UNITED STATES
DEPARTMENT OF THE NAVY

DRAFT ENVIRONMENTAL ASSESSMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED NAVAL REACTOR PLANTS FROM USS ENTERPRISE (CVN 65)

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enclosure to letter

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1. PURPOSE AND NEED

United States Navy (Navy) nuclear ships are decommissioned and defueled at the end of their useful lifetime, when the cost of continued operation is not justified by their military capability, or when the ship is no longer needed. The Navy is decommissioning the USS ENTERPRISE and must determine the method to use to dispose of the reactor plants, after the vessel is defueled. The Navy has removed the reactor compartments from 114 ships since 1986 at Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF) and placed these compartments at a designated Navy trench at the Department of Energy Hanford Site (Hanford). This ongoing program ensures secure cradle-to-grave management of the nuclear propulsion plants. This program was first described in the Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants (USN 1984) and updated and expanded in the Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants (USN 1996). In USN 1984 and 1996, the Navy evaluated many options for the disposal of reactor plants from various nuclear powered vessels. No new feasible alternatives have surfaced beyond those evaluated in these two documents. The Navy's chosen method, the removal of the reactor compartments at PSNS & IMF and the shipment of the reactor compartment packages to a designated Navy trench at Hanford (Trench 94), has been completed for 114 ships, and is the reasonable and preferred choice for reactor compartment disposal of ENTERPRISE.

Pursuant to the National Defense Authorization Act for Fiscal Year 2010, ENTERPRISE is expected to enter dry dock at Newport News Shipbuilding in Virginia for inactivation in 2013. Defueling will be conducted at Newport News Shipbuilding. Inactivation is expected to be complete in about 2017 or 2018. ENTERPRISE would arrive at PSNS & IMF in Bremerton, WA, under Navy tow, already defueled and inactivated. This Environmental Assessment evaluates the preferred alternative for disposal of reactor compartments from USS ENTERPRISE (CVN 65) at PSNS & IMF, within the Navy’s ongoing program of reactor compartment disposal. Under this alternative, ENTERPRISE reactor compartments would be prepared at PSNS & IMF, transported to the Department of Energy Hanford Site, and be placed at Trench 94 for land disposal consistent with the ongoing program. Reactor compartment disposal of ENTERPRISE could commence as early as 2018 or 2019 under the preferred alternative and is expected to take six to eight years, with shipments of reactor compartments to Hanford occurring in the final two (2) to 2 ½ years of this period (likely between 2023 and 2027).

Much description and analysis in USN 1996 is common to all Navy reactor compartments and their disposal, including ENTERPRISE, and is summarized (when relevant to ENTERPRISE) in this Environmental Assessment and referenced back to USN 1996 for additional detail.

In parallel with the reactor compartment disposal program, the Navy recycles the remnant sections of ship hull at PSNS & IMF, totaling 114 ships to date. This program was initiated for submarine hulls by the Environmental Assessment of USN 1993. Subsequent reviews for surface ship hull recycle, including ENTERPRISE Class, have concluded that there would not be a significant change from the current recycle program. Many of the processes discussed for reactor compartment disposal apply as well to remnant hull recycle. Remnant hull recycle supports reactor compartment disposal in allowing an efficient clearing of the dry dock to allow loading of the reactor compartment packages onto barges. Remnant hull recycle is discussed to present the complete picture of how the disposal occurs.

1.1 Background

USS ENTERPRISE, the Navy's first nuclear powered aircraft carrier, was commissioned in 1961 and has operated for nearly 50 years. ENTERPRISE is the oldest operating ship in the U.S. Navy, is the second oldest vessel still in commission after the three-masted frigate USS CONSTITUTION, and will reach the end of her useful life in 2012.

U.S. Navy nuclear powered ships are defueled during inactivation and prior to reassignment of the crew. The defueling removes the nuclear fuel from the reactor vessel and consequently most of the radioactivity from the reactor plant. Defueling is routinely accomplished using established procedures at shipyards qualified to perform reactor servicing work. Removed spent fuel is handled in accordance with standing National Environmental Policy Act documents for spent fuel (USN 1994, DOE 1995, USN 2009). The decision to dispose of a reactor compartment is a separate action that irreversibly destroys the ship, representing the closing of a cradle-to-grave management of the reactor plants. Since 1986, the Navy has disposed of 122 reactor compartments from 114 nuclear powered ships (the remaining ship's hulls have also been dismantled and useable metals recycled). USN 1996 described the reactor compartment disposal program in depth, but did not include aircraft carriers in its scope. It is now proposed that reactor compartment disposal for ENTERPRISE would be comparable to the LONG BEACH cruiser class evaluated in USN 1996, and much distinguished from the newer NIMITZ class carriers. ENTERPRISE has eight reactors in four pairs of reactor compartments. These eight reactor compartments, when separated, are similar in size and content to those of the LONG BEACH, and would result in reactor compartment packages of similar size, weight and content to the LONG BEACH. Preparation and transport of the LONG BEACH was discussed in USN 1996. By contrast, the newer NIMITZ class carriers have only two large reactor compartments, which if disposed of in two packages, are expected to result in packages substantially heavier and larger than any reactor compartment package analyzed in USN 1996. A method to transport these reactor compartments, in particular land transport, has not been evaluated at this time (NIMITZ Class is outside the scope of this document) but would likely be substantially different than evaluated in USN 1996.

Due to the similarity between ENTERPRISE reactor compartment packages and those of the LONG BEACH, and commonality in Navy reactor plant design, much of the content of USN 1996 encompasses the ENTERPRISE reactor compartment packages and describes their disposal. Section 1.2 of USN 1996 provides a general discussion of Navy reactor plants. In summary, naval reactor plants are composed of corrosion resistant nickel iron alloys. Naval reactor fuel is designed, built, and tested to ensure that fission products remain contained within the fuel. After defueling, about 99.9% of the remaining radioactivity in the reactor plant is within the corrosion resistant structural alloys forming the plant as activated atoms of iron and other elements within the metal alloy. The remaining 0.1% is smaller particles deposited within the corrosion resistant piping system internals of the reactor plant. In addition, virtually all (> 99 %) of this radioactivity, including long lived radioactivity of 100 year half-life or greater, is contained within the reactor vessel itself.

Table 1.1 of this Environmental Assessment shows radionuclides representing 1% or greater of total radioactivity for the ENTERPRISE reactor plants as compared to the reactor plants of USN 1996. The ENTERPRISE reactor plants add about 3% cumulatively to the radioactivity presented by the USN 1996 plants, at 5 years after shutdown (assuming a hypothetical case for comparison where it would be possible to dispose of all the USN 1996 plants at once) and less than 1% cumulatively at 500 years later. Cobalt-60, a strong gamma emitter, remains the major source of radiation but is almost completely decayed in 50 years. Ni-63 remains after 500 years but is a weak beta emitter. At 2000 years, less than 0.1 curies of total Ni-63 would remain in the reactor compartment packages from all eight ENTERPRISE plants. Radioactivity presented for ENTERPRISE is determined by the same method of appendix D of USN 1996 as cited for the USN 1996 plants. This method remains valid for the ENTERPRISE (section 4.3.7.3 of this Environmental Assessment relates).

Long lived radioactivity (100 year half-life or greater) is also present within very corrosion resistant alloys within the reactor vessel, but contributes little to total radioactivity in ENTERPRISE plants, as is the case with other reactor plants already analyzed. Table 1.2 shows long lived radioactivity for all eight ENTERPRISE plants as compared to the 100 reactor plants of USN 1996. The ENTERPRISE reactor plants would add less than 3% cumulatively to the USN 1996 plants for the long lived radionuclides presented. As described in USN 1996, the ENTERPRISE long lived radioactivity would be released from within corrosion resistant alloys at a very low rate such that substantial decay would occur prior to release and activated metallic elements such as nickel and niobium would be captured in the soil under Trench 94, greatly retarding the movement of what is released (e.g., Ni-63 would decay fully before reaching groundwater). Section 4 of this Environmental Assessment provides additional details.

The eight ENTERPRISE reactor compartments would be similar in size, shape, weight, and content to those of the LONG BEACH, discussed in USN 1996. Similarly, the ENTERPRISE reactor compartments would be regulated as dangerous waste in Washington State under the Washington Administrative Code (WA 1996)(WAC 2009) for the presence of solid lead radiation shielding, but not regulated as lead waste under federal law (40 CFR), because the lead is serving its useful purpose (as radiation shielding). They would also be considered PCB Bulk Product Waste under federal law (40 CFR 761) for the presence of non-leachable PCB within solid materials such as rubber and paint.

