments.

Table C-14: Incident-Free Transportation Risks, Windsor Site to Savannah River Disposal Site, Deferred Dismantlement Alternative

	General Population		Transportation Crew		Maximally Exposed Individual in the General Population [1]		Maximally Exposed Worker [1]		
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	Non-Radiological Fatality Risk
Misc.	2.84×10^{-2}	1.42×10^{-5}	1.17×10^{-1}	4.68×10^{-5}	2.62×10^{-3}	1.31×10^{-6}	5.85×10^{-2}	2.34×10^{-5}	3.71×10^{-4}
Pressure Vessel	4.52×10^{-3}	2.26×10^{-6}	7.03×10^{-3}	2.81×10^{-6}	6.16×10^{-4}	3.08×10^{-7}	5.43×10^{-3}	2.17×10^{-6}	5.67×10^{-5}
Steam Generator	7.20×10^{-3}	3.60×10^{-6}	1.09×10^{-2}	4.37×10^{-6}	2.88×10^{-4}	1.44×10^{-7}	5.47×10^{-3}	2.19×10^{-6}	3.90×10^{-5}
Pressurizer	2.97×10^{-3}	1.48×10^{-6}	5.23×10^{-3}	2.09×10^{-6}	1.55×10^{-4}	7.75×10^{-8}	2.61×10^{-3}	1.05×10^{-6}	1.95×10^{-5}
TOTAL	4.31×10^{-2}	2.15×10^{-5}	1.40×10^{-1}	5.61×10^{-5}	3.08×10^{-3}	1.54×10^{-6}	7.20×10^{-2}	2.88×10^{-5}	4.86×10^{-4}

1. Data for the maximally exposed individual are conservatively assumed to apply to the same person for all shipments.

Table C-15: Incident-Free Transportation Risks, Windsor Site to Hanford Disposal Site, Deferred Dismantlement Alternative

	General Population		Transportation Crew		Maximally Exposed Individual in the General Population [1]		Maximally Exposed Worker [1]		
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Person-Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	Exposure (Rem)	Latent Fatal Cancer Risk	Non-Radiological Fatality Risk
Misc.	7.51×10^{-2}	3.75×10^{-5}	1.65×10^{-1}	6.62×10^{-5}	2.62×10^{-3}	1.31×10^{-6}	8.27×10^{-2}	3.31×10^{-5}	4.35×10^{-4}
Pressure Vessel	7.28×10^{-3}	3.64×10^{-6}	1.22×10^{-2}	4.90×10^{-6}	6.16×10^{-4}	3.08×10^{-7}	1.06×10^{-2}	4.25×10^{-6}	4.90×10^{-5}
Steam Generator	1.91×10^{-2}	9.53×10^{-6}	2.70×10^{-2}	1.08×10^{-5}	2.88×10^{-4}	1.44×10^{-7}	1.35×10^{-2}	5.39×10^{-6}	4.58×10^{-5}
Pressurizer	7.87×10^{-3}	3.94×10^{-6}	1.29×10^{-2}	5.16×10^{-6}	1.55×10^{-4}	7.75×10^{-8}	6.45×10^{-3}	2.58×10^{-6}	2.29×10^{-5}
TOTAL	1.09×10^{-1}	5.46×10^{-5}	2.18×10^{-1}	8.70×10^{-5}	3.08×10^{-3}	1.54×10^{-6}	1.13×10^{-1}	4.53×10^{-5}	5.53×10^{-4}

1. Data for the maximally exposed individual are conservatively assumed to apply to the same person for all shipments.

Table C-16: Transportation Accident Risks,
Windsor Site to Savannah River Disposal Site,
Prompt Dismantlement Alternative

	General Population		Non-Radiological Fatality Risk
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	
Miscellaneous	3.97×10^{-4}	1.99×10^{-7}	3.13×10^{-3}
Pressure Vessel	2.56×10^{-6}	1.28×10^{-9}	1.03×10^{-4}
Steam Generator	3.45×10^{-4}	1.73×10^{-7}	3.29×10^{-4}
Pressurizer	2.96×10^{-5}	1.48×10^{-8}	1.65×10^{-4}
TOTAL	7.74×10^{-4}	3.88×10^{-7}	3.73×10^{-3}

Table C-17: Transportation Accident Risks,
Windsor Site to Hanford Disposal Site,
Prompt Dismantlement Alternative

	General Population		Non-Radiological Fatality Risk
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	
Miscellaneous	4.66×10^{-4}	2.33×10^{-7}	1.01×10^{-2}
Pressure Vessel	2.82×10^{-6}	1.41×10^{-9}	2.80×10^{-4}
Steam Generator	4.05×10^{-4}	2.03×10^{-7}	1.07×10^{-3}
Pressurizer	3.47×10^{-5}	1.74×10^{-8}	5.33×10^{-4}
TOTAL	9.09×10^{-4}	4.55×10^{-7}	1.20×10^{-2}

Table C-18: Transportation Accident Risks,
Windsor Site to Savannah River Disposal Site,
Deferred Dismantlement Alternative

	General Population		Non-Radiological Fatality Risk
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	
Miscellaneous	8.97 x 10^{-6}	4.49 x 10^{-9}	3.13 x 10^{-3}
Pressure Vessel	5.79 x 10^{-8}	2.90 x 10^{-11}	1.03 x 10^{-4}
Steam Generator	7.80 x 10^{-6}	3.90 x 10^{-9}	3.29 x 10^{-4}
Pressurizer	6.67 x 10^{-7}	3.34 x 10^{-10}	1.65 x 10^{-4}
TOTAL	1.75 x 10^{-5}	8.75 x 10^{-9}	3.73 x 10^{-3}

Table C-19: Transportation Accident Risks,
Windsor Site to Hanford Disposal Site,
Deferred Dismantlement Alternative

	General Population		Non-Radiological Fatality Risk
	Exposure (Person-Rem)	Latent Fatal Cancer Risk	
Miscellaneous	1.07 x 10^{-5}	5.35 x 10^{-9}	1.01 x 10^{-2}
Pressure Vessel	6.49 x 10^{-8}	3.25 x 10^{-11}	2.80 x 10^{-4}
Steam Generator	9.28 x 10^{-6}	4.64 x 10^{-9}	1.07 x 10^{-3}
Pressurizer	7.93 x 10^{-7}	3.97 x 10^{-10}	5.33 x 10^{-4}
TOTAL	2.08 x 10^{-5}	1.04 x 10^{-8}	1.20 x 10^{-2}

Table C-20: Hypothetical Severe Accident Analysis Results (Maximum Consequences), Prompt Dismantlement Alternative

Maximally Exposed Individual		Rural		Suburban		Urban	
Exposure (rem)	Latent Fatal Cancer Risk	Collective Exposure (person-rem)	Latent Fatal Cancer Risk	Collective Exposure (person-rem)	Latent Fatal Cancer Risk	Collective Exposure (person-rem)	Latent Fatal Cancer Risk
8.63×10^{-2}	4.32×10^{-5}	1.41×10^{1}	7.07×10^{-3}	1.62×10^{2}	8.10×10^{-2}	2.63×10^{2}	1.32×10^{-1}

Table C-21: Hypothetical Severe Accident Analysis Results (Maximum Consequences), Deferred Dismantlement Alternative

Maximally Exposed Individual		Rural		Suburban		Urban	
Exposure (rem)	Latent Fatal Cancer Risk	Collective Exposure (person-rem)	Latent Fatal Cancer Risk	Collective Exposure (person-rem)	Latent Fatal Cancer Risk	Collective Exposure (person-rem)	Latent Fatal Cancer Risk
4.60×10^{-3}	2.30×10^{-6}	4.28×10^{-1}	2.14×10^{-4}	3.57×10^{0}	1.79×10^{-3}	6.07×10^{0}	3.04×10^{-3}

REFERENCES

C-1 Department of Energy, *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, April 1995.

C-2 Department of Navy, *Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants*, August 1995.

C-3 Neuhauser, K. S. and F. L. Kanipe, *RADTRAN 4 Users Guide*, SAND89-2370, TTC-0943, UC-722, Sandia National Laboratories, Albuquerque, New Mexico, January 1992.

C-4 Neuhauser, K. S. and F. L. Kanipe, *RADTRAN 4 Volume II: Technical Manual*, SAND89-2370, Sandia National Laboratories, Albuquerque, New Mexico, August 1993.

C-5 Yuan, Y. C., S. Y. Chen, D. J. LePoire, R. Rothman, *RISKIND - A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, Environmental Assessment and Information Sciences Division, Argonne National Laboratory, Argonne, Illinois, February 1993.

C-6 Johnson, P. E., D. S. Joy, D. B. Clark, J. M. Jacobi, *INTERLINE 5.0, An Expanded Railroad Routing Model*: Program Description, Methodology, and Revised User's Manual, ORNL/TM-12090, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March 1993.

C-7 Johnson, P. E., D. S. Joy, D. B. Clark, J. M. Jacobi, *HIGHWAY 3.01, An Enhanced Transportation Routing Model*: Program Description, Methodology, and Revised User's Manual, ORNL/TM-12124, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March 1993.

C-8 Wallace, O. J., *SPAN4 A Point Kernel Computer Program for Shielding*, WAPD-TM-809(L), Volumes I and II, October 1972.

C-9 International Commission on Radiological Protection (ICRP), *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Annals of the ICRP, Vol. 21, No. 1-3, New York, Pergamon Press, 1991.

C-10 Rao, R. K., E. L. Wilmot, R. E. Luna, *Nonradiological Impacts of Transporting Radioactive Material*, SAND81-1703, TTC-0236, Sandia National Laboratories, Albuquerque, New Mexico, February 1982.

C-11 Saricks, C. and T. Kvitek, *The Longitudinal Review of State-Level Accident Statistics for Carriers of Interstate Freight*, ANL/ESD/TM-68, Argonne National Laboratory Center for Transportation Research, Argonne, Illinois, 1994.

C-12 Cashwell, J. W., K. S. Neuhauser, P. C. Reardon, G. W. McNair, *Transportation Impacts of the Commercial Radioactive Waste Management Program*, SAND85-2715, TTC-0633, Sandia National Laboratories, Albuquerque, New Mexico, April 1986.

C-13 Pasquill, F., *Atmospheric Diffusion*, 2nd ed., John Wiley & Sons, New York, 1974.

C-14 National Academy of Sciences - National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V*, Report of the Committee on the Biological Effects of Ionizing Radiations, 1990.

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APPENDIX D

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The Honorable Thomas D. Ritter, Connecticut State Representative
The Honorable Carl Schiessel, Connecticut State Representative
The Honorable Kevin B. Sullivan, Connecticut State Senate
The Honorable Richard D. Tulisano, Connecticut State Representative

State Agencies

State of Connecticut Department of Environmental Protection

Mr. Richard Barlow, Chief, Bureau of Waste Management
Mr. George Dews, Bureau of Waste Management, Site Remediation and Closure Division
Mr. Carmine DiBattista, Chief, Bureau of Air Management
Mr. Brian J. Emerick, Supervising Environmental Analyst, Office of Environmental Review
Mr. Michael Firsick, Physicist, Radiation Control Group
Mr. James Grier, Permits, Enforcement and Remediation Division, Bureau of Water Management
Mr. Michael J. Harder, Director, Permits, Enforcement and Remediation Division, Bureau of Water Management
Mr. Sidney J. Holbrook, Commissioner
Mr. Kevin McCarthy, Director, Monitoring and Radiation Division, Bureau of Air Management
Mr. David A. Nash, Waste Engineering and Enforcement Division, Bureau of Waste Management
Mr. Arthur Rocque, Assistant Commissioner, (3 copies)

Mr. David A. Sattler, Waste Engineering and Enforcement Division, Bureau of Waste Management
Mr. Robert L. Smith, Chief, Bureau of Water Management

State of Connecticut Department of Public Health and Safety
Ms. Susan S. Addiss, Commissioner of Health Services
Mr. Ronald Skomro, Supervisor, Environmental Health Section

State of Connecticut Department of Transportation
Mr. Kenneth Daly, Engineering Compliance Manager, Bureau of Engineering and Highway Operations

State of Connecticut Office of Emergency Management
Mr. Paul Pascarelli, Area Three Coordinator
Mr. Robert Plant, Director

Connecticut Attorney General Office
Mr. Joseph Rubin, Assistant State Attorney General

Connecticut State Council on Environmental Quality
Mr. Karl Wagener, Executive Director

Mr. William Quiss, Intergovernmental Review Coordinator

State of Connecticut Historical Commission
Ms. Dawn Maddox, Deputy State Historic Preservation Officer
Dr. David A. Poirier, Staff Archaeologist, Connecticut Historical Commission

Local Government Agencies

The Honorable Francis J. Brady, Mayor of Windsor
The Honorable Faith McMahon, Mayor of Bloomfield
The Honorable Michael P. Peters, Hartford City Mayor
Mr. Domenico B. Albano, Chairman, Windsor Air and Water Pollution Abatement Commission
Ms. Saundra Kee Borges, Hartford City Manager
Mr. Louie Chapman Jr., Bloomfield Town Manager
Mr. David K. Kilbon, First Selectman, East Granby
Mrs. Mary A. Glassman, First Selectwoman, Simsbury
Mr. Randall Graff, Deputy Mayor, Town of Windsor
Mr. Albert Ilg, Windsor Town Manager
Mr. Thomas E. Johnson, City of Hartford
Mr. William Simanski, First Selectman, Granby
Dr. Charles J. Petrillo, Jr., Director of Health, Windsor
Mr. Victor J. Puia, First Selectman, Windsor Locks
Mr. Mark R. Sussman, Chairman, Windsor Conservation Commission
Mr. Don Trinks, Town of Windsor Health and Public Safety Committee
Mr. Charles V. Wall, R.S., Sanitarian, Community Health Services, Town of Windsor
Mr. Louis Watkins, Jr., Hartford City Council

Public

Mr. Peter Allan
Mr. Brian J. Anderson
Ms. Rosemary Bassilakis
Mr. W.C. Bennett
Mr. Bruce B. Bernstein
Mr. Leo Canty, Windsor Issues Forum
Mr. Andrew Caputo, Natural Resources Defense Council
Mr. Paul Catino
Ms. Ann Catino
Mr. Harold W. Chase
Ms. Martha Collier, Culbro Land Resources, Inc.
Mr. John F. Conant, Combustion Engineering, Inc.
Mr. Tim Debey, U.S. Army Nuclear and Chemical Agency
Mr. John F. Doherty

Mr. Paul A. Ehrhardt, Greater Hartford Transit District
Mr. Dan Evans, Halliburton NUS
Mr. Ronald E. Gingerich, Connecticut Hazardous Waste Management Service
Ms. Lillian Goldberg
Mr. George D. Hess
Mr. Gary Guasco, TLG Services, Inc.
Mr. Don Johnson
Mr. Gary R. Johnson
Mr. Pat Koppel, Nuclear Fuel Services
Mr. Leo Lessard, Yankee Atomic
Mr. Daniel Mackay, Knolls Action Project
Mr. William J. Manion, President, NES Inc.
Mr. Theodore Martocchio, Greater Hartford-New Britain Building and Construction Trades Council
Ms. Mary Ellen Marucci, Cooperative Citizens Monitoring Network
Mr. Steven Masiculli
Mr. James L. McCleer, Radiological Services, Inc.
Mr. Thomas McCormick
Mr. William D. Meinert
Ms. Kristin Morico, Combustion Engineering, Inc.
Mr. Jack L. Moulton
Ms. Mary Mullen-Barnett
Ms. Catherine Murphy
Mr. Ronald Murphy
Ms. Karen Noey, Bechtel National, Inc.
Ms. Larisa Nojek, Tetra Tech
Mr. Mark Pinard
Mrs. Jean Pottinger, Cooperative Citizens Monitoring Alliance and Transportation Alternatives, Inc.
Ms. Jean M. Rioual
Mr. Paul E. Roham
Mr. Fred C. Schmidt, Colorado State University
Ms. Marie Shanahan, Hartford Courant
Mr. Don Shields
Mr. Alan Simon, Windsor Issues Forum
Mr. Bradshaw Smith

Mr. Russell St.John, Director, Greater Hartford Transit District
Ms. Lynn Sterrazza, WVIT - Channel 30
Mr. Dan Tapper, Journal Inquirer
Mr. Charles Turner
Ms. Lorraine J. Verrinder
Mr. Robert H. Wardwell, Maguire Group, Inc.
Mr. Patricia Wass, Connecticut Peace Action Group
Ms. Debbie Wilcox
Mr. Gary Williams, Argonne National Laboratory

DOE/EIS-0275

FINAL ENVIRONMENTAL IMPACT STATEMENT

S1C Prototype Reactor Plant Disposal

Volume 2 of 2

November 1996

Prepared by the
U. S. Department of Energy
Office of Naval Reactors

Printed on recycled paper

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APPENDIX E

COMMENTS AND RESPONSES

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Introduction

This Appendix did not appear in the Draft Environmental Impact Statement. It has been added to the Final Environmental Impact Statement to present comments received following distribution of the Draft Environmental Impact Statement together with Naval Reactors' responses to those comments. In cases where text of the Final Environmental Impact Statement has been changed from the Draft Environmental Impact Statement, a sidebar has been placed in the margin of the Final Environmental Impact Statement adjacent to the revised text.

On June 24, 1996, Naval Reactors began distribution of the Draft Environmental Impact Statement on the S1C Prototype Reactor Plant Disposal. Over 140 notices and Draft Environmental Impact Statements were distributed to regulatory agencies, elected officials, organizations, and individuals who have expressed an interest in the disposal of the defueled S1C Prototype reactor plant. The public comment period began with publication of the Notice of Availability in the *Federal Register* (61FR35211) on July 5, 1996 and remained open for 45 days, ending on August 19, 1996. In addition to the *Federal Register* notice, a public notice was published in the *Hartford Courant* newspaper. During the comment period, a public hearing was held in Windsor, Connecticut, as announced in the *Federal Register* and *Hartford Courant* notices.

A total of 18 written statements and 14 oral statements were received as follows:

	Written	Oral
Federal Agencies	2	0
State Agencies	3	1
Federal Officials	1	0
Local Officials	2	4
Organizations	5	3
Individuals	5	6

In the Final Environmental Impact Statement Summary, Naval Reactors has identified the prompt dismantlement alternative as its preferred alternative.

The State of Connecticut Department of Environmental Protection; The Honorable Barbara B. Kennelly, U.S. House of Representatives; Dr. Charles J. Petrillo, Director of Health, Town of Windsor; Donald Trinks, Health and Public Safety Committee, Town of Windsor; Charles V. Wall, Sanitarian, Windsor Community Health Services; Leo Canty, Windsor Issues Forum; Mark Sussman, Windsor Conservation Commission; Robert A. Bell, Business Representative, Teamsters Local 559; Anthony DeFrancesco, Jr., Business Manager, Boilermakers Local 237; and 7 private citizens supported the prompt dismantlement alternative. Rosemary Bassilakis, Citizens Awareness Network; and 2 private citizens supported the deferred dismantlement alternative. There was no support expressed for the no action alternative.

This appendix provides responses to all other comments and issues identified during the public review. A copy of each comment letter received is exhibited in this appendix with the corresponding comment response(s) immediately following each letter. A copy of the public hearing transcript is also exhibited with corresponding comment responses following the transcript. For purposes of clarity, when necessary, individual comments in the letters and public hearing transcript have been annotated with sidebars and corresponding comment numbers. Letters received only in support of a specific alternative are included for the record at the end of this appendix.

Index of Comments and Responses

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COMMENTS AND RESPONSES

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STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF ENVIRONMENTAL REVIEW
79 ELM STREET, HARTFORD, CT 06106
Tel. - 424-4114 Fax - 424-4053

AUG 21 1996

August 19, 1996

Mr. C. G. Overton, Chief
Windsor Field Office
Office of Naval Reactors
U. S. Department of Energy
P. O. Box 393
Windsor, Connecticut 06095

RE: Draft Environmental Impact Statement
S1C Prototype Reactor Plant Disposal

Dear Mr. Overton:

This letter is in response to the subject document that was forwarded to the Department by your cover letter dated June 24, 1996. The various offices of the Department to which you distributed this document and other disciplines of the agency have reviewed the Draft Environmental Impact Statement (DEIS), and this is a coordinated response.

The Department supports the selection of the Prompt Dismantlement alternative, which will allow the unrestricted reuse of the Knolls Atomic Power Laboratory (KAPL) site. This alternative has a significant environmental benefit because it eliminates the uncertainty and risks associated with a 30 year or indefinite caretaking operation for the S1C reactor and will immediately address existing site conditions. With the nuclear fuel already removed from the reactor and site, the remaining radiological risks associated with prompt dismantlement of the reactor are minimal, and the work can be accomplished without exposing workers and the public to unsafe conditions. Also, the prompt dismantlement alternative has the added advantage of being the least costly alternative.

While the DEIS, in general, is adequate with respect to the evaluation of the dismantlement of the reactor, the DEIS does not provide a sufficient basis for determining the impacts of the project goal of releasing the site for unrestricted use. This deficiency results primarily from the omission of specific information regarding the characterization of any contamination from KAPL activities and any corrective actions that may be necessary. The following technical comments focus primarily on this deficiency and other general observations regarding the proposed action.

1.) A maximum radiation exposure limit of 15 millirem/year from all sources, of which a maximum of 4 millirem/year can be from ingestion of radioactivity in water, should be the standard used in the final site assessment, and the adherence to this standard should be specifically stated in the Final Environmental Impact Statement (FEIS). The Department believes that this is a reasonable and achievable goal.

2.) The DEIS is vague with regard to a time frame for the final radiological survey that would be performed following dismantlement of the reactor. In addition, there is no discussion as to what actions would take place if additional contamination was identified during the final survey. Specifically, when would the area be further remediated, and who would perform this activity? Also, would adjacent properties be sampled and surveyed during this final survey?

3.) A designation survey of the drainage brook performed by the Oak Ridge Institute for Science and Education (ORISE) for the Asea Brown Boveri, Inc. (ABB) property (formerly Combustion Engineering), which is adjacent to the KAPL site, identified areas of highly enriched uranium contamination. Alpha spectrometry analysis of one area resulted in a total uranium concentration of 16,740 pCi/g and a U-235 enrichment of 58%. This information is inconsistent with the reported values that are presented in the DEIS for locations on the drainage brook that are virtually the same but have much lower values. This apparent discrepancy must be resolved. Also, the responsibility for this condition in the drainage brook is uncertain, and it is possible that this contamination could have come from either the KAPL site or ABB site. Why was there no attempt made by KAPL to determine the uranium enrichment of the samples they obtained? The DEIS should more fully evaluate this condition and respond accordingly.

4.) Section 4.5.4.2 states, "Only one of the ten "deep" (12 inches) samples had a higher concentration of cobalt-60 than the two-inch deep samples taken at the same location. Therefore, there is no reason to believe that there are higher concentrations of cobalt-60 buried deeper in the brook sediment by siltation." If one sample *did* have higher concentrations at a deeper level, then how can this assumption be stated so definitely?

5.) Section 4.5.4.1 states, "Radioactive materials attributable to Windsor Site operations have never been disposed of or buried on the Windsor Site property." Does this statement imply that no site-characterization survey should be performed? What documentation is available to verify that this statement is accurate? Has the entire site been evaluated for the presence of radioactive contamination?

6.) Section 5.1.13 states, "In the event that identified facilities are not available in time for treatment of mixed wastes generated at the Windsor Site, the Site Treatment Plan states that other options would be evaluated and an Alternate Measures Plan would be submitted...." This potential situation should be addressed now, rather than waiting until it develops.

7.) There is no consideration in the DEIS of possible S1C-generated contamination in the water or terrestrial environment of adjacent sites other than the drainage brook that borders the ABB property. The Department believes that other adjacent properties should be defined and sampled in order to verify that S1C-generated radiological material and hazards do not exist.

8.) There is no discussion in the DEIS of possible reverse groundwater flow conditions in the drainage brook or other watercourses caused by seasonal fluctuations in rainfall combined with the use of the facility's water supply production well, and what effect this condition would have had on the disposition of radioactive contamination.

9.) The DEIS does not evaluate the on-site septic system or dry-well with regard to the potential chemical and/or radioactive contamination of these systems (tanks and pipes), any sediment that may be in the tanks, the soil or groundwater.

10.) There is no description or discussion of the final disposition of below grade non-process systems. Will surveys be performed on these systems to verify that they are free of contamination?

11.) The DEIS states that buildings and systems will be removed to four feet below grade. There should be a discussion and explanation presented as to why four feet was selected as the removal limit.

12.) There is no plan-of-action described in the event that residual radioactivity is detected once the buildings are removed.

13.) The DEIS documents some presence of radioactive contaminated soils and groundwater, but offers a limited discussion as to how this contamination might affect the general public and the relationship of such exposure to draft regulations proposed by EPA. It is mentioned that a subsistence farmer moving in and beginning to farm the area in 1997 would receive a dose of 13.6 millirem/year due to the presence of cobalt-60 soil contamination. An average decay-corrected soil contamination value of 1.36 pCi/gram is used to reach this conclusion, although values of soil concentrations as high as 10.9 pCi/gram are reported. In addition, this assumption is based solely on cobalt-60 contamination even though the ORISE survey, previously referenced, found enriched uranium contamination on the bank of the drainage brook.

14.) There is no mention that water sampling will be part of the final radiological survey. The Department believes that the final radiological survey of this site should include water sampling.

15.) A transportation plan is delineated for the movement of the reactor vessel and other reactor plant components, but no options are presented for the transportation of contaminated building materials, if such a need should develop.

16.) An accident analysis is performed for various scenarios, but no specific safeguards that will employed to prevent or minimize these accidents are described.

17.) The dose assessment computer programs (GENII, RSAC-5 and WATER RELEASE) that were used all calculate dose by summing internal and external sources. In the analyses of the samples taken, only gamma emitters are identified. Without knowing if there are alpha and/or beta sources present, it seems that a complete internal dose assessment cannot be performed.

18.) Many of the above concerns regarding residual radioactive contamination (buildings, below grade systems, septic tank, dry well, soil, groundwater, etc.) may be addressed in the decommissioning plan for this facility, which has not been included as a part of the DEIS or been available to the Department for review and comment through another review procedure. The purpose of a DEIS is to disclose and account for all environmental problems <u>before</u> the proposed action commences. Since DOE has not disclosed the technical details of its promised post-dismantlement radiological survey and soil sampling (e.g., sampling locations, depths of sampling), the Department cannot evaluate the technical sufficiency of DOE's plans. Perhaps the most efficient way of remedying this situation would be to offer the decommissioning plan to the Department for review and comment prior to the preparation of the FEIS and then incorporate all of this information into the FEIS. Following this suggestion would establish a complete record of decision upon which to move this project forward.

19.) The DEIS reports in Section 3.1.4 that, "A voluntary facility assessment addressing the potential for environmental chemical contamination would be completed to support Windsor Site inactiviation and future release of the property....The report would summarize findings and would provide recommendations for any additional investigation or cleanup required to support the goal of unrestricted release of the Windsor Site." All of the above points made in connection with future radiological testing apply equally to future chemical pollutant testing.

20.) The DEIS in Section 2.5.1 incorrectly states the regulatory authority the Department has over hazardous air pollutants (including radionuclides). The State of Connecticut, through the Department, has concurrent regulatory jurisdiction with the EPA for airborne radionuclides, and the Clean Air Act (CAA) expressly preserves state regulatory power over such air pollutants. Section 116 of the CAA defines air pollutant to include "...radioactive (including source material, special nuclear material , and by-product material) substance or matter which is emitted into or otherwise enters the ambient air." Indeed, DOE's State RCRA permit for the Windsor facility sets specific limits on the emissions to air of radionuclides, the violation of which may subject DOE to injunctive action and civil penalties of up to $25,000 per day. The DEIS should be corrected.

21.) Under the Prompt Dismantlement alternative, the permitted RCRA hazardous waste and radioactive mixed waste (RMW) storage building may have to used prior to shipment of wastes off-site to an ultimate disposal facility. Once all hazardous and RMW have been removed from the site and the storage building is no longer required, the RCRA storage permit can lapse. However, if the dismantlement of the facility gets extended, this storage permit should remain active. It should be noted that the RCRA storage permit is for hazardous wastes and RMW generated on-site only and contains a maximum waste storage capacity. No hazardous wastes or RMW may be accepted from other sites and stored at this facility.

22.) If 5 acres or more are disturbed during dismantlement, a stormwater discharge permit pursuant to EPA regulations promulgated in November 1990 will be required. The Bureau of Water Management has issued a general permit which will cover these discharges. For further information and to obtain the necessary registration forms, contact the Bureau at 424-3018.

23.) The DEIS notes that the ultimate transfer of ownership of this site will have to conform to the Property Transfer Program administered by the Department. KAPL personnel have contacted staff in this program to discuss this requirement. In anticipation of filing for a transfer of the property for unrestricted use under the Property Transfer Program and to avoid duplication of investigative and remedial efforts, the requirements of this program should be recognized when any facility assessment work is developed and performed. These efforts should provide sufficient documentation to evaluate the degree and extent of any releases to the environment and determine whether any remediation is necessary to comply with the Remediation Standard Regulations. KAPL personnel are aware of the current Transfer Act Site Assessment Guidance Document and that this document will be replaced within the next several months by a significantly more comprehensive technical guidance document for site investigations and demonstrations of compliance with the Remediation Standard

Regulations. It is recommended that you remain current with the requirements of this program and obtain a copy of this new guidance material when it is available.

The above concerns must be addressed in order to achieve unrestricted use of the site. They are intended to support that goal and the selection of the Prompt Dismantlement alternative. I hope they are helpful in completing your environmental evaluation. If I can be of any further assistance, please give me a call. Thank you.

Sincerely,

Brian J. Emerick

Brian J. Emerick
Supervising Environmental Analyst

cc: G. Leavitt, DEP/PERD
R. Robinson, DEP/PERD
O. Inglese, Jr., DEP/PERD
P. Franson, DEP/WEED
K. McCarthy, DEP/AQMRD
A. Rapkin, DEP/OLC
D. Leff, DEP/OAC
M. Sullivan, DEP/OCE

**Commenter: Brian J. Emerick, Supervising Environmental Analyst,
State of Connecticut Department of Environmental Protection**

Comment Responses:

Comment 1.
The limits cited by the State of Connecticut are included in draft regulations under consideration by the Environmental Protection Agency and the Nuclear Regulatory Commission. As discussed in the Draft Environmental Impact Statement, Sections 3.1.4 and 5.1.5.1, any future occupant of the Windsor Site would receive less radiation exposure than limits specified in draft regulations under consideration. These sections were clarified in the Final Environmental Impact Statement to include the numerical radiation exposure limits under consideration by the Environmental Protection Agency and the Nuclear Regulatory Commission.

Comment 2.
As stated in Section 5.1.1 of the Draft Environmental Impact Statement, the Windsor Site could be made available for other uses as early as 2001 under the prompt dismantlement alternative following completion of final radiological surveys. Following all dismantlement and disposal activities, a final radiological verification survey of the entire Windsor Site would be performed as described in Section 5.1.5.1 of the Draft Environmental Impact Statement. Final radiological verification surveys of the Windsor Site are estimated to occur in the year 2000 under the prompt dismantlement alternative. As stated in Section 5.1.5.1 of the Draft Environmental Impact Statement, Federal and State regulators would be invited to perform verification surveying and sampling. In the unlikely event that radiological survey results indicated residual radioactivity exceeding the applicable release criteria, the area would be cleaned up and resurveyed. Any necessary radiological remediation and subsequent confirmatory surveys would be performed by Naval Reactors to support prompt release of the Windsor Site. Additional information on the final radiological release process, which would also include sampling of adjacent properties and water, can be found in Appendix G of the Final Environmental Impact Statement.

Comment 3.
As discussed in Section 4.5.4.2 of the Draft Environmental Impact Statement, the drainage brook is not on Federal Government property, the brook sediments contain much higher concentrations of radionuclides originating from the Combustion Engineering, Inc. site than the concentrations of radionuclides originating from the S1C Prototype reactor plant, and the brook is the subject of a separate evaluation process. For these reasons, the Draft Environmental Impact Statement did not include potential remediation of the drainage brook in any of the alternatives under immediate consideration. Nevertheless, since the Council on Environmental Quality regulations for implementing the National Environmental Policy Act require that the existing environment be described and potential cumulative effects be considered, Naval Reactors did include in Section 4.5.4.2 of the Draft Environmental Impact Statement available information on the radiological conditions of the drainage brook.

Commenter: Brian J. Emerick, Supervising Environmental Analyst, State of Connecticut Department of Environmental Protection

Comment Responses:

Additional information on the radioactivity concentrations in the drainage brook has become available since the Draft Environmental Impact Statement was issued. The Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP) has issued a report which consolidates available information on radiological analysis of samples on the Combustion Engineering, Inc. site (Reference 4-28 of the Final Environmental Impact Statement). Naval Reactors assisted in the preparation of this report by making available for additional analysis the samples taken in 1991 which were discussed in the Draft Environmental Impact Statement. FUSRAP analyzed these samples for uranium isotopic composition as well as for cobalt-60 and, for a few samples, nickel-63. The FUSRAP report provides the most complete radiological description of the drainage brook currently available, and Naval Reactors has incorporated this description into Section 4.5.4.2 of the Final Environmental Impact Statement.

The commenter states that a past sample taken from the drainage brook by the Oak Ridge Institute for Science and Education (under contract with the Formerly Utilized Sites Remedial Action Program), which was analyzed specifically for all uranium isotopes, appears inconsistent with the results shown in the Draft Environmental Impact Statement. In the Draft Environmental Impact Statement, uranium results were reported based solely on gamma analysis for uranium-235. As discussed in Section 4.5.4.2 of the Draft Environmental Impact Statement, "The total uranium-234, uranium-235, and uranium-238 radioactivity concentration would be from twenty to forty-five times greater than the radioactivity concentration of uranium-235 alone, depending on the degree of enrichment. The enrichment of these samples is unknown since only uranium-235 was measured." Also, the Oak Ridge Institute result cited by the commenter is based on the analysis of a dried sample. The results shown in the Draft Environmental Impact Statement are based on the analysis of samples which have not been dried. Section 4.5.4.2 of the Draft Environmental Impact Statement states that drying the samples could increase the concentration of the samples by about a factor of four. Applying these two factors to the highest sample result reported in the Draft Environmental Impact Statement for samples located near the Oak Ridge Institute sample location, would place the sample results in the same order of magnitude as the Oak Ridge Institute 16,740 picocuries per gram result. Tables 4-1, 4-2 and 4-3 in the Final Environmental Impact Statement show that uranium concentrations at two adjacent sampling locations in the drainage brook sometimes differ by more than an order of magnitude. Thus, there is no significant discrepancy.

It should be noted that the Oak Ridge Institute sample referred to by the commenter was taken near trash piles and a partially buried barrel located on the drainage brook bank (Figures 4-2 and 4-3 of the Final Environmental Impact Statement). This trash pile area has even higher levels of uranium contamination (24,090 picocuries per gram), and the sample referred to by the commenter may have been affected by uranium in the trash piles.

Commenter: Brian J. Emerick, Supervising Environmental Analyst, State of Connecticut Department of Environmental Protection

Comment Responses:

The commenter stated that the responsibility for the uranium in the drainage brook is uncertain, and that it is possible that this contamination could have come from either site. The different distributions of the uranium and cobalt-60 in the drainage brook samples clearly indicate that the uranium and cobalt-60 came from two different sources. The cobalt-60 is found throughout the entire length of the drainage brook and is found in the highest concentrations close to the Windsor Site outfall and upstream of the Combustion Engineering, Inc. site outfalls into the brook. This is consistent with the cobalt-60 (and nickel-63) originating from S1C Prototype reactor plant discharges. The high uranium concentrations are found at or downstream of the Combustion Engineering, Inc. site outfalls (and the nearby trash piles and partially buried barrel), which is consistent with the uranium originating from Combustion Engineering, Inc. Samples from upstream of the Combustion Engineering, Inc. site outfalls, but downstream of the S1C discharge point, have only natural background uranium concentrations.

In addition to the clear inference of this physical data, the S1C Prototype reactor plant only handled uranium in the form of high integrity, zirconium alloy clad nuclear fuel. Therefore, there was no dispersible uranium at the S1C Prototype reactor plant which could have been discharged. Combustion Engineering, Inc., on the other hand, manufactured uranium fuel. The Oak Ridge Institute report shows uranium contamination at several locations on the Combustion Engineering, Inc. site, and not just at the drainage brook.

The Department of Energy's Formerly Utilized Sites Remedial Action Program, which works on cleanup of sites associated with the Manhattan Project and early Atomic Energy Commission, has made a determination that it has authority to cleanup uranium contamination at the Combustion Engineering, Inc. site only if it is enriched above 20% in uranium-235. The uranium in the drainage brook includes both high enriched uranium (above 20%) and low enriched uranium. Therefore, the FUSRAP authority determination would only apply to a portion of the uranium contamination in the drainage brook.

Since the large majority of the radioactivity falls under FUSRAP authority or may be Combustion Engineering, Inc.'s responsibility (the drainage brook is on Combustion Engineering, Inc.'s property), and the regulatory process for addressing the radioactivity in the brook is still in its early phases, remediation of the brook is not being addressed within the scope of this Environmental Impact Statement process. Any action taken as a result of the National Environmental Policy Act decision making process for the disposal of the S1C Prototype reactor plant would not affect future evaluation of the drainage brook or any remedial action on the Combustion Engineering, Inc. site.

Commenter: Brian J. Emerick, Supervising Environmental Analyst, State of Connecticut Department of Environmental Protection

Comment Responses:

Comment 4.
The commenter is correct that the cited sentence is too definitive. The first sentence in the affected paragraph in Section 4.5.4.2 of the Draft Environmental Impact Statement, "On average, cobalt-60 concentrations are higher near the top layer of sediment," better represents the current level of knowledge regarding the vertical distribution of cobalt-60 in the drainage brook sediment. The sentence cited by the commenter has been removed. Future actions regarding characterization of the drainage brook will be performed as part of the Department of Energy's Formerly Utilized Sites Remedial Action Program evaluation of the Combustion Engineering, Inc. site adjacent to the Windsor Site.

Comment 5.
The statement does not imply that no site characterization survey should be performed. Section 5.1.5.1 of the Draft Environmental Impact Statement describes the radiological surveys that will be performed to release the Windsor Site for unrestricted use.

As described in Sections 2.1 and 4.2.1 of the Draft Environmental Impact Statement, the Windsor Site is a small 10.8-acre property that was almost entirely developed with paved areas and buildings since original construction in the late 1950s. Consequently, radioactive waste disposal on the Windsor Site was never practical.