TABLE 1.1
RADIOACTIVITY BY INDIVIDUAL RADIONUCLIDE PRESENT IN ENTERPRISE REACTOR PLANTS COMPARED TO CRUISER, LOS ANGELES, AND OHIO CLASS REACTOR PLANTS FIVE YEARS AFTER FINAL REACTOR SHUTDOWN (DEFUELED) AND 500 YEARS LATER

Radionuclide	iron-55	cobalt-60	nickel-63	Listed Radionuclides
Half-life (years)[b]	2.69	5.27	100	NA
Radiation Emitted[c]	X-rays, e^-	gamma, $beta^-$	$beta^-$	NA
Initial Radioactivity Five Years After Final Shutdown (curies)[a, d]				
ENTERPRISE Plant	1.1×10^3	2.2×10^3	8.8×10^3	1.2×10^4
Cruiser, Los Angeles, and Ohio Class Plants[e]	$5.2 \times 10^2 – 5.0 \times 10^3$	$1.7 \times 10^3 – 6.2 \times 10^3$	$7.5 \times 10^3 – 3.7 \times 10^4$	$1.1 \times 10^4 – 4.7 \times 10^4$
Cumulative:				
ENTERPRISE (8 Plants)	8.8×10^3	1.8×10^4	7.0×10^4	9.7×10^4
Cruiser, Los Angeles, and Ohio Class (100 Plants)[e]	1.8×10^5	5.0×10^5	2.4×10^6	3.1×10^6
Radioactivity 500 Years Later (curies)[d]				
ENTERPRISE Plant	$<1 \times 10^{-10}$	$<1 \times 10^{-10}$	2.8×10^2	2.8×10^2
Cruiser, Los Angeles, and Ohio Class Plants[e]	$<1 \times 10^{-10}$	$<1 \times 10^{-10}$	$2.4 \times 10^2 – 1.2 \times 10^3$	$2.4 \times 10^2 – 1.2 \times 10^3$
Cumulative:				
ENTERPRISE (8 Plants)	$<1 \times 10^{-10}$	$<1 \times 10^{-10}$	2.2×10^3	2.2×10^3
Cruiser, Los Angeles, and Ohio Class (100 Plants)[e]	$<1 \times 10^{-10}$	$<1 \times 10^{-10}$	7.5×10^5	7.5×10^5

a: radionuclides listed represent 1% or greater of total curies at five years after shutdown; long lived radioactivity representing less than 1% of total curies is discussed in Section 4.
b: KOCHER, 1981.
c: e^- represents (negatively charged) electrons emitted from orbital shells around the atomic nucleus.
d: decay constant=0.693/(half-life of radionuclide in years)
e: USN 1996 (adjusted to five years of decay after shutdown)

TABLE 1.2
LONG LIVED RADIOACTIVITY BY INDIVIDUAL LONG LIVED RADIONUCLIDES PRESENT IN ENTERPRISE REACTOR PLANTS COMPARED TO CRUISER, LOS ANGELES, AND OHIO CLASS REACTOR PLANTS FIVE YEARS AFTER FINAL REACTOR SHUTDOWN (DEFUELED)

Radionuclide	carbon-14	nickel-59	niobium-94	technetium-99	iodine-129
Half-life (years)[a]	5,730	75,000	20,300	213,000	15,700,000
Radiation Emitted[a]	$beta^-$	X-rays, e^-	gamma, $beta^-$	$beta^-$	X-rays, $beta^-$, e^-
Cumulative Radioactivity Five Years After Final Shutdown (curies):					
ENTERPRISE (8 Plants combined)[b]	3.4×10^0	6.2×10^2	1.3×10^0	5.6×10^{-2}	3.1×10^{-9}
Cruiser, Los Angeles, and Ohio Class (100 Plants combined)[c]	3.8×10^2	1.9×10^4	7.1×10^2	2.3×10^0	2.0×10^{-6}
ENTERPRISE Plants Radioactivity as a Percentage of Cruiser, Los Angeles, and Ohio Class Plants	<1%	3%	<1%	2%	<1%

a: KOCHER, 1981.
b: calculated by the method of USN 1996, Appendix D
c: USN 1996 (adjusted to five years of decay after shutdown)

2. ALTERNATIVES

The following sections discuss in detail the preferred alternative for disposal of the ENTERPRISE reactor compartments as well as the No-Action Alternative. The discussion includes estimated costs for the two alternatives.

2.1 Preferred Alternative – Disposal of the Entire Reactor Compartment at Trench 94 at the Department of Energy Hanford Site

In the preferred alternative the reactor compartments would be prepared for shipment at Puget Sound Naval Shipyard and Intermediate Maintenance Facility, shipped to and disposed of at Trench 94 at the Department of Energy Hanford Site in the State of Washington.

The packaging, transportation, and disposal of the ENTERPRISE reactor compartments would use the same proven processes that have been successfully used for the pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartments for the past twenty four years. Separating paired reactor compartments for disposal is not new to PSNS & IMF, having done this for disposal of the pre-LOS ANGELES Class submarine TRITON, which had two reactors. The scale of this work is larger for ENTERPRISE and is discussed further in section 2.1.1.3.

2.1.1 Preparations for Shipment

2.1.1.1 Liquid Removal

The piping, tanks, and fluid system components that would remain within the reactor compartment package would be drained to the maximum extent practical considering as low as reasonably achievable (ALARA) principles for controlling worker radiation exposure. Federal radiation exposure guidelines require that nuclear work be accomplished in a manner that keeps radiation exposure to workers and the public as low as reasonably achievable (10 CFR 20).

The following steps would be taken to achieve the goal of removing liquids in the packages to the maximum extent practical while minimizing the amount of work performed within the reactor compartment to reduce worker radiation exposure. Liquids existing in piping systems external to the reactor compartment bulkheads would be removed by draining from existing valves at low points, dismantling of the piping systems, or equivalent method. Liquids existing in piping systems internal to the reactor compartment bulkheads would be removed by draining from existing valves at low points, pumping out, "blowing down" using compressed gas, or equivalent method. Liquids in the reactor vessel and primary shield water tanks would be removed to the maximum extent practical by pumping or equivalent method. A non-biodegradable absorbent would be added to reactor vessels and primary shield water tanks to absorb any liquids in those locations. Washington State Department of Ecology agreed that this draining methodology is in compliance with WAC 173-303 (WA 1996).

Any additional draining operations could only be accomplished by performing difficult draining tasks within radiation areas and would result in a considerable increase in hours that workers would be exposed to radiation. Removal of the small quantity of liquid remaining within the reactor compartment package would not be warranted because the increase in radiation exposure to the workers would be in conflict with ALARA guidelines, and would not result in any measurable benefit to the quality of the environment.

The radioactive liquids from the reactor plant would be collected, stored, processed, and disposed of as discussed in section 2.1.1 of USN 1996. For ENTERPRISE, filtered radioactive material would likely be disposed of at the US Ecology Site on the Department of Energy Hanford Site, consistent with the disposal of radioactive low level waste generated in the State of WA under the Northwest Interstate Compact on Low Level Radioactive Waste Management. Section 4.3.1, ‘Hazardous Materials’, of this Environmental Assessment provides additional detail on the management of radioactive potassium chromate solution from the reactor plant.

2.1.1.2 Radiation Exposure

Since its inception, the Naval Nuclear Propulsion Program has emphasized the reduction of personnel radiation exposure. The control of radiation exposure to Shipyard workers is discussed in the annual report NT-10-2, “Occupational Radiation Exposure from U.S. Naval Nuclear Plants” issued by the Navy (NNPP 2010). USN 1996, section 4.1, also provides additional discussion that applies to reactor compartment disposal of ENTERPRISE.

The reactor compartment packaging work would involve draining fluid systems, cutting and sealing piping, removing components, and installing packaging and handling fixtures, similar to past reactor compartment disposals. For ENTERPRISE, the paired reactor compartments would also be separated by cutting through a structural space between the two reactor compartments. This would require removal of additional lead shielding as well as a primary plant component, in addition to more typical package work (section 2.1.1.3 relates). About 300 rem of collective radiation exposure (to the entire workforce involved) has been estimated to prepare the eight ENTERPRISE reactor compartment packages, or 0.1 latent cancer fatalities total based on one (1) latent cancer fatality per 2500 rem of worker exposure. Additional analysis can be found in section 4.3.1 of this Environmental Assessment. For comparison, the disposal of the reactor compartments evaluated in USN 1996 (summary and table 2.1 of the subject EIS) was estimated to be 1500 rem, or 0.6 latent cancer fatalities total (Shipyard collective exposure at one (1) latent cancer fatality per 2500 rem of occupational exposure). These doses would be spread through the work force such that an individual workers exposure would be typically limited to 0.5 rem (0.0002 latent cancer fatalities) per year and less than 2 rem (0.0008 latent cancer fatalities) in one year as a worst case.