The Windsor Site has generated and maintained detailed documentation of radioactive waste operations. Reports prepared annually since the beginning of Windsor Site operations describe the amount and disposition of radioactive waste that was generated at the Windsor Site. Each annual report states that radioactive waste was disposed of at an authorized radioactive waste disposal site. Copies of these reports have been provided to the State of Connecticut Department of Environmental Protection.

Extensive radiological survey records from Windsor Site operations provide a continuous data base that support radiological characterization of the Windsor Site. These records confirm that Naval Nuclear Propulsion Program radiological controls have effectively precluded significant environmental contamination, including radioactive waste disposal, at the Windsor Site. In addition to historical records, the State of Connecticut Department of Environmental Protection was provided with results of an aerial survey of the Windsor Site and surrounding environment. Aerial survey results demonstrated no evidence of unknown radiological conditions on or immediately adjacent to the Windsor Site. The results of this aerial survey have been added to Section 4.5.4 of the Final Environmental Impact Statement.

**Commenter: Brian J. Emerick, Supervising Environmental Analyst,
State of Connecticut Department of Environmental Protection**

Comment Responses:

The process described in Section 5.1.5.1 of the Draft Environmental Impact Statement will serve to verify whether the Windsor Site can be released from radiological controls in support of unrestricted future use.

Comment 6.
As discussed in Sections 3.1.2 and 5.1.13 of the Draft Environmental Impact Statement, any mixed waste that is generated at the Windsor Site is managed and disposed of within the framework of the Federal Facility Compliance Act. The requirements of this Act are implemented at the Windsor Site through a Site Treatment Plan. The Site Treatment Plan is enforced through a consent order issued by the Environmental Protection Agency - Region I. The Environmental Protection Agency must be notified within 30 days of identification of a delay in the availability of the planned treatment facilities. An alternate measures plan must be prepared and submitted to the Environmental Protection Agency and the State within 90 days of this initial notification. The State of Connecticut was fully involved in the development of this process which adequately provides for the timely treatment of mixed waste from the Windsor Site.

Comment 7.
Sections 4.3 and 4.4 of the Draft Environmental Impact Statement discuss the historical environmental monitoring program at the Windsor Site. Historical environmental monitoring for radioactivity has included sampling the drainage brook and Farmington River sediment, water in Goodwin Pond, the drainage brook, and the Farmington River, as well as sampling of fish from the Farmington River. In addition, radiation levels are monitored continuously at 12 perimeter locations and at off-site locations ranging from 4.1 to 17.5 miles off-site. Sample results have been provided to the State of Connecticut Department of Environmental Protection in annual reports (Reference 4-10 of the Draft Environmental Impact Statement). Since the Windsor Site was never used for disposal of solid radioactive waste, and since routine environmental monitoring has identified the effects, if any, from airborne and water pathways, there is no reason to suspect any unknown radiological conditions attributable to S1C operations in areas surrounding the Windsor Site. The results of an aerial survey of the Windsor Site, which has been added to Section 4.5.4 of the Final Environmental Impact Statement, demonstrated no evidence of unknown radiological conditions on or immediately adjacent to the Windsor Site. This will be confirmed through continued sampling under the Windsor Site environmental monitoring programs, plus the planned sampling of soil in adjacent areas as discussed in Section 5.1.5.1 of the Draft Environmental Impact Statement and in Appendix G which has been added to the Final Environmental Impact Statement.

Commenter: Brian J. Emerick, Supervising Environmental Analyst, State of Connecticut Department of Environmental Protection

Comment Responses:

Comment 8.
As discussed in the response to State of Connecticut Department of Environmental Protection Comment 3, future actions regarding characterization of the drainage brook will be performed as part of the Department of Energy's Formerly Utilized Sites Remedial Action Program evaluation of the Combustion Engineering, Inc. site adjacent to the Windsor Site.

Comment 9.
As discussed in Sections 3.1.4 and 5.1.5 of the Draft Environmental Impact Statement, all Windsor Site systems will be removed. This includes the septic system and dry well. As appropriate, surveys of these systems and surrounding soil will be completed to allow unrestricted release of the Windsor Site as described in Sections 3.1.2, 3.1.4, 5.1.5, and 5.1.13 of the Draft Environmental Impact Statement. Additional information on the surveys planned for the Windsor Site is contained in Appendices F and G which have been added to the Final Environmental Impact Statement.

Comment 10.
Sections 3.1.4 and 5.1.5 of the Draft Environmental Impact Statement identify that "all Windsor Site systems would be completely removed including all process systems that are located below grade." The Environmental Impact Statement has been revised to delete the word "process" in the above sections to more clearly reflect the intention to remove all systems from the Windsor Site including all below grade systems. As appropriate, surveys will be performed on these systems and the surrounding soil as described in Sections 3.1.2, 3.1.4, 5.1.5 and 5.1.13 of the Draft Environmental Impact Statement.

As discussed in Section 3.1.4 of the Draft Environmental Impact Statement, there is one exception to the above expressed intention to remove all systems from the Windsor Site. That is the main water line into the Windsor Site, including the former pumphouse structure at the edge of the Site which now houses the termination of the main water line. Also, some structures or systems located on the easement around the Windsor Site will remain. These include the access road into the Windsor Site, storm drains associated with the access road, and the water, power and telephone lines into the Site. As discussed in Section 3.1.4, the municipal water supply piping would be left in a drained and laid-up condition, and the electrical service would be terminated. Leaving these systems in place could provide a benefit to a future property owner.

Comment 11.
As discussed in Section 3.1.4 of the Draft Environmental Impact Statement and the response to State of Connecticut Department of Environmental Protection Comment 10, Naval Reactors intends to completely remove industrial systems from the Windsor Site (and adjacent property where appropriate) regardless of system depth below grade except for a few systems which are being left in place which could provide a benefit to a future property owner.

Commenter: Brian J. Emerick, Supervising Environmental Analyst,
State of Connecticut Department of Environmental Protection

Comment Responses:

Regarding building foundations, there is no law or regulation governing removal of building foundations. Demolition to four feet below grade is the same standard as was used for dismantlement of the Shippingport Atomic Power Station in Shippingport, Pennsylvania. Based on this standard, foundations for two buildings (6,200 square feet) and up to 370 linear feet of concrete trenches will remain on the Windsor Site. All of the foundations which remain on the Windsor Site would be completely emptied so that nothing but concrete shells remain. The foundations would then be backfilled with clean fill. The presence of benign subsurface concrete structures at the Windsor Site in small, limited areas would not encumber future possible uses of the property. For example, uses of the land surface, such as farming or gardening, would not be affected.

Comment 12.
As discussed in Section 5.1.5.1 of the Draft Environmental Impact Statement, in the unlikely event that radiological survey results indicated residual radioactivity exceeding the applicable release criteria, the area would be cleaned up and resurveyed. Any necessary radiological remediation and subsequent confirmatory surveys would be performed by Naval Reactors to support prompt release of the Windsor Site. Additional information on the final radiological release process, which would also include sampling of adjacent properties and water, can be found in Appendix G which has been added to the Final Environmental Impact Statement.

Comment 13.
As discussed in Sections 3.1.4 and 5.1.5.1 of the Draft Environmental Impact Statement and in the response to State of Connecticut Department of Environmental Protection Comments 1 and 18, the Windsor Site will be thoroughly surveyed and will meet the radiological release standards proposed in draft form by the Environmental Protection Agency. Additional information on this subject has been included in Sections 3.1.4 and 5.1.5.1 and in Appendix G of the Final Environmental Impact Statement.

The second half of this comment deals with aspects of the discussion of the drainage brook in the Draft Environmental Impact Statement. As discussed in the response to State of Connecticut Department of Environmental Protection Comment 3, the Draft Environmental Impact Statement did not specifically evaluate potential remediation of the drainage brook. The limited discussion of the drainage brook was focused on the cobalt-60 attributable to S1C Prototype reactor plant discharges. Naval Reactors agrees that future evaluation of the drainage brook should include a collective analysis of all radionuclides in the brook. The dose attributable to cobalt-60 was presented in Section 4.5.4.2 of the Draft Environmental Impact Statement in order to provide perspective on the levels of radioactivity in the drainage brook attributable to Windsor Site operations. The drainage brook is being evaluated outside of this Environmental Impact Statement process as discussed in the response to State of Connecticut Department of Environmental Protection Comment 3.

Commenter: Brian J. Emerick, Supervising Environmental Analyst, State of Connecticut Department of Environmental Protection

Comment Responses:

Comment 14.
As discussed in Section 4.3.3 of the Draft Environmental Impact Statement, water sampling of the drainage brook, Goodwin Pond, and the Farmington River for radioactivity has been routinely conducted as part of the Windsor Site environmental monitoring program (Reference 4-10) which will continue through the release of the Windsor Site. No radioactivity associated with Windsor Site activities has been detected in the water samples. Additional information on the final radiological release process, which would include sampling of ground water, is provided in Appendix G which has been added to the Final Environmental Impact Statement.

Comment 15.
Section 5.1.10.2 of the Draft Environmental Impact Statement identifies that an estimated 23 radioactive material shipments would be made. These shipments would take place after reactor plant dismantlement begins. Appendix C of the Draft Environmental Impact Statement indicates that the 23 radioactive material shipments would consist of 4 shipments of major components by rail and truck and 19 miscellaneous component shipments by truck. The miscellaneous component shipments would include miscellaneous components and other miscellaneous radioactive wastes such as building materials. Sections 5.1.10.2 and 5.1.13, and Appendix C have been revised in the Final Environmental Impact Statement to clarify the content of these miscellaneous shipments. The discussions on nonradioactive material shipments in Section 5.1.10.2 and Appendix C of the Draft Environmental Impact Statement focused on shipments of nonradioactive waste generated during dismantlement of the S1C Prototype reactor plant. Discussions on shipments of nonradioactive waste have been revised in the Final Environmental Impact Statement to include shipments of nonradioactive waste generated as part of Windsor Site restoration activities and to include incoming shipments of materials such as fill and topsoil.

Comment 16.
Sections 3.1.1 and B.1.3.5 of the Draft Environmental Impact Statement describe some of the measures taken to protect personnel, prevent the spread of radiological or hazardous materials, and mitigate the consequences of an accident. The measures are only a part of the comprehensive practices, procedures, and oversight traditionally employed by the Naval Nuclear Propulsion Program to ensure the safe conduct of work. These Naval Nuclear Propulsion Program measures have proven themselves in the successful operation of five Department of Energy facilities and six Naval Shipyards which have performed Naval Nuclear Propulsion Program work over the years (including the recent closure and release of the Naval Shipyards at Mare Island, California and Charleston, South Carolina).

Not withstanding this record, the accident analyses described in Appendices B and C of the Draft Environmental Impact Statement took no credit for preventative or mitigative measures. Thus, these analyses provide very conservative results. Even with these conservatisms, the results showed that there are no significant adverse impacts from any of the alternatives.

Commenter: Brian J. Emerick, Supervising Environmental Analyst, State of Connecticut Department of Environmental Protection

Comment Responses:

Comment 17.
Alpha, beta, gamma and x-ray emitters were included in the analyses of normal operations and accidents presented in the Environmental Impact Statement. Section 2.3 of the Draft Environmental Impact Statement provides a radiological characterization of the S1C Prototype reactor plant. Table 2-1 in the Draft Environmental Impact Statement lists the estimated radionuclide inventory, in curies, that is expected in the defueled reactor plant at four years and at thirty-four years after reactor shutdown. Table 2-1 clearly identifies that radionuclides emitting alpha, beta, gamma and x-ray radiation are expected to be present. All radionuclides listed were used in analyses of normal operations and facility and transportation accidents. Tables in Appendix B and Appendix C of the Draft Environmental Impact Statement list the source terms of radioactivity discharged in curies per year for normal operation (for example, see Table B-5) or in curies per accident (for example, see Section B.3.1.2) for hypothetical accident situations. Small changes to some of the numbers in these curie content tables have been made in the Final Environmental Impact Statement to reflect updated information on the curie content of the S1C Prototype reactor plant. These small changes caused small changes to be made to several other tables in the appendices. In addition, Appendix C, Table C-5 has been clarified in the Final Environmental Impact Statement to show all of the default and actual values used in the RADTRAN 4 computer program which was used in the transportation analysis.

Comments 18 and 19.
Sections 4.5.4 and 4.5.5 of the Draft Environmental Impact Statement discuss the minor environmental concerns which exist at the Windsor Site, the plans for addressing those concerns, and the plans for ensuring there are no unidentified concerns which require attention prior to release of the Site. A summary of the characterization and release processes and additional updated information are provided in Appendix F and Appendix G of the Final Environmental Impact Statement. There are no known conditions or concerns which would substantially impact implementation of any of the identified alternatives. More detailed work plans for addressing the environmental concerns (for example, the radiological survey plan and the voluntary facility assessment sampling plan) have been and will continue to be provided to the State for comment.

Comment 20.
Section 2.5.1 of the Draft Environmental Impact Statement discusses Federal environmental statutes and regulations which apply to the Windsor Site. This section has been revised in the Final Environmental Impact Statement to clarify that the State authorities discussed in that section are for the enforcement of Federal statutes and regulations. The comment correctly

**Commenter: Brian J. Emerick, Supervising Environmental Analyst,
State of Connecticut Department of Environmental Protection**

Comment Responses:

notes that Section 116 of the Clean Air Act provides for concurrent State regulation of air pollutants. Section 2.5.5 of the Draft Environmental Impact Statement discussed State of Connecticut air pollution statutes and regulations which apply to the Windsor Site and operate concurrently with the Federal requirements. These State statutes and regulations do not currently contain specific limits on radionuclide emissions. The Resource Conservation and Recovery Act permit issued by the State in June 1996 for the Windsor Site does contain provisions that limit radionuclide emissions to air as indicated in the comment. Although the Department of Energy complies with the requirements of these provisions, it is not clear that these are valid provisions for a Resource Conservation and Recovery Act permit.

Comment 21.
The comment of the State of Connecticut Department of Environmental Protection is acknowledged. Naval Reactors intends to pursue renewal of the existing Resource Conservation and Recovery Act permit as required. The expiration date for the current permit is June 7, 2001. However, under the preferred prompt dismantlement alternative, it may not be necessary to renew the permit. Naval Reactors understands that the storage permit for the Resource Conservation and Recovery Act hazardous waste and radioactive mixed waste storage building is for on-site generated wastes only and contains a maximum waste storage capacity. There is no intention to accept hazardous wastes or radioactive mixed wastes from other sites and store them at the Windsor Site.

Comment 22.
The comment of the State of Connecticut Department of Environmental Protection is acknowledged. Naval Reactors is aware of the State of Connecticut General Permit for the Discharge of Stormwater and Dewatering Wastewaters From Construction Activities which requires activities that result in the disturbance of more than five acres to obtain a general stormwater permit. It is anticipated that excavation activities associated with the removal of below grade systems may disturb more than five acres. Consistent with the comment, Naval Reactors will work with the Bureau of Water Management to obtain this general stormwater permit at the appropriate time, before commencing excavation work which disturbs more than five acres. Sections 5.1.3.2 and 5.2.3.2 have been revised in the Final Environmental Impact Statement to include this permit in the discussion.

Comment 23.
The comment of the State of Connecticut Department of Environmental Protection is acknowledged. Section 2.5.5 of the Draft Environmental Impact Statement identifies that one of the State of Connecticut laws applicable to Windsor Site activities is the Property Transfer Program. As indicated in the State's comment, Naval Reactors personnel have already met with State staff, including State personnel cognizant of property transfer, and with Environmental Protection Agency Region I personnel to discuss this program. Naval Reactors has also taken actions to involve the State in the development of the voluntary facility assessment to avoid unnecessary duplication of effort in this area. Naval Reactors intends to continue such interactions to remain current with the requirements of this program.

STATE OF CONNECTICUT
CONNECTICUT HISTORICAL COMMISSION

August 8, 1996

Mr. Chris Overton
Windsor Field Office
Office of Naval Reactors
U.S. Department of Energy
PO Box 393
Windsor, CT 06095

Subject: Knolls Atomic Power Laboratory
Windsor, CT

Dear Mr. Overton:

The State Historic Preservation Office understands that the U.S. Department of Energy has released an Environmental Impact Statement regarding the proposed disposition of the above-noted facility (*Hartford Courant*, August 6, 1996). This office respectfully requests a review copy of this document in order that cultural resources may be properly evaluated and considered as part of the federal decision-making process for this property. In particular, we note that federal agencies are required to consult with our professional staff vis-a-vis the National Historic Preservation Act of 1966 and the National Environmental Policy Act. Both laws mandate coordination with the respective State Historic Preservation Office and the Advisory Council on Historic Preservation.

The State Historic Preservation Office looks forward to receiving the Environmental Impact Statement from the U.S. Department of Energy in the near future in order that we might provide timely guidance regarding the state's historic, architectural, and archaeological heritage.

For further information please contact Dr. David A. Poirier, Staff Archaeologist.

Sincerely,

Dawn Maddox
Deputy State Historic
Preservation Officer

cc: Mr. Don Klima/ACHP

TEL: (203) 566-3005 *FAX: (203)566-5078*
59 SOUTH PROSPECT ST. - HARTFORD, CONN. 06106 - 1901
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DEPARTMENT OF ENERGY
Schenectady Naval Reactors Office
Windsor Field Office
P.O. Box 393
Windsor, Connecticut 06095

SNR/WFO O#96-042
August 20, 1996

Ms. Dawn Maddox
Deputy State Historic Preservation Officer
Connecticut Historical Commission
State of Connecticut
59 South Prospect Street
Hartford, CT 06106-1901

Dear Madam,

As you requested in your letter to me dated August 8, 1996, I had delivered to your office on August 14, 1996, a copy of the Department of Energy (DOE) Office of Naval Reactors' Draft Environmental Impact Statement (EIS) for disposal of the S1C Prototype reactor plant located in Windsor, Connecticut.

Your letter also noted the consultation requirements of the National Historic Preservation Act of 1966 and the National Environmental Policy Act. As confirmed by your letter of July 19, 1995 (copy attached), your office was unaware of any areas of historic significance at or in proximity to the Knolls Atomic Power Laboratory site that predate site construction in 1957. However, your attached letter also noted that the prototype training facility might be of historic importance in the application of nuclear power to submarine technology.

The DOE Office of Naval Reactors does not consider the S1C Prototype Plant to be historically significant. The S1C Prototype Plant was the fifth of eight land based prototype plants built and operated by the Office of Naval Reactors, so S1C is not significant as being the first such plant. S1C was the prototype for a single U. S. Navy submarine, USS TULLIBEE, which has been decommissioned and disposed of. Thus, S1C is not historically significant as the prototype of a large class of Naval vessels. The training and research and development missions which the S1C Prototype Plant supported for over 30 years, while important for the national defense, were not unique compared to the other prototype plants. For these reasons, the Office of Naval Reactors stated on page 4-20 of the Draft EIS that the S1C Prototype Plant does not have historical significance to Naval or commercial nuclear power.

The Office of Naval Reactors held a public hearing at the Windsor Town Hall on August 7, 1996, to receive public comment on the Draft EIS. The stated preference of the large majority of speakers was for the prompt dismantlement alternative. None of the speakers indicated that the S1C Prototype Plant was of any historical significance.

Finally, I should note that the Office of Naval Reactors maintains a large amount of technical information and documentation for all of its reactor plants, both at land based prototypes and in U. S. Navy ships. We intend to hold such information concerning the S1C Prototype in Federal archives indefinitely. Information such as this on earlier prototypes was used by historians in preparing the two official histories of the Naval Nuclear Propulsion Program, Nuclear Navy 1946-1962 by Richard G. Hewlett and Francis Duncan (University of Chicago Press, 1974) and Rickover and the Nuclear Navy - The Discipline of Technology by Francis Duncan (Naval Institute Press, 1990). Additionally, the EIS also provides a public record of the existence of this prototype plant and the plans for its disposal. Thus, considerable information about the S1C Prototype Plant will remain available in the future, protected in accordance with applicable statutory and other Federal restrictions.

I trust that the foregoing resolves any questions you have on the historic significance of the S1C Prototype Plant. If you have any further questions related to the S1C Prototype Plant, please call me at 860-687-5610.

Sincerely,

C. G. OVERTON
Chief, Windsor Field Office
Naval Reactors

Attachment: As Stated

cc: Dr. David A. Poirier
Staff Archaeologist
Connecticut Historical Commission
State of Connecticut
59 South Prospect Street
Hartford, CT 06106-1901

STATE OF CONNECTICUT
STATE BOARD OF EDUCATION
CONNECTICUT HISTORICAL COMMISSION

September 4, 1996

Mr. C. G. Overton
Department of Energy
Schenectady Naval Reactors Office
PO Box 393
Windsor, CT 06095

Subject: S1C Prototype Reactor Plant Disposal
Windsor, CT

Dear Mr. Overton:

The State Historic Preservation Office has reviewed the *Draft Environmental Impact Statement* prepared by the U.S. Department of Energy Office of Naval Reactors regarding the above-named project. This office believes that the document does <u>not</u> comprehensively address cultural resources issues pursuant to either the National Environmental Policy Act or the National Historic Preservation Act of 1966.

1 In particular, the State Historic Preservation Office believes that the S1C Prototype Reactor Plant is a significant aspect of Cold War history and the application of nuclear power to submarine technology. This office also believes that this facility is eligible for the National Register of Historic Places. Although not the first or unique, the S1C Prototype Reactor Plant appears representative of a rare engineering and training facility with respect to naval-related nuclear power.

The State Historic Preservation Office concurs with the Department of Energy's assessment that no feasible or prudent alternative exists which would provide for rehabilitation or reuse of the extant facility. This office offers no objection to the proposed remediation and dismantlement of the S1C Prototype Reactor Plant.

However, the State Historic Preservation Office recommends that the Department of Energy consult with the Advisory Council on Historic Preservation concerning Section 106 of the National Historic Preservation Act of 1966. In particular, this office recommends that a Memorandum of Agreement be drafted which provides for adequate mitigation of project-related impacts upon the historic and engineering integrity of this important research and development complex. We strongly encourage that the following stipulations be incorporated in the proposed Memorandum of Agreement: 1

1. Prior to dismantlement of the S1C Prototype Reactor Plant, the Department of Energy shall contact the Historic American Engineering Record to determine what level and kind of documentation is required for the property. Unless otherwise agreed to by the National Park Service, the Department of Energy shall ensure that all documentation is completed

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and accepted by HAER prior to dismantlement or demolition. Copies of the final documentation shall be provided to both HAER and the Connecticut State Historic Preservation Office.

2. The Department of Energy shall develop, in coordination with the State Historic Preservation Office, a public education component , including but not limited to interpretative materials, slide lectures, and popular reports which focus upon the historic significance of the S1C prototype plants. The Department of Energy shall consult with the *USS Nautilus* Museum regarding development of possible interpretative materials or educational handouts which describe the naval nuclear power application of S1C research and training programs. 1

3. The Department of Energy shall consult with the National Archives and the Historical Manuscripts and Archives at the University of Connecticut (Storrs) regarding possible disposition of S1C Prototype Reactor Plant design plans, construction drawings, and other written documents related to the Windsor, Connecticut, facility.

This office looks forward to working with the Department of Energy Schenectady Naval Reactors Office in the expeditious furtherance of the proposed undertaking as well as the professional management of the nation's cultural heritage.

For further assistance please contact Dr. David A. Poirier, Staff Archaeologist.

Sincerely,

Dawn Maddox
Deputy State Historic
Preservation Officer

cc: Mr. Don Klima/ACHP

DEPARTMENT OF ENERGY
Schenectady Naval Reactors Office
Windsor Field Office
P.O. Box 393
Windsor, Connecticut 06095

SNR/WFO O#96-050
September 17, 1996

Mr. John W. Shannahan
State Historic Preservation Officer
Connecticut Historical Commission
State of Connecticut
59 South Prospect Street
Hartford, CT 06106-1901

Dear Mr. Shannahan,

I want to express my appreciation for the time you and Dr. David Poirier of the State Historical Preservation Office spent with me and other personnel representing Naval Reactors on September 13, 1996. At the meeting, Naval Reactors provided the State Historical Preservation Office an overview of the Naval Nuclear Propulsion Program in general, and the Windsor Site in particular. The meeting enabled the State Historical Preservation Office and Naval Reactors to reach agreement on an appropriate course of action to resolve the State Historical Preservation Office comments on our Draft Environmental Impact Statement for Disposal of the S1C Prototype Reactor Plant.

Naval Reactors provided to the State Historical Preservation Office various publicly releasable documents which characterize the Windsor Site's significance and place in the Naval Nuclear Propulsion Program. We understand these documents will be submitted by the State Historical Preservation Office to the Archives and Special Collections Library at the University of Connecticut (Storrs). You and Dr. Poirier further informed us that, considering the classified nature of most of the documentation regarding site activities, these unclassified documents would satisfy the State Historical Preservation Office's desire to maintain records related to the history and operation of the S1C Prototype facility in Windsor. Dr. Poirier indicated this satisfied items one and two of the Connecticut Historical Commissions' September 4, 1996 letter.

With regard to item three of the Connecticut Historical Commissions' letter, the attached Memorandum of Agreement has been prepared for signature by the Department of Energy and the State of Connecticut for submission to the Advisory Council on Historic Preservation.

Once again, Naval Reactors appreciates the cooperation of the State Historical Preservation Office. If I can be of further assistance, please call me at (860) 687-5610.

C.G. Overton
C. G. OVERTON
Chief, Windsor Field Office
Naval Reactors

Attachment: As Stated

DEPARTMENT OF ENERGY
Schenectady Naval Reactors Office
Windsor Field Office
P.O. Box 393
Windsor, Connecticut 06095

SNR/WFO 0#96-052
September 19, 1996

Mr. Don L. Klima
Director, Eastern Office of Review
Advisory Council on Historic Preservation
The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, D.C. 20004

Dear Mr. Klima,

Attached for acceptance by the Advisory Council on Historic Preservation is a Memorandum of Agreement signed by the Department of Energy Office of Naval Reactors and the Connecticut State Historic Preservation Officer.

The S1C Prototype reactor plant, in Windsor, Connecticut, was operated by Naval Reactors from 1959 to 1993 when it was permanently shut down. Enclosure (1) to this letter is the Draft Environmental Impact Statement for disposal of the S1C Prototype reactor plant. Enclosures (2) and (3) to this letter are the comments received from the Connecticut State Historic Preservation Office on the Draft Environmental Impact Statement and the Naval Reactors resolution of those comments, respectively.

Naval Reactors appreciates the cooperation of the Advisory Council on Historic Preservation in accepting the attached Memorandum of Agreement. It is appropriate to include a copy of the accepted Memorandum of Agreement in the Final Environmental Impact Statement. Therefore, we would appreciate your action on this Memorandum of Agreement by October 25, 1996, to support our schedule to complete our Environmental Impact Statement. If I can be of further assistance, please call me at (860) 687-5610.

CG Overton
C. G. OVERTON
Chief, Windsor Field Office
Naval Reactors

Attachment and Enclosures: As Stated

cc: (without Attachment and Enclosures)
Dr. David A. Poirier
Connecticut State Historic Preservation Office
Connecticut Historical Commission
59 South Prospect Street
Hartford, CT 06106-1901

**Advisory
Council On
Historic
Preservation**

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

SEP 27 1996

Mr. Chris Overton
U.S. Department of Energy
Windsor Field Office
Naval Reactors
P.O. Box 393
Windsor, CT 06095

REF: S1C Prototype Reactor Facility, Windsor, Connecticut

Dear Mr. Overton:

Enclosed is your copy of the executed Memorandum of Agreement for the referenced project. By carrying out the terms of the Agreement, you will have fulfilled your responsibilities under Section 106 of the National Historic Preservation Act and the Council's regulations. A copy of the Agreement has also been sent to the Connecticut State Historic Preservation Officer.

We appreciate your cooperation in reaching this Agreement.

Sincerely,

Don L. Klima
Director
Eastern Office of Review

Enclosure

MEMORANDUM OF AGREEMENT
SUBMITTED TO THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
PURSUANT TO 36 CFR 800.6(a)

WHEREAS, the Department of Energy has determined that any dismantlement of the S1C Prototype reactor plant will have an effect upon the Windsor Site, a property that may be considered eligible for the National Register of Historic Places, and has consulted with the Connecticut State Historic Preservation Officer (SHPO) pursuant to 36 CFR Part 800, regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f);

WHEREAS, the Connecticut SHPO has agreed that remediation and dismantlement of the S1C Prototype reactor plant is an acceptable course of action and that the appropriate historical record should be maintained in documentary form;

WHEREAS, there is an extensive historical record regarding the Naval Nuclear Propulsion Program in Program reports, Congressional testimony, various texts, and other documentation;

NOW, THEREFORE, the Department of Energy and the Connecticut SHPO agree that the undertaking shall be implemented in accordance with the following stipulation in order to take into account the effect of the undertaking on historic properties.

Stipulation

The Department of Energy will ensure that the following measures will be carried out.

> Records and documentation regarding the construction and operation of the prototype facility including pertinent training and operation manuals and construction drawings will be maintained and preserved in accordance with applicable Federal regulations governing the maintenance of such records.
>
> The Department of Energy shall provide the Connecticut SHPO with unclassified photographs from existing files which document the construction and physical appearance of the S1C Prototype facility in Windsor, Connecticut over its period of existence.

Execution of this Memorandum of Agreement by the Department of Energy and the Connecticut SHPO, its subsequent acceptance by the Council, and implementation of its terms, evidence that the Department of Energy has afforded the Council an opportunity to comment on the dismantlement of the S1C Prototype reactor plant and its effects on historic properties, and that the Department of Energy has taken into account the effects of the undertaking on historic properties.

DEPARTMENT OF ENERGY:

By: CG Overton Date: 9/17/96

C. G. Overton
Chief, Windsor Field Office
Naval Reactors

CONNECTICUT HISTORIC PRESERVATION OFFICE:

By: Date: 9/17/96

John W. Shannahan
Historic Preservation Officer
State of Connecticut

ADVISORY COUNCIL ON HISTORIC PRESERVATION:

By: Robert D. Bush Date: 9/17/96

Robert D. Bush
Executive Director

**Commenter: Dawn Maddox, Deputy State Historic Preservation Officer,
State of Connecticut Historical Commission**

Comment Response:

Comment 1.
The concerns identified in the State of Connecticut Historical Commission letter have been addressed by Naval Reactors, the State of Connecticut, and the Advisory Council on Historic Preservation in the correspondence included in this appendix and by issuance of a Memorandum of Agreement, a copy of which is also included in this appendix. The memorandum identifies the measures that will be carried out to maintain a historical record of the prototype facility. Sections 4.7, 5.1.7 and 5.2.7 have been revised in the Final Environmental Impact Statement to reflect execution of the Memorandum of Agreement by the Department of Energy and the State of Connecticut, and its acceptance by the Advisory Council on Historic Preservation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-0001

August 19, 1996

OFFICE OF THE
REGIONAL ADMINISTRATOR

Mr. Christopher G. Overton, Chief
Windsor Field Office, Office of Naval Reactors
U.S. Department of Energy
PO Box 393
Windsor, Connecticut 06095

Dear Mr. Overton:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, we have reviewed the U.S. Department of Energy's (DOE'S) Draft Environmental Impact Statement (DEIS) for the proposed disposal of the S1C Prototype reactor plant, located in Windsor, Connecticut.

According to the DEIS, the S1C Prototype reactor plant, located at the Knolls Atomic Power Laboratory Windsor Site in Windsor, Connecticut, was permanently shut down in March 1993 as a result of the end of the Cold War and the projected downsizing of the U.S. Naval fleet. All spent nuclear fuel was removed from the reactor and shipped off-site (DEIS, p. S-1). The purpose of this EIS is to evaluate alternative disposal options for the 10.8-acre facility.

The DEIS evaluates three disposal options for the reactor plant: prompt dismantlement and disposal, deferred dismantlement and disposal, and a No Action alternative. Under the prompt dismantlement alternative, dismantlement of the reactor plant would begin immediately and release of the property would occur once any necessary investigation and cleanup of the site has been completed. Under the deferred dismantlement alternative, dismantlement of the reactor plant would be postponed for 30 years to allow for radioactive decay to occur at the site, followed by release of the property. Under No Action, the reactor plant would remain in a protected condition for an indefinite period of time. The DEIS concludes that all of these alternatives present a comparably very low level of risk to human health and that no adverse environmental affects will result from whichever alternative is chosen.

Based on our review of the DEIS, we believe that additional information should be provided to more fully disclose environmental conditions at the Windsor site and to evaluate the potential future disposition of this facility. In particular, we recommend that final EIS characterize the levels of contamination at the Windsor site, the type of contamination that exists (e.g., non-radioactive contamination), and what measures would be necessary for cleanup. In addition, we believe the final EIS should more fully address potential reuse options for the site, at least in general terms, 1 what the target levels for cleanup would be based on potential reuse, and whether there is community support for these potential uses of the site.

We are aware, as the DEIS indicates, that DOE intends to conduct a voluntary facility assessment that would address some of these issues. Given, however, that the purpose and need for this project is the disposal of the Windsor site property for future reuse, the EIS should address these issues so that adequate opportunity for public review and comment is provided under NEPA <u>prior</u> to DOE's decision on how to proceed. 2

Based on our review, we have rated this DEIS "EC-2" (Environmental Concerns-Insufficient Information) in accordance with our national rating system. An explanation of this rating is attached for your information.

Please feel free to call me (617/565-3400) or Patience Whitten of my staff (617/565-3413) if you have any questions or comments.

Sincerely,

John P. DeVillars
Regional Administrator

SUMMARY OF RATING DEFINITIONS AND FOLLOW UP ACTION

Environmental Impact of the Action

LO–Lack of Objections
The EPA review has not identified any potential environmental impacts recurring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC–Environmental Concerns
The EPA review has identified environmental impact that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO–Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU–Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this potential will be recommended for referral to the CEQ.

dequacy of the Impact statement

Category 1–Adequate
EPA believes that draft EIS adequately sets forth the environmental impact(s)of the preferred alternatives and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2–Insufficient Information
The draft EIS does not contain sufficient information for EPA to full assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyzes or discussion should be included in the final EIS.

Category 3–Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussion are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purpose of the NEPS and or/ Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

**Commenter: John P. DeVillars, Regional Administrator,
United States Environmental Protection Agency - Region I**

Comment Responses:

Comments 1 and 2.
Sections 4.5.4 and 4.5.5 of the Draft Environmental Impact Statement discuss the minor environmental concerns which exist at the Windsor Site, the plans for addressing those concerns, and the plans for ensuring there are no unidentified concerns which require attention prior to unrestricted release of the Site. Broad support for the objective of unrestricted release of the Windsor Site was evident from the comments received during the public comment period. A summary of the release processes and additional updated information are provided in Appendix F and Appendix G which have been added to the Final Environmental Impact Statement. There are no known conditions or concerns which would substantially impact implementation of any of the identified alternatives. More detailed work plans for addressing the environmental concerns (for example, the voluntary facility assessment sampling plan) have been and will continue to be provided to the Environmental Protection Agency and the State of Connecticut Department of Environmental Protection for comment.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
408 Atlantic Avenue - Room 142
Boston, Massachusetts 02210-3334

August 16, 1996
(ER96-456)

Mr. Christopher G. Overton, Chief
Windsor Field Office, Office of Naval Reactors
U.S. Dept. of Energy
P.O. Box 393
Windsor, CT 06095

Dear Mr. Overton:

This responds to your request for comments on the Draft Environmental Impact Statement for the disposal of the S1C Prototype Reactor Plant, in Windsor, Connecticut.

The document accurately indicates that there are few ecological resources on the site, itself, due to its highly developed nature. The document also indicates that the 3600-foot long drainage brook that carries stormwater from the site, and which received permitted discharges of cooling water, is classified as suitable for fish and wildlife habitat, as is the Farmington River, which receives flow from the drainage brook. The Department of Energy conducted comprehensive radiological sediment sampling of the drainage brook, including its confluence with the Farmington River, and monitored fish in the Farmington River for radiological residues attributable to the Reactor Site. DoE is voluntarily conducting additional sediment sampling of the drainage brook for chromate compounds that were released to the brook in its cooling water discharges.

We recommend that the Final EIS incorporate the findings of the voluntary assessment of chromate compounds in brook sediments, and that the assessment include investigation and documentation of the potential effects of other compounds released to the brook in cooling water, including copper, lead and zinc. 1

We also believe that the FEIS would be strengthened by including a discussion of the potential effects of the radioactive compounds in sediments and water of the discharge brook on the brook's biota. Although the document indicates that no fish in the Farmington River had tissue levels of radioactive compounds attributable to the Reactor Site, there is no indication if biota of the drainage brook either accumulated radioactive materials, or were adversely affected by their presence in sediments or water. 2

Similarly, the DEIS discusses the relative exposure and health risks of hypothetical human
users of the Site, but neglects to assess the potential impacts to likely ecological receptors at 3
the Site and in the drainage brook. We note that DoE has initiated a voluntary facility
assessment that will involve collection and assessment of additional soil, sediment and water
samples. It is likely that these data can provide much of the information needed to enhance the
assessments we have recommended.

Thank you for the opportunity to review the DEIS. Please contact me at (617) 223-8565, if you have any questions regarding this letter.

Sincerely,

Andrew L. Raddant
Regional Environmental Officer

Commenter: Andrew L. Raddant, Regional Environmental Officer, United States Department of the Interior

Comment Responses:

Comment 1.
As discussed in Section 4.5.5.2 of the Draft Environmental Impact Statement, the Voluntary Facility Assessment Program will include further investigation of the drainage brook sediment. Sediment samples will be collected and analyzed for the inorganics identified in Appendix F, Target Parameters List C. This list includes copper, lead and zinc. A report containing a description of the sampling and analytical results and environmental setting characterization will be provided to the Environmental Protection Agency and the State of Connecticut Department of Environmental Protection. Naval Reactors will meet with both regulatory agencies to review report findings.

Comment 2.
As discussed in the response to State of Connecticut Department of Environmental Protection Comment 3, the Draft Environmental Impact Statement did not specifically evaluate potential remediation of the drainage brook. The limited discussion of the drainage brook was focused on the cobalt-60 attributable to S1C Prototype reactor plant discharges. A complete evaluation of the drainage brook will need to be performed as part of the overall evaluation of the brook and the rest of the Combustion Engineering, Inc. site.

Comment 3.
As discussed in Section 5.1.2 of the Draft Environmental Impact Statement, there are virtually no ecological resources currently on the Windsor Site property since the Site is small and mostly developed. The radiological release criteria that will be used for release of the Windsor Site, as discussed in Section 5.1.5.1 of the Draft Environmental Impact Statement and in the response to State of Connecticut Department of Environmental Protection Comment 1, are sufficiently stringent that any remaining radioactivity would be well within the variations in natural background radioactivity. Thus, after Windsor Site release, no appreciable health risk would remain for either human or nonhuman occupants of the Site, and the Site would be suitable for unrestricted use (for example, farming). If no use of the Windsor Site were to follow the cleanup, natural reforestation would be expected to occur. This represents at worst no change and most likely an improvement in the local ecological resources. Further detailed analysis is not considered necessary.