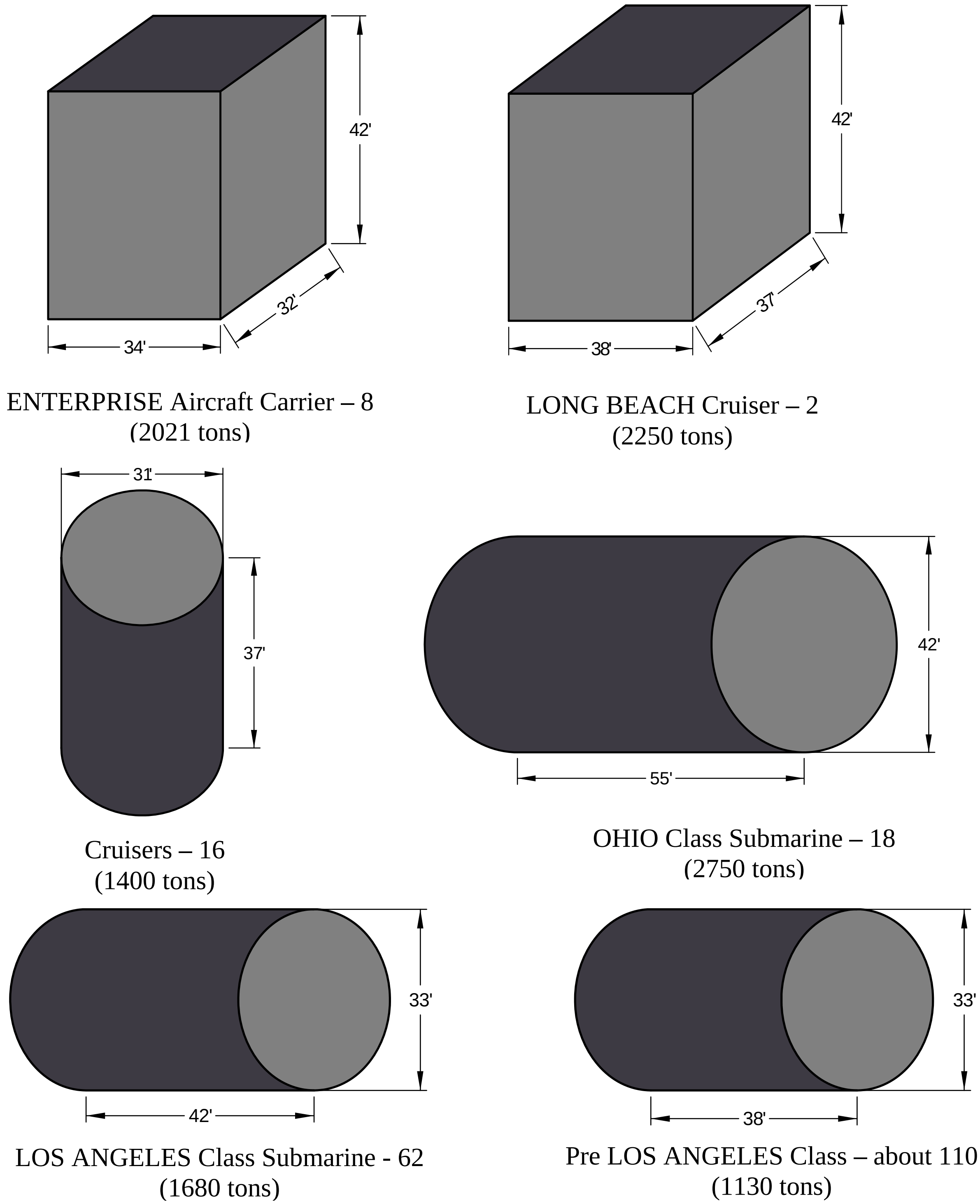
2.1.1.3 Equipment Removal and Package Containment

The process of removing equipment and material (including hazardous material) from ENTERPRISE during reactor compartment disposal would be similar to that described for cruisers in section 2.1.1.3 of USN 1996. As described in USN 1996, asbestos is found in the insulation of pipes and other components, including the reactor plant, and would be fully contained within the reactor compartment package. Wool felt sound damping is considered to contain liquid PCB and would be removed from the reactor compartments along with electrical equipment containing liquid PCBs and disposed of under 40 CFR 761. The remaining PCBs in Navy reactor compartment packages are in a solid, non-leachable form (rubber, plastic and paint) and are considered ‘PCB bulk product waste’ under 40 CFR 761 (EPA 1999). Lead is found in Navy reactor compartment packages, primarily as canned (inside a metal jacket) radiation shielding, ballast, and paint. If ballast lead is found, it will be removed from the reactor compartment packages per agreement with the State of Washington. Permanently installed ship’s shielding lead would remain in the reactor compartment packages except for some shielding that must be removed to construct the package. The remaining lead is regulated as a state-only dangerous waste under Washington State law (WAC 2009) but is not regulated as a hazardous waste under federal law (40 CFR).

The process of removing the ENTERPRISE reactor compartments from the ship and constructing the packages would be similar to that described for cruisers in section 2.1.1.3 of USN 1996. However, ENTERPRISE can only fit into the largest dry dock at PSNS & IMF. This dry dock is normally reserved for active aircraft carrier maintenance and must remain free for that work. To minimize the time required in the large aircraft carrier dry dock, interferences inside the ship in the way of the bow and deck cutting operations could be removed while ENTERPRISE is pier side. A barge may be positioned temporarily next to ENTERPRISE to aid in material removal while it is pier side. In the large carrier dry dock, the cut areas of hull would be resealed, external surfaces cleaned, and the ship then re-floated into a smaller dry dock better configured for reactor compartment disposal and remnant hull recycle. To facilitate this docking, a number of actions may be taken to guide the hull into the smaller dry dock, including installing bumpers or rollers in the dry dock, placing concrete or steel fender piles (overlaid with rubber) into the water at the dock entrance, or temporarily placing floating barges into place at the dock entrance until the docking is complete.

The ENTERPRISE reactor compartments would be separated by cutting through a structural space between the paired reactor compartments. Separating paired reactor compartments for disposal is not new to PSNS & IMF, as this was done for disposal of the pre-LOS ANGELES Class submarine TRITON, which had two reactor compartments that shared a common wall. The scale of this work is larger for ENTERPRISE and will involve additional lead shielding removal and, as was completed for TRITON, the removal of an interfering primary plant component. Sections 4.3.1, 4.3.7.2, and 4.3.7.5 of this Environmental Assessment provide related discussion and analysis.

A containment structure would be built around the reactor compartments, enclosing them to form a package, similar in concept to cruiser reactor compartment packaging. Handling fixtures would be welded to the package. Figure 2.1 compares the size of various reactor compartment packages. While the packages are being constructed, the ship would be on a combination of



Note: Dimensions (may be increased by up to 10%) and weights are approximate. Current projected quantities.

Figure 2.1. Comparison of Reactor Compartment Packages (from Figure 2.1 of USN 1996)

blocks and track mounted cradles that are designed to support and move the reactor compartments away from each other and the ship.

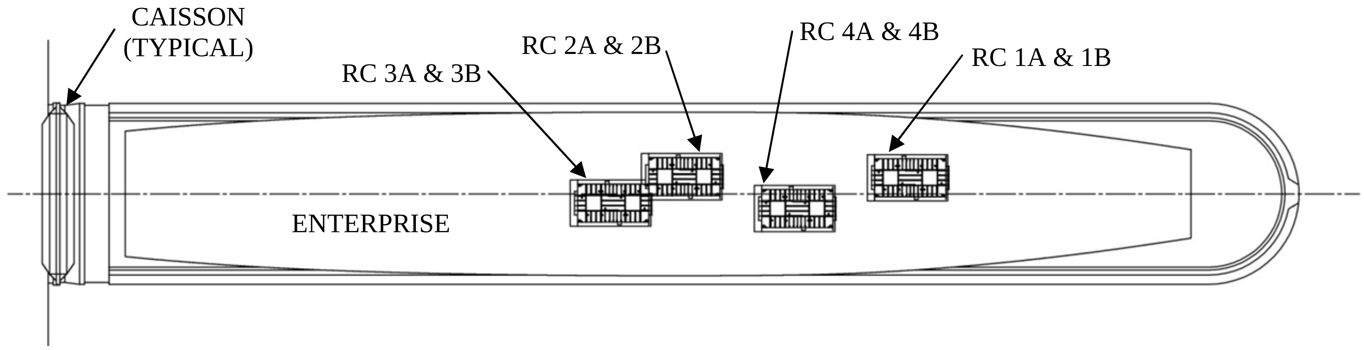
The ENTERPRISE would be dismantled around the reactor compartments to allow for separating and packaging the reactor compartments. The remainder of the ship (remnant hull) would also be dismantled with re-useable metals recycled to allow the separated reactor compartment packages to be moved onto transport barges. At the end of this recycle process, only the packaged reactor compartments would remain in the dry dock. Dedicated material bridges from the hull to the dry dock apron would be utilized, as was done for the cruisers of USN 1996. Material would be removed from ENTERPRISE via these bridges for ultimate disposal. Services and material handling equipment used for the current program would be adapted for ENTERPRISE, in sufficient quantity and capacity for the material removed. A six to eight year period in dry dock is estimated for completion of the metal/material processing required for reactor compartment disposal and remnant hull recycle of ENTERPRISE.

2.1.2 Transport

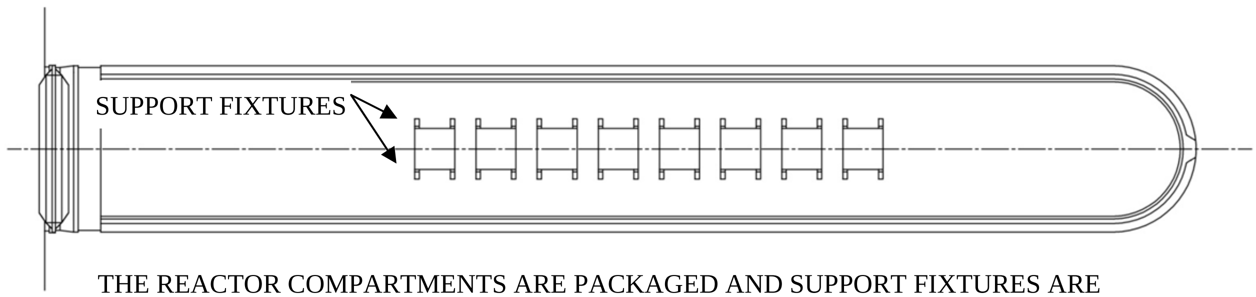
The Navy has transport barges that have been specially modified for transporting the pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartment packages. These barges are reinforced ocean-going barges. Support bulkheads have been installed to carry the reactor compartment package load in the center of the barge. Additional structural modifications are necessary for one of the barges to transport the LONG BEACH reactor compartment packages. These modifications would precede the ENTERPRISE reactor compartment disposal. This modified barge would then be used for ENTERPRISE. An additional barge may be modified to provide flexibility in scheduling shipments of the ENTERPRISE reactor compartments. The barges are maintained to both Navy and commercial standards and are inspected by the American Bureau of Shipping and the United States Coast Guard on a regularly scheduled basis. The same strict criteria would be used for the barge that transports the ENTERPRISE reactor compartment packages.

After the reactor compartment packages are sealed and prepared for shipment, they are moved to locations in the dry dock to allow for placement of the transport barge. For example, seven packages could be moved to the north side of the dry dock while one is placed for loading onto the barge. The barge would be placed next to the package. The package would be loaded onto the barge using the same methods as described in section 2.1.2 of USN 1996. In summary, Figure 2.2 shows the ENTERPRISE reactor compartment packages being loaded onto the transport barge from the side. It may be necessary to load the packages onto the transport barge from the end. The same high capacity hydraulic jacks that would be used for loading the LONG BEACH reactor compartment packages would be re-used for ENTERPRISE. The ENTERPRISE packages would be equipped with salvage slings and associated connectors similar to the cruiser packages transported under the current program.

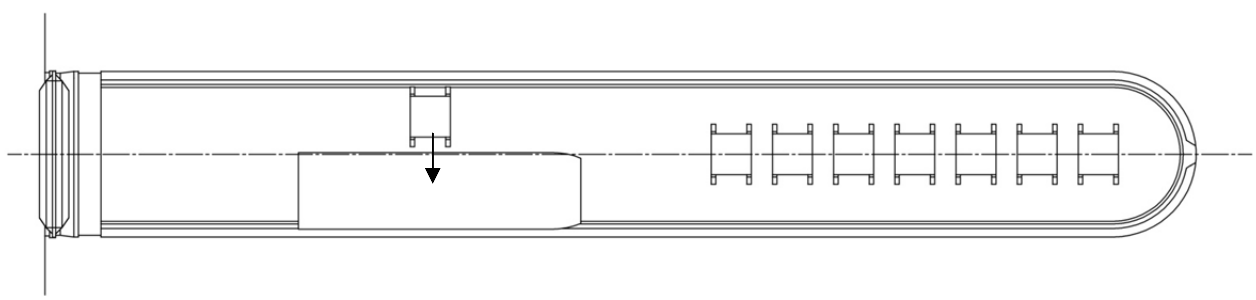
The ENTERPRISE reactor compartment packages would be towed and escorted from PSNS & IMF to a barge slip on the Columbia River near Richland using the same process as



SHIP IS PLACED IN DRYDOCK AND THE REACTOR COMPARTMENTS ARE CUT FROM THE SHIP AND SEPARATED FOR PACKAGING. THERE ARE FOUR PAIRS OF REACTOR COMPARMENTS. CONCEPT: THE TWO REACTOR COMPARTMENTS IN EACH PAIR ARE SEPARATED AND PACKAGED SEPARATELY FOR A TOTAL OF EIGHT PACKAGES FROM THE SHIP.



THE REACTOR COMPARTMENTS ARE PACKAGED AND SUPPORT FIXTURES ARE INSTALLED. THE PACKAGES ARE POSITIONED SO CENTERLINES ARE ALIGNED TRANSVERSELY IN THE DRYDOCK.



ONE REACTOR COMPARTMENT IS POSITIONED FOR PLACEMENT ONTO THE BARGE. THE REMAINING REACTOR COMPARTMENTS ARE POSITIONED AT THE END OF THE DRYDOCK. THE BARGE IS PLACED IN THE DRYDOCK ALONGSIDE THE PACKAGE. THE BARGE IS LOADED AND PREPARED FOR SHIPMENT. THIS PROCESS REPEATS FOR THE REMAINING SEVEN REACTOR COMPARTMENTS.

Figure 2.2. ENTERPRISE Reactor Compartment Barge Loading Concept

described in section 2.1.2 of USN 1996 and used for the current program. In summary, the tow would be accompanied by a back-up tug and a Navy or Coast Guard escort vessel. Figure 2.3 shows the transport route. The transport route would be the same as used for the pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartment packages. The waterborne transport route follows the normal shipping lanes from PSNS & IMF in Sinclair Inlet, through Rich Passage, past Restoration Point, and northerly through the Puget Sound. The route is then westerly through the Strait of Juan de Fuca (staying south of the inbound Vessel Traffic System lane when transiting out the Strait of Juan de Fuca to remain in U.S. waters), around Cape Flattery, south along the Washington coast (outside the Olympic Coast National Marine Sanctuary Area to be Avoided) to the mouth of the Columbia River. The route is then up the Columbia River, following the shipping channel used for the regular transport of commercial cargo. Shipments would be scheduled to avoid the less favorable ocean weather and sea conditions that occur in the late fall and winter. Shipments would not depart PSNS & IMF during the months of November through February, and also during the time of spring flood on the Columbia River.

In addition to the backup tug, there is also a rescue tug stationed at Neah Bay that could assist the towing vessel at Cape Flattery in the event it is disabled. This rescue tug is contracted by the Washington State Department of Ecology for maritime traffic and is not a part of the reactor compartment package transport process. This tug is not required or relied upon for reactor compartment transport.

The river route passes through the navigation locks at the Bonneville, The Dalles, John Day, and McNary dams as shown in Figure 2.3. The time from departure at PSNS & IMF to arrival at the Port of Benton would be approximately three days. To ensure the reactor compartment packages cross the Columbia River bar on an incoming tide, departure times from PSNS & IMF would be calculated to arrive at that time.

The overhead obstructions along the transport route are described in section 2.1.2 of USN 1996. The lowest point on the 115 kV Benton County Public Utility District power line was stated as 25 meters (82 feet) above the water with a McNary pool elevation at 104 meters (340 feet). The actual height of this line above water is about 79 feet above the water at a pool elevation of 340 feet. This height still provides over 30 feet of clearance above the ENTERPRISE reactor compartment packages. The most restrictive overhead clearance is the Pasco, South 10th Avenue bridge (known as the Cable Bridge) at river mile 328.4 with a vertical clearance of 16.9 meters (55.4 feet) from the navigation light mounted 0.6 meter (2 feet) under the bridge at the center of the navigation channel to the water at pool elevation of 340 feet. This would result in a minimum 0.6 meter (2 feet) of clearance from the top of the package to the navigation light if the tow proceeded up the center of the navigation channel and a minimum 1.3 meters (4 feet) of clearance to the bridge itself. Traversing under the bridge at 20 feet off center from the navigation channel would miss the navigation light entirely. In addition, the pool height in this area can be several feet below 340 feet due to upstream dam operations, which would add to the above clearances. These clearances also assume an ENTERPRISE package height at the upper

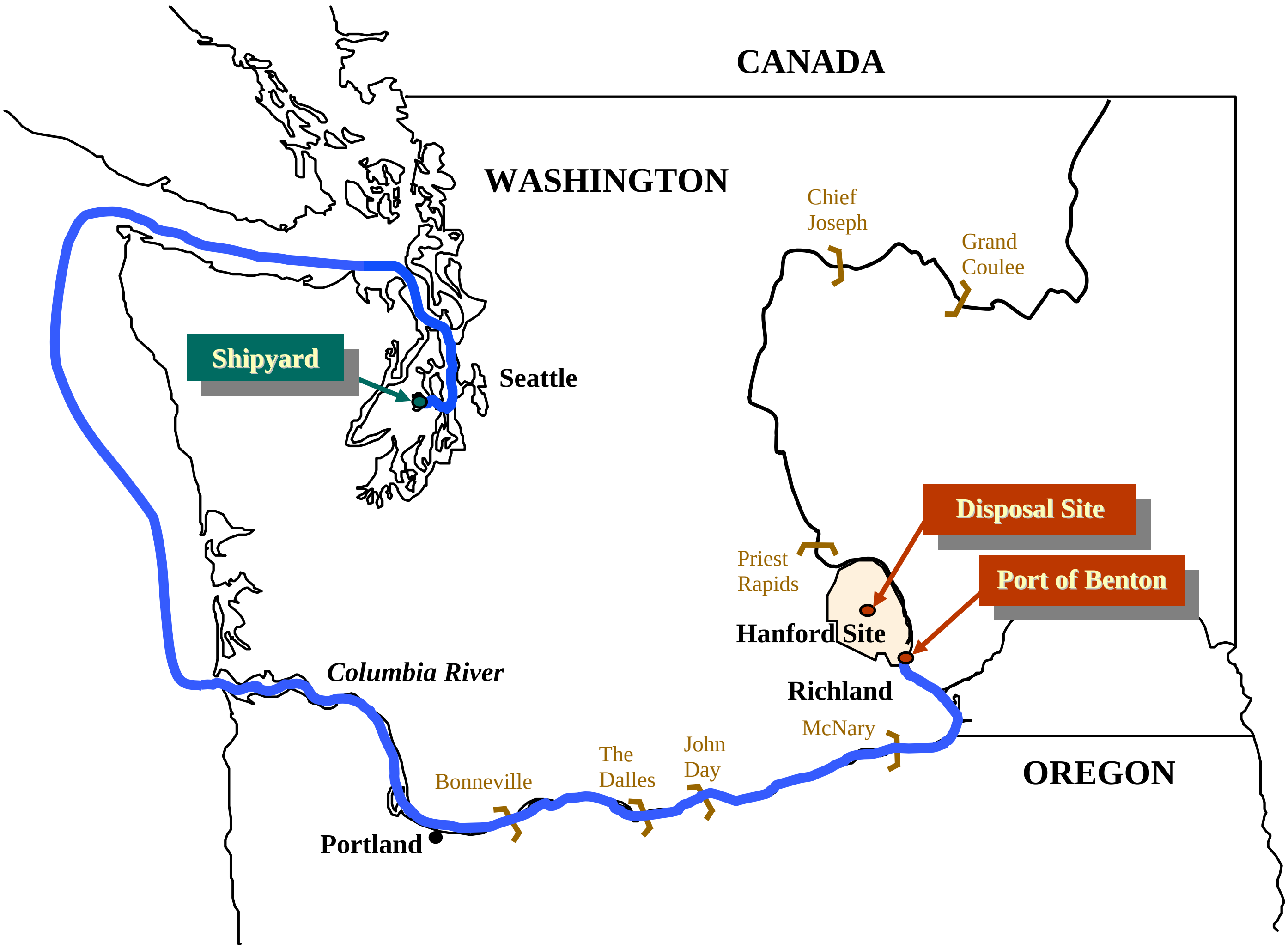


Figure 2.3. Reactor Compartment Package Transport Route

end of the range provided in Figure 2.1 (42 feet plus 10% rounded up to 47 feet total for conservatism). Lower package heights would add additional clearance.