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ABB
ASEA BROWN BOVERI

August 19, 1996

Mr. C. G. Overton
Chief, Windsor Field Office
Department of Energy
P. O. Box 393
Windsor, Connecticut 06095

Subject: Draft Environmental Impact Statement - S1C Prototype Reactor Plant Disposal

Reference: (A) Letter, C. G. Overton (DOE) to Jack C. Moulton (CE), dated June 24, 1996

Dear Mr. Overton:

Reference (A) invited comments on the content of the Subject Draft Environmental Impact Statement. CE has prepared comments and questions to the Subject document and has included them as Enclosure I to this letter.

We appreciate the opportunity to comment on this important document and sincerely hope that our input is of assistance to a successful project. If there are any questions or comments regarding this matter, please feel free to contact me or Mr. Robert Sheeran at (860) 285-5021.

Very truly yours,
COMBUSTION ENGINEERING, INC.

John F. Conant

John F. Conant
Sr. Project Manager

Enclosure

JFC:bwf

siceis.doc

ENCLOSURE I

COMMENTS APPLICABLE TO:
DRAFT EIS - S1C PROTOTYPE REACTOR PLANT DISPOSAL

1. Page S-4: Table S-1 notes 19 radioactive shipments for miscellaneous components and 4 radioactive shipments for major components. No shipments are included for soils, radioactive trash, and other radioactive debris. From this omission and other omissions throughout the report, one might infer that costs have not been allocated for radiological environmental cleanup.

2. Page S-4: Table S-1 does not include public risk from residual radioactive material left on and adjacent to the Windsor Site.

3. Page 2-9, Subsection 2.4: What welding materials were previously employed in the operation? What "impurities," specifically are contained within the lead in the S1C prototype plant? What hazardous materials were used at the plant? What quantities of hazardous materials were used at the plant? Were any solvents used (e.g., PCE, TCE, Acetone, etc.)? What water treatment chemicals were used? What biocides were used? What has been the historical hazardous waste generation (i.e., generator status)? Does zirconium exist in any form on the Site? What are the historical quantities of PCB containing materials? What is the quantity of asbestos containing materials, friable vs. non-friable? Were there any Connecticut regulated materials used (e.g., fuel oils, etc)? Do any underground or above ground storage tanks exist on Site? If underground or above ground storage tanks do exist, what is their respective capacity and what type(s) of material did they hold?

4. Page 2-10, Section 2.5.1: Federal Environmental Statute and Regulations, does not include Title 42 USC, 300, et. seq., Safe Drinking Water Act.

5. Pages 2-10 through 2-15: With regard to the "Applicable Regulatory Considerations" included on the noted pages, will the most stringent remediation criteria be selected from all of the regulations noted and used to release the S1C Site, including its environs? Will NRC and EPA Regulations be used as the basis for the eventual free release of the S1C Site? Will the CT Remediation Standard Regulations (RSR) for a GA area be complied with?

6. Page 3-1: With regard to the dismantlement operation (where grinding, sawing, flame cutting, plasma arc cutting, etc. are used) please explain the type(s) of emission monitoring that will be conducted both on/off the S1C Site. If emission monitoring is planned both on and offsite, where and what type of monitoring equipment will be installed? What are the types of constituents that will be monitored for? What applicable regulatory requirements will be used to judge the adequacy of the imposed monitoring program both to workers on Site and the public at large?

7. Page 3-4, Section 3.1.4: Windsor Site Restoration and Disposition of Property, notes that characterization is required for the Windsor Site. However, no mention is made of performing characterization and release of areas adjacent to the Site or bodies of water potentially affected by the Site.

8. Page 3-4: Line 23 notes that "The access roadway leading to the U.S Government owned property will be left intact." Will characterization and remediation of this road be done in order to declare it to be free of all contaminants from prior operations?

9. Pages 3-4 and 3-5: Will underground lines <u>of all types</u> be excavated and removed from the S1C Site? To what extent will this piping be surveyed to guarantee that it is not contaminated with <u>any</u> contaminants? Will any piping be left underground? If yes, why? If the piping goes beyond the S1C Site boundary, what action will be taken with regard to removal of this piping? How far will the removal of such piping extend beyond the S1C Site boundary? How does this apply to Site drainage lines, both covered and uncovered on the Site and the Site access road?

10. Pages 3-4 and 3-5: Will the release criteria for the S1C Site and materials released from the S1C Site meet NRC/EPA criteria as well as the DOE criteria? If not, why not?

11. Page 3-5: Line 1 states that "A final radiological survey of the Windsor Site would be performed ..." Who will prepare the survey plan? What regulations will be used as the basis to prepare the survey plan? Will the plan be reviewed by an independent agency(s) for completeness and compliance with selected regulations (e.g., the NRC or the EPA)? Who will approve the plan and QA the sampling and statistical analysis features of the plan?

12. Page 3-5: Line 5 states "...Order 5400.5 ..." This order is not in agreement with the current NRC/EPA guidelines as they relate to the free release of sites that have been decommissioned for unrestricted use. Please comment.

13. Page 3-6, Section 3.2.1: Caretaking Period Operations, does not require implementation of an environmental monitoring program, other than air, for the caretaking period. Please provide clarification.

14. Page 3-7, Section 3.2.3: Windsor Site Restoration and Disposition of the Property, addresses the voluntary facility assessment for soil within or adjacent to the Windsor Site. However, no mention is made of performing characterization and release of bodies of water potentially affected by the site. In addition, no mention is made of performing radiological characterization and release of areas adjacent to the site or bodies of water potentially affected by the site. Please provide clarification.

15. Page 3-8, Section 3.3: No Action Alternative. There are no provisions to characterize and release areas and bodies of water outside of the Windsor Site fence. Also, it does not require implementation of an environmental monitoring program, other than air, for the indefinite delay period. Please provide clarification.

16. Page 4-1, Line 14 states "The Windsor Site property and the surrounding Asea Brown Boveri, Inc. property..." Please note that Combustion Engineering, Inc. is the owner and operator of the property surrounding the Windsor Site property, not Asea Brown Boveri, Inc. All references in the Draft EIS identifying Asea Brown Boveri, Inc. as the owner, operator, successor in interest, or otherwise responsible for the property surrounding the Windsor Site, including, but not limited to, references on Page 3-5, Lines 18-21, and Page 4-9, Lines 12-16, must be corrected accordingly to eliminate Asea Brown Boveri, Inc. and substitute Combustion Engineering, Inc.

17. Page 4-3: With regard to the groundwater monitoring program involving the four monitoring wells, what chemical constituents are routinely monitored? How long has this program been in place? Have the resultant testing data been trended for evidence of an increase/decrease in reported values? If yes, does the trending data show evidence of an increase/decrease in the materials being tested for?

18. Page 4-3: Line 43 states that "...the production wells will be closed..." Does this mean that the well standpipe will be removed and the hole filled in or that the standpipe will be capped and left in place? If the plan is to leave the standpipe in place, why?

19. Page 4-4, Lines 3-9: Did nonradioactive waste water discharges contain any chemical additives (i.e., water treatment chemicals, etc.)? Historically, did drains and associated piping from inside or outside any of the buildings on the Site ever connect to the brook outfall?

20. Page 4-4, Lines 21-22: Characterize (in terms of capacity, use, material stored) "retention tank liquids."

21. Page 4-4, Lines 33-36: Did the on-site septic system ever receive process waste water including, but not limited to, solvents, washwaters, detergents, metal cleaning effluent, etc?

22. Page 4-5, Lines 1-8: Why were copper levels elevated in the stormwater? What were the levels? What corrective actions were taken?

23. Page 4-5, Lines 10-13: Pertaining to the cooling water system employing chromate containing constituents, what was the associated flow rate (average, maximum)? Over what period of time was this material used?

24. Page 4-6: With regard to paragraph 4.4.4 it is noted on line 27 "The annual radioactivity concentration at the nearest Windsor Site boundary ...was less than 0.01 of the Department of Energy .....guide for effluent release to unrestricted areas..." How does the same data compare to the NRC and EPA guidelines for the same airborne contaminants both at the Site boundary and downwind from the Site.

25. Page 4-6: With regard to paragraph 4.4.4 it is noted on line 30 that "There is no residual radioactivity in vegetation or in the surface layers of soil which would indicate any significant fallout from past emissions or airborne activity." Where on the S1C Site was the soil and vegetation sampled? Was trending applied to the data? What were the results of the trending? Was a similar type of sampling conducted away from the S1C Site? How far from the Site was the sampling conducted? Was trending applied to this data? Do the trended data show any sign of increase/decrease? If trending was not performed, why not?

26. Page 4-6, Lines 36-40: Does the facility operate boilers on Site? Has the cooling water operation (if exhausted to the atmosphere) or any underground or above ground storage tank been evaluated for VOC emissions? (Cooling water typically contains biocides which meet the definition of VOC pursuant to both federal and CT regulations).

27. Page 4-7, Lines 12-14: Where were the borings taken? What was the basis for determining boring locations (i.e., random,etc.)?

28. Page 4-7, Lines 21-27: Please provide the corresponding references for this discussion.

29. Page 4-9, on Line 12 it is stated: "The uranium 235 detected in the brook is due to discharges from the Asea Brown Boveri, Inc. (Combustion Engineering, Inc.) facility adjacent to the Windsor Site and is not attributable to the Windsor Site

operations," This statement is not supported by conclusive information identifying Combustion Engineering, Inc. as the undisputed and sole source of the uranium 235. Therefore, the phrase "... is due to discharges from the (Combustion Engineering, Inc.) facility adjacent to the Windsor Site..." and should be deleted.

30. Page 4-15, Section 4.5.4.2: Existing Radiological Conditions in the Surrounding Area Relating to S1C Prototype Operations. Makes a direct reference to a report by Argonne National Laboratory sponsored by the Department of Energy Office of Environmental Restoration for calculation of soil guidelines for the Windsor Site. This report is stamped with "Do Not Cite" and marked as a "Draft" so its use in the S1C EIS is suspect.

31. Page 4-15, Section 4.5.4.2: Soil guidelines were reported in the ANL Report as the quantity of each nuclide, which would yield the specified dose limit. Why weren't all nuclides evaluated collectively, since each nuclide will contribute dose to the public? When evaluated collectively, the individual isotopic soil guidelines would be lowered considerably. If the guidelines are applied as listed in the Report, the resulting dose could significantly exceed the selected dose limit. In addition, the Report does not demonstrate compliance with proposed 10 CFR 834 regulations pertaining to airborne effluent discharges of radioactive material and specific radionuclide concentration limits in various media.

32. Page 4-15: On line 8 it is stated that "...there is no reason to believe that there are higher concentrations of Cobalt-60 buried deeper in the brook sediments by siltation." The sampling levels noted may not provide sufficient data to be able to make this statement. Will further sampling be performed to establish statistical evidence to assure with some degree of confidence that the levels of Cobalt in the brook sediment, at all depth levels, do not exceed the free release criteria?

33. Page 4-15: On line 21 it is stated "...residual cobalt-60 and nickel-63 in the brook can be evaluated based on a report by Argonne National Laboratory..." NRC has submitted written comments on this report to the DOE. The comments take exception to many of the assumptions used and the conclusions drawn in the report.

34. Page 4-16, Lines 5-8: What is the hazardous waste generator status (i.e., CSQG, SQG, or LQG)? What (specifically) types of laboratory chemicals were discharged to the septic system?

35. Page 4-16, Lines 9-11: What types of battery acid was discharged to the dry well? Where is the dry well located on the Site? Over what time period did this practice take place? How will the dry well and the surrounding area be evaluated?

36. Page 4-16: On line 13 it is stated that "As part of the voluntary facility assessment, a work plan for sampling the Windsor Site was developed..." Is a copy of this plan available for review and comment at this time? Does this "work plan" include the sampling of local waterways? If not, why not? Does the plan include a planned data treatment with release criteria related to regulatory requirements? If not, why not? If yes, what are the regulatory criteria that are being used?

37. Page 4-16: On line 29 it states "...a report will be prepared and provided to the regulatory agencies. The report will summarize findings and will identify the need for any additional investigation..." There is no mention made in the EIS as to what regulations will be used to establish free release levels for <u>all</u> the chemical constituents used during the period in which the Site was in operation.

38. Page 4-17, Lines 4-15: Were samples analyzed for both tri- and hexavalent chromium? Of the samples that were obtained, were analyses performed for total or filtered chromium? The current chromium results (assuming that this represents a total) indicate a concentration range between 11-70 mg/L which is significantly higher than the established CT RSR for chromium of 0.05 mg/L in a GA area (Pollutant mobility criteria). What was the basis for determining the sampling locations (i.e., random, etc.)? Was this determination statistically valid?

39. Page 4-17: On line 26 it states "...conditions in soil at the Windsor Site and immediately surrounding areas." A definition of "immediately surrounding areas" is requested.

40. Page 4-17: On line 26 it states "Surface soil and sediments from the brook and Goodwin Pond will be collected and analyzed..." Will any samples be taken subsurface? If not, why not? If yes, at what depth(s) will the samples be taken? On what basis will the sample depth be selected?

41. Page 5-1, Section 5.0: Environmental Consequences, states that public exposure resulting from any of the reasonable alternatives would be negligible. This appears to be in direct conflict with Section 4.5.4.2 which indicates a possible exposure of 14 mrem/year. In addition, this calculated dose may be non-conservative.

42. Page 5-3: On line 3 it states "Prompt dismantlement activities would not involve any discharges of radioactive liquid effluents." Based on the extent of dismantling activities and the amount of dust and debris generated, it would appear that airborne contamination would be present and eventually become part of the liquid effluent flowing from the site. How can it be said that no radioactive liquid effluents will be generated? On what basis is this statement made?

43. Page 5-3, Lines 9-16: What type of effluents will be discharged to the septic system (e.g., domestic waste, laboratory waste, etc.)? It is stated that effluents will continue to be monitored: for what parameters and at what frequency?

44. Page 5-3, On line 12 it is stated that "Effluent from the sanitary sewer would continue to be treated in the anaerobic septic system..." Will the septic system be completely removed as part of the dismantlement option? If not, why not? If it is removed will all piping, junction boxes, holding tank(s) associated with the system also be removed? If not, why not? Will complete soil sampling be done around and under the boxes, lines, etc. that made up the septic system? If not, why not?

45. Page 5-5, Section 5.1.5.1: Expected Final Radiological Conditions of the Windsor Site Property After Prompt Dismantlement, states the extent of soil remediation is expected to be small. It also states that a typical cobalt-60 screening level is 1 pCi/g. This appears to be in conflict with Section 4.5.4.2, which shows an average concentration, along the drainage brook, of 1.36 pCi/g with hot spots of up to 10 pCi/g. The EIS makes no mention of remediating this cobalt.

46. Page 5-5, Section 5.1.5.1: Expected Final Radiological Conditions of the Windsor Site Property After Prompt Dismantlement, states that radiation exposures would be less than those proposed in the proposed EPA and NRC regulations; these proposed limits are 15 mrem/yr, and Cobalt at the creek alone almost exceeds this limit. When other nuclides are considered, the dose could easily exceed these proposed limits. Also, both of these proposed regulations require the application of ALARA, as does DOE's regulations.

47. Page 5-14, Section 5.1.13: Waste Management. Except for mixed waste (approximately 55 drums), this Section does not discuss the volume of soils that may have to be shipped as radioactive waste.

48. Pages 5-18 & 5-29: Will the facility Stormwater Pollution Prevention Plan (SPPP) be amended in response to these facility modifications? Will S1C be responsible for performing additional analyses (perhaps for radiological contamination) of its stormwater discharges?

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Comment 1.
Section 5.1.10.2 of the Draft Environmental Impact Statement identifies that an estimated 23 radioactive material shipments would be made. These shipments would take place after reactor plant dismantlement begins. Appendix C of the Draft Environmental Impact Statement indicates that the 23 radioactive material shipments would consist of 4 shipments of major components by rail and truck and 19 miscellaneous component shipments by truck. The miscellaneous component shipments would include miscellaneous components and other miscellaneous radioactive wastes such as building materials. Sections 5.1.10.2 and 5.1.13, and Appendix C have been revised in the Final Environmental Impact Statement to clarify the content of these miscellaneous shipments. The costs presented in Sections 3.1.5 and 3.2.4, and the Summary Table S-1 have been updated in the Final Environmental Impact Statement to include estimates for the cost of completing surveys and performing any necessary remediation at the Windsor Site and other costs associated with releasing the property for unrestricted use.

Comment 2.
As discussed in Sections 3.1.4 and 5.1.5.1 of the Draft Environmental Impact Statement, any future occupant of the Windsor Site would receive less radiation exposure than limits specified in draft regulations under consideration by the Environmental Protection Agency and the Nuclear Regulatory Commission. As discussed in the response to State of Connecticut Department of Environmental Protection Comment 1, these sections have been clarified in the Final Environmental Impact Statement to include the numerical radiation exposure limits specified in the draft Environmental Protection Agency and Nuclear Regulatory Commission regulations. Since the radiation exposure limits specified in draft regulations are well within the range of normal background radiation levels as described in Appendix A of the Draft Environmental Impact Statement, there is no appreciable public health risk. Therefore, no change is required to Summary Table S-1 of the Draft Environmental Impact Statement for the prompt and deferred alternatives. Under the no action alternative, the public health risk for leaving the S1C Prototype reactor plant at the Windsor Site is included in Summary Table S-1.

Additional discussion of residual radioactivity on or adjacent to the Windsor Site is discussed in Appendix G which has been added to the Final Environmental Impact Statement. For the reasons stated in the response to Comment 3 from the State of Connecticut Department of Environmental Protection, remediation of the drainage brook is not being addressed within the scope of this Environmental Impact Statement process.

Comment 3.
Section 2.4 of the Draft Environmental Impact Statement provides general characterization of materials in the S1C Prototype reactor plant and specifically notes the presence of hazardous materials. Section 3.1.2 of the Draft Environmental Impact Statement discusses the management of waste generated during reactor plant dismantlement activities. As stated in Section 3.1.2, materials would be disposed of in accordance with all applicable Federal, State and local regulations, including thorough characterization and segregation of waste or recyclable materials prior to shipment off-site. Potential impact of disposal of these materials is provided in Sections 5.1, 5.2, 5.3, Appendix B, and Appendix C of the Draft Environmental

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Impact Statement. Thus, more detailed information is not required to evaluate the environmental impacts covered in this Environmental Impact Statement.

Similarly, Chapter 4 of the Draft Environmental Impact Statement provides a general discussion of ongoing Windsor Site characterization. Characterization of Windsor Site facilities and soils, based on historical use of chemicals, hazardous materials, or other regulated materials, is part of the voluntary facility assessment discussed in Sections 3.1.4 and 5.1.5.2 of the Draft Environmental Impact Statement. Both the Environmental Protection Agency - Region I and State of Connecticut Department of Environmental Protection have been provided with a work plan that details sampling for potential chemical contamination. In July 1996, Naval Reactors met with personnel from the Environmental Protection Agency - Region I and the State of Connecticut Department of Environmental Protection to finalize the sampling plan. Appendix F of the Final Environmental Impact Statement provides a discussion of the process for completing the ongoing voluntary facility assessment and the results to date. In addition, as noted in Section 2.5.1 of the Draft Environmental Impact Statement, a separate evaluation conducted by the Environmental Protection Agency in 1988 concluded that the Windsor Site does not require remediation under the Federal Superfund program. Consequently, characterization and, if necessary, clean up of any low-level chemical contamination is not expected to be a significant factor in implementation of any of the identified alternatives.

Comment 4.
Sections 2.5.1 and 2.5.5 have been updated in the Final Environmental Impact Statement to include the Safe Drinking Water Act in the list of Federal and State statutes and regulations applicable to Windsor Site activities.

Comment 5.
As discussed in Sections 3.1.4 and 5.1.5.1 of the Draft Environmental Impact Statement, any future occupant of the Windsor Site would receive less radiation exposure than limits specified in draft regulations under consideration. As discussed in the response to State of Connecticut Department of Environmental Protection Comment 1, these sections were clarified in the Final Environmental Impact Statement to include the numerical radiation exposure limits under consideration by the Environmental Protection Agency and the Nuclear Regulatory Commission. Appendix G has been added to the Final Environmental Impact Statement and discusses the process that would be followed to verify final radiological conditions at the Windsor Site.

For chemical remediation, the criteria selected will similarly allow unrestricted release of the Windsor Site following dismantlement. As discussed in Sections 3.1.4 and 3.2.3 of the Draft Environmental Impact Statement, the criteria will be agreed to by the Environmental Protection Agency and the State of Connecticut, consistent with their authority under the Comprehensive Environmental Response, Compensation and Liability Act, the Resource Conservation and Recovery Act and the State of Connecticut Property Transfer Program to ensure that the criteria are sufficiently stringent to allow unrestricted release of the Windsor Site property.

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Comment 6.
As discussed in Section 5.1.4 of the Draft Environmental Impact Statement, the presence of radioactivity and materials such as asbestos insulation, lead-based paint and lead shielding introduce the potential for minor emissions of criteria pollutants and hazardous air pollutants from dismantlement operations. Monitoring will be performed in accordance with applicable Federal and State regulations to ensure emissions are adequately controlled. Compliance with these regulations is not expected to require off-site monitoring.

Comment 7.
Sections 4.3 and 4.4 of the Draft Environmental Impact Statement discuss the historical environmental monitoring programs at the Windsor Site. Historical environmental monitoring for radioactivity has included sampling of sediment in the drainage brook and the Farmington River, water in the Goodwin Pond, drainage brook, and Farmington River, as well as sampling of fish in the Farmington River. In addition, radiation levels are monitored continuously at 12 perimeter locations and at off-site locations ranging from 4.1 to 17.5 miles off-site. Sample results have been provided to the State of Connecticut Department of Environmental Protection in annual reports (Reference 4-10 of the Draft Environmental Impact Statement). Since the Windsor Site was never used for disposal of solid radioactive waste, and since routine environmental monitoring has identified the effects, if any, from airborne and water pathways, there is no reason to suspect any unknown radiological conditions attributable to S1C in areas surrounding the Windsor Site. The results of an aerial survey of the Windsor Site, which has been added to Section 4.5.4 of the Final Environmental Impact Statement, demonstrated no evidence of unknown radiological conditions on or immediately adjacent to the Windsor Site. This will be confirmed through continued sampling under the Windsor Site environmental monitoring programs, plus the planned sampling of soil in adjacent areas as discussed in Section 5.1.5.1 of the Draft Environmental Impact Statement and in Appendix G which has been added to the Final Environmental Impact Statement.

Section 4.5.5 of the Draft Environmental Impact Statement states that the voluntary corrective action program includes sampling of areas adjacent to the Windsor Site to confirm that no significant contamination has occurred resulting from Windsor Site operations. Additional information on the nonradiological assessment process can be found in Appendix F which has been added to the Final Environmental Impact Statement.

Comment 8.
Windsor Site operational history reviews revealed only one instance involving a release of material on the access road. This instance involved a minor traffic accident on the access road which resulted in a small leak of an ethylene glycol and water mixture (antifreeze) from the radiator of one vehicle. The antifreeze was contained and immediately cleaned up from the pavement and did not pose a threat to the environment. Although the amount was small (approximately one gallon) and resulted in no potential environmental impact, the appropriate regulatory agencies were notified. Since Windsor Site operational history reviews identified no other known spills, no further sampling of the access road or adjacent area is considered necessary.

Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.

Comment Responses:

Comment 9.
As discussed in the response to State of Connecticut Department of Environmental Protection Comment 10, Sections 3.1.4 and 5.1.5.2 of the Draft Environmental Impact Statement have been clarified to state that all systems would be completely removed from the Windsor Site. The majority of the systems are located on government-owned property. However, some underground systems are located on Combustion Engineering, Inc. property used under a permanent easement. For example, relatively short lengths of abandoned sewage and industrial waste system piping extend onto Combustion Engineering, Inc. property from the southwest corner of the government-owned Windsor Site. These lines are believed to be capped near manholes located on Combustion Engineering, Inc. property. These lines would be removed to their point of termination at the capped end or at the manholes if the lines are found to be intact and plugged instead of cut and capped. All wastes from system removal will be fully characterized as part of routine waste management practices described in Section 3.1.2 of the Draft Environmental Impact Statement.

A section of the present day industrial drain line, which terminates at the Windsor Site outfall, also lies on Combustion Engineering, Inc. property. The present day industrial drain line will be removed entirely as part of Windsor Site dismantlement. A memorandum of agreement would be established with Combustion Engineering, Inc. before removal of any piping located on Combustion Engineering, Inc. property not included in easements for the Windsor Site.

As discussed in Section 3.1.4 of the Draft Environmental Impact Statement, there is one exception to the above expressed intention to remove all systems from the Windsor Site. That is the main water line into the Windsor Site, including the former pumphouse structure at the edge of the Site which now houses the termination of the main water line. Also, some structures or systems located on the easement around the Windsor Site will remain. These include the access road into the Windsor Site, storm drains associated with the access road, and the water, power and telephone lines into the Site. As discussed in Section 3.1.4, the municipal water supply piping would be left in a drained and laid-up condition, and the electrical service would be terminated. Leaving these systems in place could provide a benefit to a future property owner.

Comment 10.
The Naval Reactors radiological release criteria for the Windsor Site and materials released from the Windsor Site are as restrictive as comparable Nuclear Regulatory Commission and Environmental Protection Agency criteria. As discussed in Sections 3.1.4 and 5.1.5.1 of the Draft Environmental Impact Statement, any future occupant of the Windsor Site would receive less radiation exposure than limits specified in draft regulations under consideration. As discussed in the response to State of Connecticut Department of Environmental Protection Comment 1, these sections were clarified in the Final Environmental Impact Statement to include the actual numerical radiation exposure limits under consideration by the Environmental Protection Agency and the Nuclear Regulatory Commission. Appendix G of the Final Environmental Impact Statement provides a comparison of release criteria and discusses the process that would be followed to verify final radiological conditions at the Windsor Site.

Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.

Comment Responses:

Comment 11.
The Knolls Atomic Power Laboratory is preparing the survey plan, which will be approved by Naval Reactors. The plan will meet the requirements of Department of Energy Order 5400.5 (Radiation Protection of the Public and the Environment) and will meet the dose limits specified in draft regulations under consideration by the Environmental Protection Agency and the Nuclear Regulatory Commission. Although the Windsor Site is not on the National Priorities List and does not require cleanup under the Comprehensive Environmental Response, Compensation and Liability Act, the property transfer requirements of the Act still apply as discussed in Section 2.5.1 of the Draft Environmental Impact Statement. In addition, the State of Connecticut Property Transfer Program applies to the Windsor Site as discussed in Section 2.5.5 of the Draft Environmental Impact Statement. To ensure that the survey plan is sufficient to allow transfer of the property under these programs, Naval Reactors will solicit and resolve comments on the plan from the Environmental Protection Agency and the State.

Comment 12.
The intent is to meet the dose limits of the Department of Energy Order as well as the dose limits contained in the draft Environmental Protection Agency and Nuclear Regulatory Commission regulations. This has been clarified in the Final Environmental Impact Statement.

Comment 13.
The Draft Environmental Impact Statement does not document the presence of radioactive contaminated soils or ground water on the Windsor Site. No such environmental contamination is known to exist on the Windsor Site. As discussed in Section 5.2.2 of the Draft Environmental Impact Statement, environmental monitoring would continue in addition to the specific monitoring discussed in Section 3.2.1. The elements of the Windsor Site environmental monitoring program, which includes sampling of air, surface waters, ground water and sediment, are discussed in Sections 4.3, 4.4 and Reference 4-10 of the Draft Environmental Impact Statement. Sections 3.2.1 and B.1.1.1 have been modified for clarity in the Final Environmental Impact Statement.

Comment 14.
Sections 4.3 and 4.4 of the Draft Environmental Impact Statement discuss the historical environmental monitoring programs at the Windsor Site. Historical environmental monitoring for radioactivity has included sampling of sediment in the drainage brook and the Farmington River, water in the Goodwin Pond, drainage brook, and Farmington River, as well as sampling of fish in the Farmington River. In addition, radiation levels are monitored continuously at 12 perimeter locations and at off-site locations ranging from 4.1 to 17.5 miles off-site. Sample results have been provided to the State of Connecticut Department of Environmental Protection in annual reports (Reference 4-10 of the Draft Environmental Impact Statement). Since the Windsor Site was never used for disposal of solid radioactive waste, and since routine environmental monitoring has identified the effects, if any, from airborne and water pathways,

Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.

Comment Responses:

there is no reason to suspect any unknown radiological conditions attributable to S1C in areas surrounding the Windsor Site. The results of an aerial survey of the Windsor Site, which has been added to Section 4.5.4 of the Final Environmental Impact Statement, demonstrated no evidence of unknown radiological conditions on or immediately adjacent to the Windsor Site. Additional information on the radiological release process for the Windsor Site, which would include sampling of adjacent properties and water, can be found in Appendix G which has been added to the Final Environmental Impact Statement.

The commenter's description of the scope of the voluntary facility assessment is incorrect. Section 4.5.5 of the Draft Environmental Impact Statement states that both surface water and ground water will be sampled from areas within and adjacent to the Windsor Site to confirm that no significant contamination has occurred resulting from Windsor Site operations. Additional information on the nonradiological assessment process, which would include limited sampling of adjacent properties and water potentially affected by Windsor Site chemical releases, can be found in Appendix F which has been added to the Final Environmental Impact Statement.

Comment 15.
Regarding characterization and remediation, the commenter is correct. The no action alternative by definition is an indefinite period of no action and would consist only of caretaking activities for the S1C Prototype reactor plant and the Windsor Site, as described in Section 3.2.1 of the Draft Environmental Impact Statement, and is consistent with the requirement of the Council on Environmental Quality regulations that a no action alternative be analyzed. As stated in Section 3.3.1 of the Draft Environmental Impact Statement, caretaking period operations for the no action alternative would be the same as for the deferred dismantlement alternative "except that the voluntary facility assessment process and any associated remediation activities would not be completed." Likewise, the radiological survey plan process and any associated remediation activities would not be completed. With regard to environmental monitoring during this period, see the response to Combustion Engineering, Inc. Comment 13.

Comment 16.
Naval Reactors acknowledges the commenter's preference for use of the term Combustion Engineering, Inc. instead of Asea Brown Boveri, Inc. The Final Environmental Impact Statement has been revised to reflect this preference.

Comment 17.
As indicated in Section 4.3.2 of the Draft Environmental Impact Statement, details of the ground water monitoring program are contained in the Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-10). This report is updated annually; copies have been routinely provided to Combustion Engineering, Inc. and other interested members of the public and are available at the Town of Windsor Public Library for review.

Commenter: John F. Conant, Senior Project Manager, Asea Brown Boveri - Combustion Engineering, Inc.

Comment Responses:

As discussed in the environmental monitoring report, the principal purpose of the wells is to monitor for indications of migration of chemical contaminants from spills of Stretford solution on adjacent Combustion Engineering, Inc. property in the early 1980s. In the past, Stretford solution constituents have been sporadically detected in these wells. Results for other constituents and parameters, as indicated in the environmental monitoring reports, have been unremarkable. Consequently, no analytical trending of the data has been performed.

Comment 18.
Naval Reactors acknowledges that Section 4.3.2 of the Draft Environmental Impact Statement does not specify the method of closure for the service water production wells. This section was left general because applicable State of Connecticut regulations define at least two acceptable closure methods that block the pathway from surface water to ground water and the closure method to be used has not been selected. Naval Reactors will ensure that the former production wells at the Windsor Site are closed in accordance with all applicable Federal and State regulations by a qualified vendor licensed by the State of Connecticut.

Comment 19.
Nonradioactive waste water discharges contained chemical additives utilized in Windsor Site operations. Chemicals associated with these waters included phosphate-containing compounds such as sodium phosphate, oxygen scavenging compounds such as sodium sulfite, corrosion control compounds such as potassium chromate and organo-phosphate compounds, and chlorine for the treatment of site drinking water. Historically, nonsanitary drains and associated piping from inside and outside buildings (stormwater runoff) have discharged to the drainage brook through the Windsor Site outfall. All discharges from the Windsor Site were made in accordance with Federal and State requirements which, after 1975, included a permit issued by the Environmental Protection Agency - Region I as part of the National Pollutant Discharge Elimination System permit program. The State of Connecticut Department of Environmental Protection ultimately assumed responsibility for this permit. As discussed in Section 4.3.4 of the Draft Environmental Impact Statement, this permit was terminated in February 1996 because all industrial waste water discharges from the Windsor Site have been terminated. Discharges from the Windsor Site are in accordance with a State general stormwater permit.

Comment 20.
Section 4.3.4 of the Draft Environmental Impact Statement describes certain nonradiological discharges from the Windsor Site as "retention tank liquids." This phrase refers to nonradiological, nonhazardous waste water from the S1C Prototype plant which was accumulated and intermittently discharged. Two tanks were used to accumulate the waste water, which was limited to processed S1C Prototype plant bilge water and steam generator blowdown water. Each tank had a capacity of 5,000 gallons, and approximately 2,500 gallons per day were discharged when the S1C Prototype was in full operation. The waste water accumulated in the retention tanks was analyzed prior to discharge to confirm acceptability with all applicable Federal and State requirements.

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Comment 21.
Industrial process wastewaters were not disposed of via the Windsor Site septic system. As stated in Section 4.5.5.1 of the Draft Environmental Impact Statement, only small amounts of chemicals have been disposed of at the Windsor Site. Until 1978, small quantities of expired acids and oxidizing agents were discharged to the septic system and leach field. Minute quantities of a variety of laboratory chemicals (residuals from laboratory analyses) have been included in drain water from two analytical laboratories that discharged to the septic system and leach field. The general types of chemicals disposed of included acids and caustics, such as nitric acid, sulfuric acid and sodium hydroxide; salts, such as potassium chloride; sulfites, such as sodium sulfite; phosphates, such as sodium phosphate; and organics, such as acetone and Freon-113. Only sanitary waste and small quantities of dilute nonhazardous pH buffer solutions are currently disposed of via the septic system and leach field. These discharges have been consistent with the established applicable regulations. In addition, there was a one-time accidental discharge of 15 gallons of solution containing 7 parts per million cadmium in late 1991. As described in Appendix F of the Final Environmental Impact Statement, the voluntary facility assessment includes an assessment of the septic system environs.

Comment 22.
Copper levels in stormwater have ranged from none detectable to 0.17 milligrams per liter. As discussed in Section 4.3.4 of the Draft Environmental Impact Statement, in October 1995, the State of Connecticut Department of Environmental Protection modified the General Permit for the Discharge of Stormwater Associated with Industrial Activity. This modification changed the comparison value for copper from 0.014 milligrams per liter to the current value of 0.200 milligrams per liter. All sample results meet this updated value. No corrective action is required.

Comment 23.
Section 4.3.4 of the Draft Environmental Impact Statement states that prior to 1980, water containing chromate compounds from cooling water systems were discharged to the drainage brook from the Windsor Site. The chromate compounds were used to inhibit corrosion and biological growth in the cooling water systems from about 1960 to 1980. These discharges were made in accordance with applicable Federal and State regulations and were incorporated in a National Pollutant Discharge Elimination System permit in 1975. The maximum daily cooling water discharge allowed by the permit was 43,000 gallons per day.

Comment 24.
The annual airborne radioactivity concentration at the nearest Windsor Site boundary, allowing for typical diffusion conditions, was less than 0.01 percent of the level permitted by Nuclear Regulatory Commission regulations, 10 CFR Part 20, Appendix B, Table 2 (Effluent Concentrations), for the mixture of radionuclides present in the Windsor Site effluent air emissions. The Environmental Protection Agency does not have similar air effluent concentration limits. However, 40 CFR Part 61, Subpart H (National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities), Section 61.92 includes a 10 millirem per year exposure standard. The dose to the maximally exposed

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

member of the public from Windsor Site effluent air emissions in 1994 was less than 1 percent of this standard. As with the comparison to Department of Energy standards discussed in Section 4.4.4 of the Draft Environmental Impact Statement, these additional comparisons demonstrate that airborne radiological emissions from the Windsor Site were negligible.

Comment 25.
The conclusion in Sections 4.4.4 and 5.4.3 of the Draft Environmental Impact Statement that "there is no residual radioactivity in vegetation or in surface layers of soil which would indicate any significant fallout from past emissions of airborne radioactivity," was based on the fact that Windsor Site effluent air is continuously monitored for airborne particulate radioactivity to confirm that only minute amounts of radioactivity are released to the atmosphere. As noted in Section 4.4.4 of the Draft Environmental Impact Statement, airborne radioactivity releases are reported in the Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference 4-10 of the Draft Environmental Impact Statement). As discussed in that report, radiation doses from airborne effluents, including fallout, are too small to be measured and must be calculated using computer models qualified for this specific task. These models conservatively estimate the radiation exposure to the public through many pathways, including radioactivity in surface soil, vegetation and animal pathways from airborne radioactivity sources. The above statement from Sections 4.4.4 and 5.4.3 of the Draft Environmental Impact Statement has been replaced in the Final Environmental Impact Statement with a discussion on how public radiation exposure is determined based on actual measured airborne emissions.

Comment 26.
The Windsor Site no longer operates boilers. Operation of the two Windsor Site heating boilers, which were registered with the State of Connecticut Department of Environmental Protection, permanently ceased in June 1995. The heating oil was stored in underground storage tanks that were vented to the atmosphere until 1988 when the tanks were removed and replaced by above ground tanks that were also vented to the atmosphere. The above ground tanks were also removed in 1995. Both the above ground and below ground tanks were evaluated for Volatile Organic Compound emissions and did not require permitting by the State of Connecticut Department of Environmental Protection. The Windsor Site also had four diesel generators which had seven associated diesel fuel tanks. These diesel tanks were also evaluated for Volatile Organic Compound emissions and did not require permitting by the State. Temporary fuel storage tanks that could be brought on site would be evaluated for Volatile Organic Compound emissions prior to being brought on site. To date no temporary fuel storage tanks have been used at the Windsor Site.

As discussed in Section 4.4.5 of the Draft Environmental Impact Statement, Windsor Site heating is now provided by three liquid propane heating units. Air emissions, including Volatile Organic Compounds, associated with operation of the units and filling the pressure-type liquid propane storage tanks, are below that which would require any regulatory permits.

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

As stated in Section 4.3.4 of the Draft Environmental Impact Statement, non-contact cooling water was formerly used at the Windsor Site. Biocides used in the non-contact cooling water did not meet the definition of Volatile Organic Compounds pursuant to the Federal or State regulations.