The ENTERPRISE reactor compartments would be offloaded at the Port of Benton barge slip at river mile 342.8 using a method similar to that described in section 2.1.2 of USN 1996. The current process involves grounding the transport barge, cutting the reactor compartment package to barge attachment welds, jacking the packages and placing them on steel columns, and loading the transport vehicle. The variation for ENTERPRISE and possibly the Long Beach and Ohio packages discussed in USN 1996, involves moving the packages off the barge to land first, and then jacking and placing them on the transporter as opposed to jacking on the barge deck. This option may be driven by loads on the transport barge structure.

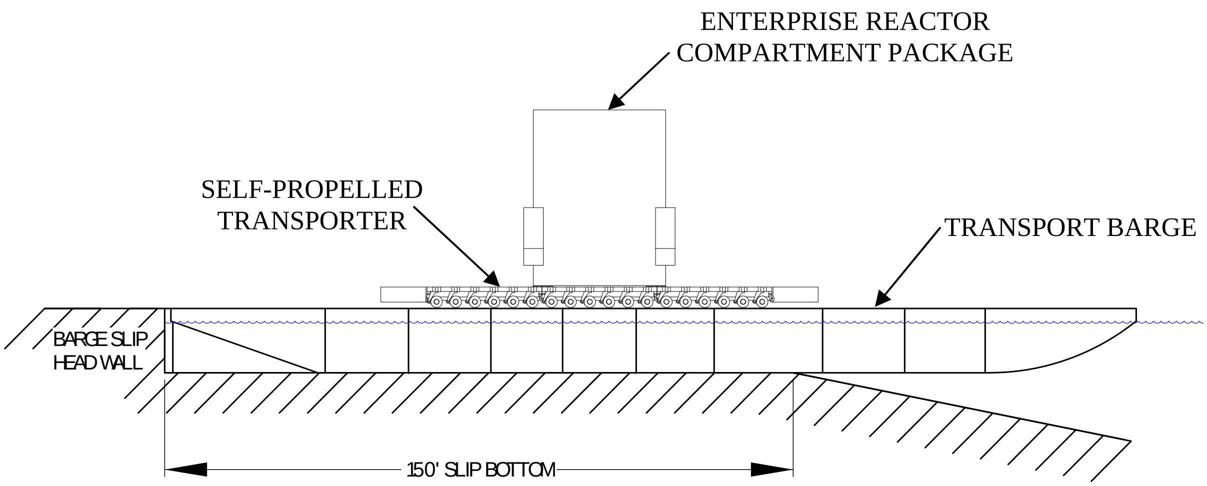
Pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartment packages are currently transported using a towed type transporter. The ENTERPRISE packages, along with other heavier packages from the OHIO Class and LONG BEACH, would likely use a self-propelled transporter since this type of transporter would have a higher load capacity than towed type transporters. Figure 2.4 of this Environmental Assessment shows an off-loading concept with a self-propelled transporter.

2.1.3 Land Transport Route

The ENTERPRISE reactor compartments would be transported from the Port of Benton barge slip to Trench 94 at the Hanford Site using the same process and route as described in section 2.1.3 of USN 1996 and used for the current program. Figure 2.5 of this Environmental Assessment shows the Hanford Site map and transport route.

2.1.4 Land Disposal Site

The Hanford Site is located in the southeastern corner of the State of Washington, about 30 miles east of Yakima and immediately north of Richland. Trench 94 is situated within the 218-E-12B Low Level Burial Ground within the 200 East Area, near the center of the Hanford Site in the Central Plateau region. Trench 94 is in an isolated area about seven miles from the Columbia River. Trench 94 contains 122 pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartment packages as of April, 2010. Figure 2.6 is an aerial photograph of Trench 94 taken in November of 2009. The current trench configuration consists of 55 reactor compartment packages placed on concrete column foundations and 67 packages placed on concrete ground level foundations. PSNS & IMF began placing reactor compartment packages on the ground level foundations in fall of 1996. This substantially reduced the trench floor space occupied by each package since they could be spaced closer together. On the ground level foundations, the reactor compartment package hulls are a minimum of two feet apart. The transport support fixtures for the packages extend beyond the hull, but are not considered part of the package and can be removed if necessary to allow access and placement of adjacent packages. PSNS & IMF would use ground level foundations to place the ENTERPRISE reactor



Note: Not to scale. Transporter length and configuration may vary.

Figure 2.4. Port of Benton ENTERPRISE Package Off-loading Concept

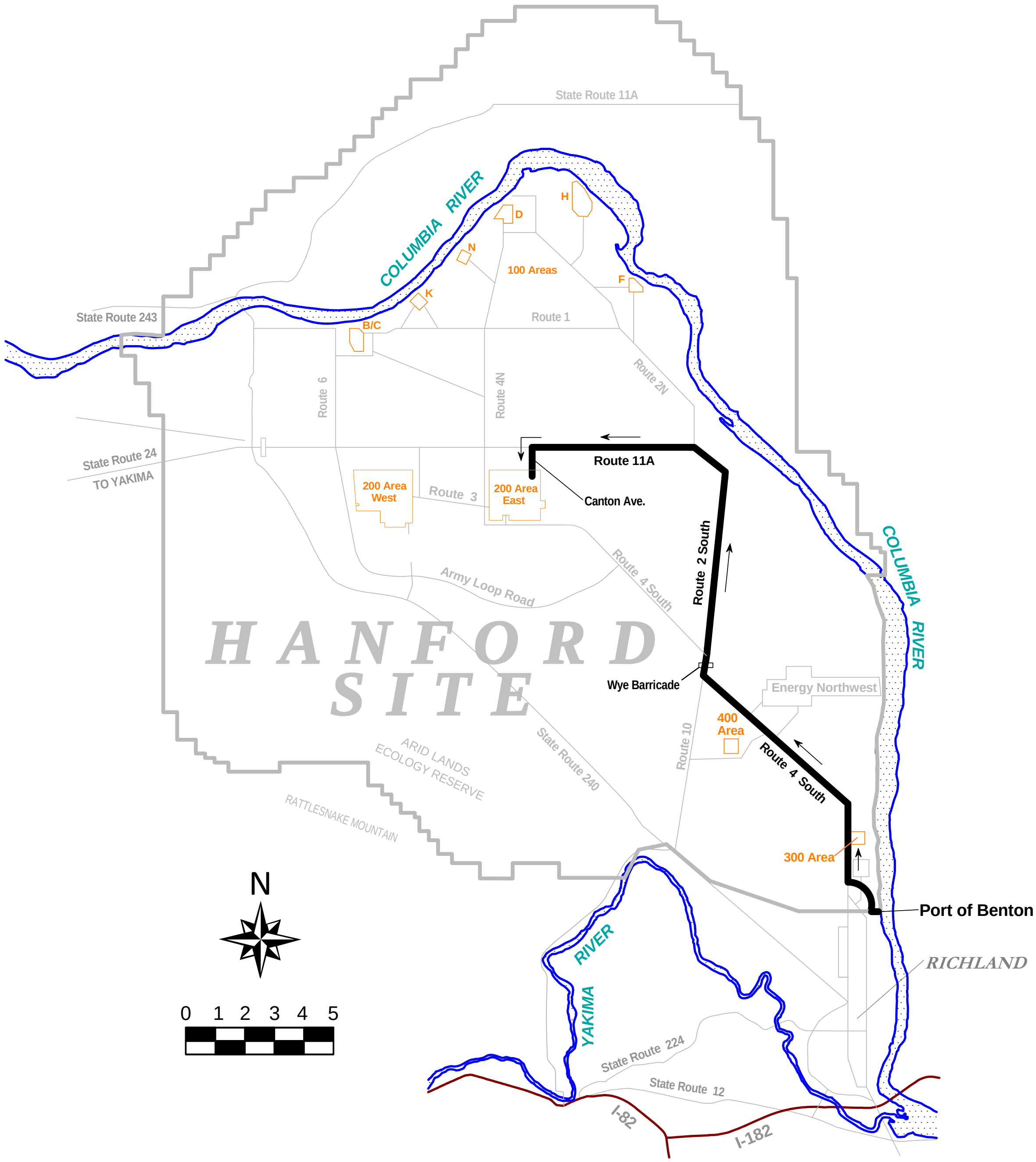


Figure 2.5. Hanford Site Transport Route

Figure 2.6. Pre-LOS ANGELES Class, LOS-ANGELES Class, and Cruiser Reactor Compartments in Trench 94, November 2009

compartment packages in the configuration currently used. Consequently, expansion of Trench 94 is not required to accommodate the ENTERPRISE reactor compartment packages.

It is expected the existing Trench 94 ramp would be used for transport of the ENTERPRISE reactor compartment packages. The current ramp provides sufficient area for a transporter to position the package for offload onto rail foundations.