Comment 27.
Section 4.5.2 of the Draft Environmental Impact Statement provides information concerning the geologic setting of the Windsor Site, which covers about 10 acres. Geologic conditions at the Windsor Site have been investigated at various times and locations. Both the Knolls Atomic Power Laboratory and Combustion Engineering, Inc. have performed investigations in support of site development. In addition, the U. S. Geological Survey has taken borings in areas on and adjacent to the Windsor Site (Reference 4-13 of the Draft Environmental Impact Statement). Overall, 22 borings have been taken in the developed areas of the Windsor Site and 10 borings have been taken in undeveloped areas of the Site. Additional borings have also been taken as part of the Voluntary Facility Assessment Program during the drilling of ground water monitoring wells as discussed in Appendix F of the Final Environmental Impact Statement.

Comment 28.
The corresponding references for the discussion on soils at the Windsor Site are: Metzler, K.J. and K. Rozsa, Connecticut Department of Environmental Protection, *Soil Catenas of Connecticut*, Hartford, Connecticut, April 1986; and United States Department of Agriculture, Soil Conservation Service, Soil Survey Series 1958, No. 14, *Soil Survey, Hartford County, Connecticut*, Sheet Number 20, February 1962. These references have been added to Section 4.5.2 and the list of references in the Final Environmental Impact Statement.

Comment 29.
As discussed in Section 4.5.4.2 of the Draft Environmental Impact Statement and the response to the State of Connecticut Department of Environmental Protection Comment 3, the uranium in the drainage brook near the Windsor Site originated from facilities on Combustion Engineering, Inc. property. Because the Council on Environmental Quality regulations require consideration of the existing environment and the potential cumulative impacts, Section 4.5.4.2 of the Draft Environmental Impact Statement provides information on the radiological condition of the drainage brook.

Additional information on the radioactivity concentrations in the drainage brook has become available since the Draft Environmental Impact Statement was issued. The Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP) has issued a report which consolidates available information on the radiological analysis of samples on the Combustion Engineering, Inc. site. Naval Reactors assisted in the preparation of this report by making available for additional analysis the 1991 samples which were discussed in Section 4.5.4.2 and Figure 4-1 of the Draft Environmental Impact Statement. The FUSRAP report provides the most complete radiological description of the drainage brook and excerpts have been incorporated into the Final Environmental Impact Statement.

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

The distributions of the uranium and cobalt-60 in the drainage brook samples clearly indicate that the uranium and cobalt-60 came from different sources. Cobalt-60 is found throughout the entire length of the drainage brook and is found in the highest concentrations close to the Windsor Site outfall. The high uranium concentrations are found at or downstream of the Combustion Engineering, Inc. outfalls and the nearby trash piles and partially buried barrel on Combustion Engineering, Inc. property discussed in response to State of Connecticut Department of Environmental Protection Comment 3. This is consistent with the uranium originating from Combustion Engineering, Inc. operations. Both uranium and cobalt-60 concentrations in drainage brook samples have been reported annually to Combustion Engineering, Inc. and the State of Connecticut Department of Environmental Protection.

In addition to the clear inference of this physical data, the S1C Prototype reactor plant only handled uranium in the form of high integrity, zirconium alloy clad nuclear fuel. Therefore, there was no dispersible uranium at the S1C Prototype reactor plant which could have been discharged. Combustion Engineering, Inc. on the other hand, manufactured uranium fuel. The FUSRAP report shows uranium contamination at several locations on the Combustion Engineering, Inc. site, and not just at the drainage brook.

Comment 30.
The Argonne National Laboratory report (Reference 4-22 of the Draft Environmental Impact Statement) was prepared at the request of the Department of Energy Office of Environmental Restoration. The use of this report in the Draft Environmental Impact Statement was made with the knowledge and consent of the Department of Energy Office of Environmental Restoration and is considered to be appropriate by Naval Reactors because it had been made available by the Department of Energy for public review.

Comment 31.
Naval Reactors agrees that future evaluation of the drainage brook should include a collective analysis of all radionuclides in the brook. The dose attributable to cobalt-60 was presented in section 4.5.4.2 of the Draft Environmental Impact Statement in order to provide perspective on the levels of radioactivity in the drainage brook attributable to Windsor Site operations. Resolution of comments on the report prepared by Argonne National Laboratory for the Department of Energy's Formerly Utilized Sites Remedial Action Program is part of the separate process, outside of this Environmental Impact Statement process, to comprehensively evaluate the Combustion Engineering, Inc. site (including the drainage brook) and is beyond the scope of this Environmental Impact Statement. Naval Reactors has forwarded the comment to the Department of Energy's Formerly Utilized Sites Remedial Action Program.

Comment 32.
Please refer to the response to State of Connecticut Department of Environmental Protection Comment 4.

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Comment 33.
Resolution of Nuclear Regulatory Commission comments on the report prepared by Argonne National Laboratory for the Department of Energy's Formerly Utilized Sites Remedial Action Program is part of the separate process to comprehensively evaluate the Combustion Engineering, Inc. site adjacent to the Windsor Site, and is beyond the scope of this Environmental Impact Statement. Naval Reactors has forwarded the comment to the Department of Energy's Formerly Utilized Sites Remedial Action Program.

Comment 34.
The Windsor Site is permitted by the State of Connecticut Department of Environmental Protection for greater than ninety day storage (>90 days) of hazardous waste. Based on the definition in 40 CFR Part 260, the Windsor Site would be classified as a large quantity generator (that is, generation of greater than 1,000 kilograms of hazardous waste in any single calendar month). On average, the Windsor Site generates 14,400 kilograms of hazardous waste per year.

Until 1978, small quantities of expired acids and oxidizing agents were discharged to the septic system and leach field. Minute quantities of a variety of laboratory chemicals (residuals from laboratory analyses) have been included in drain water from two analytical laboratories that discharged to the septic system and leach field. The general types of chemicals disposed of included acids and caustics, such as nitric acid, sulfuric acid and sodium hydroxide; salts, such as potassium chloride; sulfites, such as sodium sulfite; phosphates, such as sodium phosphate; and organics, such as acetone and Freon-113. Only sanitary waste and small quantities of dilute nonhazardous pH buffer solutions are currently disposed of via the septic system and leach field. These discharges have been consistent with the established applicable regulations. In addition, there was a one-time accidental discharge of 15 gallons of solution containing 7 parts per million cadmium in late 1991.

Comment 35.
As stated in Section 4.5.5.1 of the Draft Environmental Impact Statement, small amounts of dilute battery acid rinse water were disposed of in a dry well. The dry well was used prior to 1991 to dispose of small battery acid samples and associated rinse water. The acid was dilute sulfuric acid. The dry well is located near the middle of the Windsor Site (See Appendix F, Figure F-1, Location 3). As stated in Section 3.1.4 of the Draft Environmental Impact Statement and the response to State of Connecticut Comment 7, all Windsor Site underground systems will be completely removed and characterized to allow unrestricted release of the Site, including the dry well.

Comment 36.
As stated in Section 4.5.5.1 of the Draft Environmental Impact Statement, the voluntary facility assessment work plan for the Windsor Site was submitted to the Environmental Protection Agency - Region I and the State of Connecticut Department of Environmental Protection in September 1995. In July 1996, Naval Reactors met with personnel from the Environmental Protection Agency - Region I and the State of Connecticut Department of

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Environmental Protection to finalize the sampling plan. A description of the sampling plan and a summary of the results to date are also provided in Appendix F of the Final Environmental Impact Statement. As described in Appendix F, sampling under the work plan is approximately 70 percent complete. Naval Reactors understands that the Environmental Protection Agency will solicit public comments on future actions (including additional detailed characterization, risk assessment, or no action) as part of the process for documenting the conclusions of the assessment under the Resource Conservation and Recovery Act.

Regarding sampling of surface waters, please see the response to Combustion Engineering, Inc. Comment 7. Regarding the criteria which will be used, please see the response to Combustion Engineering, Inc. Comment 5.

Comment 37.
For chemical remediation, the criteria selected will allow unrestricted release of the Windsor Site following dismantlement. As discussed in Sections 3.1.4 and 3.2.3 of the Draft Environmental Impact Statement, the criteria will be agreed to by the Environmental Protection Agency and the State of Connecticut, consistent with their authority under the Comprehensive Environmental Response, Compensation and Liability Act, the Resource Conservation and Recovery Act and the State of Connecticut Property Transfer Program to ensure that the criteria are sufficiently stringent to allow unrestricted release of the Windsor Site property.

Comment 38.
The samples discussed in Section 4.5.5.2 of the Draft Environmental Impact Statement were analyzed for total chromium. Sampling was conducted within the drainage brook bed at locations utilized historically for radiological characterization. Regarding the commenter's concern that measured levels of chromium were significantly above the established State of Connecticut Department of Environmental Protection Remediation Standard Regulation for chromium, Naval Reactors notes that the referenced 0.05 milligrams per liter pollutant mobility criterion is for leachable chromium by Toxicity Characteristic Leaching Procedure (Environmental Protection Agency Method 1311) or Synthetic Precipitation Leaching Procedure (Environmental Protection Agency Method 1312). Analysis for leachable chromium by either of these methods was not performed for the 1978 study, rather the total chromium content of the sediment was analyzed. The State of Connecticut Department of Environmental Protection Remediation Standard Regulations do not specify standards for surface water sediment. A more appropriate and conservative benchmark for comparison of the 1978 total chromium data is the 100 parts per million direct exposure residential soil criteria for hexavalent chromium used in the Draft Environmental Impact Statement. All samples collected from the drainage brook and analyzed for total chromium in 1978 were below this standard.

As discussed in Appendix F, which has been added to the Final Environmental Impact Statement, additional sampling will be conducted to identify any conditions requiring remedial actions or further investigation. Samples will be collected and analyzed for the target parameters provided in Appendix F Lists C (Inorganics - includes chromium),

Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.

Comment Responses:

D (Polychlorinated Biphenyls (Aroclors)), G (Volatile Organic Compounds) and H (Semi-Volatile Organic Compounds).

Comment 39.
As illustrated in the third paragraph of Section 4.5.5.2 of the Draft Environmental Impact Statement, the terminology of "immediately surrounding areas" as used in Section 4.5.5.2 refers to the drainage brook and the Goodwin Pond. Appendix F has been added to the Final Environmental Impact Statement and includes a discussion of sampling that will be done of the drainage brook and Goodwin Pond.

Comment 40.
Appendix F of the Final Environmental Impact Statement provides a discussion of soil and sediment sampling for investigation of chromium. Subsurface soil samples would be obtained near system piping as the piping is removed. Samples would be taken at selected piping joints, at locations where piping integrity has been lost, and at locations with visual evidence of leakage. Subsurface sediment samples would be collected from several locations covering the entire area of Goodwin Pond and the portion of the drainage brook upstream of the nearest Combustion Engineering, Inc. outfall (See Figure F-2 in Appendix F). Sediment from the bottom of Goodwin Pond and the drainage brook bed would be collected to a depth of two feet. Based on the low-flow conditions and limited sediment load in Goodwin Pond and the drainage brook, this depth was deemed adequate to penetrate sediments potentially affected by Windsor Site operations.

Comment 41.
As indicated in the response to the State of Connecticut Department of Environmental Protection Comment 3, remediation of the drainage brook is not included in any of the alternatives under consideration in this Environmental Impact Statement. For the actions covered by this Environmental Impact Statement, exposures are summarized in Table S-1 of the Draft Environmental Impact Statement. These exposures are judged to be negligible.

The radiological dose discussed in Section 4.5.4.2 of the Draft Environmental Impact Statement only includes the dose from radionuclides in the drainage brook that are attributable to Windsor Site operations and provides perspective on the impact of Windsor Site operations on the adjacent property. As discussed in the response to the State of Connecticut Department of Environmental Protection Comment 3, conditions in the drainage brook are part of a separate comprehensive evaluation of the Combustion Engineering, Inc. site.

Comment 42
The commenter is correct in noting that airborne particulate contamination can indirectly result in waterborne contamination. The Draft Environmental Impact Statement acknowledges that airborne contamination can indirectly result in waterborne contamination. Section B.1.3.1 of Appendix B states, "There are two processes by which radionuclides might enter water - via liquid discharge or via airborne discharges."

Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.

Comment Responses:

The statement in Section 5.1.3.1 of the Draft Environmental Impact Statement was only intended to apply to direct liquid discharges of radioactivity. None of the alternatives evaluated by this Environmental Impact Statement would result in any direct discharge of radioactive liquid effluents.

With regards to airborne discharges, effluents from the Windsor Site have no discernible effect on normal background radiation levels as discussed in the response to Combustion Engineering, Inc. Comment 25. Nonetheless, computer models, which are discussed in Section B.1.3.1 of the Draft Environmental Impact Statement, are used to calculate exposures to humans from airborne discharges and account for the indirect waterborne pathway. Dose estimates included in Summary Table S-1, Chapter 5 and Appendices B and C of the Draft Environmental Impact Statement all take into account the indirect waterborne pathway.

Comment 43.
Until 1978, small quantities of expired acids and oxidizing agents were discharged to the septic system and leach field. Minute quantities of a variety of laboratory chemicals (residuals from laboratory analyses) have been included in drain water from two analytical laboratories that discharged to the septic system and leach field. The general types of chemicals disposed of included acids and caustics, such as nitric acid, sulfuric acid and sodium hydroxide; salts, such as potassium chloride; sulfites, such as sodium sulfite; phosphates, such as sodium phosphate; and organics, such as acetone and Freon-113. Only sanitary waste and small quantities of dilute nonhazardous pH buffer solutions are currently disposed of via the septic system and leach field. These discharges have been consistent with the established applicable regulations. In addition, there was a one-time accidental discharge of 15 gallons of solution containing 7 parts per million cadmium in late 1991. As discussed in Sections 3.1.4 and 5.1.5.2 of the Draft Environmental Impact Statement and the response to Combustion Engineering, Inc. Comment 44, the septic system will be completely removed and soil will be sampled as appropriate to allow unrestricted release of the Windsor Site.

Section 5.1.3.2 of the Draft Environmental Impact statement also notes that the only liquid effluent from the Windsor Site in the future would be stormwater runoff. These effluents will be monitored in accordance with the appropriate State of Connecticut General Permit for the Discharge of Stormwater.

Comment 44.
As discussed in Sections 3.1.4 and 5.1.5.2 of the Draft Environmental Impact Statement, all Windsor Site systems including the underground septic system piping, junction boxes, and tanks will be completely removed. During removal, inspections will be performed and soil will be sampled as appropriate to allow unrestricted release of the Windsor Site. Appendix F has been added to the Final Environmental Impact Statement and provides a discussion of sampling in the vicinity of the septic system leach field.

**Commenter: John F. Conant, Senior Project Manager,
Asea Brown Boveri - Combustion Engineering, Inc.**

Comment Responses:

Comments 45 and 46.
As discussed in the response to State of Connecticut Department of Environmental Protection Comment 3, the Draft Environmental Impact Statement did not specifically evaluate potential remediation of the drainage brook. The limited discussion of the drainage brook in Section 4.5.4.2 of the Draft Environmental Impact Statement is focused on the cobalt-60 attributable to S1C Prototype reactor plant discharges. The comparison of the average drainage brook cobalt-60 concentration to specific concentration guidelines was intended to provide a general perspective on the significance of the residual cobalt-60. Naval Reactors agrees that future evaluation of the drainage brook should include a collective analysis of all radionuclides in the brook as well as an evaluation of localized higher concentrations. The drainage brook is being evaluated apart from this Environmental Impact Statement as discussed in the response to State of Connecticut Department of Environmental Protection Comment 3.

With regard to the application of the ALARA (As Low As Reasonably Achievable) concept to Windsor Site release, the most recent draft of the Environmental Protection Agency site release regulation does not require an ALARA demonstration provided that the Environmental Protection Agency release criteria (15 millirem per year overall, 4 millirem per year for ground water from beta and gamma emitters) are met. The Department of Energy applies ALARA to site release, but starts from a higher dose criterion before applying ALARA. The proposed Nuclear Regulatory Commission release regulation includes the Environmental Protection Agency dose criteria and includes an ALARA evaluation.

The radiological release process that is further discussed in Appendix G of the Final Environmental Impact Statement would result in a site that not only meets the absolute release criteria of all three standards, but on average is well under those criteria. Thus, the ALARA concept would be met for release of the Windsor Site.

Comment 47.
As discussed in Section 5.1.5.1 of the Draft Environmental Impact Statement, the extent of soil remediation, if any, is expected to be small. The potential small volume of soil would fall within the category of miscellaneous waste unsuitable for recycling or volume reduction discussed in Section 5.1.13 of the Draft Environmental Impact Statement. The Final Environmental Impact Statement has been revised to provide a quantitative estimate of the volume of the miscellaneous low-level radioactive waste associated with dismantlement activities at the Windsor Site other than S1C Prototype reactor plant dismantlement.

Comment 48.
No changes to the current Stormwater Pollution Prevention Plan would be made for the deferred dismantlement or no action alternatives. Effluents would continue to be monitored and reported as discussed in Sections 5.2.3.2 and 5.3.3.2 of the Draft Environmental Impact Statement. For the dismantlement period under the deferred dismantlement alternative, additional stormwater permits would be obtained as discussed in the response to State of Connecticut Department of Environmental Protection Comment 22. The Windsor Site Stormwater Pollution Prevention Plan would then be adjusted accordingly.

BARBARA B. KENNELLY
1ST DISTRICT, CONNECTICUT

COMMITTEE ON WAYS AND MEANS
SUBCOMMITTEE ON HUMAN RESOURCES
SUBCOMMITTEE ON SOCIAL SECURITY

E CHAIR, DEMOCRATIC CAUCUS

201 CANNON BUILDING
WASHINGTON, DC 20515
(202) 225-2265

ONE CORPORATE CENTER
HARTFORD, CT 06103
(203) 278-8888

Congress of the United States
House of Representatives
Washington, DC 20515

September 10, 1996

Mr. C. G. Overton
Chief
Windsor Field Office
Department of Energy
P.O. Box 393
Windsor, Connecticut 06095

Dear Mr. Overton:

I am writing to express my support for the prompt dismantlement of the S1C Prototype reactor plant at the Knolls Atomic Power Laboratory Site in Windsor, Connecticut.

The Windsor site has preformed an admirable service to the United States Navy and the nation for almost forty years. Like my constituents who live and work near the site, I believe it is time for the reactor to be dismantled and the site made available for new applications.

Of the three options outlined in your Draft Environmental Impact Statement, I believe that prompt dismantlement is the most beneficial to the community and the state. Because the spent fuel already has been removed from the reactor, there is minimal environmental risk from prompt dismantlement. In addition, immediate dismantlement would ensure that the waste would be disposed of properly once and for all and would allow the site to be re-developed. The other options -- deferring dismantlement for thirty years or taking no action -- will keep this waste on site unnecessarily, precluding any economic advantages the region could gain from the site. Lastly, prompt dismantlement would be the least costly of the three options in the DEIS.

Naturally, any shipment of waste and reactor components from the site must be performed carefully and in consultation with all local authorities. Although I am concerned about the circumstances surrounding the November, 1995 shipment of radioactive fuel rods from the Windsor site, I am confident that the Department has the capability to conduct a dismantlement that safeguards the environment and surrounding communities and will work with local authorities to ensure future shipments take place safely. 1

I appreciate your efforts on behalf of the Knolls Atomic Power Laboratory Site, and look forward to working with you on this endeavor on the coming weeks.

Sincerely,

Barbara

Barbara B. Kennelly
Member of Congress

BBK:alg

Commenter: The Honorable Barbara B. Kennelly, United States House of Representatives

Comment Response:

Comment 1.
The Draft Environmental Impact Statement provides the assessment of the potential safety and health impacts to workers and the public from the transportation of low-level radioactive materials from the Windsor Site during the dismantlement of the Site facilities. The results of the analysis provided in Appendix C of the Draft Environmental Impact Statement show that the potential impacts to workers and to people living along the transportation routes would be small from either the prompt dismantlement alternative or the deferred dismantlement alternative.

Appendix C of the Draft Environmental Impact Statement in Sections C.3, C.4, C.5 and C.7 describes the analysis input variables and the potential risks to the public. Variables used in the computer codes for the risk analysis include estimated stop times and radiation levels. Estimated risks to the public were based on exposure to persons living within about ½ mile of the length of the transportation route, exposure to persons sharing the transportation route (such as train passengers), and exposure to persons (such as residents along the transportation route) during stops. All of the assumptions used in the analysis are conservative, and the results of the analysis indicate that the potential risks are very small.

All shipments of radioactive materials from the Windsor Site would be low-level radioactive waste or recyclable material. Low-level radioactive materials have been shipped safely from Naval Nuclear Propulsion Program facilities, including the Windsor Site during its operations, for over 35 years. All shipments have been accomplished in accordance with applicable transportation regulations.

Although there is no regulatory requirement for prenotification of such shipments from the Windsor Site in Connecticut or to escort these shipments, Naval Reactors has periodically interfaced with appropriate regulatory agencies regarding such shipments and will continue to do so. In the past, such as the November 1995 shipment of the spent nuclear fuel from the Windsor Site, overweight and oversize permits were required for the heavy hauler shipment leg to the Griffin Line. This required coordination with the State of Connecticut Department of Transportation. Additionally, a Town of Windsor police escort accompanied this part of the shipment to ensure traffic safety. Due to the very infrequent use of the Griffin Line, the rail shipment was coordinated with City of Hartford and Town of Bloomfield law enforcement officials to ensure traffic safety at places where the Griffin Line crosses roads. Similar coordination would occur for the one or two rail shipments that would result from the prompt and deferred dismantlement alternatives.

For further discussion of the spent nuclear fuel shipment which occurred in November 1995, please refer to the response to Public Hearing Comment 11.

CITY OF HARTFORD

OFFICE OF THE CITY MANAGER
550 Main Street, Hartford, CT 06103

COUNCIL – MANAGER GOVERNMENT

August 19, 1996

Mr. C. G. Overton, Chief
Windsor Field Office
Office of Naval Reactors
U.S. Department of Energy
P.O. Box 393
Windsor, CT 06095

Re: S1C Nuclear Reactor Plant, Windsor, CT
Draft Environmental Impact Report

Dear Mr. Overton:

The purpose of this letter is to provide the City of Hartford's official comments concerning the disposal of the S1C reactor plant in Windsor, Connecticut. The attached Court of Common Council resolution was approved on August 12, 1996, and expresses the safety concerns that the City of Hartford has with respect to shipments of radioactive materials from the S1C reactor plant.

In particular, the City of Hartford is requesting that this office be notified well in advance of any further shipments of radioactive materials through the City of Hartford. Additionally, the City of Hartford is requesting information concerning the radiation levels associated with the February 1995 nuclear fuel shipment and the likely radiation exposure to city residents. We would also expect this type of information to accompany any future shipments through the City of Hartford. 1

While the City of Hartford acknowledges that it may be beneficial to have the S1C reactor plant disposed of, our overriding concern is that the Department of Energy use every possible safety precaution in making shipments of radioactive materials from the site.

Your cooperation in this matter is greatly appreciated.

Sincerely,

Saundra Kee Borges

Saundra Kee Borges
City Manager

SKB/JHM/jwv

Court of Common Council

CITY OF HARTFORD

550 MAIN STREET
HARTFORD, CONNECTICUT 06103

Michael P. Peters, Mayor
Frances Sanchez, Deputy Mayor
John B. Stewart, Jr., Majority Leader
Veronica Airey-Wilson, Councilwoman
Luis A. Ayala, Councilman
Anthony F. DiPentima, Councilman
Art J. Feltman, Councilman
Michael T. McGarry, Councilman
John B. O'Connell, Councilman
Louis Watkins, Jr., Councilman

Clerk—
Daniel M. Carey

August 12, 1996

This is to certify that at a meeting of the Court of Common Council, August 12, 1996, the following RESOLUTION was passed.

WHEREAS, The U. S. Department of Energy has issued a draft environmental impact statement for the disposal of the SIC Nuclear Reactor Plant in Windsor, Connecticut; and

WHEREAS, The disposal of the SIC Nuclear Reactor Plant may involve shipments of radioactive materials through the City of Hartford; and

WHEREAS, Prior to the issuance of the draft environmental impact statement, the Department of Energy caused a shipment of highly radioactive nuclear fuel from the SIC Reactor Plant to be shipped through the City of Hartford in February, 1995; and

WHEREAS, The City of Hartford was not informed by the Department of Energy as to the radiation levels which would exist surrounding the radioactive fuel container, nor was the potential radiation exposure to Hartford residents identified to the City by the Department of Energy; and

WHEREAS, The aforesaid shipment of nuclear fuel was allegedly delayed in the City of Hartford due to a railroad switching problem which could have resulted in increased radiation exposure to nearby residents; and

WHEREAS, While the City of Hartford acknowledges the Town of Windsor's desire to have the SIC Reactor Plant removed from the site, the City of Hartford is concerned that the U. S. Department of Energy take all safety precautions necessary in making any shipments of radioactive material; and

WHEREAS, The Department of Energy is accepting written comments on the draft environmental impact statement until August 19th, 1996; now, therefore, be it

RESOLVED, That the City Manager shall prepare a correspondence to the Department of Energy on behalf of the Court of Common Council expressing safety concerns about further shipments of radioactive materials through the City of Hartford and the potential radiation exposure to Hartford residents. Said correspondence shall include the Court of Common Council's strong desire to be notified prior to any further shipments of radioactive fuel and a request for the Department of Energy to supply further information about radiation levels and potential exposures from the December 1995 nuclear fuel shipment and any future shipments which may occur.

Attest:

M. Carey

Daniel M. Carey,
City Clerk

Copies to: City Manager, Director of Public Works and Director of Health.

Commenter: Saundra Kee Borges, City Manager, City of Hartford, Connecticut

Comment Response:

Comment 1.
The Draft Environmental Impact Statement provides the assessment of the potential safety and health impacts to workers and the public from the transportation of low-level radioactive materials from the Windsor Site during the dismantlement of the Site facilities. The results of the analysis provided in Appendix C of the Draft Environmental Impact Statement show that the potential impacts to workers and to people living along the transportation routes would be small from either the prompt dismantlement alternative or the deferred dismantlement alternative.

Appendix C of the Draft Environmental Impact Statement in Sections C.3, C.4, C.5 and C.7 describes the analysis input variables and the potential risks to the public. Variables used in the computer codes for the risk analysis include estimated stop times and radiation levels. Estimated risks to the public were based on exposure to persons living within about ½ mile of the length of the transportation route, exposure to persons sharing the transportation route (such as train passengers), and exposure to persons (such as residents along the transportation route) during stops. All of the assumptions used in the analysis are conservative, and the results of the analysis indicate that the potential risks are very small.

All shipments of radioactive materials from the Windsor Site would be low-level radioactive waste or recyclable material. Low-level radioactive materials have been shipped safely from Naval Nuclear Propulsion Program facilities, including the Windsor Site during its operations, for over 35 years. All shipments have been accomplished in accordance with applicable transportation regulations.

Although there is no regulatory requirement for prenotification of such shipments from the Windsor Site in Connecticut or to escort these shipments, Naval Reactors has periodically interfaced with appropriate regulatory agencies regarding such shipments and will continue to do so. In the past, such as the November 1995 shipment of the spent nuclear fuel from the Windsor Site, overweight and oversize permits were required for the heavy hauler shipment leg to the Griffin Line. This required coordination with the State of Connecticut Department of Transportation. Additionally, a Town of Windsor police escort accompanied this part of the shipment to ensure traffic safety. Due to the very infrequent use of the Griffin Line, the rail shipment was coordinated with City of Hartford and Town of Bloomfield law enforcement officials to ensure traffic safety at places where the Griffin Line crosses roads. Similar coordination would occur for the one or two rail shipments that would result from the prompt and deferred dismantlement alternatives.

For further discussion of the spent nuclear fuel shipment which occurred in November 1995, please refer to the response to Public Hearing Comment 11.

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TOWN OF WINDSOR • CONNECTICUT
FIRST IN STATE • FIRST IN SERVICE • FIRST IN VALUE

August 13, 1996

Mr. C. G. Overton, Chief
Windsor Field Office
Office of Naval Reactors
U.S. Department of Energy
P.O. Box 393
Windsor, CT 06095 - 0393

RE: Comments on the Draft Environmental Impact Statement on the Disposal of the S1C Prototype Reactor Plant

Dear Mr. Overton:

The Windsor Health Department on behalf of the Town of Windsor has reviewed the document entitled Draft Environmental Impact Statement S1C Prototype Reactor Plant Disposal dated June 1996 and prepared by the U.S. Department of Energy Office of Naval Reactors. While the EIS is quite detailed, the Town wishes to make the following comments regarding this draft.

First, sections 5.1.6, 5.2.6, and 5.3.6 make reference to the "socioeconomic" impacts of the three alternative actions being considered. None of these sections makes reference to the fact that the 10.8 acres of land occupied by this facility is not presently taxed by the Town of Windsor. If the "Prompt Dismantlement Alternative" is selected and the property is released for unrestricted use, there is a good possibility that this property could be placed back on the tax rolls and benefit the town and its residents economically. This fact should be part of the EIS as a benefit for the Prompt Dismantlement Alternative and a "cost" for both the "Deferred Dismantlement " and the "No Action" alternatives. 1

Second, section 3.1.4 refers to completion of a "voluntary facility assessment" which would address the potential for environmental chemical contamination and which would support the Site inactivation and future release of property. The section goes on to state that "following completion of all sample collecting and analytical work, a report would be prepared and provided to the U.S. Environmental Protection Agency, Region I and the State of Connecticut Department of Environmental Protection." While we applaud this action, we feel that such an assessment report should be sent to appropriate Town of Windsor officials for their review and comment also. 2

Third, the Deferred Dismantlement Alternative assumes that the political, legal, and environmental thinking stated in the discussion of this alternative, i.e. that diamantlement will take place after a 30 year caretaker period, will still be the thinking in 30 years. Given the rapid changes occurring in the political, legal, and environmental areas and given the possible closure of existing disposal sites, we feel that there is a real possibility that the Windsor Site could become the permanent disposal site for the Prototype reactor plant and the low level radioactive waste if the Deferred 3

Dismantlement Alternative is selected. Wording reflecting this possibility should be placed in the appropriate sections of the report. 3

Fourth, the transportation of the S1C reactor from the site to its final destination should be timed such that delays along rail routes are minimized to the extent possible. While the reactor is packaged so that radiation is contained with no danger to the public, the fact remains that any prolonged delay of the train at any one location is perceived as endangering residents or the public in general in that area. 4

Finally, cost for the No Action Alternative as stated in Table S-1 is slightly misleading in that it does not take into consideration the eventual need for a permanent disposal decision. This can be clarified by putting a footnote in the table with wording similar to that which appears in the last sentence of Section 3.2.2 which states "taking into consideration the eventual need for a permanent disposal decision, the no action alternative would ultimately result in a higher figure." 5

In summary, for the reasons stated in the EIS and for the additional issues stated above, the Town of Windsor fully endorses the Prompt Dismantlement Alternative as the disposal strategy for the defueled S1C Prototype reactor plant. This alternative appears to be supported by the evidence as presented in the Environmental Impact Statement. We look forward to our continuing involvement in the shutdown process.

Very truly yours,

Charles J. Petrillo Jr. Dr.PH

Charles J. Petrillo, Jr. Dr.PH
Director of Health

cc: Mayor Francis Brady
Town Council
Town Manager

Commenter: Dr. Charles J. Petrillo, Director of Health, Town of Windsor, Connecticut

Comment Responses:

Comment 1.
The commenter correctly identifies that the land comprising the Windsor Site is not presently on the tax rolls of the Town of Windsor. If the property were to be transferred to a taxpaying entity, it is expected that the land would be added to the tax rolls. However, considering the small size of the Windsor Site, the impact on the tax base of the town is not expected to be significant. Sections 5.1.6, 5.2.6 and 5.3.6 have been revised in the Final Environmental Impact Statement to reflect the above.

Comment 2.
A copy of the voluntary facility assessment report will be provided to the Town of Windsor for information when it is provided to the State of Connecticut and the Environmental Protection Agency - Region I.

Comment 3.
The analysis of the deferred dismantlement alternative in the Draft Environmental Impact Statement is consistent with reasonably foreseeable radioactive waste disposal practices. In particular, there are no active discussions of closing the Savannah River Site in South Carolina, and an Environmental Impact Statement (Reference 5-2 of the Draft Environmental Impact Statement) analyzing future radioactive waste disposal operations at the Savannah River Site was recently issued.

Naval Reactors acknowledges that analysis of any action 30 years in the future brings with it uncertainties about how such an action would be executed. The relative certainty of the prompt dismantlement alternative is one of the favorable aspects of this alternative. In the Final Environmental Impact Statement, Naval Reactors has identified the prompt dismantlement alternative as the preferred alternative. Also, an acknowledgment of the greater degree of certainty associated with the prompt dismantlement alternative has been added to the Final Environmental Impact Statement Summary.

Comment 4.
The Draft Environmental Impact Statement provides the assessment of the potential safety and health impacts to workers and the public from the transportation of low-level radioactive materials from the Windsor Site during the dismantlement of the Site facilities. The results of the analysis provided in Appendix C of the Draft Environmental Impact Statement show that the potential impacts to workers and to people living along the transportation routes would be small from either the prompt dismantlement alternative or the deferred dismantlement alternative.

Appendix C of the Draft Environmental Impact Statement in Sections C.3, C.4, C.5 and C.7 describes the analysis input variables and the potential risks to the public. Variables used in the computer codes for the risk analysis include estimated stop times and radiation levels. Estimated risks to the public were based on exposure to persons living within about ½ mile of

Commenter: Dr. Charles J. Petrillo, Director of Health, Town of Windsor, Connecticut

Comment Responses:

the length of the transportation route, exposure to persons sharing the transportation route (such as train passengers), and exposure to persons (such as residents along the transportation route) during stops. All of the assumptions used in the analysis are conservative, and the results of the analysis indicate that the potential risks are very small.

All shipments of radioactive materials from the Windsor Site would be low-level radioactive waste or recyclable material. Low-level radioactive materials have been shipped safely from Naval Nuclear Propulsion Program facilities, including the Windsor Site during its operations, for over 35 years. All shipments have been accomplished in accordance with applicable transportation regulations.

Although there is no regulatory requirement for prenotification of such shipments from the Windsor Site in Connecticut or to escort these shipments, Naval Reactors has periodically interfaced with appropriate regulatory agencies regarding such shipments and will continue to do so. In the past, such as the November 1995 shipment of the spent nuclear fuel from the Windsor Site, overweight and oversize permits were required for the heavy hauler shipment leg to the Griffin Line. This required coordination with the State of Connecticut Department of Transportation. Additionally, a Town of Windsor police escort accompanied this part of the shipment to ensure traffic safety. Due to the very infrequent use of the Griffin Line, the rail shipment was coordinated with City of Hartford and Town of Bloomfield law enforcement officials to ensure traffic safety at places where the Griffin Line crosses roads. Similar coordination would occur for the one or two rail shipments that would result from the prompt and deferred dismantlement alternatives.

For further discussion of the spent nuclear fuel shipment which occurred in November 1995, please refer to the response to Public Hearing Comment 11.

Comment 5.
The following additional words have been added to Note 8 of Table S-1 in the Final Environmental Impact Statement: "Taking into consideration the eventual need for a permanent disposal decision, the no action alternative would ultimately result in a higher figure."

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Greater
Hartford
Transit District

August 19, 1996

Mr. Christopher G. Overton, Chief
Windsor Field Office, Office of Naval Reactors
U.S. Department of Energy
P.O. Box 393
Windsor, CT 06095

Dear Mr. Overton:

Thank you for providing the Greater Hartford Transit District (GHTD) with a copy of the Draft Environmental Impact Statement for the "S1C Prototype Reactor Plant Disposal", Windsor, Connecticut. This public agency has a particular interest in the timing of the Windsor plant disposal plans of the U.S. Energy Department.

The Greater Hartford Transit District is the lead agency for the development of the Griffin Line for light rail passenger service from downtown Hartford ultimately to Bradley International Airport. A US Department of Transportation required "Major Investment Study" was completed in 1995 and the Capitol Region Council of Governments (CRCOG) has selected the light rail alternative for the Griffin corridor. GHTD is currently working with CRCOG, the private sector and other public agencies to secure financing for engineering the Griffin Line as a light rail facility.

If any material from the Windsor facility is planned for disposal via the current Griffin Line
tracks in the next 12 to 18 months, there likely would not be any disruption of the
implementation of the Griffin Line as currently envisioned. If, however, plans called for
disposal of material via the current Griffin Line facility, e.g. in the 24, 36 or 48 month time
frame (from the current date) then, it is possible, even probable that the current tracks will be in 1
the process of being replaced in order to support light rail operation. In this latter time frame
there would also likely be other related construction at designated station stops along the Griffin
Line which could be incompatible with the disposal plans. Any later disposal via the Griffin
Line would have to be reassessed since it is then expected to be providing ongoing passenger
service which may be incompatible with the removal of any material from the Windsor plant.

Please contact me to pursue this matter further. I will be happy to discuss this matter and share further timing information as it may impact the Department of Energy's disposal plans.

Sincerely.

Paul A. Ehrhardt

Paul A. Ehrhardt
Chairman

One Union Place • Hartford, CT 06103 • (203) 247-5329 • FAX: 549-3879

Commenter: Paul A. Ehrhardt, Chairman, Greater Hartford Transit District

Comment Response:

Comment 1.
Naval Reactors holds a 5 year lease from the State of Connecticut Department of Transportation for occasional use of the Griffin Line. This lease expires March 31, 2000 and can be terminated by the State of Connecticut Department of Transportation. The State of Connecticut Department of Transportation has not provided any indication that it intends to terminate this lease early.

If the preferred alternative of prompt dismantlement is selected, use of the Griffin Line by Naval Reactors should be complete by the end of 1998. In the event of any potential conflict, Naval Reactors would work with the Greater Hartford Transit District to minimize any inconvenience or delay.

Additional detailed engineering evaluation of dismantlement methods has indicated that it may be desirable to ship the S1C Prototype reactor plant primary shield tank in a single large package by rail rather than cutting it into smaller sections for truck shipment. In that case, there would be two rail shipments rather than one as discussed in the Draft Environmental Impact Statement. A discussion on the possibility of a second rail shipment has been added to the Final Environmental Impact Statement. Although radiological and nonradiological impacts from both truck and rail shipments are very small, rail shipments have lower impacts than truck shipments. Therefore, the transportation analysis in the Final Environmental Impact Statement continues to assume one rail shipment.

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August 15, 1996

Mr. C. G. Overton, Chief
Windsor Field Office
Office of Naval Reactors
U. S. Department of Energy
P. O. Box 393
Windsor, CT 06095

COMMENT: DEPARTMENT OF ENERGY (DOE) OFFICE OF NAVAL REACTORS' DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR DISPOSAL OF THE S1C PROTOTYPE REACTOR PLANT LOCATED IN WINDSOR, CONNECTICUT.

I comment that there is an injustice (typically seen in the disposal of nuclear waste) present in the "Prompt Dismantlement Alternative" for S1C reactor disposal. This alternative says, in effect, take the contaminated thing away to another place, we are through benefitting from it in Connecticut.

Of Course, this was a Navy reactor, so the benefit (in the traditional "cost-benefit" sense went to the United States and its far flung naval nuclear program. But, Connecticut got some benefits no other states such as the states which contain the D. O. E. radioactive waste disposal sites got. Indeed, the "Prompt Dismantlement Alternative" puts the "costs" (that is, exposure to workers and possible accident consequences, for example) on these locales after Connecticut, has received the benefits such as jobs, repair contracts, and economic benefits of Naval Personnel stationed at the Windsor, site.

Connecticut should have to absorb some of the what I call costs now. The way this can be done would be to use the "Deferred Dismantlement Alternative". This would prevent one part of this country from using another (as yet unnamed, but South Carolina, 1
Washington, and New Mexico, come to mind) to free it of the radioactive waste created within its borders, which I have labled an "injustice". Thus, there is an additional reason to favor the "Deferred Dismantlement Alternative" not included in the DEIS analysis.

It would be foolish to believe the people of north Connecticut, would welcome this nuclear waste any longer than necessary. But, this "Deferred Dismantlement Alternative" is a more responsible way to act 1
than to give the radioactive materials to someone far away, for all intents and purposes "gone".

You may publish and otherwise circulate this COMMENT in furtherance of the E.I.S. process. Thank you for the opportunity to comment.

Sincerely,
John F. Doherty
Dr. John F. Doherty
289 Angell St.
Providence, R. I. 02906

Commenter: Dr. John F. Doherty, Providence, Rhode Island

Comment Response:

Comment 1.
The Draft Environmental Impact Statement fully discloses the fact that some of the alternatives (prompt dismantlement and deferred dismantlement) assume that waste would be removed from one location in the country and placed in another location. As analyzed in Section 5 and summarized in Section 6 of the Draft Environmental Impact Statement, there are no significant impacts to the public for any of the identified alternatives. The decision maker can take this into account in making the decision on the alternative selected for implementation. Please refer to Public Hearing Comment 17 (Mr. McCormick) for further discussion on disposal site options and impacts.

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Mrs. Jean Pottinger
241 Nahum Drive Apt. A-2
Hartford, Conn. 06112-2659
August 12, 1996

Mr. C. G. Overton
Chief, Windsor Field Office
Naval Reactors
Department of Energy
P.O. Box 393
Windsor, Conn. 06095

Dear Mr. Overton,

Thank you for the opportunity to comment on the Department of Energy's "Draft of the Environmental Impact Statement" for the final disposal of the S1C Prototype Reactor plant in Windsor, Connecticut. This letter is to reinforce my comments made at that meeting on August 7, 1996.

As I stated last year, the Greater Hartford Transit District and the Capitol Region Council of Governments are studying the feasibility of having a light-rail train system on the Griffin Line. If they are successful in getting funds to build it and the fact that the Lockheed Martin Corp., the contractor that runs Knolls Atomic Power Laboratory for the Federal Government, has renewed thier license from the ConnDot to ship radioactive material or other freight on the Griffin Line until March 2000, what kind of time-frame are you looking at? How soon and how long will it take to ship the low-level radioactive parts on the Griffin Line? 1

When the Department of Energy shipped the high-level radioactive fuel rods on November 29, 1995, both the City of Hartford and the Town of Bloomfield Officials said that "they were not notified of the shipment in advanced" I know that the shipment has to be kept secret for security reasons, but shouldn't the necessary Officials be notified in case of an emergency? 2

Finally, when the shipment reached Union Station in Hartford, it was switched to Amtrak lin to travel to Springfield, Mass. When the shipment reached Conrail freight yards on Windsor Street in Hartford, the Department of Energy ran into a "snafu" when Conrail refused to activate the switch at Fishfry St. (which would have allowed the train to continue on to Springfield) until the track was cleared for two (2) hours in both directions. As a result, the high-level radioactive waste was left standing across the street from Bellevue Square Housing Project for four (4) hours, putting the Tenants if grave danger. Both the Griffin Line and Amtrak Line passed through heavily populated areas Hartford.

Since the Town of Windsor wants to promptly dismantle the S1C Prototype Reactor and clean up the area as soon as possible, which will necessitate the use of trucks and/or rail (Griffin Line and Amtrak) to ship the low-level radioactive waste out of Connecticut, it is of utmost importance that the Department Of Energy should make arrangements with all parties concerned in this matter, before-hand, to insure that the safe and swift transportation of all radioactive materials through heavily populated areas in the future.

Sincerely,

Mrs. Jean Pottinger

Mrs. Jean Pottinger

cc: Hartford City Manager Sandra Kee Borges
Hartford City Council Louis Watkins, Jr.
Mr. Tom Johnson, Director, Hartford Public Works Department
The Honorable Senator Eric Coleman
The Honorable Representative Kenneth Green
The Honorable Hartford Mayor Michael P. Peters

Commenter: Jean Pottinger, Hartford, Connecticut

Comment Responses:

Comment 1.
Naval Reactors holds a 5 year lease from the State of Connecticut Department of Transportation for occasional use of the Griffin Line. This lease expires March 31, 2000 and can be terminated by the State of Connecticut Department of Transportation. The State of Connecticut Department of Transportation has not provided any indication that it intends to terminate this lease early.

If the preferred alternative of prompt dismantlement is selected, use of the Griffin Line by Naval Reactors should be complete by the end of 1998. In the event of any potential conflict, Naval Reactors would work with the Greater Hartford Transit District to minimize any inconvenience or delay.

Additional detailed engineering evaluation of dismantlement methods has indicated that it may be desirable to ship the S1C Prototype reactor plant primary shield tank in a single large package by rail rather than cutting it into smaller sections for truck shipment. In that case, there would be two rail shipments rather than one as discussed in the Draft Environmental Impact Statement. A discussion on the possibility of a second rail shipment has been added to the Final Environmental Impact Statement. Although radiological and nonradiological impacts from both truck and rail shipments are very small, rail shipments have lower impacts than truck shipments. Therefore, the transportation analysis in the Final Environmental Impact Statement continues to assume one rail shipment.

Comment 2.
The Draft Environmental Impact Statement provides the assessment of the potential safety and health impacts to workers and the public from the transportation of low-level radioactive materials from the Windsor Site during the dismantlement of the Site facilities. The results of the analysis provided in Appendix C of the Draft Environmental Impact Statement show that the potential impacts to workers and to people living along the transportation routes would be small from either the prompt dismantlement alternative or the deferred dismantlement alternative.

Appendix C of the Draft Environmental Impact Statement in Sections C.3, C.4, C.5 and C.7 describes the analysis input variables and the potential risks to the public. Variables used in the computer codes for the risk analysis include estimated stop times and radiation levels. Estimated risks to the public were based on exposure to persons living within about ½ mile of the length of the transportation route, exposure to persons sharing the transportation route (such as train passengers), and exposure to persons (such as residents along the transportation route) during stops. All of the assumptions used in the analysis are conservative, and the results of the analysis indicate that the potential risks are very small.

All shipments of radioactive materials from the Windsor Site would be low-level radioactive waste or recyclable material. Low-level radioactive materials have been shipped safely from

Commenter: Jean Pottinger, Hartford, Connecticut

Comment Responses:

Naval Nuclear Propulsion Program facilities, including the Windsor Site during its operations, for over 35 years. All shipments have been accomplished in accordance with applicable transportation regulations.

Although there is no regulatory requirement for prenotification of such shipments from the Windsor Site in Connecticut or to escort these shipments, Naval Reactors has periodically interfaced with appropriate regulatory agencies regarding such shipments and will continue to do so. In the past, such as the November 1995 shipment of the spent nuclear fuel from the Windsor Site, overweight and oversize permits were required for the heavy hauler shipment leg to the Griffin Line. This required coordination with the State of Connecticut Department of Transportation. Additionally, a Town of Windsor police escort accompanied this part of the shipment to ensure traffic safety. Due to the very infrequent use of the Griffin Line, the rail shipment was coordinated with City of Hartford and Town of Bloomfield law enforcement officials to ensure traffic safety at places where the Griffin Line crosses roads. Similar coordination would occur for the one or two rail shipments that would result from the prompt and deferred dismantlement alternatives.

For further discussion of the spent nuclear fuel shipment which occurred in November 1995, please refer to the response to Public Hearing Comment 11.

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UNITED STATES DEPARTMENT OF ENERGY

In the Matter

-of-

a Public Hearing to Receive Comments
on the Draft Environmental Impact
Statement for the S1C Prototype Reactor
Plant Disposal.

Windsor Town Hall
Windsor, Connecticut

August 7, 1996
7:00 p.m.

PRESIDING:

ANDREW SEEPO

Director of Radiological/
Environmental Controls and
Safety, Schenectady Naval Reactors
Office, Department of Energy

PRESENT:

CHRIS OVERTON, Naval Reactors Windsor
Field Office

JEFF HILL, Naval Reactors Windsor Field
Office

PROCEEDINGS

MR. SEEPO: Good evening, ladies and gentlemen. Thank you for attending. My name is Drew Seepo. I am the Director of Radiological/Environmental Controls and Safety at the Department of Energy Naval Reactors Schenectady Office. I will be the moderator for tonight's public meeting. With me this evening are Mr. Chris Overton and Mr. Jeff Hill from the Naval Reactors Windsor Field Office.

(A slide presentation accompanied the remarks of Mr. Seepo and Mr. Overton.)

On July 1st, 1996, the Department of Energy announced in the Federal Register the availability of the Draft Environmental Impact Statement, or Draft EIS for short, concerning disposal of the S1C Prototype reactor plant. After completion of general distribution of the document to public officials and interested citizens, Naval Reactors filed copies with the Environmental Protection Agency. On July 5th, the Environmental Protection Agency published another notice of availability in the Federal

Register to start the formal comment period.

Tonight's meeting is being held as part of the decision-making process required by the National Environmental Policy Act, or NEPA. NEPA is our basic national charter for protection of the environment. NEPA procedures ensure that environmental information is made available to public officials and citizens before decisions are made and before actions are taken.

The Draft EIS was developed with consideration of public input received during the scoping phase of the NEPA process.

The purpose of tonight's meeting is to receive comments on the Draft EIS. We are here to listen to what you have to say. It is our responsibility to receive statements so that your comments can be considered in the development of the Final EIS. For that reason, this meeting is being recorded.

The order of tonight's meeting will begin with a brief overview by Mr. Overton of the S1C Prototype plant and the dismantlement alternatives addressed in the Draft EIS.

This presentation will last approximately 15 minutes. We will then take a short break and reconvene the meeting to receive public comments. After all oral comments have been given, I will conclude the meeting.

The comment period is the time we listen to you. As stated in the July 1st Notice of Availability, speakers will be allotted five minutes each to allow sufficient time for all individuals desiring to speak. Please be considerate of your fellow participants by adhering to this limit. The order in which speakers will be heard is as follows: Federal government, State government, county government, local government, organizations, private citizens. As time permits depending on the number of persons requesting to speak, individuals who have spoken subject to the five-minute rule will be afforded additional speaking time. Additional time will be allotted first to elected officials or speakers representing multiple parties, or organizations.

Persons wishing to speak on behalf of organizations are requested to identify the organization that they represent. Anyone wishing to speak who did not register on the way in should, at the break following Mr. Overton's presentation, fill out a registration form at the table by the door. That way, we can assure that all persons who want to speak are given an opportunity to do so.

This is not an evidentiary hearing. Speakers will not be cross-examined. However, to ensure that comments are clearly reflected in the record, we may ask some clarifying questions.

Whether or not you speak this evening, you may also provide written comments. Oral and written comments will be considered equally in the development of the Final EIS. Responses to each comment or question will be addressed in the Final EIS. If you have written comments with you this evening, you may leave them with support staff at the registration table. If you choose to provide written comments at a later time, they should be sent to Mr. Overton. His address is as indicated above (on a slide projection). The address is also shown on the first page of the Draft EIS and is available at the registration table. Your written comments should be postmarked by August 19th to be considered during development of the Final EIS. Comments postmarked after that date will be considered to the extent practicable. A written transcript of tonight's meeting will be included in the Final EIS. Distribution of the Final EIS will include placing a copy in the Windsor Library. Following completion of the Final EIS, Naval Reactors will issue a Record of Decision after a 30-day waiting period.

I would like to now introduce Mr. Chris Overton, from the Naval Reactors Windsor Field Office. He will provide a general overview of the S1C reactor plant and discuss alternatives for reactor plant disposal.

MR. OVERTON: Thank you, Mr. Seepo.

The S1C Prototype reactor plant

is located on a Federally-owned 10.8-acre site in Windsor. The access road to the site is located off of Day Hill Road just west of its intersection with Prospect Hill Road.

This photograph was taken in October of 1995. The S1C Prototype is this structure here. Reactor plant operations commenced in 1959. For over 30 years, the S1C Prototype reactor plant served as a reactor plant component and equipment test facility as well as a training platform for Naval personnel.

As a result of the end of the Cold War and the downsizing of the Navy, the S1C Prototype reactor plant was shut down in 1993. Because the S1C Prototype reactor plant is the only activity at this small site and there is no further need for this plant, a decision is needed on its disposal. For that purpose, a Draft Environmental Impact Statement was prepared.

This is a drawing of the S1C Prototype. This prototype is roughly the aft half of the USS Tullibee, the only submarine constructed in its class. The reactor plant, located in the purple section called the reactor compartment, provided steam for turbines located in the engine room, the green section.

This is a simplified schematic of a submarine nuclear propulsion plant. Typical of Naval nuclear propulsion plants, the S1C Prototype reactor plant is a rugged, compact pressurized water reactor. Major components inside the reactor compartment include the reactor vessel, steam generators, pressurizer and main coolant pumps. The reactor compartment is separated from the rest of the prototype by shielded walls or bulkheads.

Because of its high density, lead is an excellent radiation shielding material. The reactor compartment bulkheads contain lead to shield the crew members from radiation during reactor operation. The S1C reactor plant contains over 100 tons of lead.

The reactor plant contains other hazardous materials used in the construction of the plant but in much lesser quantities. These include polychlorinated biphenyls, or PCBs, and chromium found in small amounts in common industrial materials such as paint, rubber, adhesives and brazing alloys.

Another factor requiring consideration in disposing of the S1C Prototype reactor plant is the radioactivity remaining from reactor operation.

Defueling the reactor removed about 95 percent of the radioactivity from the shutdown reactor plant, but some radioactivity remains. Of the remaining 5 percent, approximately 99.9 percent is an integral part of the reactor plant's internal structural metals and components. This is a result of structural metals becoming activated during reactor operations. The other 0.1 percent of the remaining radioactivity is radioactive corrosion and wear products which have been deposited onto the inside surfaces of piping systems and components.

Tonight, I will first discuss the

alternatives Naval Reactors considered for disposal of the S1C Prototype reactor plant. Later I will cover the potential environmental consequences. Alternatives considered in the Draft Environmental Impact Statement included: prompt dismantlement; deferred dismantlement; one piece off-site disposal; entombment; on-site disposal, and the no action alternative.

These alternatives were eliminated from further consideration: [Slide stating one piece off-site disposal, entombment, and on-site disposal were eliminated from detailed review.]

The one piece off-site disposal alternative is based on the submarine reactor compartment disposal program for dismantling decommissioned U.S. Navy submarines. Defueled reactor compartments are packaged in their entirety at the Puget Sound Naval Shipyard. The packaged reactor compartments are then sent by barge and special ground transport for disposal at the Department of Energy's low-level waste burial ground at the Hanford Site in Washington

State.

As a single package, the S1C Prototype reactor compartment would measure approximately 23 feet in length, 24 feet in diameter and would weigh approximately 400 tons.

This alternative was ruled out because, unlike Puget Sound Naval Shipyard, the Windsor Site is not located adjacent to navigable water. Transport of the S1C Prototype reactor compartment to the nearest barge facility on the Connecticut River is considered impractical by either highway or rail due to interferences and load limiting bridges along the route.

The entombment and on-site disposal alternatives were both ruled out from further consideration because both alternatives would result in restrictions on the future use of the Windsor Site land. The Windsor Site has never been used for burial or permanent storage of radioactive or hazardous waste materials.

The remaining alternatives,

prompt dismantlement, deferred dismantlement and no action, were evaluated in detail.

The first alternative would involve the prompt dismantlement of the reactor plant. All structures and radioactive material would be removed from the Windsor Site. The Site would be carefully surveyed to confirm that it could be released for unrestricted use. That means, when this alternative is complete, this property could be used for any purpose that the future owner desires, whether it be agricultural, residential or industrial.

Prompt dismantlement involves cutting out piping, valves, pumps and instrumentation and placing the items in containers for shipping. Large components, including the steam generators, pressurizer, and reactor pressure vessel would be packaged individually.

To the extent practical, the resulting low-level radioactive metals would be recycled at existing commercial facilities that recycle radioactive metals. The remaining low-level radioactive waste would be disposed at the

Department of Energy's Savannah River Site in South Carolina.

The Savannah River Site currently receives low level radioactive waste from Naval Reactors sites in the eastern United States. Both the volume and the content of the S1C Prototype reactor plant waste fall within the projections of the Naval Reactors waste provided to the Savannah River Site which, in turn, are included in the July 1995 Savannah River Site Waste Management Final Environmental Impact Statement.

Under the deferred dismantlement alternative, the S1C Prototype reactor plant would be kept in protective storage for about 30 years. This would allow almost all of the cobalt-60 radioactivity to decay away. Nearly all of the gamma radiation within the reactor plant comes from cobalt-60.

Cobalt-60 has a radioactive half-life of about five years. After 30 years, only two percent of the original radioactivity will remain. The reactor plant would then be

dismantled and disposed of in the same manner as under the prompt dismantlement alternative.

During the 30-year caretaking period, the defueled S1C Prototype reactor plant would be periodically monitored. The monitoring would verify the overall physical integrity of the plant and verify that all the radioactivity remains contained.

The National Environmental Policy Act specifically requires consideration of a "no action" alternative. This no action alternative would involve keeping the S1C Prototype reactor plant in protective storage indefinitely.

The no action alternative would leave the long-lived radioactivity and lead shielding at the Windsor Site indefinitely. This alternative would preclude releasing the land for unrestricted use and would not provide for permanent disposal.

The environmental consequences can be broken down into two major affected groups. The first group consists of the workers involved with disassembling the S1C Prototype reactor plant and then transporting material off-site.

The second major affected group is the general public, both in the area surrounding the Windsor Site and along the routes used to transport material from the dismantled prototype.

The health risks we considered for the Windsor Site workers, transportation crews, and the general public are summarized on this slide [Workers and public: radiological and non-radiological. Accidents: facility and transportation]. We looked at the possible side effects from disassembly processes as well as the risks associated with transportation.

This is a comparison of costs for the various alternatives. These costs are all in 1996 dollars to offset the effects of inflation.

The deferred dismantlement process is roughly the sum of the other two alternatives since the deferred dismantlement alternative is a combination of the other two

alternatives.

The no action alternative will have the highest cost since dismantlement will need to take place some time in the future. The dollar amount on the slide only represents care-taking and not dismantlement or disposal.

Therefore, of the three alternatives, prompt dismantlement will result in the lowest cost overall.

We have concluded that all of the alternatives would have minimal impact on the general public and the environment.

The principal impact associated with prompt dismantlement is that Windsor Site workers would receive some exposure to radiation. The occupational radiation exposure associated with the prompt dismantlement alternative is comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval prototype reactors and would be well within Federal guidelines. Prompt dismantlement has the advantage of not requiring long-term commitment of the land for surveillance and maintenance of the S1C Prototype reactor plant. Prompt dismantlement results in the lowest cost.

While deferred dismantlement has the advantage of less radiation exposure, radiation exposure is low for all alternatives. Deferred dismantlement delays the unrestricted release of the land for reuse and has a higher cost.

That concludes my presentation. Thank you for your courtesy and attention.

We'll take a short break and then reconvene the meeting to take public comments. After all comments have been given, Mr. Seepo will conclude the meeting.

MS. BASSILAKIS: Can we just ask questions, rather than to make comment?

MR. SEEPO: The way the meeting is structured, ma'am, is that there will not be a question and answer period. We're going to take a five or ten minute break. We want to reconfigure the podium for speakers and determine how many people have registered and,

at that time, we'll start the public comment period.

One final reminder: Anyone wishing to speak needs to register at the front table so that we can determine the number of speakers and the sequence in which people will be afforded the opportunity to speak.

Thank you.

(A short recess was taken.)

MR. SEEPO: Would everyone please be seated. We're ready to reconvene.

At this time we have 14 individuals that have registered to provide public comment. I'm going to quickly read the names, and the names will be read in the order in which we'd like to have the commenters speak.

First would be Mr. Mike Firsick from the Connecticut Department of Environmental Protection. We have three local government representatives: Mr. Charles Wall from the Town of Windsor, Mr. Don Trinks from the Town of Windsor Council, and Mr. Louis Watkins from the Hartford City Council. We have four individuals representing organizations: Rosemary Bassilakis; Leo Canty, I believe it is, Jean Pottinger and Mark Sussman. We also have six private citizens that have registered: Harold Chase, Lillian Goldberg, Don Johnson, Mary Mullen-Barnett, Gary Johnson and Tom McCormick.

Anyone else that desires to speak, I would request to please go back to the registration table and sign up, and we'll get you onto the list.

At this time, I'd like to call Mr. Mike Firsick. We'd like you to use the podium up front, if that's not a problem, Mr. Firsick.

MR. FIRSICK: Hi. I just have a brief comment. My name is Mike Firsick. I'm a physicist in the Radiation Control Group in the Department of Environmental Protection. We are currently preparing our comments, and we're conferring with other agencies in the Department and we will be submitting our comments in to the Department of Energy on August 19th.

MR. SEEPO: Thank you, Mr.

Firsick.

Number two, I'd like Mr. Don Trinks to come up, please. Just for the record, Mr. Trinks, if you could state your title and affiliation.

MR. TRINKS: O.K. I'm here on behalf of the Health and Public Safety Committee of the Town of Windsor.

I have not taken an official poll on the full proposal, but I'm sure if I did they would call for an immediate dismantling and removal of all the S1C core operation. The vital industrial and residential use of nearby sites have been in the shadow of this reactor too long.

We appreciate the many alternatives you've offered; however, any one short of dismantling - permanently and shortly - will be totally unacceptable to our group.

Thank you.

MR. SEEPO: Thank you, Mr. Trinks.

Mr. Charles Wall.

MR. WALL: Good evening. My name is Charles Wall. I'm a sanitarian with the Community Health Services. We have looked through the Draft Environmental Impact Statement and have some comments.

First, Sections 5.1.6, 5.2.6 and 5.3.6 refer to the socioeconomic impacts of the three alternative actions. None of these sections make reference to the fact that the acres of land comprising the facility are not presently on the tax roll. Under the prompt dismantling alternative, if this land were released for unrestricted use, there is a good possibility this property could be placed back on the tax rolls and the town would benefit from this economically. This fact should be part of the environmental impact under the socioeconomic impact as a benefit from the prompt dismantling alternative and as a cost of the deferred dismantling and no action alternatives. 1

Secondly, Section 3.1.4 refers to completion of a voluntary facility assessment which would address the potential for 2

environmental chemical contamination being completed to support Windsor Site inactivation and future release of the property, and it goes on to state that, following all sample collection and analytical work, a report will be prepared and provided to the U.S. EPA, Region I, and the DEP in the State of Connecticut. We feel we should be part of that group. 2

Third, under the deferred dismantlement, in the environmental data and the discussion on that alternative, the plant will still be in place 30 years from now. We think that that is unrealistic, given the changes that have occurred just in the last ten years and considering the changes that are occurring in both the political and the environmental climate in the area. And given possible closure of the existing permanent disposal site in Savannah River which may be in effect, we feel there is a possibility the site may become a permanent one, so we think that you should perhaps introduce wording to that effect. 3

Finally, the cost of the "no 4

4 action" alternative as stated in Table S-1 is slightly misleading because you're only considering the same 30-year period that you are for the deferred dismantlement, and I think it may be clarified that that period can go on a lot longer, and sooner or later we're going to have to make a permanent disposal decision, at more cost, and perhaps introduce that which you have stated in 3.2.2 which indicates that the 4B "no action" alternative without a permanent disposal decision, no action to be taken, would also result in higher radioactivity. And, in summary, for those reasons, we fully urge the prompt dismantlement alternative as the disposal alternative of choice for that facility.

We will be submitting written comments before the period is over. Thank you.

MR. SEEPO: Thank you very much, Mr. Wall.

Mr. Louis Watkins.

MR. WATKINS: Good evening. My name is Louis Watkins, and I'm a Councilperson in the City of Hartford, and my comments are

purely mine. I have not told my colleagues, haven't consulted the Mayor on this particular discussion, but my concern is certainly very deep, because the last time this facility did major work, use of the Griffin Line railhead which sits behind the Bellevue Square housing project that's been there for a long period of time, was required.

I like to think if we're going to dismantle this, if it happens, that you're very sympathetic with the Town of Windsor, that you want to clear up this particular area of land, and I understand, I think you should use every possible safety precaution for the town and certainly the neighboring towns and industries, so that we will understand you give us consideration when you remove this, if you decide to remove it, and remove it safely. 5

I am concerned as well as anyone else that the last time we removed something, that this is all top secret, and we don't know who is exposed to anything, let alone the amount of time it sits behind the Bellevue Square housing project waiting to get on the right track. I am concerned about this. 5

I am also concerned and I'd like to know if, once we load this, if we start moving it on rails, what intervals or levels we will measure; I mean how many times will we measure this before -- after we load this, before we even move it. I am concerned about that. 6

Also the plan for safety of escorting this out of the Hartford area and really, I don't really just mean out of the Hartford area, I'm not concerned only about Hartford but this town and protecting where it's going to go through any town. In the bottom of my heart I am concerned about that, and I'd like to thank you all too, but I want to make sure that we do everything possible to make sure that it's safely moved, what exposure is going to happen if it's moved from one rail to the next rail. 5

I don't know, if we had an escort to get it out of this particular New England

area and you have someone meet you before you get to wherever you're going. I understand that that might still be under discussion, but I'm hoping that we work together and be concerned about safety for everyone, concerned about safety from the time it's loaded, which includes the workmen, and I'm not saying it because I don't think you care, but I'm saying it because we want every possible precaution taken. 5

Thank you very much.

MR. SEEPO: Thank you, Mr. Watkins.

The next speaker will be Rosemary Bassilakis. Hopefully I pronounced your name correctly.

MS. BASSILAKIS: You did.

My name is Rosemary Bassilakis. I live in Haddam, Connecticut and I'm a member of the Citizens Awareness Network, CAN, and I come to you today not just as an outsider but also as a resident who lives in a reactor community. I live a mile from the Haddam nuclear power plant. I also come representing the organization that intervened in northwestern Massachusetts in connection with the currently decommissioned reactor at the Yankee Rowe plant.

I think it's very important, and a point I have is this reactor, the Yankee Rowe reactor, was allowed to be decommissioned without an environmental impact study and in violation of the Atomic Energy Act which allows the people the right to a public hearing. This is not a public hearing, and I do hope that the public will be allowed the right to a public hearing. 7

What I would like to bring up right now is litigation that my group is involved with. There is currently litigation going on with the Nuclear Regulatory Commission because the Nuclear Regulatory Commission allowed Yankee Commons, that's the owner of this reactor, to get involved with rapid dismantlement of the reactor.

The contention that our group has is that this rapid dismantlement may have

exposed workers to higher radiation levels than they would have been exposed to if they had let the reactor sit for 30 years and then dismantle it. This is in violation of the ALARA mandate. The ALARA mandate is a mandate which states that workers should be exposed to levels as low as reasonably achievable, so the court has accepted the validity of our contention and they have granted disclosure of all of Yankee Commons files so that they can pull together a brief.

So I come to you today. You may not think the decision is somewhat simple, although I think it might not be very popular in this room, and that is what should be most important is the workers' safety and that if they can be exposed to less radiation by letting the reactor sit for 30 years, then that's what should be done. This is the ALARA mandate, and it's also what's safest for the people.

We're talking about people's lives. Radiation causes sickness and it's pretty well known it causes disease and death and that is more important than $14 million. 8

E-110

So that's my opinion on the dismantlement. I would also like to say that as very hard as it is in the community, my community, the State of Connecticut and the nation itself needs to analyze whether or not it's fair to clean up one community by contaminating another community. You want to take away the reactor here and then it's going to get buried in someone else's community, and we feel as if there are some ethical questions that need to be addressed there.

Thank you.

MR. SEEPO: Thank you very much.

Mr. Leo Canty, please.

MR. CANTY: My name is Leo Canty. I live on 27 Devon Way in Windsor, and I'm here on behalf of an organization called the Windsor Issues Forum. I've lived in Windsor since five years after the Knolls plant was put in place making me almost a better than 30-year resident of the community, and we've been involved -- our organization, Windsor Issues Forum, have been involved in a lot of issues and

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actually we had a vote of our membership last night, and our official position is that we'd like the prompt dismantlement. Our organization has been working over the last year on a variety of issues, and it wasn't until yesterday actually that our organization adopted its by-laws and statement of principles and other things, and I'd like to let you hear two of these statements of principles that we embraced, to give you an idea where we're coming from on that.

One is we believe our children are the hope for a brighter future and we'll do everything we can to nurture and to educate them, and to protect the world that they will inherit, and secondly, amongst these principles in tonight's discussion, we believe clean air, water and land are vital to the stability of life in our communities, and we will do everything we can to prevent destruction and erosion of our planet, and we will undertake all efforts to restore what may have been lost through past abuse and neglect.

Now, I'm not the biggest fan of nuclear energy and nuclear reactors and other things. This plant was put in place there for a specific purpose. That purpose is now ended, and what we would like to see is that the area be restored to the environment that was there previous to the installation of that operation.

I, too, have a very tremendous concern for the health and well-being of the working people there and also the community, and what I thought that I read in the report that was submitted is that there would be safeguards and guarantees. I will -- with the prompt removal of that particular reactor and all the associated waste and other things that are involved, I would want to hold you up to the highest standard of performance to guarantee that these people are adequately protected along with the community too, but on the other hand, the risk of leaving that filth there, the risk of the political will being lost to use the money to try to sustain those types of things, the risk that we have with a lot of other areas

and nuclear power plants and the like and other types of activities that are going on with the dismantling of other nuclear areas all being focused on the possibility of a concentrated area, I think it definitely is in our best interest at this point in time for the sake of the community and the working people involved that we go ahead and take action as soon as possible. Now, "as soon as possible" still means that it may not be five years until this task is complete, and that for me is even too long, but I'd like you to move as fast as possible. Our organization is behind it, and we hope that you consider what we had to say tonight.

I do have a written piece that I'll submit to you. Thank you.

MR. SEEPO: Thank you.

Ms. Jean Pottinger.

MS. POTTINGER: My name is Jean Pottinger. I'm a member of the Hartford Griffin Line Corridor Advisory Committee, although tonight I am strictly speaking for my own self.

One of the things that we deal with all the time is having to live right on the border of this. 10 However, I am concerned that we talk about prompt dismantlement. Prompt dismantlement calls for shifting of the large pieces that will not fit on the truck to be shipped on the Griffin rail line. If this happens, what kind of time frame are we looking at? Are we looking at two years from now when this happens?

11 Also when this happens, I have to agree with Councilman Watkins to make it safely and swiftly as possible. Now, on November 29, 1995, when you moved the high-level radioactive garbage on the Griffin line you ran into a snafu on AMTRAK's line right across the street from the Bellevue Square when CONRAIL refused to trip the switch at this gate until the track was cleared both ways for two hours.

As a result, that high-level radioactive waste sat four hours across from Bellevue Square on the Griffin Line. I hope that in the future you get your act together and

11 ship it as safely and swiftly as possible and don't have it sitting across from our housing on that siding.

Thank you.

MR. SEEPO: Thank you. Next is Mr. Mark Sussman.

MR. SUSSMAN: My name is Mark Sussman. I'm the chairman of the Windsor Conservation Commission, which is an agency of the town. We're charged with advising the Town Council and other agencies on the environmental issues.

Last fall when you were scoping out the plan for this Draft EIS, the agency and also, I would add, the Windsor Air and Water Pollution Abatement Commission voted to strongly support the preferred alternative of prompt dismantlement. I understand you have to go through this process for NEPA and, frankly, it seems to me it's really a no-brainer of a decision. It's not only the cheapest alternative, but it also will allow the Town of Windsor to put this site back into beneficial use.

I am concerned about the comment that was made with respect to the health of workers, but I'm sure that you will make sure that the workers are not exposed to unnecessary radiation, so in sum, our commission strongly supports prompt dismantlement.

Thank you.

MR. SEEPO: Thank you.

I want to deviate from the list sequence that I first announced. If Mary Mullen-Barnett is still here, she had requested to try to get --

VOICE: She had to leave, I'm sorry.

MR. SEEPO: She had to leave. Fine. Next then would be Mr. Harold Chase. Mr. Chase here?

MR. CHASE: There you go.

MR. SEEPO: How do you do, sir.

MR. CHASE: Hi. Harold Chase, Windsor resident, U.S. Navy Retired, and past instructor in SIC.

A comment was proposed for keeping the reactor there for 30 years, where it is in Windsor. To my knowledge, right now, there is no proposed use for that land; is that right? In a 30-year plan, if there is no proposed use now, you could stop it in ten years and then start dismantling. You could go in any time during that 30 years, but, as the people say, if you have less radioactivity when you dismantle it, you have a little safer job; but 12
getting to the Goodwin Pond drainage brook, no matter what's down there, clean that up now, and 13
talk to A.B.B. (Asea Brown Boveri) about maybe draining that portion and get the money from them because they're the problem. Why should we clean up their mess? That was private money. 14
They made profit on that, the company, whatever.

I believe on my proposal you're going to maintain a permanent force there, even a 30-year plan. There will be a manned force, not the modern type security by some alarm company. Will it be man force? Well, O.K. 15

That's all I wanted to say. Thank you.

MR. SEEPO: Thank you, Mr. Chase.

Lillian Goldberg.

MS. GOLDBERG: I'm Lillian Goldberg, 38-year resident of Windsor. This shirt represents the National Survivors group my husband and I started many years ago.

MR. SEEPO: If you could speak just a little bit slower and maybe a little bit louder.

MS. GOLDBERG: My husband was in the service, in the Army, and received the radiation exposure that caused the cancer, and I sat right next to him and I watched him die over a three-year period nine years ago. When we moved to Windsor in 1959, he started working at Combustion Engineering and with the start-up, he was an electronic technician. Watching him die of that cancer was horrible.

I didn't move out, but I saw what that ground was like. That ground is not usable. I have grandchildren now that live in

town. I would like to see the grounds there be cleaned up completely, and soon if possible, and I know it can be done safely if you try to do that.

I've spoken to the Department of Energy, and there are ways of getting rid of it so that we can have a safe environment. We have a park, a Northwest Park that we established there, a big recreation area for the children, and it's not too far from the site at the present time. My recommendation is we clean it up as soon as possible and make our environment safe because I don't want to see more radiation exposure victims, because right now, we're at a point where there's the possibility of that.

MR. SEEPO: Thank you very much. Next up is Mr. Don Johnson.

MR. JOHNSON: My name is Don Johnson. I live at 908 Plymouth Street.

I'll keep it very short. I think if there are any considerations other than the immediate removal of this site, it's unconscionable. We've dealt with this site, although in a fair amount of secrecy, for over 30 years. We've given our parks to the Navy. One of my friends trained there at the Site. It's time to get rid of it, and I think anything short of that is unfair to the Town of Windsor; it's unfair to my kids, and to the future kids of the community. That's all.

MR. SEEPO: Mr. Gary Johnson.

MR. JOHNSON: Gary Johnson, 248 Ethan Drive.

Just to reiterate on the past comments, I'd like to see a prompt clean-up. It's still the most cost-effective alternative, and also the complete clean-up of the sediment of the associated pond and stream regardless if it was this site or the neighboring site, that it get done at the same time and cleaned. 16

MR. SEEPO: Thank you.

Mr. Tom McCormick.

MR. McCORMICK: Good evening. I'd like to say I'm prejudiced against DOE. I don't believe anything you say because you have a history of lying. You have a history of the

worst kind of radiation research, the Hanford studies, Mancuso, Maxey Flats, the tri-state leukemia studies, and numerous other examples. You fund disposal facilities that leak and leak and leak and leak, West Valley, Savannah, Rocky Flats, let's go through the list. You guys do a bad, bad job.

You're the guys that have killed at least 100,000 people from fallout from nuclear bombs. You know who you are. So I'm prejudiced against you. I'll say it, I am, maybe a little worse than prejudiced; but I guess there's always a future and maybe in the future there will be some reason why I shouldn't be so prejudiced against you.

There's only one thing to do with that pressure vessel over there, and that's really what the issue is. Took a lot of other stuff, lot of other pieces, but the pressure vessel, that's really the thing involved in this whole story -- not a lot of old junk. Just one thing. 17

Put it in the biggest possible

17 pieces in the biggest possible stainless steel container. Put it in concrete, put it above the ground in a dry on-site area. That's what the whole story is about when you get to it. Don't bury it. Don't dig a trench like you've done so many times in the past. You dump it in the ground, and you take the bulldozer and bury it. That's what's done historically time and time again. And what do we have as a result? Migration of plutonium, Maxey Flats.

One of your other great disposal methods, tanks at Hanford leaking hundreds and hundreds of thousands of gallons of radioactive waste stuff in the soil headed toward the Columbia River, thanks to DOE.

West Valley, massive contamination. Now, you want to take something from Windsor, you want to take it to another one of your low level sites. What's going to happen there? Going to contaminate another site? That site going to leak? One thing -- just one thing: Put it in stainless steel, encase it, keep it dry. And we know why that's not done,

because of cost. We know it's the safest; you know it's the safest, and I think safety is really the big issue here.

We know from testimony of people like Karl Morgan, who was Assistant Health Director for the Department of Energy, Oak Ridge, a consistent, persistent pattern of firing people, of taking away their contracts when they said radiation was more dangerous than the government was saying previous.

I think he listed seven examples to Congress. Mancuso was the most outstanding one. Are you people going to change your story? Going to change your modus of operation? I doubt it. You see that the NRC is just like Northeast Utility, and there's some opinion out there that NRC is a little bit better than the Department of Energy. Gives cause for some concern.