2.1.5 Applicable Regulatory Considerations

The following sections discuss the applicable regulations for management, packaging, transport, and disposal of ENTERPRISE reactor compartments.

2.1.5.1 Shipyard Preparations Prior to Transport

The applicable regulations for the reactor compartment disposal program at the Shipyard include the Clean Air Act, the Clean Water Act, Toxic Substances Control Act (TSCA), and the Resource Conservation and Recovery Act (RCRA). The Puget Sound Clean Air Agency (PSCAA) has regulatory authority for the Clean Air Act. The Washington State Department of Ecology has RCRA regulatory authority. The EPA has TSCA regulatory authority and issues an NPDES permit to the Shipyard under the Clean Water Act.

2.1.5.2 Normal Conditions of Transport

Transportation would meet the requirements for normal conditions of transport as specified in 10 CFR 71 (Packaging and Transportation of Radioactive Materials) and 49 CFR 171-179 (Hazardous Material Regulations). The requirements of 10 CFR 71 involve evaluating the reactor compartment package containment structure under: (1) free drop striking the surface in a position for which maximum damage is expected; (2) puncture; (3) temperature influences; (4) external pressure (reduced and increased); (5) water spray; and (6) vibration conditions. These requirements are more restrictive than those of 49 CFR 171-179.

An engineering analysis of the reactor compartment package design would be performed to assess the performance under the conditions discussed above. The analysis results would then be compared with the specific requirements for normal transport listed in 10 CFR 71.51. The package design based on this analysis would ensure that 10 CFR 71 requirements are met. Actual physical testing of reactor compartment packages would be impractical due to weight and size considerations and is not required by 10 CFR 71.

Section 2.1.5.2 of USN 1996 provides an analysis of the effect on reactor compartment packages of the conditions of 10 CFR 71 discussed above. This analysis covers all USN 1996 packages including LONG BEACH. The ENTERPRISE reactor compartment packages would be of similar size, shape, and design to the LONG BEACH packages and the subject analysis would cover the ENTERPRISE packages as well. In summary, all packages would maintain their integrity of containment for the conditions analyzed (i.e., free drop, puncture test, high temperature, external pressure, water spray, vibration).

The ENTERPRISE reactor compartment packages would be surveyed prior to shipment to determine radiation levels. External surface radiation levels for the packages are expected to be less than one millirem per hour on contact, a fraction of the 200 millirem per hour allowed under 49 CFR 173. The major source of this radiation would be cobalt-60 with 5.3 year half-life. This estimate is based on the fact that the highest contact radiation readings on cruiser packages were less than one millirem per hour and based on a comparison between ENTERPRISE and cruiser packages. The radioactivity inside the ENTERPRISE packages at shipment is expected to be significantly less than the cruiser packages because less activation has occurred in the reactor vessel (refer to Table 1.1 and Table 1.2). Also, about ten years would elapse between shutdown of the ENTERPRISE reactor plants and shipment of the reactor compartment packages, resulting in significant short lived radioactivity decay. Ten years of decay would reduce cobalt-60 to about 1/4 of its original amount at shutdown. Since Co-60 is the primary driver of observed radiation in the reactor plant, radiation levels would drop correspondingly. There would be no removable or fixed radioactive contamination on the outside of the ENTERPRISE packages.

2.1.5.3 Hypothetical Accident Conditions

Section 2.1.5.3 of USN 1996 provides an analysis of the effect on reactor compartment packages of the hypothetical accident conditions of 10 CFR 71.73. The ENTERPRISE reactor compartment packages would be of similar size, shape, and design to the LONG BEACH packages of USN 1996 and the subject analysis would cover the ENTERPRISE packages as well.

Similar to the current program, the ENTERPRISE reactor compartment packages would be designed to meet the transportation requirements for hypothetical accident conditions of transport as specified by 10 CFR 71.73. These requirements involve evaluating the reactor compartment package shipping containment structure under a 9 meter (30 feet) free drop onto an unyielding surface, puncture by a 15 cm (6 inch) bar, and 800°C (1475°F) fire for 30 minutes. Immersion in 15 meters (50 feet) of water is considered a separate accident. The results are compared with 10 CFR 71.51(a)(2) requirements. Figure 2.13 of USN 1996 depicts the sequential hypothetical accident scenario of 10 CFR 71.73 and encompasses the ENTERPRISE.

The conditions of an unyielding surface and a 9 meter (30 feet) drop would not be encountered along the transport route for the ENTERPRISE packages. Also, the regulatory assumption that the 15 cm (6 inch) steel bar is mounted on an essentially unyielding surface would not be encountered. However, the containment structure of the package would be designed and constructed so the 10 CFR 71.51 requirements would not be exceeded by the sequential accidents.

An undamaged package is required to be analyzed for immersion under a head of water of at least 15 meters (50 feet) as specified by 10 CFR 71.73(c)(6). As a result of the engineering analysis work discussed previously and the design of the reactor compartment packages, the packages would not deform under this immersion and not exceed the radioactive material release requirements of 10 CFR 71.51.

The ENTERPRISE reactor plants are contained within the shielded structural bulkheads of the ship's reactor compartments. Like the cruisers analyzed in 1996, these bulkheads are designed to accommodate normal and emergency ship's operating conditions including the ability to withstand battle shock, but do not have the larger design margins to meet the Type B package criteria in 10 CFR 71. Therefore, the ENTERPRISE reactor compartments will similarly require a containment structure to be fabricated around the reactor compartment to meet the Type B package criteria in 10 CFR 71. The thick, fully-welded, steel containment structure (typically two inches or more thick) would be designed, constructed, and prepared so the packaging would prevent the release of the radioactivity in excess of the limits specified in 10 CFR 71 for normal transportation and hypothetical accident conditions.

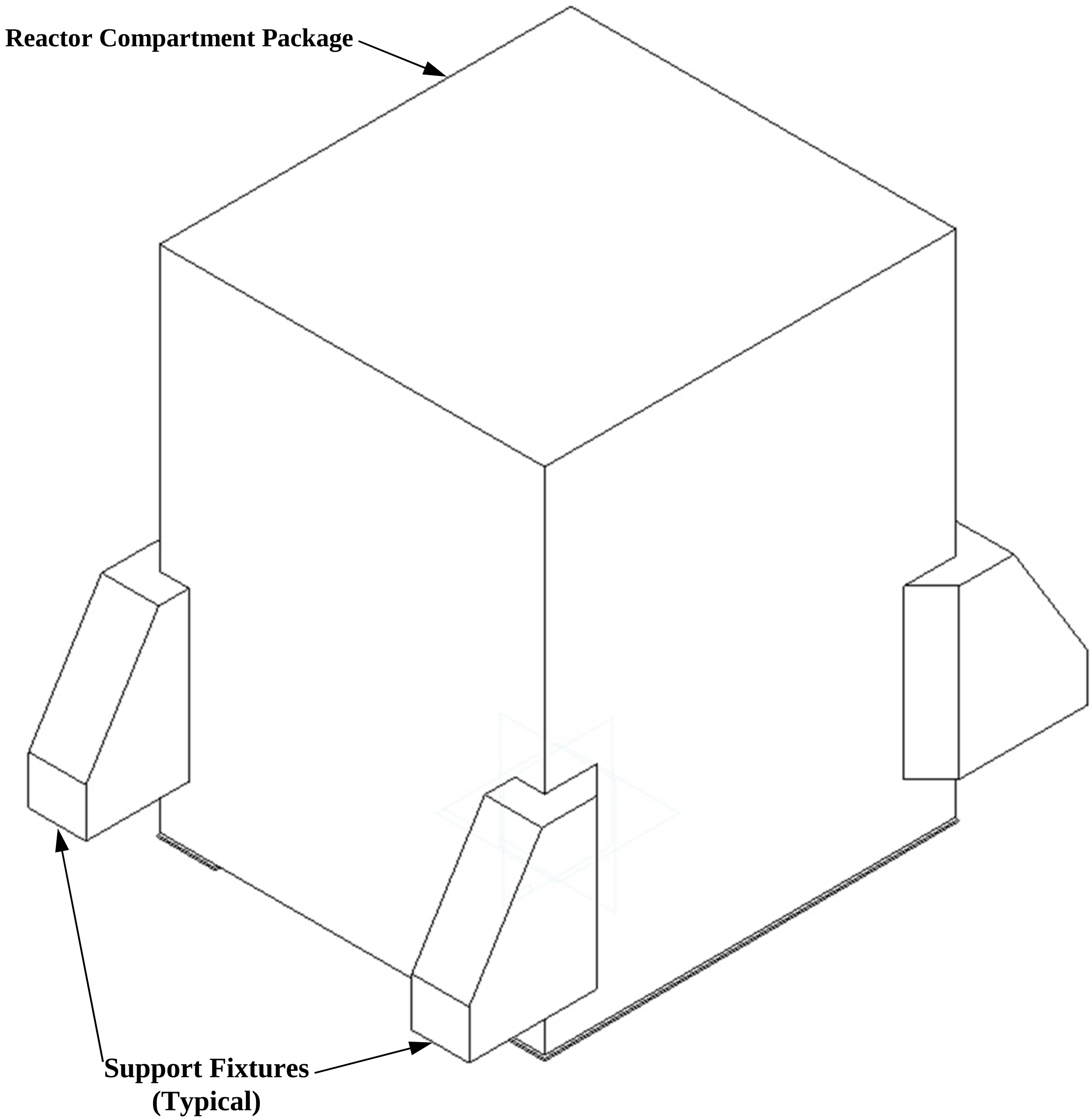
Even though the ENTERPRISE reactor compartment packages would contain quantities of radioactivity requiring the Type B level of containment for transportation, the majority of the radioactivity (approximately 99.9%) is in the form of neutron activated structural metal components contained within the reactor vessel. Only the surface-deposited activated corrosion products, the remaining 0.1% of the radioactivity, could potentially become available for release to the environment.