18 And what about this stuff in the brook? What about this stuff in the pond? That's really a very difficult situation. The levels aren't outrageously high, but the stuff is in there. It's in there just the same, as a

result of the Department of Energy, I think it's safe to say that you're involved in it. And how bad, we don't know, so please get it cleaned up. 18

It's going to cost a lot of money, sure. Now, who's going to pay? The following issue, who is going to pay? Just one thing, the stockholders of the company that put it there, one thing. Not the taxpayers. And if maybe it can be proven that there were 19 government officials involved in that sort of business, well maybe we can go after their pension. Maybe we'll have to make them sell their houses to pay for it. People that are responsible for poisoning have to be responsible for cleaning it up. I am not allowed to take a poison and throw it into the water, nor should DOE be allowed, nor any corporation be allowed. It's a criminal offense, and we know that the DOE is one of the major criminals on the face of this earth, having killed at least 100,000 people with the fallout from their bomb tests, and that they suppressed the dangers of that

fallout consistently, and that's not my -- my finding, but the finding of the United States Congress.

So we know who you are. We'll be watching. What else can I say? You push the limit too far, there'll be a consequence.

Now, what's that danger? What's that radiation sitting right over there in the pool? Tritium -- carcinogenic, mutagenic, generally considered a lot more dangerous than ever previously believed, and I think people should not only know what's over there, but low-level radiation does not mean low danger. In fact, there's some research coming out now, even some of it done by these guys at INEL up in Idaho, showing that extremely low levels of radiation spread out over time with chronic 19B exposure, so to speak, at levels approaching background levels are even more hazardous than some higher levels, with the creation of free radicals in the cells. Radiation hits the cells, hits the water molecule, splits that water molecule; a radical migrates to the cell wall, destroys the cell wall and knocks down the immune system. If people get sick from Windsor one day, they may go to DOE or the corporation that dumped their poison saying, you may be sick, maybe not, because how do I prove that I have a major case, say that of a horrible virus, and the only event I can show if I'm being exposed to radiation that knocks down my immune system.

I think this lady here knows all about it. There are Congressional findings from studies that have been done with guinea pigs. The DOE and their predecessor, the Atomic Energy Commission, literally misled the American public and deliberately exposed us to radiation. The United States government tried to step in and expose the danger. The Atomic Energy Commission, the predecessor to these guys, went in with armed guards and seized the records, seized the information, and took it away, just seized it, took it away.

When other people around their facilities have shown there's danger from this

low-level radiation, they're attacked, they're criticized, and every attempt is made to drive them out of their office that they hold.

There's an outstanding case in Colorado around their plutonium trigger factory there. They had a county health director who was just harangued and harassed and harassed and lies told about, and it was proven that he was right and that these guys, you know what they were doing. So there is a danger.

People, please push for
clean-up. One thing, clean up the sediment, get 18
the stuff out of the water and, two, insist that
the pressure vessel be encased in stainless 17
steel because all you're doin', in a sense, like
this lady mentioned before, is you're taking
your poison from Windsor, and you're taking it
and giving it to someone else, and I don't have
an ethical question about that. There's no mind
-- no question in my mind it's unethical, 20
simply unethical, to take your trash and to dump
it on someone else in one of their facilities
which they monitor, that leaks at Hanford, leaks

at Mancuso, leaks at West Valley, leaks at Sheffield.

There's not an ethical question. The ethics really have been decided. Now it's really a matter of putting that stuff in the best container that can hold it.

Thank you.

MR. SEEPO: Thank you.

Mr. Graff?

MR. GRAFF: Randall Graff, Deputy Mayor of the Town of Windsor.

I, like Councilman Trinks before me, speak more as a citizen than anything else. I'm a lifelong resident of the Town of Windsor, have known for most of my life about the facility over there. In addition to that, my oldest son was trained at that facility and is still in the Navy serving in the submarines in Washington.

This Federal facility has been, to my knowledge, a relatively good citizen over these years. I know that the health risks and concerns everyone has in regard to exposure to

---

radiation, but as a resident and a member of the Town Council my position would be I would like it cleaned up totally as soon as possible, and I think this is a concern that is facing the town and it's not Windsor's trash. It's everybody in the country's trash, if we can look at it that way.

Who's going to pay for it? We all are. We're all taxpayers; we're all going to pay for the facility that belongs to us. The only suggestion I might have for those here, people say there's no plan for this property long range. As the Mayor and Town Councilman, just as we're saying if this site is totally cleaned up based on where it is, I'd like to see it given to the town or sold to the town in some way that would be in keeping with that area and would be, once it's determined it's useful and clean, that it would be, I think, a great gesture from the government. 21

Thank you.

MR. SEEPO: Thank you.

Now, ladies and gentlemen, at

this time, we have no further registrants. Is there anyone else that would like to speak?

(There was no response.)

As I indicated earlier, this meeting is not the only method for providing us input. Comments can be provided in writing. Written comments should be sent to Mr. Overton. The address, as we earlier stated, is available at the registration table. It's also on the first page of the Draft EIS document. The comment period remains open until August 19th.

On behalf of the U. S. Department of Energy, I would like to thank all of you for taking the time to participate in tonight's meeting. We appreciate your input and we will make sure that all comments are addressed in the Final Environmental Impact Statement.

This meeting is now adjourned. Good night.

(Whereupon at 8:20 p.m., the meeting was adjourned.)

STATE OF NEW YORK)
COUNTY OF ALBANY)

Pauline E. Williman, being duly sworn, deposes and says:

That she is a Certified Shorthand Reporter licensed by the University of the State of New York under permanent Certificate Number 297 issued May 21, 1949; that she acted as the Official Reporter at the hearing herein on August 7, 1996; that the transcript to which this affidavit is annexed is an accurate transcript of said proceedings to the best of deponent's knowledge and belief.

Pauline E. Williman

Sworn to before me this
21 day of August, 1996

Irma H. Davis

IRMA H. DAVIS
Notary Public, State of New York
No. 4611020
Commission Expires March 30, 19 97

Public Hearing Commenters

Comment Responses:

Comment 1 (Mr. Wall).
The commenter correctly identifies that the land comprising the Windsor Site is not presently on the tax rolls of the Town of Windsor. If the property were to be transferred to a taxpaying entity, it is expected that the land would be added to the tax rolls. However, considering the small size of the Windsor Site, the impact on the tax base of the town is not expected to be significant. Sections 5.1.6, 5.2.6 and 5.3.6 have been revised in the Final Environmental Impact Statement to reflect the above.

Comment 2 (Mr. Wall).
A copy of the voluntary facility assessment report will be provided to the Town of Windsor for information when it is provided to the State of Connecticut and the Environmental Protection Agency - Region I.

Comment 3 (Mr. Wall).
The analysis of the deferred dismantlement alternative in the Draft Environmental Impact Statement is consistent with reasonably foreseeable radioactive waste disposal practices. In particular, there are no active discussions of closing the Savannah River Site in South Carolina, and an Environmental Impact Statement (Reference 5-2 of the Draft Environmental Impact Statement) analyzing future radioactive waste disposal operations at the Savannah River Site was recently issued.

Naval Reactors acknowledges that analysis of any action 30 years in the future brings with it uncertainties about how such an action would be executed. The relative certainty of the prompt dismantlement alternative is one of the favorable aspects of this alternative. In the Final Environmental Impact Statement, Naval Reactors has identified the prompt dismantlement alternative as the preferred alternative. Also, an acknowledgment of the greater degree of certainty associated with the prompt dismantlement alternative has been added to the Final Environmental Impact Statement Summary.

Comment 4 (Mr. Wall).
The following additional words have been added to Note 8 of Table S-1 in the Final Environmental Impact Statement: "Taking into consideration the eventual need for a permanent disposal decision, the no action alternative would ultimately result in a higher figure."

Comment 4B (Mr. Wall).
As discussed in Section 3.2.2 of the Draft Environmental Impact Statement, many of the materials from the S1C Prototype reactor plant would still be radioactive after a thirty year deferral period due to the presence of longer-lived radionuclides which would remain. However, the total amount of radioactivity present in the reactor plant would decrease with time due to radioactive decay. Therefore, the no action alternative would not result in a higher amount of radioactivity.

Public Hearing Commenters

Comment Responses:

Comment 5 (Mr. Watkins).
The Draft Environmental Impact Statement provides the assessment of the potential safety and health impacts to workers and the public from the transportation of low-level radioactive materials from the Windsor Site during the dismantlement of the Site facilities. The results of the analysis provided in Appendix C of the Draft Environmental Impact Statement show that the potential impacts to workers and to people living along the transportation routes would be small from either the prompt dismantlement alternative or the deferred dismantlement alternative.

Appendix C of the Draft Environmental Impact Statement in Sections C.3, C.4, C.5 and C.7 describes the analysis input variables and the potential risks to the public. Variables used in the computer codes for the risk analysis include estimated stop times and radiation levels. Estimated risks to the public were based on exposure to persons living within about ½ mile of the length of the transportation route, exposure to persons sharing the transportation route (such as train passengers), and exposure to persons (such as residents along the transportation route) during stops. All of the assumptions used in the analysis are conservative, and the results of the analysis indicate that the potential risks are very small.

All shipments of radioactive materials from the Windsor Site would be low-level radioactive waste or recyclable material. Low-level radioactive materials have been shipped safely from Naval Nuclear Propulsion Program facilities, including the Windsor Site during its operations, for over 35 years. All shipments have been accomplished in accordance with applicable transportation regulations.

Although there is no regulatory requirement for prenotification of such shipments from the Windsor Site in Connecticut or to escort these shipments, Naval Reactors has periodically interfaced with appropriate regulatory agencies regarding such shipments and will continue to do so. In the past, such as the November 1995 shipment of the spent nuclear fuel from the Windsor Site, overweight and oversize permits were required for the heavy hauler shipment leg to the Griffin Line. This required coordination with the State of Connecticut Department of Transportation. Additionally, a Town of Windsor police escort accompanied this part of the shipment to ensure traffic safety. Due to the very infrequent use of the Griffin Line, the rail shipment was coordinated with City of Hartford and Town of Bloomfield law enforcement officials to ensure traffic safety at places where the Griffin Line crosses roads. Similar coordination would occur for the one or two rail shipments that would result from the prompt and deferred dismantlement alternatives.

For further discussion of the spent nuclear fuel shipment which occurred in November 1995, please refer to the response to Public Hearing Comment 11.

Public Hearing Commenters

Comment Responses:

Comment 6 (Mr. Watkins).
Prior to leaving the Windsor Site, radiation levels for all packages of radioactive material are measured on contact with the package and at one meter from the package. These measurements assure that the loaded package complies with Department of Transportation requirements. Upon arrival at its destination, packages are rechecked by receiving personnel as part of their receipt procedure to confirm that the radiation levels still meet the Department of Transportation requirements. There is no need or requirement for additional monitoring during transit.

Comment 7 (Ms. Bassilakis).
The public hearing of August 7, 1996 was conducted in accordance with and fulfilled the requirements issued by the Council on Environmental Quality (40 CFR § 1506.6) and the requirements issued by the Department of Energy (10 CFR § 1021.313).

Comment 8 (Ms. Bassilakis).
Naval Reactors' practices for minimizing occupational radiation exposure are consistent with ALARA standards. As stated in Section 5.1.10.1.1 and Appendix B, Table B-6 of the Draft Environmental Impact Statement, under the prompt dismantlement alternative individual occupational radiation exposures would be limited to 2 rem per year even though Federal limits allow exposures of up to 5 rem per year. As stated on page S-3 of the Draft Environmental Impact Statement, the occupational radiation exposure associated with the prompt dismantlement alternative is comparable in magnitude to the radiation exposure routinely received during operation and maintenance of Naval prototype reactors. Table S-1 of the Draft Environmental Impact Statement shows that the risk of latent fatal cancers to workers is small for all the alternatives evaluated. There is no requirement in the National Environmental Policy Act or any other law or regulation to choose the alternative with the lowest occupational radiation exposure. The National Environmental Policy Act requires full disclosure of the impacts but does not require selection of any particular alternative. The occupational radiation exposure was fully considered in identifying the prompt dismantlement alternative as the preferred alternative in the Final Environmental Impact Statement. Similarly, the Final Environmental Impact Statement clearly lays out all of the advantages and disadvantages of each alternative for use by the Federal official who will make the final decision.

Comments 9 (Ms. Bassilakis) and 20 (Mr. McCormick).
The Draft Environmental Impact Statement fully discloses the fact that some of the alternatives (prompt dismantlement and deferred dismantlement) assume that waste would be removed from one location in the country and placed in another location. As analyzed in Section 5 and summarized in Section 6 of the Draft Environmental Impact Statement, there are no significant impacts to the public for any of the identified alternatives. The decision maker can take this into account in making the decision on the alternative selected for implementation. Please

Public Hearing Commenters

Comment Responses:

refer to Public Hearing Comment 17 (Mr. McCormick) for further discussion on disposal site options and impacts.

Comment 10 (Mrs. Pottinger).
Naval Reactors holds a 5 year lease from the State of Connecticut Department of Transportation for occasional use of the Griffin Line. This lease expires March 31, 2000 and can be terminated by the State of Connecticut Department of Transportation. The State of Connecticut Department of Transportation has not provided any indication that it intends to terminate this lease early.

If the preferred alternative of prompt dismantlement is selected, use of the Griffin Line by Naval Reactors should be complete by the end of 1998. In the event of any potential conflict, Naval Reactors would work with the Greater Hartford Transit District to minimize any inconvenience or delay.

Additional detailed engineering evaluation of dismantlement methods has indicated that it may be desirable to ship the S1C Prototype reactor plant primary shield tank in a single large package by rail rather than cutting it into smaller sections for truck shipment. In that case, there would be two rail shipments rather than one as discussed in the Draft Environmental Impact Statement. A discussion on the possibility of a second rail shipment has been added to the Final Environmental Impact Statement. Although radiological and nonradiological impacts from both truck and rail shipments are very small, rail shipments have lower impacts than truck shipments. Therefore, the transportation analysis in the Final Environmental Impact Statement continues to assume one rail shipment.

Comment 11 (Mrs. Pottinger).
Section 2.2 of the Draft Environmental Impact Statement explains that the removal of spent nuclear fuel from the S1C Prototype reactor plant was completed in February 1995. The shipment of a single package of spent nuclear fuel occurred on November 29, 1995. The dose rate at one meter from the package measured less than 0.1 millirem per hour which is 1 percent of the allowable Federal limit and is indistinguishable from naturally occurring background radiation levels.

During normal railroad track switching operations, the shipment waited at the Griffin and Conrail Line intersection for about 1½ hours. This was confirmed by a check of record logs maintained by couriers who accompanied the shipment. The time for the railroad track switching was within the range of routine stopping times during normal railroad transportation operations. Since the radiation levels from the package were indistinguishable from background radiation levels, the short stop during transit posed no additional risk to the public.

The Draft Environmental Impact Statement provides the assessment of the potential safety and health impacts to workers and the public from the transportation of low-level radioactive

Public Hearing Commenters

Comment Responses:

materials from the Windsor Site during the dismantlement of the Site facilities. The results of the analysis provided in Appendix C of the Draft Environmental Impact Statement show that the potential impacts to workers and to people living along the transportation routes would be very small from either the prompt dismantlement alternative or the deferred dismantlement alternative.

Appendix C of the Draft Environmental Impact Statement in Sections C.3, C.4, C.5 and C.7 describes the analysis input variables and the potential risks to the public. Variables used in the computer codes for the risk analysis include estimated stop times and radiation levels. Estimated risks to the public were based on exposure to persons living within about ½ mile of the length of the transportation route, exposure to persons sharing the transportation route (such as train passengers), and exposure to persons (such as residents along the transportation route) during stops longer than the one which occurred during the spent fuel shipment discussed above. All of the assumptions used in the analysis are conservative, and the results of the analysis indicate that the potential risks are small.

Comment 12 (Mr. Chase).
As stated on page S-2 of the Summary and in Chapter 3 of the Draft Environmental Impact Statement, three alternatives have been evaluated; prompt dismantlement, deferred dismantlement for 30 years, and no action. Impacts are described in detail in the Environmental Impact Statement for each of these alternatives. The commenter suggests another alternative; deferred dismantlement for about 10 years. The alternative suggested by the commenter is a variation between the prompt and deferred dismantlement alternatives. The environmental impacts of this variation would fall within the range between those of the prompt dismantlement and the deferred dismantlement. Section 1505.1 (e) of the Council on Environmental Quality guidelines allows the decision maker to consider alternatives that are encompassed by the range of alternatives evaluated in detail. Consequently, the Draft Environmental Impact Statement is sufficient to allow for consideration of variations of the type proposed by the commenter.

Comments 13 (Mr. Chase), 16 (Mr. G. Johnson) and 18 (Mr. McCormick).
As discussed in Section 4.5.4.2 of the Draft Environmental Impact Statement, the drainage brook is not on the Windsor Site property. Since the large majority of the radioactivity falls under the Formerly Utilized Sites Remedial Action Program authority or may be Combustion Engineering, Inc.'s responsibility (the drainage brook is on the Combustion Engineering, Inc.'s property), and the regulatory process for addressing the radioactivity in the brook is still in its early phases, remediation of the brook is not being addressed within the scope of this Environmental Impact Statement process. Any action taken as a result of the National Environmental Policy Act decision making process for the disposal of the S1C Prototype reactor plant would not affect future evaluation of the drainage brook or remedial action on the Combustion Engineering, Inc. site.

Public Hearing Commenters

Comment Responses:

Further details on the drainage brook are included in the response to the State of Connecticut Department of Environmental Protection Comment 3.

Although no radioactivity from Windsor Site operations is expected to be present in Goodwin Pond, confirmatory sampling for radioactivity will be performed. This sampling is further discussed in Appendix G which has been added to the Final Environmental Impact Statement.

Sampling for chemical residuals in Goodwin Pond will also be performed as described in Appendix F which has been added to the Final Environmental Impact Statement. This sampling will assist in determining if remediation or further investigative action concerning the pond is necessary.

Comments 14 (Mr. Chase) and 19 (Mr. McCormick).
Please refer to the State of Connecticut Department of Environmental Protection Comment 3 for additional information. Since the actions to be taken have not yet been determined, the financial liability of the various parties is not yet known. These liabilities will be defined as part of the ongoing Former Utilized Sites Remedial Action Program process.

Comment 15 (Mr. Chase).
During a caretaking period, access to fenced areas and buildings at the Windsor Site would be controlled by both a staffed security force and a remote alarm system. This additional information has been added to Section 3.2.1 of the Final Environmental Impact Statement.

Comment 16 (Mr. G. Johnson).
See response to Comment 13 above.

Comment 17 (Mr. McCormick).
On-site disposal of the S1C Prototype reactor plant or its component parts is discussed in Sections 3.4.2 and 3.4.3 of the Draft Environmental Impact Statement. Based on the small size of the Windsor Site property, the fact that it has no history as a radioactive waste disposal site, and land disposal restrictions for radioactive materials, on-site disposal was not considered to be a practical alternative.

With regard to the packaging of the reactor pressure vessel, the Draft Environmental Impact Statement discussed the robust nature of the packaging that would be employed for the reactor pressure vessel. As discussed in Section 3.1.3, the inherent nature of the reactor pressure vessel itself provides for long term containment of the radioactivity. Nearly all of the radioactive atoms are within the metal matrix of the thick reactor pressure vessel steel since these radioactive atoms were created by neutrons being absorbed by some of the metal atoms. This type of radioactivity can only be released by the slow process of corrosion, and even if

Public Hearing Commenters

Comment Responses:

there were no package at all, nearly all of this radioactivity would decay to stable atoms before it could be released. Nevertheless, Sections 3.1.3 and C.5.2 of the Draft Environmental Impact Statement discuss how the reactor pressure vessel would be packaged in a large shielded container for shipping and burial. This container would provide additional long term containment. This shipping container would meet all transportation and burial site requirements.

Section 5.1.13 of the Draft Environmental Impact Statement discusses how disposal of the radioactive waste that would be generated by the prompt dismantlement alternative has already been evaluated in the Savannah River Site Waste Management Final Environmental Impact Statement (Reference 5-2 of the Draft Environmental Impact Statement).

Comment 18 (Mr. McCormick).
See response to Comment 13 above.

Comment 19 (Mr. McCormick).
See response to Comment 14 above.

Comment 19B (Mr. McCormick).
As discussed in Appendix A, Section A.4 of the Draft Environmental Impact Statement, the risk estimates for radiation exposure used in the Environmental Impact Statement are based on the most recent risk estimates prepared by the United Nations Scientific Committee on the Effects of Atomic Radiation (Reference A-2), and the National Academy of Sciences - National Research Council Advisory Committee on the Biological Effects of Ionizing Radiations (Reference A-3).

Comment 20 (Mr. McCormick).
See response to Comment 9 above.

Comment 21 (Mr. Graff).
As discussed in Section 3.1.4 of the Draft Environmental Impact Statement, transfer of Windsor Site property ownership must follow prescribed processes defined in Federal, State, and local regulations, including the State of Connecticut Property Transfer Program and the Windsor Site property deed.

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ADDITIONAL LETTERS

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GROCERY, BAKERY, CONSTRUCTION DRIVERS AND HELPERS

LOCAL 559

Affiliated with the International Brotherhood of Teamsters
Teamsters Joint Council No. 64
400 CHAPEL ROAD • SOUTH WINDSOR, CONNECTICUT
(860) 528-9461 • FAX (860) 289-6568

ROBERT DUBIAN
Secretary-Treasurer

August 16, 1996

Mr. Christopher G. Overton, Chief
Windsor Field Office
Office of Naval Reactors
U.S. Dept. of Energy
P.O. Box 393
Windsor, CT 06095

Dear Mr. Overton:

Teamsters Local 559 has had four members working at the Knowles Lab site for sometime doing warehouse and relocated work.

The area monitor, Ed Daily, and Local 559 members have had no cases of any danger to them up to now. Local 559 feels that there has been minimum risk involved. The nuclear regulator agency has been monitoring all safety and health issues on site. Local 559 feels that the Reactor should be dismantled now while trained and qualified people are available. Letting the reactor sit to be dismantled at a later date or to never be dismantled will only endanger the public for years to come.

Local 559 is strongly in favor of dismantling the Knowles Lab Reactor immediately.

If I can be of any further service, don't hesitate to call.

Sincerely,

Robert A Bell

Robert A. Bell
Business Representative

RAB:mgm
cc: G. Harper, Electric Boat
G. Clark

WINDSOR Issues Forum

Information, education, activation, and participation for a progressive age

August 8, 1996

Mr. C.G. Overton
Chief, Windsor Field Office
Office of Naval Reactors, U.S. Dpt. of Energy
P.O. Box 393
Windsor CT, 06095

Dear Mr. Overton,

On behalf of the members of the Windsor Issues Forum, a community based organization in Windsor dedicated by its principles to the preservation of clean water, air, and environment, we wish to voice our overwhelming support for the option of immediate removal of the S1C Prototype Reactor and all associated nuclear components and waste located at the Knolls Atomic Power Lab and surrounding area. It is our belief that Windsor is a beautiful and pristine community and in no way do we wish to contaminate our environment with a waste site that could haunt us for many years.

Windsor is a caring and giving community. We have given our government the use of our land for reactor training and testing for over 30 years. We have endured the fear of hazards and suffered the scarring caused by the spills. The activity has ended at the lab and all that remains are the scraps of a program that served its purpose but is no longer wanted or needed. Windsor has given its air, water and land so our nation could foster world peace. The job is done here now it's time we are granted peace of mind and relieved of the burden of this waste site.

Housing the waste for 30 years for the Cobalt to decay and then removal is no option. Not making a decision is also out of the question. All indications I have seen are that immediate removal of the reactor, infrastructure, and all contamination is the best way to go. I don't need to make technical environmental arguments dealing with geological, meteorological or agricultural composition for the area, they are a factor but, the bottom line is that we had no radioactive storage or contamination in the area before 1959 and if the program is serving no purpose, we don't need it now.

For our current residents, and especially for our children who will soon inherit our beautiful town, we implore you to give back our land in the condition you found it. Windsor is Connecticut's first town. It is first in our hearts and first in our minds in the most positive of ways. We don't ever want Windsor to become the first town one thinks of when the topic of nuclear waste comes up, otherwise Windsor will end up being the last place anyone will want to go, and that will be a real waste of a lovely place.

Please consider our pleas. Do all you can to remove the reactor and clean the site as soon as you can.

Sincerely,

Leo Canty

Leo Canty, Board Member
Windsor Issues Forum
P.O. Box 14
Windsor CT, 06085

Al Simon, Chairperson Eric Bailey ,Treasurer P.O. Box 14, Windsor, CT 06095

International Brotherhood of

BOILERMAKERS · IRON SHIP BUILDERS BLACKSMITHS · FORGERS & HELPERS

753 State Avenue
Kansas City, Kansas 66101

LOCAL LODGE NO. 237

ADDRESS OF WRITER BELOW

Anthony DeFrancesco, Jr.
297 Burnside Avenue
East Hartford, CT 06108

DATE *August 15,* 19 *96*

Mr. Christopher G. Overton, Chief
Windsor Field Office,
Office of Naval Reactors
U.S. Department of Energy
P.O. Box 393
Windsor, CT 06095

Dear Mr. Overton,

I would like to express my views on the full completion of the Knolls Atomic Power Laboratory dismantlement project.

This project was awarded to General Dynamics Electric Boat Division and with good reason, they possess a knowledgeable engineering staff experienced in the nuclear industry.

Having worked on this project for two (2) years, I speak from experience when saying that I recognize the effectiveness of their well planned procedures to minimize radiation exposure and to provide a safe working environment. This site is under the guidelines of N.A.V.S.E.A. in regards to personal radiation exposure. These exposure limits are far lower than the exposure limits accepted at commercial power plants throughout the state. Through engineered procedures and the exclusive training of the work force, I view this project as one of the safest I've ever seen.

It should be of great comfort to the Windsor area citizens, to witness a nuclear reactor, including all support facilities, being decommissioned in such a safe and controlled manner.

With completion of this project comes an additional reward; An atomic reactor site that has been restored to it's original environmental condition.

This is the goal of everyone involved and we are looking forward to seeing it's completion.

Sincerely,

Anthony DeFrancesco, Jr.

Anthony DeFrancesco, Jr.
Business Manager

AD:jl

Kenneth Lawhorn
205 West Street
Windsor, CT 06095
August 16, 1996

Mr. Christopher G. Overton, Chief
Windsor Field Office,
Office of Naval Reactors
U.S. Department of Energy
P.O. Box 393
Windsor, CT 06095

Dear Mr. Overton,

As a resident of the town of Windsor and an employee of a contractor currently working at the Knolls Atomic Laboratory site, I feel that the appropriate decision for the Department of Energy would be to, immediately, dismantle the SIC Prototype Reactor. The environment and the citizens of Windsor would benefit greatly if this site were restored to it's natural state. This would also be the most cost effective way to manage this facility in the future.

I have worked in the construction industry for approximately twenty-five (25) years. Although the death and injury rate is higher among construction workers in comparison to other industries, this rate, at nuclear facilities, is much lower than the normal rate. As I have worked at numerous site's, both nuclear and commercial, the safety guidelines and procedures set forth by the D.O.E., Office of Naval Reactors, are the safest that I have seen in my line of work. The levels of exposure to radiation and contamination are also much lower on this site than the levels allowed by the N.R.C. at other nuclear sites. Having been involved in the de-fueling of the SIC, I feel confident that the Office of Naval Reactors will be competent enough to oversee the dismantlement and will ensure the highest priority being towards the health & safety of the workers. All workers at the SIC site have been trained to follow specific procedures as to minimize their exposure to radiation. Using the right technology and proper planning, the dismantlement can be performed with a minimal amount of exposure to the workers.

As I stated previously, I currently live in the town of Windsor with my family and live within two (2) miles of the site. If I thought that this project would jeopardize my health and well being, I would not be in favor of dismantling and disposing of the SIC Reactor.

Sincerely,

Kenneth Lawhorn

125 Duncaster Road, Bloomfield, Ct. 06002

August 18, 1996

Mr. Christopher G. Overton, Chief
Windsor Field Office, Office of Naval Reactors
U.S. Department of Energy
PO Box 393
Windsor. CT 06095

Dear Mr. Overton:

As a resident of Bloomfield, CT living within the three mile radius of the Windsor Site, I wish to urge you to proceed with the Prompt Dismantlement Alternative outlined in your June 1996 Draft Environmental Impact Statement, leading to unrestricted release of the site. This option certainly appeared to be preferred by the public and public officials at your public meeting to receive comments. Now would seem to be the moment when this nation has the political will to see this task completed. Delaying the task for a later generation and at higher estimated total cost does not appear to be an attractive alternative.

Thank you for the opportunity to read and comment on this Draft Environmental Impact Document. Please keep me on your mailing list for any further public information releases as this decommissioning project proceeds. I am a most interested nearby resident.

Yours truly,

Jack Moulton

August 14, 1996

Mark Pinard
650 Stone Road
Windsor, CT 06095

Mr. Christopher G. Overton, Chief
Windsor Field Office
Office of Naval Reactors
U.S. Dept. of Energy
P.O. Box 393
Windsor, CT 06095

Dear Mr. Overton,

As a lifelong resident of the town of Windsor and an employee of a contractor, currently working at the Knolls Laboratory site, I feel that the proper decision for the Department of Energy should be to immediately dismantle the SIC Prototype Reactor. The environment and the citizens of Windsor would benefit if this site were to be restored to it's natural state as soon as possible. The immediate dismantlement is also the most cost effective way to manage this facility in the future.

I have worked in the construction field for approximately fifteen (15) years. And, although the death and injury rate for construction workers is higher than other industries. The death and injury rate for construction workers at nuclear facilities is lower than the normal rate. Having worked at numerous site's, both nuclear and conventional, the safety guidelines and procedures set forth by the D.O.E. Office of Naval Reactors are the safest that I have seen in my line of work. The levels of exposure to radiation and contamination are also much lower on sites overseen by the office of Naval Reactors than the N.R.C. allows on commercial nuclear sites. Having been involved first hand in the de-fueling of the SIC, I feel confident that the Office of Naval Reactors will be competent enough to oversee the dismantlement of the SIC reactor, ensuring the highest priority be towards the health & safety of the workers. All the workers at the SIC site have been trained in procedures to minimize their exposure to radiation. They are also made aware of the minimal risks involved in working with radiation. Using the right technology and proper planning the dismantlement could be performed with a minimal amount of exposure to the workers.

As I stated previously I have lived in the town of Windsor all my life. I currently reside, with my family, within three (3) miles of the site. If I thought that this project would, in any way, jeopardize my children's health and well being I would not be in favor of dismantling and disposing of the SIC Reactor.

Thank You,

Mark Pinard

Mark Pinard

APPENDIX F

DESCRIPTION OF THE NAVAL REACTORS VOLUNTARY FACILITY ASSESSMENT PROGRAM FOR THE WINDSOR SITE

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F.1 Purpose

This Appendix has been added to the Final Environmental Impact Statement to provide additional information on the Naval Reactors Voluntary Facility Assessment Program for the Windsor Site. It did not appear in the Draft Environmental Impact Statement.

F.2 Background

In support of the inactivation activities at the Windsor Site, Naval Reactors initiated a Voluntary Facility Assessment Program under the authority of the United States Environmental Protection Agency. The Voluntary Facility Assessment is being conducted within the framework of the Federal Resource Conservation and Recovery Act (RCRA) Corrective Action Program. The State of Connecticut Department of Environmental Protection has been invited to participate in all aspects of this work to provide an opportunity for their concerns to be properly addressed. The first step of this assessment is to determine whether chemical releases exist which would require further characterization to assess human health or environmental impacts.

The major aspects of the Windsor Site Voluntary Facility Assessment Program are described below:

1. Review historical Windsor Site operations to identify areas at the Windsor Site that require further investigation (See Section F.3). Naval Reactors completed this review and provided a summary of historical Windsor Site operations to the Environmental Protection Agency - Region I and the Connecticut Department of Environmental Protection in 1995.

2. Design a sampling plan to investigate the areas identified from the historical operations review (See Section F.4). The Windsor Site Voluntary Facility Assessment sampling plan was developed by Naval Reactors and transmitted to the Environmental Protection Agency - Region I and the Connecticut Department of Environmental Protection for review and comment in 1995. In July 1996, Naval Reactors met with personnel from the Environmental Protection Agency - Region I and the Connecticut Department of Environmental Protection to finalize the sampling plan.

3. Implement the sampling plan by collecting samples and performing laboratory analyses (See Sections F.5 and F.6). Following completion of the sampling plan, a report will be prepared and provided to regulatory agencies. The report will provide the basis for discussions among the Environmental Protection Agency - Region I, the Connecticut Department of Environmental Protection, and Naval Reactors on the need for any additional investigation or cleanup.

The assessment process described above is supplemented by inspections and sampling which routinely occur during the removal of site systems. As stated in Sections 3.1.4 and 5.1.5.2 of this Environmental Impact Statement, Windsor Site dismantlement activities will include removal of all site systems. Inspections will be performed for evidence of potential releases (e.g., odors, soil staining, loss of integrity) during the removal of systems. In the event potential releases to the environment are indicated by these inspections, additional samples will be collected. Such sampling activities would be conducted consistent with the sampling plan. Any release indications would be discussed with the Environmental Protection Agency - Region I and the Connecticut Department of Environmental Protection and evaluated for addition to the Voluntary Facility Assessment Program for further action.

F.3 Review of Windsor Site Operations

A detailed review of historical operations was performed to identify areas where chemical releases did or may have occurred at the Windsor Site. The review process followed the guidance contained in the Environmental Protection Agency document EPA/530-86-053, *RCRA Facility Assessment Guidance*, October 1986, as well as other Environmental Protection Agency - Region I guidance. This process included a detailed review of Windsor Site records, interviews with personnel knowledgeable of Windsor Site operations, and an inspection of the site facilities. The review focused on operations and equipment that could have had a potential environmental impact, such as in-ground tanks, heating boilers, cooling tower, industrial drainage, waste management, and known chemical releases no matter how minor.

Results of the detailed review were compiled in a summary which was provided to the Environmental Protection Agency - Region I and the Connecticut Department of Environmental Protection. The summary provides a detailed description of Windsor Site operations and establishes that burial of discarded chemicals did not occur on the Windsor Site. However, the summary identified a few areas where minor releases of chemicals to the environment did or may have occurred from past operations.

F.4 Sampling Plan Description

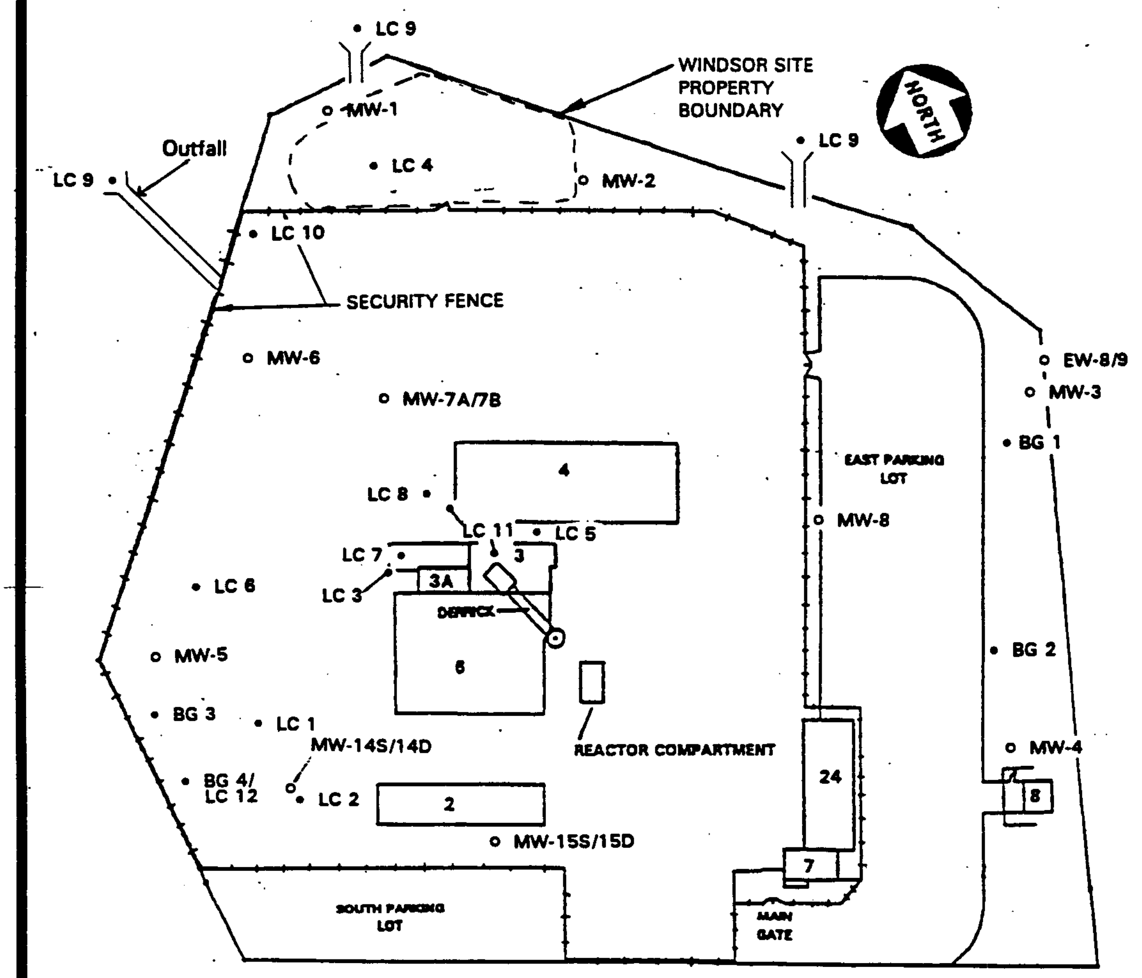
A sampling plan was prepared consistent with the guidance contained in the Environmental Protection Agency document EPA/530-86-053, *RCRA Facility Assessment Guidance*, October 1986 as well as other Environmental Protection Agency - Region I guidance documents. The plan is designed to develop high quality environmental data to be used in the decision making process for additional action ultimately leading to the goal of unrestricted release of the Windsor Site.

F.4.1 Sampling Plan Objectives

The primary objective of the sampling plan is to determine if chemical releases occurred on the Windsor Site or adjacent areas which require further investigation or cleanup. A second objective is to confirm the current understanding of the environmental setting in which chemical releases attributable to Windsor Site operations may have occurred. Adjacent areas include the Goodwin Pond and the drainage brook located on Combustion Engineering, Inc. property.

F.4.2 Sampling Plan Summary

The areas subject to investigation under the plan include the specific Windsor Site locations where chemical releases did or may have occurred as well as areas where contaminants may have migrated from the potential release points. Undeveloped areas of the site are also investigated to evaluate background conditions. The samples include surface soils, subsurface soils, sediment, groundwater, and surface water. Figures F-1 and F-2 show the various sampling locations relative to the Windsor Site. Table F-1 provides detailed information for twelve target locations and related environmental media. Table F-1 also identifies target parameters and provides the sampling rationale. The specific target parameters are provided in Lists A through H (included at the end of this appendix).