The same processes used to safely and successfully transport the pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartment packages would be adapted for the ENTERPRISE packages. Figure 2.7 shows the conceptual design of the ENTERPRISE reactor compartment package. As shown in Figure 2.7, structural support fixtures would be welded to the package to facilitate moving it horizontally and vertically.

2.1.5.4 Disposal

Land disposal at Trench 94 is regulated by State and Federal agencies. The United States Department of Energy would manage the disposal of the radioactive material contained in the reactor compartment packages under Department of Energy Order 435.1, Radioactive Waste Management (DOE 2001). The Washington State Department of Ecology would regulate the reactor compartment packages as a state only dangerous waste under Washington Administrative Code (WAC) 173-303, Dangerous Waste Regulations (WAC 2009) due to the quantity of permanent lead shielding present.

Polychlorinated Biphenyls (PCB) are found shipboard, commonly in wool felt sound damping, electrical cable rubber, and in paint. Wool felt sound damping and electrical equipment containing liquid PCBs are removed and disposed of under 40 CFR 761. The remaining PCBs in the reactor compartment packages are in a solid, non-leachable form such as in rubber, plastic and paint, and are considered 'PCB bulk product waste' under 40 CFR 761. 'PCB bulk product



Note: Figure 2.1 dimensions of 32’ by 34’ wide by 42’ high may be increased by up to 10%, in particular height, to accommodate package design requirements.

Figure 2.7. Conceptual ENTERPRISE Reactor Compartment Package

waste' of the types found in reactor compartment packages may be disposed of in solid waste (municipal) landfills.

Asbestos insulation is commonly found in older ships. Asbestos is regulated in the work place, in removal operations, and in the environment. Asbestos would be properly contained to meet local (Benton Clean Air Authority) and Federal (40 CFR 61) requirements.

Sections 173-303-280 through 173-303-395 of the Washington Administrative Code (WAC) describe the Washington State requirements for facilities which store, treat, or dispose of dangerous wastes and which must be permitted by the State. The disposal of reactor compartments from a defueled, decommissioned ENTERPRISE at Trench 94 would be regulated under these sections.

2.2 No-Action Alternative – Indefinite Waterborne Storage

Under the No-Action Alternative, ENTERPRISE would be placed in waterborne storage following inactivation. This alternative would include work to prepare the ship for indefinite waterborne storage in a safe and environmentally acceptable manner. Storage would only occur at a designated Navy nuclear powered ship inactive storage facility. The only such facility on the west coast is at PSNS & IMF. This facility has the required water depth and area to accommodate ENTERPRISE. An existing facility on the east coast at Norfolk Naval Shipyard is not considered feasible for ENTERPRISE, given the size and deep draft of the ship (requiring 37 feet of depth), dredging required at Norfolk (minimum depths at the facility are under 20 feet), and the need to move the ship to PSNS & IMF for reactor compartment disposal.

Ship preparations for storage at PSNS & IMF would include removing fluids, removing militarily useful equipment, blanking sea connections, ensuring the preservation of containment barriers such as the hull, and installing fire and flooding alarm systems. PSNS & IMF would perform periodic inspection and maintenance of the ship while it is in storage. This would include a detailed interior and exterior inspection of the hull after 8 years in waterborne storage and placing the ship in dry dock for inspection and repair after 15 years in waterborne storage. Most ships have been placed in dry dock for recycle and reactor compartment disposal prior to reaching the 15-year point of waterborne storage. Some ships have been in waterborne storage for over 15 years and dry docking for hull maintenance has been performed as necessary on these ships or an extension to the 15-year dry docking has been approved based on underwater hull inspections and the material condition of the hull. The LONG BEACH has been in waterborne storage for over 15 years and an extension to the 15-year dry docking was approved.

The disadvantage of the No-Action Alternative for ENTERPRISE is that it only delays ultimate permanent disposal. Waterborne storage is not a permanent solution to disposing of the ship and is considered satisfactory only as an interim measure, for reasons such as to accommodate dry dock and funding availability for reactor compartment disposal, or provide the time to develop and test methods and procedures for disposal and transport of the various classes of ship (e.g., for the heavier LONG BEACH packages). Maintenance and costs would increase as ENTERPRISE ages and the hull deteriorates requiring necessary repairs to ensure watertight integrity.

2.2.1 Moorage Facility Requirements

Pre-LOS ANGELES Class submarines, LOS ANGELES Class submarines, and nuclear-powered cruisers have been moored at the PSNS & IMF storage facility for nuclear vessels, which is referred to as Mooring Alpha. LONG BEACH is the only cruiser remaining at Mooring Alpha. The rest of the cruisers have undergone reactor compartment disposal, with the reactor compartment packages shipped to Hanford and the remnant ship hull recycled (LONG BEACH will also have undergone reactor compartment disposal prior to arrival of the ENTERPRISE at PSNS & IMF). There is one pre-LOS ANGELES Class submarine and several LOS ANGELES Class submarines currently moored at Mooring Alpha.

A study was performed in 2009 to investigate concepts and preliminary designs for mooring ENTERPRISE at Mooring Alpha (NAVFAC 2009). The results of the study determined the existing structures at the storage facility have adequate capacity and the mooring fittings are well placed to moor ENTERPRISE. The ENTERPRISE would require a water depth of about 37 feet for moorage. The study showed that water depths are adequate based on the results of a 2007 hydrographic survey (NOAA 2007). This survey characterized the west side of Mooring Alpha well but did not completely characterize the east side of Mooring Alpha because vessels moored there interfered with the survey work. The unsurveyed area extends from Mooring Alpha 250 feet to the east and from the shoreline to 300 feet south of the southern end of Mooring Alpha, but is surrounded by surveyed areas with adequate water depth and not known to have any submerged obstacles.

There were three options provided in NAVFAC 2009. The option preferred by PSNS & IMF would be to moor ENTERPRISE on the west side of Mooring Alpha. Figure 4.1 of this Environmental Assessment (in Section 4.4) shows the ENTERPRISE moored on the west side of Mooring Alpha. The west side of Mooring Alpha has been surveyed and the water depths found to be acceptable. No dredging would be required for this option. Another advantage to this option is that ships presently at Mooring Alpha would not have to be relocated. This option would require several hundred feet of chain and several chain equalizers. The estimated initial cost for this option was $11.2 million.

It is also possible to moor ENTERPRISE on the east side of Mooring Alpha, however, this option is not preferred because it would require relocating ships moored on the east side over to the west side and would require that bottom depths in the unsurveyed area be verified. The presence of numerous moored vessels in this area prevents an exact confirmation of water depth. Because surrounding areas have acceptable water depth and no submerged obstacles, dredging would be considered as not likely to occur, and should be, if required, of a limited nature with only local disturbance. Enough uncertainty exists such that the potential effects of using this area cannot be fully defined at this time. Any such dredging would be accomplished as described in the 'Dredging and Disposal' discussion of section 4.3.2.1 of Volume 1 of the

Navy's Pacific Fleet CVN Homeport EIS (USN 1999). In addition to this possible work, this option would require installation of 60-foot wide camels and a large number of pretensioned mooring lines. The estimated initial cost for this option was $10.2 million, not including possible dredging costs. A third option, which involved chaining ENTERPRISE to LONG BEACH, was not considered at all since LONG BEACH is scheduled to be removed from Mooring Alpha for reactor compartment disposal before ENTERPRISE arrives.

Additional services would be required to moor ENTERPRISE at Mooring Alpha. Fire and flooding alarm systems, a dehumidification system, cathodic protection and lighting, and associated electrical power distribution would have to be installed or upgraded since the current systems are inadequate to meet the demands of ENTERPRISE. In addition to the cost of these upgrades, there would be periodic maintenance and inspection costs associated with long-term waterborne storage of a nuclear-powered ship, including the extensive 8-year hull inspection and the 15-year dry docking inspection and repair.

3. AFFECTED ENVIRONMENT

3.1 Preferred Alternative

The existing environment of the preferred alternative includes that portion of the Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF) located in Bremerton, WA where the reactor compartment packages would be prepared for shipment, the waterborne transport route between PSNS & IMF and the barge off-load site at the Port of Benton, Richland, WA, the land transport route on the Hanford Site, and the designated Navy trench at the Hanford land disposal site.

3.1.1 PSNS & IMF

In 2003, Puget Sound Naval Shipyard in Bremerton, WA and the Naval Intermediate Maintenance Facility, Pacific Northwest (located at Bangor, Bremerton and Everett, WA) consolidated into one maintenance activity creating PSNS & IMF. PSNS & IMF is responsible for performing authorized work in connection with ship conversion, overhaul, repair, alteration, dry-docking, and outfitting. It is the single maintenance provider for all ships operating and home ported in the Puget Sound area.

PSNS & IMF is a major tenant of Naval Base Kitsap at Bremerton. Naval Base Kitsap is the largest naval organization in Navy Region Northwest and is composed of installations in Bremerton, Bangor, and Keyport. Naval Base Kitsap encompasses 344 acres of land, 336 acres of submerged marine lands, 382 buildings, six dry docks, and 13 moorings and piers. The eastern portion of the naval base is a fenced, high security area known as the Controlled Industrial Area (CIA), which defines the Shipyard operating area. The CIA is bordered on the south by Sinclair Inlet, and on the north and east by the city of Bremerton. Reactor compartment disposal, up to shipment of the reactor compartments and remnant hull recycle, would be conducted within the CIA of PSNS & IMF at Bremerton. There would be no significant changes in use of this area from the industrial operations that have been conducted therein for decades.