2	Auxiliary Shops	6	Operations Building
3	Power Plant Building	7	Guard House
3A	Battery Room	8	Well Pump House
4	Warehouse	24	Offices

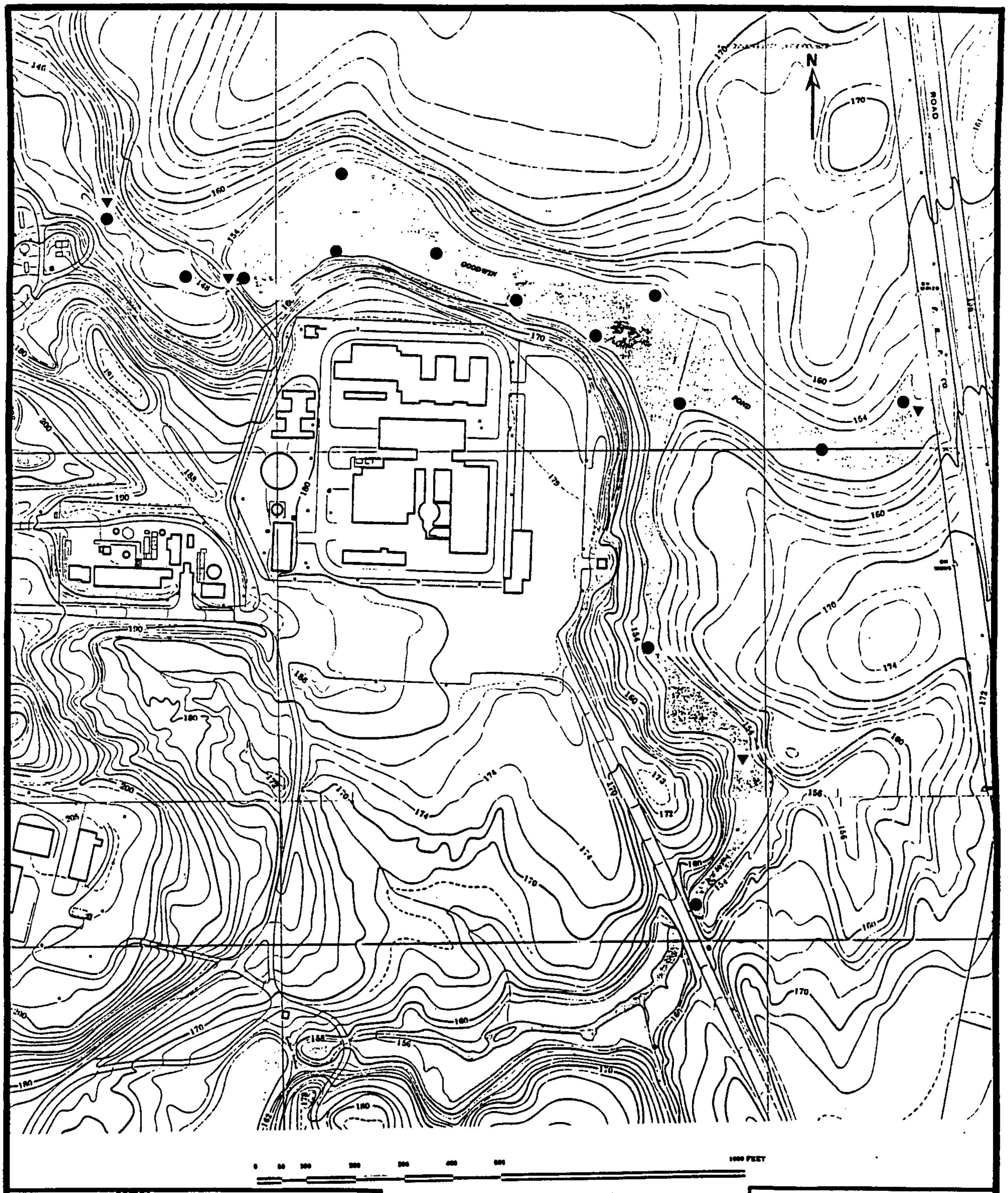
○ MW-1	Monitoring Well (14S/14D and 15S/15D existing wells)
○ EW-8/9	Exploratory Water Supply Wells (Historic)
● LC 1	Sampling Plan Investigation Areas

LC = Location
BG = Background Surface Soil

Figure F-1

Sampling Plan
Investigation Map

Windsor Site Operations
Knolls Atomic Power Laboratory



KEY

- ● Sediment Sampling Location
- ▼ Surface Water Sampling Location

Source: The Metropolitan District, Geodetic and Topographic Survey, Sheets 543 & 640, March 1977

Figure F-2

Surface Water and Sediment Sampling Location Map

Windsor Site Operations
Knolls Atomic Power Laboratory

Table F-1 Windsor Site Locations Identified for Sampling

Location 1 - Former Container Storage Area - From 1980 to 1984, this 20 by 40-foot outdoor area was used to stage containerized non-liquid solid waste for off-site disposal. No specific waste releases are known to have occurred at this location. However, a historic composite sample collected as part of closure, which mixed soil from this location with debris (sweepings) from indoor container storage areas in an adjacent building, contained low levels of lead and cadmium. An evaluation determined that there were no concerns for releases from the indoor areas.

Affected Media: Surface Soil

Target Parameters: List E

Number of Samples/Rationale: Two composite samples were collected at this location. Each composite sample consisted of five grab samples collected from a 20 by 20-foot area, resulting in ten samples from this 20 by 40- foot location. Each grab sample included soil from the top 12 inches of the soil profile.

Location 2 - In-ground Tank - From approximately 1958 to 1990, this concrete tank received deionized water from equipment cleaning operations as well as floor wash water from a quality control clean room. The tank is 4 feet wide and 8.5 feet long and extends from the ground surface to depth of approximately 15 feet. Tank construction details indicate the inside walls and floor of the tank were covered with a black bituminous coating. Remnants of the coating were evident on the tank walls and floor, and in the slurry found in the bottom of the tank during a 1990 inspection. Samples of the tank coating and concrete walls contained low levels of Polychlorinated Biphenyls (PCBs) ranging from 1.1 to 6 ppm. Visual inspection of the tank did not reveal any outlet from the tank or obvious integrity problems; however, water appears to infiltrate the tank. The source of the water may be percolating rainwater, as groundwater is typically 10 feet below the tank bottom.

Affected Media: Subsurface Soil

Target Parameters: List A, List B, List C, and List D [Initial Round]
List C, List D, List G, and List H [Follow-up Round]

Number of Samples/Rationale: Groundwater-level data suggest groundwater under this location moves to the northeast. For the initial round of sampling, one test boring was drilled approximately 5-feet off the northeast end of the tank. Three soil samples were collected from the boring - one each at the bottom of the tank, between the bottom of the tank and the water table, and at the water table. Based on the results of the initial sampling, a follow-up sampling round will be performed to collect additional soil samples for analysis to further assess the significance of the low level PCBs and organic compounds detected in the sample from the boring (See section F.5.1.2).

Table F-1 Windsor Site Locations Identified for Sampling

Location 3 - Dry Well - The dry well is an in-ground well approximately 4 feet deep filled with crushed stone. From approximately 1959 to 1991, it received rinse water from battery testing equipment such as battery water-level devices and hydrometers as well as drainage from the battery room floor drain. Samples of rinse water collected since 1991 contained very dilute sulfuric acid and low levels of lead and cadmium.

Affected Media: Subsurface Soil

Target Parameters: List C and pH

Number of Samples/Rationale: One test boring was drilled directly through the dry well. Four soil samples were collected from the boring, spaced from just below the dry well to the water table. Drilling through the dry well allowed direct assessment of any effects at this location from discharges to the dry well. The sample spacing should detect any releases and will allow a preliminary assessment of the potential migration of contaminants from the dry well to the water table.

Location 4 - Septic System and Leach Field (SSLF) - The SSLF is similar, except for size, to an ordinary household septic system. The septic system has been operational from approximately 1962 to present. Until 1978 small quantities of expired acids and oxidizing agents were discharged to the SSLF. Minute quantities of a variety of laboratory chemicals (residuals from laboratory analysis) have also been included in drain water from two analytical laboratories that discharge to the SSLF. The general types of chemicals disposed of included acids and caustics, such as nitric acid, sulfuric acid and sodium hydroxide; salts, such as potassium chloride; sulfites, such as sodium sulfite; phosphates, such as sodium phosphate; and organics, such as acetone and Freon 113. Only small quantities of dilute nonhazardous pH buffer solutions are currently disposed of via the SSLF. These discharges have been consistent with the established applicable regulations. In addition, there was a one-time accidental discharge of 15 gallons of solution containing 7 ppm cadmium in late 1991.

Affected Media: Subsurface Soil

Target Parameters: List A, List B, List C, List D

Number of Samples/Rationale: One boring was drilled in the central portion of the western side of the leach field. Two samples were collected from the boring: one just below the bottom of the leach field and one at the water table. Until 1986, the west side of the leach field received the majority of the discharges to the septic system. Maintenance performed in 1986 corrected this problem resulting in an even flow distribution in the leach field. Therefore, if a release occurred, these samples should detect the release and allow a preliminary assessment of the migration of contaminants to the water table. In addition, nearby monitoring wells (see Figure F-1) provide groundwater information to assist in evaluating the impacts, if any, of this location on groundwater quality.

Table F-1 Windsor Site Locations Identified for Sampling

Location 5 - Former Chemical Products Storage Racks - These fascilon (reinforced polyvinyl chloride) covered racks were located outside on asphalt pavement and were revetted to contain any liquids. The racks were used from approximately 1959 to 1989 to store solvents and petroleum products. Minor spillage or dripping of chemicals to the pavement occurred during dispensing of the chemicals.

Affected Media: Surface Soil

Target Parameters: List F, List G, and Total Petroleum Hydrocarbons

Number of Samples/Rationale: Two samples were collected from the surface soil underlying the revetted portion of the asphalt pavement. Initial visual inspection and organic vapor survey of the underlying soil did not indicate any release to the soil. Additional soil samples will be collected for laboratory analysis from the 12 to 24-inch interval below the bottom of the pavement to confirm the initial results. This sampling interval will allow appropriate separation from the pavement and associated pavement-related petroleum interferences.

Location 6 - Process Cooling Water - The site utilized a process cooling water system which included a cooling tower situated over an 80-foot diameter concrete basin. The basin also served as water storage to charge the fire main header. The system was operational from approximately 1959 to 1993. Until approximately 1980, chromium-containing chemicals were added to the cooling water system for corrosion and biological control. Cooling water was periodically discharged via the site's former National Pollutant Discharge Elimination System outfall in accordance with the site's discharge limits. Sediment samples collected in the drainage brook in 1978 indicated elevated concentrations of chromium downstream of the Windsor Site outfall. The maximum chromium level detected was 70 parts per million, which is below the most conservative Connecticut Department of Environmental Protection Remediation Standard Regulation chromium (100 ppm) for direct exposure to residential soils.

Affected Media: Surface soil beneath basin; subsurface soil next to system piping; sediment

Target Parameters: Chromium

Number of Samples/Rationale: Surface soil sampling was conducted subsequent to the removal of the concrete basin in 1995. There was no evidence of cracks in the basin floor prior to its removal. Subsequent to removal, there was no visual evidence of leakage from the basin to the underlying soil. Four composite samples were collected over the footprint of the concrete basin. One composite was collected from a 40 by 40-foot area over each quadrant of the basin. Each composite sample consisted of five grab samples, resulting in 20 samples from this location. Each grab sample included soil from the top 12 inches of the soil profile. Based on the results of the composite samples, additional soil samples are planned for the western portion of the basin footprint.

Subsurface soil sampling will be conducted as system piping is removed. Samples will be taken at selected piping joints, at locations where piping integrity has been lost, and at locations with visual evidence of leakage.

Sediment sampling is discussed on page F-15.

Table F-1 Windsor Site Locations Identified for Sampling

Location 7 - Transformer Pad - Transformers containing oil with approximately 100 ppm PCB were used on site until 1993. Records review indicated low levels of PCBs were detected on two concrete pads beneath the transformers. Both pads were cleaned in 1993 in accordance with an Environmental Protection Agency PCB decontamination protocol.

Affected Media: Surface Soil

Target Parameters: List D

Number of Samples/Rationale: The sampling focused on the soil likely to receive run-off from the pad locations that had the highest PCB concentration prior to cleaning. Two soil samples were collected immediately adjacent to the pad. Each soil sample included soil from the top 12 inches of the soil profile. Based on the result of those samples, additional samples in this area are planned.

Location 8 - Former Fuel Oil/Diesel Fuel Underground Storage Tanks - Until 1988, fuel oil and diesel fuel were stored in three underground storage tanks. Tightness tests of the tanks while in place did not indicate any integrity problems with the tanks. These tanks were removed in 1988. At that time, approximately two cubic yards of soil in the vicinity of the tanks stained by fuel oil were removed. The staining was reportedly from a leak in the fill line. Additional soil samples following removal of the stained soil did not contain detectable concentrations of petroleum-related volatile organic compounds.

Affected Media: Subsurface Soil

Target Parameters: List F

Number of Samples/Rationale: One test boring was drilled through the previously identified area of fuel oil staining to directly assess the effectiveness of the cleanup. Three samples were collected from the boring, spaced from just below the area of fuel oil staining to the groundwater table. These samples will confirm the adequacy of the prior cleanup and check for migration of petroleum-related contaminant to the water table.

Location 9 - Industrial Discharge Piping - The industrial discharge piping has evolved over the history of the site. The industrial discharge piping has included discharges via now inactive outfalls to Goodwin Pond and the Windsor Site's former National Pollutant Discharge Elimination System outfall. Records review revealed liquid wastes from the Windsor Site's support systems and laboratories were discharged via the industrial drain in accordance with the site's discharge limits.

Affected Media: Sediment

Target Parameters: List A, List B, List C, and List D

Number of Samples/Rationale: See sediment sampling, page F-15.

Table F-1 Windsor Site Locations Identified for Sampling

Location 10 - Material Laydown Area - This area is an 85-foot by 35-foot concrete pad located in the northwest corner of the Windsor Site. A variety of material has been staged on this pad including lead shielding, refueling support equipment, batteries, scaffolding, and excess office equipment. The potential existed for release of metals associated with these materials to stormwater. Stormwater drainage from the pad runs across a paved area to a storm sewer, which discharges to the Windsor Site's former National Pollutant Discharge Elimination System outfall.

Affected Media: Sediment

Target Parameters: List C

Number of Samples/Rationale: See sediment sampling, page F-15.

Location 11- Underground Fuel Oil Storage Vault and Building 3 Pipe Trench - This concrete vault contained piping and valves for supplying fuel oil from the underground fuel oil storage tanks to the heating boiler in Building 3. Limited spillage from this piping to the floor of the vault occurred when the piping was modified to remove the in ground storage tanks and place the above ground storage tanks in service. The spill was cleaned up, though staining is evident on the vault floor. Fuel oil staining also is present in Building 3 along the concrete trench used to route fuel oil pipes to the various boiler components. Both the vault and trench are in good condition with no evidence of cracks or holes.

Affected Media: Surface Soil beneath vault and pipe trench

Target Parameters: List F and List G, and Total Petroleum Hydrocarbons

Number of Samples/Rationale: Four samples will be collected from the soil underlying the concrete floor of the vault, and two samples will be collected from the soil underlying the Building 3 pipe concrete trench. Holes will be cut through the concrete in areas of staining. The soil samples will be collected from the first 12 inches of soil underlying the concrete where oil would most likely be encountered.

Location 12- Surficial Black Material - During implementation of the sampling plan, an area (approximately 20 by 30 feet) of black ash-like material was discovered beneath a crushed stone surface layer at background surface soil location number 4, near the western property boundary of the Windsor Site. The black material formed a layer approximately 2 inches thick. The source of the material is a spill from a former coal degasification operation (unrelated to Windsor site operations) on neighboring property.

Affected Media: Surface Soil

Target Parameters: List C, List D, List G, and List H

Number of Samples/Rationale: A composite sample was taken from this location consisting of 5 grab samples from a 20 by 20-foot area. Each grab sample consisted of soil from the top 12 inches of the soil profile. In addition, a sample of the roughly 2-inch thick black material layer was obtained and analyzed.

Table F-1 Windsor Site Locations Identified for Sampling

Background Soil

Affected Media: Surface Soil

Target Parameters: List E

Number of Samples/Rationale: Three composite surface soil samples were collected - two samples from the eastern side of the site and one from the western side of the site, currently the only unpaved indigenous soil areas on the site. These areas are also in locations with low potential for impacts from site operations. Each composite sample consisted of 5 grab samples, resulting in 15 samples of surface soil. Each grab sample included soil from the top 12 inches of the soil profile. The background surface soil sampling was designed to provide information on background concentrations of metals in the soils for comparison with location-specific metals results. The composite sampling scheme inherently decreases the range and variability of concentrations, thereby providing conservative concentrations for assessment purposes.

Sediment Sampling

Affected Media: Sediment

Target Parameters:	Preliminary:	List A, List B, and List D
	Principal:	List C, List D, List G, and List H

Number of Samples/Rationale: The overall sediment sampling program was designed in two phases - a preliminary phase and a principal phase. The preliminary phase was designed to assess the presence of organic compounds in the sediment potentially associated with the Windsor Site and provide data to refine the principal phase. Sediment from the bottom of Goodwin Pond (3 locations) and the drainage brook (2 locations) was collected to a depth of two feet. This depth is adequate to penetrate sediments potentially affected by Windsor Site operations. This is based on the low-flow conditions and limited sediment load in the Goodwin Pond and drainage brook. The locations in Goodwin pond are at the former industrial outfalls and just upstream of the spillway. The drainage brook locations were in areas of sediment deposition (e.g., meander bends) located between the Windsor Site's former National Pollutant Discharge Elimination System outfall, and the nearest Combustion Engineering, Inc. outfall.

These results will be incorporated into the more comprehensive principal sampling and analysis program, which will be implemented over the entire pond and the portion of the brook upstream of the nearest Combustion Engineering, Inc. outfall. Samples will be collected from the locations depicted in Figure F-2. The planned sampling locations were selected to assess any contribution from the Windsor Site as well as from non-Site related sources.

Monitoring Wells - Subsurface Soil Sampling

Affected Media: Subsurface Soil

Target Parameters: List C

Number of Samples/Rationale: To provide confirmation of the present understanding of site hydrogeologic characteristics, nine new monitoring wells were installed on site concurrent with the sampling program. One test boring was drilled and continuously sampled for organic vapors and visual staining at each new monitoring well location. One soil sample was collected from each boring at the water table interface. These samples were analyzed for List C constituents to aid in the interpretation of inorganic constituents in groundwater samples and establish background subsurface soil data.

Table F-1 Windsor Site Locations Identified for Sampling

Monitoring wells - Groundwater Sampling

Affected Media: Groundwater

Target Parameters: List A, List B, List C, and List D [Initial Round]
List C, List D, List G, and List H [Follow-up Round]

Number of Samples/Rationale: To provide confirmation of the present understanding of site hydrogeologic characteristics, nine new water table monitoring wells were installed on site concurrent with the sampling program. The nine new wells supplement two preexisting monitoring wells, located near the water table, bringing the total number of water table monitoring wells to eleven. Field parameters pH, temperature, specific conductivity, and turbidity were measured at the time of sample collection. Water levels were measured in all wells during well purging and groundwater sampling activities to support groundwater mapping and assessment of flow direction.

Based on the results of the initial samples (discussed in Section F.5.1.14.2), a follow-up round of samples will be collected. The follow-up round will also include the two remaining preexisting wells, which are located approximately forty and seventy feet below the water table, bringing the total number of groundwater monitoring wells to thirteen. The purpose of the follow-up round is to verify the presence of the organic parameters and attempt to eliminate apparent turbidity interferences on groundwater quality analytical results. The purpose of sampling at the two deep wells is to assess potential off-site up gradient impacts to deeper groundwater quality.

Surface Water Sampling

Affected Media: Surface Water

Target Parameters: List C, List D, List G, and List H

Number of Samples/Rationale: The surface water sampling and analysis program was designed to detect target parameters identified in the groundwater or sediment which potentially could be transferred to and be migrating with the surface water. Samples from four locations will be collected. Field parameters pH, temperature, specific conductivity, and turbidity will be measured at the time of sample collection. The planned sampling locations have been selected to assess potential contributions from the Windsor Site and to assess for background or non-Windsor Site related concentrations of targeted parameters.

F.4.2 Sampling Plan Summary, Continued

The sampling plan for surface soils, groundwater, sediment, and surface water is designed to be implemented in a phased approach. This approach allows for collection and evaluation of data to ensure that the next phase is effectively designed to obtain the necessary information. A further description of this approach for each media follows:

Surface Soils - Surface soil sampling was performed early in the sampling program. This permitted release assessment at specific locations, evaluation of potential impacts associated with offsite operations, and also will allow follow-on sampling to assess the extent and significance of any detected releases.

Groundwater - Groundwater sampling was conducted in advance of the principal sediment and surface water sampling so that the analytical results could be evaluated for constituents potentially migrating to the sediments or surface water and therefore assist in refining those sampling and analysis programs. Environmental setting information (e.g., groundwater and surface water elevations; stratigraphy) generated during these activities was also considered in the evaluation of potential migration of constituents to sediment and surface water.

Sediment - The overall sediment sampling and analysis program is designed to assess the presence of both organic and inorganic constituents. To focus analytical efforts, the sediment sampling and analysis program was divided into preliminary and principal stages.

The preliminary sediment sampling and analysis program looks for a wide spectrum of organic compounds, which, if detected, would be indicative of an anthropogenic (i.e., human) source. The preliminary sampling effort focuses on sediments most likely to have received, or accumulated, potential contaminants in historic discharges from the Windsor Site.

The principal sediment sampling and analysis program covers a broader area of sediments but focuses analyses on organic compounds identified in the preliminary sediment sampling and analysis program. It also looks for inorganic parameters potentially associated with the Windsor site. As inorganic parameters can be naturally present, the sampling plan includes evaluation of background or non-Windsor Site related concentrations of inorganic parameters. These background locations will also be utilized to evaluate background concentrations of any organic compounds detected in the preliminary sediment sampling.

Surface water - The surface water does not currently receive any known direct discharges of chemicals from the Windsor Site. Therefore, surface water sampling and analysis will be conducted near the end of the sampling program, so that analytical parameters potentially present in the surface water can be appropriately defined based on preliminary sediment and groundwater data.

As of June 1996, approximately 70 percent of the plan was completed. The remainder of the plan is scheduled for completion by mid-1997. Remaining sampling work includes principal sediment and surface water as well as follow-up groundwater and soils.

F.4.3 Data Quality Objectives

Inorganic and organic analyses are performed by State certified analytical laboratories in accordance with procedures specified in the Environmental Protection Agency's Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846 (Third Edition). Such testing is performed to fulfill the Quality Control/Quality Assurance and deliverable requirements specified in the Environmental Protection Agency's Contract Laboratory Program (CLP) Statements of Work (SOW) for Inorganic Analysis, Multi-Media, Multi-Concentration, December 1994; and Organic Analysis, Multi-Media, Multi-Concentration, July 1993. The analytical laboratory data packages include full analytical and Quality Control documentation consistent with the appropriate Statements of Work.

An independent validation of each data package is performed in accordance with the latest revisions and updates of the following documents:

- USEPA - Region I, February 1, 1988. Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses.
- USEPA - Region I, June 13, 1988. Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses.
- USEPA - Region I, July 1, 1993. Tiered Organic and Inorganic Data Validation Guidelines.
- USEPA - Region I, July 3, 1991. CSF Completeness Evidence Audit Program.

F.5 Sample Collection and Analysis - Results to Date

This discussion provides field observations, analytical results and conclusions based on sampling and analyses completed as of June 1996. This represents approximately 70 percent of the sampling plan.

Naval Reactors has not proposed, nor has the Environmental Protection Agency approved under the corrective action provisions of the Resource Conservation and Recovery Act, criteria for cleanup of chemical residuals associated with Windsor Site operations. These criteria will be established in discussions among Naval Reactors, the Environmental Protection Agency, and the Connecticut Department of Environmental Protection after completion of the current sampling plan to ensure that the objective of unrestricted release of the site will be met. However, to provide perspective on the analysis results, the following discussion uses as benchmarks the Connecticut Department of Environmental Protection Remediation Standard

Regulations, contained in Section 22a-133k of the Regulation of Connecticut State Agencies. These regulations establish remediation standards for soil, groundwater, and surface water, based on future use (e.g., residential criteria, industrial/commercial criteria) and groundwater classification. In each case, the results have been compared to the most restrictive applicable Connecticut Department of Environmental Protection Remediation Standard Regulation criterion.

F.5.1 Location Specific Results

F.5.1.1 Location 1 - Former Container Storage Area

All sampling and analysis has been completed. The sample results do not suggest a release from this location. Detected metal concentrations in the surface soil are consistent with background soil concentrations.

F.5.1.2 Location 2 - In-ground Tank

The initial round of sampling and analyses has been completed. The sample results suggest a minor release has occurred from this location. Very low levels of polychlorinated biphenyls (PCBs), specifically Aroclor 1254 (43 ppb), were detected approximately five feet below the base of the tank, in the 20-22 feet sample interval. This aroclor is consistent with historical analyses of the slurry found in the tank in 1990. A trace of Aroclor 1260 (2.8 ppb) was detected in the 16-18 feet sample interval. These levels are well below the 1000 ppb Remediation Standard Regulations criteria for direct exposure to residential soils. PCBs were not detected below the 20-22 feet sample interval. Trace levels of methylene chloride (2-3 ppb) or chloroform (3 ppb) were detected in two and one of the samples, respectively. The detected organic compound concentrations are below the applicable Remediation Standard Regulations; methylene chloride (100 ppb) and chloroform (120 ppb). In addition, no PCBs, methylene chloride, or chloroform were detected in any of the eleven groundwater monitoring wells.

Based on the results of the initial sampling, a follow-up sampling round will be performed to collect additional soil samples for analysis to further assess the significance of the PCBs and detected organic compounds.

F.5.1.3 Location 3 - Dry Well

All sampling and analyses have been completed. There were no indications of a release in the sample results. Detected concentrations of parameters of concern (i.e., metals) in the boring are consistent with subsurface soil concentrations of similar geologic composition. In particular, there is no indication of elevated levels of lead or cadmium or depressed soil pH attributable to the dry well.

F.5.1.4 Location 4 - Septic System and Leach Field

All sampling and analysis is complete. The sample results suggest the presence of a minor release from this location. Trace levels of methylene chloride (4 ppb) and chloroform (3 ppb) were detected in the test boring samples just below the leach field and at the water table interface. These concentrations are below the applicable Remediation Standard Regulations for methylene chloride (100 ppb), and chloroform (120 ppb). Low levels (28-410 ppb) of nine polynuclear aromatic hydrocarbons were detected in the soil sample just below the leach field, but not in the soil sample at the water table. These concentrations are all below the applicable Remediation Standard Regulations, the lowest of which is 1000 ppb. None of the detected compounds were detected in groundwater samples from nearby wells (MW-1 and MW-2). However, similar levels of methylene chloride (5 ppb) and chloroform (3 ppb) were present at approximately 20 feet below the surface in the boring for monitoring well MW-1. Toluene (1 ppb) was also present at this elevation in the boring for monitoring well MW-1 at levels far below the applicable Remediation Standard Regulations (20,000 ppb).

F.5.1.5 Location 5 - Former Chemical Products Storage Racks

As discussed in Table F-1, visual inspection and organic vapor screening of the soil underlying this location did not indicate the presence of any release from this location. Sampling activities at this location are scheduled for completion by mid-1997.

F.5.1.6 Location 6 - Process Cooling Water

The composite surface soil sampling and analysis beneath the basin is complete. The composite sample results indicated that total chromium concentrations were slightly elevated in the western half of the footprint of the former cooling tower basin (24 ppm). Concentrations found in the eastern half were comparable to background (9-10 ppm). The elevated concentrations are well below the Remediation Standard Regulations of 100 ppm for direct exposure to residential soils. Additional soil sampling is planned in the western half to further assess the extent and significance of the elevated chromium found in the composite sample.

Sampling activities near system piping will be completed as the piping is removed. Samples will be taken at selected piping joints, at locations where piping integrity has been lost, and at locations with visual evidence of leakage.

Sediment sampling is discussed in Section F.5.1.16.

F.5.1.7 Location 7 - Transformer Pad

Sampling and analysis of the two surface soil samples collected immediately adjacent to the transformer pad is complete. The sample results suggest the presence of a minor release at this location. Trace concentrations (3-8 ppb) of PCBs, specifically Aroclor 1260, were detected at this location. The levels are well below the 1000 ppb Remediation Standard Regulations for direct exposure to residential soils. Additional samples will be collected to verify the presence and to further assess the extent and significance of the PCBs.

F.5.1.8 Location 8 - Former Fuel Oil/Diesel Fuel Underground Storage Tanks

All sampling and analysis is complete. The sample results do not suggest a release. No polynuclear aromatic hydrocarbons were detected.

F.5.1.9 Location 9 - Industrial Discharge Piping

See sediment discussion, Section F.5.1.16.

F.5.1.10 Location 10 - Material Laydown Area

See sediment discussion, Section F.5.1.16.

F.5.1.11 Location 11 - Underground Fuel Oil Storage Vault and Building 3 Pipe Trench

Sampling activities at this location are scheduled for completion by mid-1997.

F.5.1.12 Location 12 - Surficial Black Material

All sampling and analyses are complete. The results are summarized in Table F-2. Results of the single grab sample of the black material layer revealed metal concentrations at levels above applicable Remediation Standard Regulations and background levels. The composite sample of the top 12 inches of the soil profile showed significantly reduced concentrations to levels below the applicable Remediation Standard Regulations, though still elevated above background. The results suggest that the extent of the chemical impact associated with the black material is likely limited to the near surface.

Table F-2 Summary of Location 12 Results

Constituent	Results of grab sample	Results of composite sample of top 12 inches of soil profile	Remediation Standard Regulations [Residential Direct Exposure Criteria for Soil]
Lead	3950 ppm	40.2 ppm	500 ppm
Chromium	680 ppm	21.2 ppm	100 ppm
Beryllium	114 ppm	1.6 ppm	2 ppm
Copper	2500 ppm	38.6 ppm	2500 ppm

F.5.1.13 Background Soil Results

All sampling and analyses are complete. Background soil results reveal no significant anthropogenic effects on soil chemistry. All results, are generally consistent and below any applicable Remediation Standard Regulations.

F.5.1.14 Monitoring Wells

F.5.1.14.1 Subsurface Soil Results

Results of soil samples from monitoring well borings revealed metal chemistry consistent with the site geology. The results do not indicate any significant anthropogenic effects on metal chemistry. Additional samples for organic analyses were collected from the borings for MW-1 and MW-3 in response to field observations of minor odors or organic vapors. The results for MW-1 are included in the discussion of the septic system and leach field in Section F.5.1.4. The MW-3 results revealed trace levels of methylene chloride (2 ppb) and polynuclear aromatic hydrocarbons (6-28 ppb) in two samples (0-2 and 2-4 feet). The detected concentrations are well below applicable Remediation Standard Regulations for methylene chloride (100 ppb), and polynuclear aromatic hydrocarbons (lowest Remediation Standard Regulations is 1000 ppb).

F.5.1.14.2 Groundwater Results

The groundwater table was encountered at a general depth of 25 feet. Groundwater results are generally unremarkable.

Metal concentrations in groundwater samples are apparently influenced by particulates associated with the site geology. Lead was detected in MW-1 (15.1 ppb), MW-4 (23.6 ppb), and MW-7B (32.9 ppb) at levels above the applicable Remediation Standard Regulations (15 ppb). Vanadium was detected in MW-7B (55.1 ppb) at a level above the applicable Remediation Standard Regulations (50 ppb). These results are coincident with those samples having the highest turbidity.

Trace concentrations of 1,1,1 trichloroethane (0.8-4 ppb), tetrachloroethylene (1-2 ppb), acetone (1-7 ppb), and carbon disulfide (0.3-4 ppb) were detected in a number of groundwater samples. The detected concentrations are below applicable Remediation Standard Regulations for 1,1,1-trichloroethane (200 ppb), tetrachloroethylene (5 ppb), and acetone (700 ppb). Carbon disulfide does not have an established Remediation Standard Regulation. The initial results do not indicate any specific, on-site source for the detected parameters. In addition, none of the organic parameters detected in the subsurface soil samples from monitoring well borings or location-specific borings were detected in the groundwater samples. This suggests no migration of the detectable parameters to the groundwater and no releases of concern from the specific locations.

Additional samples will be collected using a low flow sampling methodology (the initial round of samples was collected via an inertial pump system) in an attempt to eliminate turbidity interferences on groundwater quality analytical results for metals and to further assess the significance of organic parameters detected at low levels.

F.5.1.15 Surface Water Results

Sampling activities for surface water are scheduled for completion by mid-1997.

F.5.1.16 Sediment Results

The preliminary phase of sediment sampling and analysis has been completed. These results are summarized in Table F-3. Low levels of several organic parameters were detected in the sediments, the distribution of which is generally consistent with layering in the sediment. Remediation Standard Regulations have not been established for sediment. However, for comparison, the levels detected are below the Remediation Standard Regulations for direct exposure to residential soils.

Inspection of the preliminary sediment samples revealed a layer of decayed vegetation and silt (muck/peat) over sand. Occasionally, pockets of more recently deposited sand are found to overlie the muck/peat. Preliminary results revealed low levels of polynuclear aromatic hydrocarbons, PCBs, acetone and 2-Butanone. The acetone concentrations were deemed suspect based on the concentrations detected and the fate and mobility of acetone in the environment. A possible source of the acetone was contamination from the isopropyl alcohol used in the sampling equipment cleaning procedure.

A second round of preliminary samples was collected to address the presence of acetone by omitting the isopropyl rinse and to assess the distribution of organic parameters in the layered sediment. These samples were collected in the vicinity of the locations exhibiting the highest concentrations of detected organic compounds during the first sampling round. The results confirmed the presence of the organic parameters and revealed that they typically are confined to the muck/peat layer. Acetone concentrations were markedly reduced, though acetone was detected within and below the muck/peat layer.

Table F-3 Summary of Sediment Results

Constituent	1st preliminary round	2nd preliminary round	Remediation Standard Regulations [Residential Direct Exposure Criteria for Soil]
Polynuclear aromatic hydrocarbons:			
Acenaphthene	17-52 ppb	Not Detected	Not Established
Acenaphthylene	9 ppb	Not Detected	1,000,000 ppb
Anthracene	19-110 ppb	Not Detected	1,000,000 ppb
Benzo(a)anthracene	56-380 ppb	Not Detected	1,000 ppb
Benzo(b)fluoranthene	67-600 ppb	Not Detected	1,000 ppb
Benzo(k)fluoranthene	47-590 ppb	Not Detected	8,400 ppb
Benzo(a)pyrene	53-410 ppb	Not Detected	1,000 ppb
Chrysene	58-500 ppb	Not Detected	Not Established
Fluoranthene	9-1000 ppb	33-94 ppb	1,000,000 ppb
Flourene	12-58 ppb	Not Detected	1,000,000 ppb
Naphthalene	8-12 ppb	Not Detected	1,000,000 ppb
Phenanthrene	6-650 ppb	19 ppb	1,000,000 ppb
Pyrene	7-100 ppb	37-80 ppb	1,000,000 ppb
PCBs	7.8-53 ppb	57 ppb	1,000 ppb
2-Butanone	9-21ppb	95 ppb	500,000 ppb
Acetone	350-39,000 ppb	23-310 ppb	500,000 ppb

The principal phase of the sediment sampling program will be completed by mid-1997. Data derived from the principal sediment sampling will allow assessment of the distribution of inorganic and organic parameters in the Goodwin Pond and drainage brook and evaluate the potential contribution by the Windsor Site to parameters detected in the preliminary phase.

F.5.2 Media Summary

Surface soil results are mostly unremarkable, with the exception of Location 12 which resulted from off-site operations and not Windsor Site operations. Only two other locations have indicated the presence of slightly elevated target parameters thus far. With the exception of Location 12, all surface soil results are below applicable Remediation Standard Regulations.

Subsurface soil results do not indicate any significant releases at the Windsor Site. Metals results varied consistent with the variable site geology. Trace levels of several organic compounds were detected at several locations above the groundwater table. The concentrations were below applicable Remediation Standard Regulations, and none of the organic compounds detected in the soil were detected in any groundwater samples.

Groundwater results do not indicate any releases of concern at the Windsor Site. Metals results appear to be influenced by soil particles in the groundwater samples, a condition which will be addressed in subsequent sampling. Trace levels of several volatile organic parameters were detected in wells across the Windsor Site, the results of which are below applicable Remediation Standard Regulations. The initial results do not indicate any specific, on-site source of the detected organic parameters. The presence of the detected organic parameters will be verified in subsequent sampling.

The preliminary sediment sampling revealed the presence of low concentrations of several organic parameters. The distribution of the parameters is controlled, in part, by layering observed in the sediment profile. These preliminary findings will assist the principal sediment sampling to assess the pervasiveness of the detected compounds and any potential contribution from the Windsor Site.

F.6 Overall Conclusions and Projection of Future Remedial Work

The Voluntary Facility Assessment Program sampling plan to date has identified no issues which would be expected to substantially affect the goal of achieving unrestricted release of the Windsor Site. Approximately 70% of the sampling plan has been completed, with only a very limited number of target parameters detected, which in most cases were well below the applicable Connecticut Department of Environmental Protection Remediation Standard Regulation. These results do not, at this time, indicate the need for specific remedial actions. The one the exception is Location 12, which resulted from off-site operations and not Windsor Site operations. The extent of the black material layer at this location is limited and well defined. Based on the size and depth of the black material layer, it is estimated cleanup of this area will require removal of approximately 10 to 15 cubic yards [1 truckload] of soil. The Environmental Protection Agency and Connecticut Department of Environmental Protection agreement with the future actions for this location will be obtained.

Target Parameters List A

Volatile Organic Compounds

Acetone
Acetonitrile
Acrolein
Acrylonitrile
Allyl chloride
Benzene
Bromodichloromethane
Bromoform
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloroprene
Dibromochloromethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
trans-1,4-Dichloro-2-butene
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
trans-1,2-Dichloroethylene
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
1,4-Dioxane
Ethylbenzene
Ethyl methacrylate
2-Hexanone
Isobutyl alcohol
Methylacrylonitrile
Methyl Bromide (Bromomethane)
Methyl Chloride (Chloromethane)
Methylene Bromide (Dibromomethane)
Methylene chloride (Dichloromethane)
Methyl ethyl ketone (2-Butanone)
Methyl Iodide (Iodomethane)
Methyl methacrylate
4-Methyl-2-pentanone (methyl isobutyl ketone)
Propionitrile (Ethyl cyanide)
Pyridine
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluoromethane
1,2,3-Trichloropropane
Vinyl acetate
Vinyl chloride
Xylenes (total)

Source: Title 40 Code of Federal Regulations Part 264 Appendix IX

Target Parameters List B

Semi-Volatile Organic Compounds

Acenaphthene
Acenaphthylene
Acetophenone
2-Acetylaminofluorene
4-Aminobiphenyl
Aniline
Anthracene
Aramite
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Benzyl alcohol
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloro-1-methylethyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
2-sec-Butyl-4,6-dinitrophenol (Dinoseb)
p-Chloroaniline
Chlorobenzilate
p-Chloro-m-cresol
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
m-Cresol
o-Cresol
p-Cresol
Diallate
Dibenzo(a,h)anthracene
Dibenzofuran
Di-n-butyl phthalate
o-Dichlorobenzene

m-Dichlorobenzene

Diethyl phthalate
p-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
2,6-Dichlorophenol
0,0 Diethyl 0-2-pyrazinyl phosphorothioate
Dimethoate
p-(Dimethylamino)azobenzene
7,12-Dimethyl-benzo(a)anthracene
3,3'-Dimethylbenzidine
alpha, alpha-Dimethylphenethylamine
2,4-Dimethylphenol
Dimethyl phthalate
m-Dinitrobenzene
4,6-Dinitro-o-cresol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octyl phthalate
Diphenylamine
Disulfoton
Ethyl methanesulfonate
Famphur
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexachlorophene
Hexachloropropene
Indeno(1,2,3-cd)pyrene
Isodrin
Isophorone

Target Parameters List B (continued)

Semi-Volatile Organic Compounds

Isosafrole
Kepone
Methapyrilene
3-Methylcholanthrene
Methyl methanesulfonate
2-Methylnaphthalene
Methyl Parathion
Naphthalene
1,4-Naphthoquinone
1-Naphthylamine
2-Naphthylamine
o-Nitroaniline
m-Nitroaniline
p-Nitroaniline
Nitrobenzene
o-Nitrophenol
p-Nitrophenol
4-Nitroquinoline 1-oxide
N-Nitrosodi-n-butylamine
N-Nitrosodiethylamine
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitrosodipropylamine
N-Nitrosomethylethylamine
N-Nitrosomorpholine
N-Nitrosopiperidine
N-Nitrosopyrrolidine
5-Nitro-o-toluidine
Parathion
Pentachlorobenzene
Pentachloroethane
Pentachloronitrobenzene
Pentachlorophenol
Phenacetin
Phenanthrene
Phenol
p-Phenylenediamine
Phorate
2-Picoline
Pronamide
Pyrene
Safrole
1,2,4,5-Tetrachlorobenzene
2,3,4,6-Tetrachlorophenol
Tetraethyl dithiopyrophosphate (Sulfotepp)
o-Toluidine
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
0,0,0-Triethylphosphorothioate
sym-Trinitrobenzene

Source: Title 40 Code of Federal Regulations Part 264 Appendix IX

Target Parameters List C

Inorganics

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc
Cyanide

Source: Target Analyte List (TAL) from Environmental Protection Agency Contract Laboratory Statement of Work for Inorganics Analysis, document number ILM02.0, September, 1991

Target Parameters List D

Polychlorinated Biphenyls (Aroclors)

Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

Source: Target Compound List (TCL) from Environmental Protection Agency Contract Laboratory Statement of Work for Organics Analysis, document number ILM01.0, August, 1991

Target Parameters List E

Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Source: Target Analyte List (TAL) from Environmental Protection Agency Contract Laboratory Statement of Work for Inorganics Analysis, document number ILM02.0, September, 1991

Target Parameters List F

Polynuclear Aromatic Hydrocarbons

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
Pyrene

Environmental Protection Agency Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd Edition with updates

Target Parameters List G

Volatile Organic Compounds

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene (Total)
Dichloromethane
(Methylene chloride)
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethyl benzene
2-Hexanone
Methyl ethyl ketone (2-Butanone)
4-Methyl-2-pentanone
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl chloride
Xylenes (total)

Source: Target Compound List (TCL) from Environmental Protection Agency Contract Laboratory Statement of Work for Organics Analysis, document number ILM01.0, August, 1991

Target Parameters List H

Semi-Volatile Organic Compounds

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i,)perylene
Benzo(a)pyrene
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
2,2'-oxybis
    (Bis(2-chloroisopropyl) ether)
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
Carbazole
4-Chloroaniline
4-Chloro-3-methylphenol
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
2-Methylphenol
4-Methylphenol
Dibenzo(a,h)anthracene
Dibenzofuran
Di-n-butyl phthalate
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
Diethyl phthalate
2,4-Dimethylphenol
Dimethyl phthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotroluene
Di-n-octyl phthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitrosodiphenylamine
N-Nitroso-di-n-propylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

Source: Target Compound List (TCL) from Environmental Protection Agency Contract Laboratory Statement of Work for Organics Analysis, document number ILM01.0, August, 1991

APPENDIX G

DESCRIPTION OF THE NAVAL REACTORS RADIOLOGICAL SURVEY PLAN FOR THE WINDSOR SITE

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TABLE OF CONTENTS

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Introduction

This Appendix did not appear in the Draft Environmental Impact Statement. It has been added to the Final Environmental Impact Statement to provide additional information on the Naval Reactors Radiological Survey Plan to support unrestricted release of the Windsor Site. All Windsor Site buildings, structures, miscellaneous areas and the land, including adjacent properties (as discussed in Section G.5), are covered under the Radiological Survey Plan. The plan may be revised if radiological conditions change in any specific area or if additional historical information is found.

G.1 Brief History of Work Associated with Windsor Site Operations

From 1959 to 1993, Windsor Site was engaged in the testing, maintenance and operation of the S1C Naval nuclear prototype. The Windsor Site has been operated for the US Government by contracted companies: Combustion Engineering, Inc. (now a part of Asea Brown Boveri, Inc.) from 1959 to 1971, followed by the Knolls Atomic Power Laboratory under General Electric from 1971 to 1993 and Knolls Atomic Power Laboratory, Inc. (a Lockheed Martin company) from 1993 to present.

In March 1993, the S1C Prototype reactor plant was permanently shut down. Operations to inactivate the Windsor Site and defuel the S1C Prototype reactor plant commenced. Plans for inactivation were developed to place the Windsor Site in a benign condition for a possible extended caretaking period. As discussed in Chapter 3 of the Environmental Impact Statement, the objective of the prompt dismantlement alternative and deferred dismantlement alternative is to remove the S1C Prototype reactor plant and to establish final Windsor Site conditions that would support unrestricted release of the property.

G.2 Sources of Radioactivity Attributable to Windsor Site Operations

Due to the design of Naval nuclear propulsion plants, there are only a few radionuclides that must be considered in the radiological survey plan. Fission products and uranium are not a concern because the Naval Nuclear Propulsion Program has utilized high integrity rugged fuel design and construction. Uranium and all its fission products are retained in the reactor fuel. Sensitive measurements were made frequently to verify the integrity of reactor fuel during operation. Consequently, fission products and uranium do not require consideration on Windsor Site property.

As discussed in Appendix A of this Environmental Impact Statement, materials exposed to a neutron flux become radioactive materials. The principal source of radioactivity associated with reactor plant maintenance and support at the Windsor Site is from trace amounts of activated corrosion and wear products from materials exposed to a neutron flux during reactor plant operations. As discussed in Section 2.3 of this Environmental Impact Statement, cobalt-60 is the predominant radionuclide in activated corrosion and wear products. Cobalt-60 has a 5.27-year half-life. Cobalt-60 emits gamma radiation having two energy levels

(1.17 MeV and 1.33 MeV) and beta radiation (with a maximum energy level of 0.318 MeV). All Naval Nuclear Propulsion Program standards are based on cobalt-60, and it is the limiting radionuclide for releasing the Windsor Site from radiological controls. Essentially, cobalt-60 is a "tag" for Program radioactivity; if cobalt-60 concentration is acceptably low, other radionuclides will not be of concern.

Tritium is an activation product in the primary coolant of Naval reactor plants. For several reasons, tritium does not pose a significant concern for Windsor Site release. In 1979, Windsor Site terminated discharge of all radioactive liquid effluents and commenced recycling all primary coolant. Tritium is an isotope of hydrogen in water and also occurs naturally in the environment. Chemically, tritium is the same as hydrogen, therefore, it does not concentrate. Rather, it diffuses in the environment commingling with naturally occurring hydrogen (including naturally occurring tritium). Tritium emits only very low-level beta radiation with consequently low impact on human health and the environment. As a result, the radioactivity concentration limit for tritium is at least one hundred times higher than for cobalt-60 (Reference G-1). For these reasons, tritium is not judged to be a remediation concern.

Carbon-14 is also formed in small quantities in reactor coolant systems as a result of neutron interactions with nitrogen and oxygen. This carbon is in the form of a gas, primarily methane and ethane as well as carbon dioxide, although some insoluble carbonates may be present. Carbon-14 is chemically indistinguishable from other isotopes of carbon and also occurs naturally (carbon-14 permits "carbon dating" of deceased organisms, since carbon-14 in dead matter decays and is not replenished). Gaseous releases are dispersed in the atmosphere and are not concentrated in the environment. Also, carbon-14 emits only low-level beta radiation with consequently low impact on human health and the environment. As a result, the radioactivity concentration limit for carbon-14 in its chemical form in air is sixty times higher than for cobalt-60 (Reference G-1). Furthermore, a study around a large civilian nuclear power plant showed no measurable carbon-14 in downwind foliage (Reference G-2). For these reasons, carbon-14 is not judged to be a remediation concern.

In addition to radioactive materials resulting from reactor plant operations and maintenance, other types of radioactive materials are also attributable to Windsor Site operations. These materials include very small radioactive sources used to check measuring equipment, and other radioactive sources used for nondestructive testing of reactor plant equipment; such materials will be removed. Finally, common commercial items containing Nuclear Regulatory Commission-exempt quantities of radioactive material, such as thoriated tungsten welding electrodes and smoke detectors, will be removed when their associated facilities are removed.

G.3 Summary of Radiological Controls Used While Performing Radiological Work

Stringent Naval Nuclear Propulsion Program radiological controls are invoked by trained personnel during all aspects of Program radiological work. Detailed radiological training is conducted for all personnel involved in radiological work document preparation, operations, maintenance, and management. Personnel responsible for monitoring radiologically controlled work undergo the most extensive radiological training. Training for all personnel generally includes lectures and mock-up training, followed by written tests, performance tests and, for some, oral examinations. Training and formal requalification programs are repeated regularly. Training emphasizes the concept that personnel responsible for monitoring the conduct of radiologically controlled work cannot ensure correct performance alone; everyone involved in radiological work must understand and adhere to the requirements. Lessons learned from Windsor Site experience were continuously incorporated into training plans and local instructions. To the maximum extent practical, Windsor Site also adopted radiological control improvements developed at other Naval Nuclear Propulsion Program sites and shipyards.

Radioactive materials at the Windsor Site are subject to stringent handling, inventory, and storage controls. Throughout Windsor Site history, selected site facilities were utilized for radiological work or controlled storage of radioactive materials in support of routine maintenance, overhauls and refueling work. Radioactive material storage areas at the Windsor Site are controlled to prevent the loss or misuse of radioactive materials. To prevent the spread of loose radioactive contamination, radioactive materials are packaged in yellow wrappings and labeled to clearly identify the item as radioactive. A radioactive material accountability system has been in effect at the Windsor Site since initial construction. The accountability system includes a formal logging system and regular inventory checks.

Extensive radiological surveys are conducted with the use of sensitive instruments designed to measure radioactivity. Radiological monitoring surveys associated with specific work activities are performed to identify radiological conditions before, during, and after execution of each related task. If unplanned conditions are encountered, the work is stopped. If needed, a cleanup is performed and engineering personnel make appropriate changes to work documents before the work resumes. Other radiological monitoring surveys are routinely performed in areas not associated with a specific task to confirm radiological conditions are as expected. These routine radiological monitoring surveys are performed most frequently in or near radiologically controlled areas. On the rare occasions when unexpected radiological conditions are encountered, affected areas are placed under additional controls until a cleanup is completed and the cause of any problem is corrected. Routine surveys of the environment are conducted and all Windsor Site facilities and work areas, including non-radiological areas, are surveyed at least annually. The results of environmental surveys and general surveys of the Windsor Site have demonstrated the success of the stringent Naval Reactors radiological control policies.

Written procedures, which include detailed instructions to prevent the uncontrolled spread of radioactive contamination, are prepared for all radiological work conducted at the Windsor Site. Verbatim compliance with work procedures is enforced during work performance by trained radiological control monitoring personnel. Any deviation from the written requirements requires documentation and implementation of appropriate corrective actions before work resumes.

Work at the Windsor Site on radiologically controlled equipment or systems with loose surface contamination has been performed contained at the work site using devices such as glovebag-type containments. This approach ensured that radioactivity was controlled within designated areas and was not free to spread to the environment. Packaged items are opened and worked within designated areas referred to as Controlled Surface Contamination Areas. A Controlled Surface Contamination Area is an area that surrounds a surface or contains loose beta-gamma contamination in excess of 450 picocuries per 100 square centimeters per swipe, as measured by a beta-gamma survey instrument. All Controlled Surface Contamination Areas are clearly designated with barriers and postings. Strict entry and exit controls are enforced to prevent the spread of contamination. Controlled Surface Contamination Areas are normally surrounded and bounded by a Radiologically Controlled Area, which is also posted. Entry to and exit from a controlled area is made through a designated location called a Control Point Area. A Control Point Area also provides a location for personnel monitoring (frisking). Monitoring is performed to ensure beta-gamma contamination is not affixed to personnel leaving the area. When a Controlled Surface Contamination Area is not bounded by a Radiologically Controlled Area, additional controls are implemented to ensure no spread of radioactivity from the Controlled Surface Contamination Area to personnel or surrounding areas.

Radiological control personnel make frequent checks of radiological work areas to ensure that all requirements are being met. In addition to checks by radiological control personnel, a knowledgeable individual from a separate and independent auditing organization periodically monitors various aspects of radiological work. This individual's responsibility includes surveillance of radiological work in progress. The findings recorded by this individual are regularly reported to senior site managers.

Radiological controls at the Windsor Site are overseen by Naval Nuclear Propulsion Program headquarters. Naval Nuclear Propulsion Program headquarters performs on-site biennial audits of Windsor nuclear work practices, including radiological controls, worker training, quality control, and compliance with work procedures and headquarters requirements. The Naval Nuclear Propulsion Program also maintains a field office at the Windsor Site, to oversee day-to-day activities.

Besides enforcing strict radiological controls during applicable work activities, Naval Reactors has placed emphasis on minimizing the generation of low-level radioactive waste and mixed waste. Naval Reactors has been successful at minimizing waste generation, as exemplified by Windsor Site's long history of small waste volumes. Techniques used include reuse of radioactively contaminated tools, a prohibition on unnecessary commingling of clean and contaminated materials, minimizing the amount of clean materials needed to perform work in a radiologically controlled area, and routine decontamination efforts while work is in progress.

G.4 Radiological Release Strategy

The following points summarize the overall strategy to confirm all radioactivity attributable to Windsor Site operations is removed to levels that support future unrestricted use:

- Conduct a detailed review of the use and radiological history of all facilities and areas at the Windsor Site. This review will include radiological survey records, operational records and problem reports, and interviews with senior employees familiar with former operations. Categorize Windsor Site facilities and areas to identify the necessary measurements and solid samples needed to confirm final radiological conditions. (See Section G.5 for further detail)

Execution of the following steps would be completed if the prompt dismantlement alternative is selected. If the deferred dismantlement alternative is selected, this process would also be deferred for 30 years.

- Remove all radioactive material from individual areas prior to performing the release survey for that area. In order to dispose of all radioactive equipment and material at Windsor Site and at the same time minimize the generation of radioactive waste, radioactively contaminated or potentially contaminated material and equipment will be made available at no cost to other organizations engaged in Naval nuclear propulsion work. Examples of these items are vacuum cleaners, test equipment, radioactive liquid processing tanks and hoses, and portable ventilation systems. Some equipment may be suitable for decontamination and surveyed for release per Naval Reactors radiological criteria. This will be done when appropriate to minimize radioactive waste. When possible, radioactive metals will be recycled for use in appropriate applications. Those items which are identified as radioactively contaminated waste which are not decontaminated and released, or recycled, will be packaged and shipped to a Department of Energy radioactive waste disposal site.

- After removal of all radioactive materials, perform radiological survey measurements and solid samples of buildings and areas. General technique details are provided in Section G.6. All results will be documented.

- If any areas are discovered that exceed Naval Reactors radiological release criteria, execute additional measurements and sampling to determine the extent of the contamination.

  - Remediate any radiologically contaminated areas to meet Naval Reactors radiological release criteria.

  - Reperform the required measurements and sampling to confirm the area does not exceed Naval Reactors radiological release criteria. All results will be documented.

- Where buildings that have a history of use for radioactive material storage or radiological work have been completely demolished, perform radiological survey measurements and sampling within the building footprint in accordance with the Radiological Survey Plan. In addition, surveys in accordance with the Radiological Survey Plan will be conducted upon removal of pavement in areas that had been used for storage of radioactive material.
  - If any areas are discovered that exceed Naval Reactors radiological release criteria, execute additional measurements and sampling to determine the extent of the contamination.
  - Remediate any radiologically contaminated areas to meet Naval Reactors radiological release criteria.
  - Reperform the required measurements and sampling to confirm the areas do not exceed Naval Reactors radiological release criteria. All results will be documented.
  - The State of Connecticut Department of Environmental Protection and the Environmental Protection Agency - Region I will be invited to comment on the building footprint surveys or surveys of building materials that remain.

- When removal of buildings and radioactive materials from the site is complete, execute a final set of radiological measurements and sampling to cover the entire Windsor Site. This survey will verify that no radioactive materials above release criteria remain on Windsor Site property. In addition to surveys of soil, this survey will confirm that ground water remains in a condition that supports the final unrestricted radiological release of the Windsor Site.

- The results of the Windsor Site's building footprint surveys and final Windsor Site verification surveys, including sample analyses, will be compiled in a report to document the final radiological conditions at the Windsor Site (see Section G.10 for further detail).

- The State of Connecticut Department of Environmental Protection and the Environmental Protection Agency - Region I will be invited to comment on the release report and perform their own independent confirmatory surveys.

G.5 Categorization of Windsor Site Facilities and Areas

Windsor Site areas and facilities have been categorized according to the potential for residual radioactivity based on radiological work history. The radiological work history of the Windsor Site is extensively detailed. Facility categorization took into consideration the past and present use of every Windsor Site area, reviews of past radiological surveys and operating records, and interviews with long-time employees. There are no known areas of radioactively contaminated soil or ground coverings on the Windsor Site. Surveys have been performed after infrequent spills of radioactive material to ensure cleanups have been thorough and complete. At least annually, searches for unidentified radioactive material are performed using sensitive survey instruments. These searches have always demonstrated the lack of unidentified contaminated areas at the Windsor Site. Additionally, an aerial survey (shown in Section 4.5.5.2 of this Environmental Impact Statement) performed in 1982 identified no unknown areas of radioactivity on or adjacent to the Windsor Site.

All areas of the Windsor Site, including the east and south paved parking lots and adjacent areas, will be surveyed and sampled prior to unrestricted release. Areas currently in use or previously used for radioactive work or radioactive material storage are listed and categorized according to their potential for having residual radioactivity. Areas with a higher potential for contamination will be surveyed more extensively than areas with a low potential for contamination.

Besides radioactive materials attributable to S1C Prototype reactor plant operations, the Windsor Site has used and stored other general radioactive materials such as radiographic sources used for nondestructive testing, and naturally occurring radioactive materials such as thorium in welding electrodes. Windsor Site radiological control requirements have included a long standing program for ensuring the integrity of radioactive sources. Historical records indicate there has been no detectable spread of radioactivity from any radioactive sources used at the Windsor Site. Areas which have a potential for residual radioactivity from the grinding of welding electrodes, which contain naturally occurring radioactive thorium, will be surveyed consistent with the strategy outlined in Section G.4.

Windsor Site facilities and areas have been categorized into six general groups as follows:

> Group 1 areas have no history of radiological work, radiological systems or radiological material transfers. General area surveys will be conducted to provide assurance that such areas contain no radiological materials.
>
> Group 2 areas have no history of radiological work and never contained radiological systems. However, Group 2 areas may have been utilized for transfers of contained radiological materials or may be located adjacent to higher risk areas (Groups 3 - 5). The highest probability of encountering radioactive contamination in Group 2 areas is on the floor or ground. Grid patterns will be established on floor or ground surfaces and detailed surveys performed.

Group 3 areas have a potential for having been contaminated to low levels of beta-gamma radioactivity (less than 1000 picocuries per 100 square centimeters). Particular attention will be paid to potential areas of contamination, such as walls below shoulder height, floors, and work areas. A complete survey of the floors and walls up to 6 feet will be performed. Group 3 areas include corridors and radiologically controlled areas in which contained contaminated materials were handled or stored.

Group 4 areas have a potential for having been contaminated to levels of loose beta-gamma contamination between 1000 - 10,000 picocuries per 100 square centimeters. A thorough survey will be made over all floor areas and all walls up to 12 feet vertically. For walls and ceiling more than 12 feet in height, representative surveys will be made. Selected floor covering will be removed, and selected wall joints will be opened for a survey along heavy traffic routes and previous work areas. Particular attention will be paid to areas with higher potential for contamination, such as walls and floors.

Group 5 areas, have a potential for having been contaminated to levels of loose beta-gamma contamination greater than 10,000 picocuries per 100 square centimeters. A thorough survey will be made of all floor areas and all walls up to 12 feet vertically. For walls and ceiling more than 12 feet in height, representative surveys will be made. Floor covering will be removed, and all wall joints will be opened for a survey.

Groups 4 and 5 compose less than 10% of the area to be surveyed at the Windsor Site.

Group 6 areas have a potential for having been contaminated to alpha contamination. Certain areas of the Windsor Site were used to store alpha emitting radioactive sources and materials with naturally occurring radioactivity (welding rods). A location-specific survey of the work surfaces used for storage of these materials will be performed. This classification is in addition to the classification for potential beta-gamma contamination.

Building surveys are designed to identify residual radioactivity in the building and define the bounds of any identified contamination so a complete cleanup can be accomplished. Additionally, sampling of the soil beneath buildings associated with radiological work (Groups 3 and above) and that have their foundations completely removed, will be performed after removal of the building foundation.

Ground water samples will be taken from beneath the Windsor Site, surface water and sediment samples will be taken adjacent to the site (Goodwin Pond), and soil samples will be taken on and adjacent to the Site. While no residual radioactivity is expected or likely in these locations, this final set of radiological measurements and samples will verify that these locations have no radioactive materials due to Windsor Site operations or dismantlement.

Soil samples adjacent to the Windsor Site will be taken in the immediate proximity of three below grade pipes which have the potential to contain low levels of radioactivity and which are on the Combustion Engineering, Inc. property used under a permanent easement or extend slightly beyond the easement boundary. One pipe extends to Goodwin Pond and was inactivated in 1959. One pipe extends just on to Combustion Engineering, Inc. property to the west of the Windsor Site and was also inactivated in the 1960s. The remaining pipe currently discharges storm water to the drainage brook, but was used to discharge water containing low levels of radioactivity until 1979, as discussed in Section 4.3.3 of this Environmental Impact Statement. When the pipes are removed during the dismantlement, soil samples will be taken at all end points, joints or other portions of the pipes that are not leak tight. Residual radioactivity, if present, will be removed consistent with the on-site release limits.

G.6 Summary of Radiological Survey Instrumentation and Measuring Techniques

This section provides a general description of the radiological survey instrumentation and measuring techniques that will be used for unrestricted release of Windsor Site facilities. All surveys will be conducted per Naval Reactors approved requirements. Not all survey techniques will be used for all group areas. Survey techniques are chosen based on the extent and type of radioactivity potentially present within the area.

1. Beta-Gamma Surveys

   This survey technique is used in Group 2-5 areas. Surveys will be made using an E-140N meter with a DT-304 probe or equivalent. These instruments are useful for detecting low levels of beta and gamma radiation. Surveys are made within ½ inch of all accessible surfaces within a grid, including attachments and depressions. Surveys are performed slowly (about 1 to 2 inches per second).

2. Gamma Scintillation Surveys - Narrow Energy Range (1.1 - 1.4 MeV)

   This survey technique is used in Group 2-5 areas. Surveys will be made using an IM-253 operating in the HV-1/PHA mode which detects low-levels of gamma radiation in a narrow energy range around the energy of cobalt-60 gamma radiation. Surveys are made within ½ inch of all accessible surfaces within a grid including attachments and depressions. Surveys are performed slowly (about 1 to 2 inches per second). Readings equal to, or exceeding, twice the natural background readings on the X1 range will be investigated and the cause identified. Any discernible increase above natural background on the X10, X100, and X1000 range will be investigated and the cause identified.

   Natural background is determined in the HV-1/PHA mode by measuring levels of similar building materials in analogous areas of the Windsor Site, based on environmental factors that affect natural background radiation levels. If an analogous building or area is not available at the Windsor Site, the building or area to be surveyed may be used for determination of its own background. In this case, background surveys will be performed outside of the building or at the perimeter of the building. The location selected for determining natural background levels will not have been affected by radioactive material handled by the Windsor Site. The background radiation level and background location for the gamma scintillation survey will be documented in the final facility status report for each area surveyed.

3. Gamma Scintillation Surveys - Wide Energy Range (0.1 - 2.1 MeV)

This survey technique is used in Group 3-5 areas. Surveys will be made using an IM-253 operating in the HV-2/GROSS mode which detects low-levels of gamma radiation over a wide energy range (0.1 - 2.1 MeV). Surveys are made within ½ inch of all accessible surfaces including attachments and depressions. Surveys are performed slowly (about 1 to 2 inches per second). Readings equal to, or exceeding, twice the natural background shall be investigated and the cause identified. Natural background will be determined in the HV-2/GROSS mode by measuring levels of similar building materials in analogous areas of the Windsor Site, based on environmental factors that affect natural background radiation levels. If an analogous building or area is not available at the Windsor Site, the building or area to be surveyed may be used for determination of its own background. Background surveys will be performed outside of the building or at the perimeter of the building. The location selected for determining natural background levels will not have been affected by radioactive material handled by the Windsor Site. The background radiation level and background location for the gamma scintillation survey will be documented in the final facility status report for each area surveyed.

4. Waist-Level Gamma Scintillation Survey - Narrow Energy Range (1.1 - 1.4 MeV)

This survey technique is used in Group 1 areas. Surveys of an area will be performed with a IM-253 operating in the HV-1/PHA mode for detecting gamma radiation in a narrow energy range around the energy of cobalt-60 gamma radiation. The surveys will be performed approximately three feet above the floor or ground. Any readings which exceed twice established background for that area shall be investigated and the cause identified.

5. Waist-Level Gamma Scintillation Survey - Wide Energy Range (0.1 - 2.1 MeV)

This survey technique is used in Group 1 areas. Surveys of an area will be performed with a IM-253 operating in the HV-2/GROSS mode which detects low-level gamma radiation over a wide energy range. The surveys will be performed approximately three feet above the floor. Any readings which exceed twice established background for that area will be investigated and the cause identified.

6. Alpha Survey

This survey technique is used in Group 6 areas. Surveys will be made using with a Ludlum 43-2 Alpha Survey Probe coupled with an E-140N or equivalent for detection of alpha radiation. Light contact will be maintained between the alpha probe and the affected surfaces within the grid, including attachments and depressions.

7. Gamma Analysis of Water Samples

Water samples will be analyzed using a multi-channel analyzer and a minimum detectable activity level of 2×10^{-8} microcuries per milliliter equivalent cobalt-60 will be attained. Sample results which exceed 1×10^{-7} microcuries per milliliter will be investigated and the cause identified.

8. Gamma Analysis of Solid Samples

Solid samples will be taken and will include potentially contaminated ground coverings (for example, asphalt or porous concrete) and building materials. Samples with gross gamma results greater than 1 picocurie per gram for solid samples and 3 picocuries per gram for paint samples will be analyzed for cobalt-60 specific radioactivity. A gamma energy spectrum analysis will be performed to determine whether any of the radioactive isotopes present are attributable to Windsor Site operations or result from naturally occurring radionuclides.

9. Gamma Analysis of Sediment/Soil

Soil samples will be analyzed using a multi-channel analyzer and a minimum detectable activity level of 0.25 picocuries per gram for radionuclides attributable to Windsor Site operations will be attained. If detectable activity above 1 picocurie per gram is measured, isotopic analysis will be performed on samples to characterize any residual radioactivity to investigate and identify the cause of the detectable activity.

G.7 Summary of the Naval Reactors Radiological Release Criteria

Naval Reactors radiological release criteria are at least as protective of human health and the environment as the criteria used by other agencies. Naval Reactors radiological release criteria provide assurance that final radiation exposure levels at the Windsor Site will be indistinguishable from normal background radioactivity. The first column of the following table shows Naval Reactor radiological release criteria that will be used for unrestricted radiological release of Windsor Site facilities areas. Radiological release criteria of other agencies are provided for comparison.

SITE RELEASE CRITERIA COMPARISON

Sample	NNPP	DOE	NRC	EPA
Surface (1) contamination	450 pCi/per frisk (about 20 cm^2)	NRC criteria used	2250 pCi/100 cm^2 (2) 6750 pCi/100 cm^2 450 pCi/100 cm^2	Not specified
Material samples	1 pCi/g (cobalt-60)	Varies, 5-15 pCi/g (3) (cobalt-60)	Not specified	Not specified
Paint samples	3 pCi/g	Not specified	Not specified	Not specified
Annual dose	Not specified (4)	30 mrem/yr (5)	15 mrem/yr (proposed) (6)	15 mrem/yr (proposed) (7)

ABBREVIATIONS:

DOE = Department of Energy
NNPP = Naval Nuclear Propulsion Program
NRC = Nuclear Regulatory Commission
EPA = Environmental Protection Agency

cm^2 = square centimeters
g = gram
mrem/yr = millirem per year
pCi = picocuries (10^{-12} curies)

NOTES:

1. The surface contamination limit is also used for release of items.

2. Nuclear Regulatory Guide 1.86 average, maximum and loose values, respectively. Disintegration per minute figures converted to picocuries for the purpose of comparison. Naval Nuclear Propulsion Program criteria are identical to the Nuclear Regulatory Commission criteria with the exception that the Naval Nuclear Propulsion Program does not allow the peak values.

3. Shippingport Atomic Power Station was decommissioned by the Department of Energy. Shippingport criteria were 5 picocuries per gram to a depth of 1 meter, and 15 picocuries per gram at depths greater than 1 meter.

4. Computer modeling using the RESRAD code demonstrates that if a large area were contaminated to a considerable depth with an average of 1 picocurie per gram cobalt-60, the exposure above background to later site residents would be less than 15 millirem per year. In fact, any residual radioactivity on the site would be restricted to small areas of past inadvertent releases which were cleaned up at the time. Since 1 picocurie per gram is used as a peak acceptance criteria for closure, rather than an allowable average, the expected exposure level to any subsequent site users would be substantially below 15 millirem per year (that is, orders of magnitude lower, as shown during the recent shipyard closure activities). It is worth noting that 1 picocurie per gram cobalt-60 is well below the level detectable by sensitive field survey instruments.

5. Proposed 10 CFR Part 834 rule-making.

6. Reference 3-4 of this Environmental Impact Statement.

7. Reference 3-5 of this Environmental Impact Statement.

G.8 Basis for the Naval Reactors Radiological Release Criteria

The radioactivity of interest at and adjacent to the Windsor Site consists of two parts: radioactivity attributable to Windsor Site operations and naturally occurring background radioactivity. Both constituents must be understood to quantify measurements and assess compliance to release criteria.

As discussed in Appendix A, Section A.1, background radioactivity is always present, regardless of location, and the levels vary widely from place to place. Background radioactivity must be considered when surveying for radioactivity and when establishing cleanup standards. The survey process must be able to distinguish the naturally occurring radioactivity from man made radioactivity.

There has been considerable national debate over the radiological release criteria and associated health risks from conditions at industrial facilities. The Nuclear Regulatory Commission and the Environmental Protection Agency have proposed or drafted similar standards of 15 millirem per year for radioactivity, but neither agency has enacted these standards. As discussed in Appendix A of the Environmental Impact Statement, the principle health risk from radioactivity is the potential of developing a cancer at a rate higher than statistically found in the US population from natural causes. The International Commission on Radiological Protection estimates a fatal cancer risk of 5 x 10^{-4} per man-rem. A risk of 10^{-4} = 1 chance in 10,000 over a lifetime. Assuming a linear relationship between radiation dose and risk of cancer the following can be concluded:

- There is a 10^{-2} theoretical lifetime fatal cancer risk from natural background radiation (approximately 300 millirem per year, or about 21 rem for a 70 year lifetime).
- There is a 5 x 10^{-4} risk theoretical lifetime fatal cancer risk from receiving 15 millirem per year above background radiation for a 70-year exposure scenario (about 1 rem). An exposure of 15 millirem per year is consistent with the proposed Nuclear Regulatory Commission and draft Environmental Protection Agency cleanup standards.

For perspective, the additional exposure a person receives due to naturally occurring radioactivity during three round trip airline flights from coast to coast of the United States amounts to about 15 millirem (Reference G-3). Also, a resident of Denver, Colorado receives on average 23 millirem per year more naturally occurring cosmic radiation than the average U.S. citizen simply due to the elevation of the city of Denver (Reference G-3). This does not include the increased naturally occurring terrestrial sources of background radiation in Denver and elsewhere, which can be substantially higher than the average across the United States.

Standard computer models used by the Environmental Protection Agency and the Nuclear Regulatory Commission, such as RESRAD, can be used to estimate the radiation dose from a residual cobalt-60 radioactivity concentration of 1 picocurie per gram distributed uniformly over a site the size of the Windsor Site (about 10.8 acres). The result is less than 15 millirem per year. The RESRAD program models the various pathways (such as ingestion, inhalation, and direct exposure) from which an individual could receive exposure from residual radioactivity.

Since the stringent Naval Reactors radiological controls have been highly effective at preventing the uncontrolled spread of radioactive contamination at all facilities, nearly all areas of the Windsor Site are expected to contain no residual radioactivity. The extent of soil remediation, if any, to meet the criteria of less than 1 picocurie per gram, is expected to be small. The annual dose at the Windsor Site following closure will be substantially less than 15 millirem per year based on highly conservative scenarios analyzed with the computer models and the fact that the average cobalt-60 concentration will be substantially below 1 picocurie per gram.

The Naval Reactors material sample criterion of 1 picocurie per gram is a very low, but practically measurable, concentration. Analysis sensitivity is a fraction of this limit. This limit is well below the natural background radioactivity in soil which often contains more than 10 picocuries per gram of naturally occurring radionuclides. Although the cobalt-60 concentration in soil will be lower than the naturally occurring radioactivity in the soil, cobalt-60 does not occur in nature, and hence is readily distinguishable from background when using sensitive laboratory gamma spectroscopy equipment. This criterion is lower than typical Department of Energy limits or Nuclear Regulatory Commission limits which have been specified.

The Naval Reactors surface contamination limit of 450 picocuries per frisk has been a conservative control limit since the 1960s. This limit is within the range of background radioactivity. Radioactivity at this low level contributes negligible exposure to personnel. This limit is comparable to the Nuclear Regulatory Commission Regulatory Guide 1.86 limits, as shown in the table in Section G.7.

Metal surfaces with potentially contaminated paint are not released for unrestricted use until the areas are inspected and samples do not exceed a concentration of 3 picocuries per gram. Paint has a different limit due to the practical difficulties of collecting large enough paint samples to detect 1 picocurie per gram. Since paint is thinly spread, paint at 3 picocuries per gram will result in radiation levels lower than other solid material at 1 picocurie per gram.

G.9 Quality Assurance Program

Key elements of the quality assurance program include data collection by trained personnel, use of calibrated instruments, use of written procedures, formal sample custody, independent audits, and sample analysis cross-checks.

The Windsor Site quality assurance program is supported by the Knolls Site Laboratory located in Schenectady, New York to validate Windsor Site radiological sample analysis data. On a quarterly frequency, the Windsor Site provides samples to the Knolls Site Laboratory for independent analysis. These samples consist of 50 to 60 randomly selected solid Windsor Site closure survey samples. Samples to date have included asphalt, concrete, and paint. On a semi-annual frequency, the Knolls Site Laboratory provides the Windsor Site with 10 "blind" samples (samples containing radionuclide concentrations unknown to the Windsor Site) which contain various concentrations of cobalt-60 known to the Knolls Site.

In addition, the Knolls Site Laboratory participates in interlaboratory quality assurance programs, conducted by the Department of Energy Environmental Measurements Laboratory and the Environmental Protection Agency Environmental Monitoring Systems Laboratory as discussed in the annual Knolls Atomic Power Laboratory Environmental Monitoring Report (Reference G-4).

Quality Assurance Surveys and Sampling

Quality assurance surveys and sampling will occur by repeating sampling and surveying of specific areas during Windsor Site radiological release efforts. These quality assurance measurements will occur in areas comprising 1 to 10 percent of the surveyed area.

Independent Surveys

The State of Connecticut Department of Environmental Protection and the Environmental Protection Agency - Region I will be invited to independently check the performance of the radiological survey process for unrestricted release of the Windsor Site.

G.10 Final Report

The final release report will be a comprehensive document that describes the survey and sampling process and includes detailed results from surveys of the final condition of the Windsor Site. The report will specify unique sample location identifications and will diagrammatically show all sample locations on maps. Results will include the radionuclides of concern, the sample media (air, water, soil, sediment, direct survey, etc.), and the concentrations or radiation levels measured. The significance of the results will be summarized. The report will be approved by Naval Reactors. The State of Connecticut Department of Environmental Protection and the Environmental Protection Agency - Region I will be invited to comment on the final report prior to publication.

REFERENCES

G-1 Nuclear Regulatory Commission regulations 10 CFR Part 20

G-2 G.Uchrin et al., *^{14}C Release from a Soviet-Designed Pressurized Water Reactor Nuclear Power Plant*, Health Physics, Volume 63, Number 6, December 1992.

G-3 Nuclear Council on Radiation Protection and Measurements Report No. 94, *Exposure of the Population in the United States and Canada from Natural Background Radiation*.

G-4 Knolls Atomic Power Laboratory, *Environmental Monitoring Report*, calendar year 1994, KAPL-4812.