The majority of PSNS & IMF is developed and covered with impervious surface. Most of the remaining, non-contiguous, undeveloped areas are also disturbed and typically landscaped with a mix of ornamental and native trees and shrubs and lawn. Section 3.1.1.3 of USN 1996 provides additional detail.

<u>Endangered Species</u>

The National Marine Fisheries Service (NMFS) is responsible for implementing Endangered Species Act (ESA) regulations to protect federally listed marine fish and marine mammals, and the U.S. Fish and Wildlife Service (USFWS) is responsible for implementing ESA regulations for other federally listed wildlife and freshwater fish. Table 3.1 contains the list of federally listed species that may occur in the region of PSNS & IMF and outbound along the waterborne transport route (section 3.1.1).

TABLE 3.1 FEDERALLY LISTED SPECIES
(PSNS & IMF and outbound along waterborne transport route)

Species	Regulatory Agency	Status	Critical Habitat
Puget Sound Chinook	NMFS	Threatened	Designated (narrow zone from extreme high tide to mean low water)
Puget Sound Steelhead	NMFS	Threatened	Under Development
Southern Resident Killer Whale	NMFS	Endangered	Designated; Not designated in Sinclair Inlet and NW Navy Installations
Steller Sea Lion Eastern DPS	NMFS	Threatened	Designated; Not designated in Washington State
Humpback Whale	NMFS	Endangered	Under Development
Georgia Basin/Puget Sound Bocaccio DPS	NMFS	Endangered	Under Development
Georgia Basin/Puget Sound Yelloweye Rockfish DPS	NMFS	Threatened	Under Development
Georgia Basin/Puget Sound Canary Rockfish DPS	NMFS	Threatened	Under Development
Coastal/Puget Sound Bull Trout	USFWS	Threatened	Designated; Not designated on NW Navy Installations
Marbled Murrelet	USFWS	Threatened	Designated; Not designated on NW Navy Installations

Puget Sound chinook salmon in Sinclair Inlet are predominantly of hatchery origin from the Gorst Creek hatchery. Naturally spawning chinook salmon may occur in Sinclair Inlet on occasion during migration or other movements (NMFS 2004).

Puget Sound steelhead are found in very small numbers in Sinclair Inlet, as a wild (non-hatchery) population. Of the 73,615 fish caught during the 2001-2002 Sinclair Inlet juvenile salmonid outmigration study performed by WDFW, only four were steelhead (WDFW 2006).

Southern resident killer whales occasionally move into rarely visited areas and inlets. In 1997, southern residents moved into Dyes Inlet near Bremerton and spent nearly a month feeding on a salmon run (WA 2004). There are currently no steller sea lion haul-out sites within Sinclair Inlet and no rookeries within Washington State. Steller sea lion residence in the area is highly unlikely (WA 2000). Humpback whale sightings were infrequent in Puget Sound and the Georgia Basin through the late 1990s (Falcone 2005). In 2003 and 2004, 13 individual humpback whales were sighted in the inside waters of Washington. The occurrence of humpback whales in the Puget Sound area is rare.

Georgia Basin/Puget Sound bocaccio have always been rare in the north Puget Sound surveys of the recreational fishery (NMFS 2008). It is possible that bocaccio can occur within the PSNS & IMF area. Yelloweye rockfish have been observed infrequently in the WDFW fisheries independent trawl surveys in Puget Sound proper, and in north Puget Sound. It is possible that yelloweye rockfish can occur within the PSNS & IMF area. Canary rockfish have not been observed in the WDFW fisheries independent trawl surveys. NMFS 2008 concluded that canary rockfish occur in low and decreasing abundances in Puget Sound. It is possible that canary rockfish can occur in the PSNS & IMF area.

Puget Sound bull trout do not have any core populations that occur in any of the streams that empty into Sinclair Inlet. There is the potential for adult fish from other drainages within the Puget Sound to be in the PSNS & IMF area.

Marbled murrelets are rarely seen in Sinclair Inlet. There are no marbled murrelet nesting sites in the vicinity of PSNS & IMF. The lack of mature forests with PSNS & IMF area makes the presence of this species unlikely.

PSNS & IMF consults with NOAA Fisheries and the United States Fish and Wildlife service under the Endangered Species Act as required to support ongoing operations, such as for flooding and draining of dry docks to dock and re-float ships. This activity has supported work at PSNS & IMF including the reactor compartment disposal program and will continue as required to support ongoing shipyard operations.

Air Quality

The Clean Air Act requires the U.S. Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS) for wide-spread pollutants from sources considered harmful to public health and the environment. The USEPA has set NAAQS for seven principal pollutants, which are called “criteria” pollutants. The criteria pollutants are: particulate matter less than or equal to 10 microns in diameter, particulate matter less than or equal to 2.5 microns in diameter, ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead.

The Puget Sound Clean Air Agency (PSCAA) has jurisdiction over air quality in King, Kitsap, Pierce and Snohomish counties. PSCAA monitors and regulates levels of criteria air pollutants along with the Washington State Department of Ecology to assure the region meets federal air quality standards. Kitsap County is in attainment of the NAAQS for all seven criteria pollutants.

Seismic Risk

The entire Puget Sound area is seismically active. Since 1993, there have been more than 130 notable (greater than magnitude 2.5) earthquakes in the Pacific Northwest region. Of these, 8 have been located in the immediate vicinity of Bremerton (WA 2007). The U.S. Geological Survey (USGS) shows PSNS & IMF within a high seismic range extending down the west coast of the United States. Peak ground acceleration in the Puget Sound at a 10% probability of occurrence within 50 years is estimated at about 0.3g as compared to about 0.5g for the San Andreas Fault extending through California. Peak ground acceleration at a 2% probability of occurrence within 50 years is estimated at about 0.6g as compared to about 0.8g or above for most of the San Andreas Fault zone (USGS 2008).

Cultural Resources

PSNS & IMF and Sinclair Inlet lie within the usual and accustomed (U&A) fishing grounds of the Suquamish Tribe. The Suquamish Tribe has a right to take a percentage of fish that pass through their U&A. The Suquamish Tribe has a salmon fishery at Gorst Creek, at the upper reaches of Sinclair Inlet. The Suquamish Tribe fishes for hatchery salmon in the Sinclair Inlet as these fish return to Gorst Creek. PSNS & IMF consults with the Suquamish Tribe on matters affecting the U&A. ENTERPRISE reactor compartment disposal would occur within the controlled secure boundary of PSNS & IMF as part of an ongoing program, consistent with normal shipyard work, and would not be expected to require changes to this boundary.

PSNS & IMF is a National Historic Landmark with a number of National Register listed buildings in the vicinity. ENTERPRISE reactor compartment disposal would occur within the controlled industrial boundary of PSNS & IMF as part of an ongoing program, consistent with normal shipyard work, and would not be expected to affect these properties.

Socioeconomic Background Information

PSNS & IMF is located in the city of Bremerton, Kitsap County, Washington. The U.S. Census Bureau and the Washington State Office of Financial Management reported the existing demographics and employment statistics which are summarized in Table 3.2.

The unemployment rate in Kitsap County averaged 4.9% from 2004 to 2008, less than the Washington State’s average rate of 5.3% during the same period. In May, 2010 the unemployment rate in Kitsap County was 7.6%, less than Washington State’s overall rate of 8.8%.

TABLE 3.2 DEMOGRAPHICS AND EMPLOYMENT STATISTICS

	City of Bremerton	Kitsap County
Year 2010 Population[a,b]	37,729	251,133
Racial Profile[a,b]		
Caucasian	69.5%	79.1%
African American	6.3%	2.6%
Hispanic origin	9.6%	6.2% [c]
Asian and Pacific Islander	6.6%	5.8%
American Indian and Alaskan Native	1.6%	1.6%
Other	6.4%	5.8% [c]
Labor Force Population[d,e]	--	125,060
Non-government Employed	--	68%
Government Employed	--	24%
Unemployed	--	8%
Not in Labor Force	--	50%

a: 2010 census data for Kitsap county from < http://quickfacts.census.gov/qfd/states/53/53035.html

b: 2010 census data for Bremerton from < http://www.cubitplanning.com/city/14805-bremerton-city-census-2010-population

c: Hispanic origin may be partly counted under both categories, thus totals may add to over 100%.

d: 2010 data from http://www.workforceexplorer.com/cgi/databrowsing/localAreaProfileQSResults.asp?selectedarea=Kitsap+County&selectedindex=18&menuChoice=localAreaPro&state=true&geogArea=5304000035&countyName=

e: Labor force is age 16 and over, either employed or seeking employment, including the Bremerton-Silverdale metro areas (data not available for Bremerton city limits only).

<u>Safety</u>

PSNS & IMF personnel may be exposed to a variety of physical and chemical hazards during the course of their work. All operations at PSNS & IMF are governed by the Navy Occupational Safety and Health (NAVOSH) program. Personnel are trained in the hazards applicable to their work and how to minimize these hazards. Personnel are routinely monitored for exposure to certain hazards such as high noise levels or lead and asbestos and are placed into medical surveillance programs for the applicable physical or chemical hazard. Sections 4.2 and 4.3.1 of this Environmental Assessment provide additional discussion on management of hazardous materials encountered with ENTERPRISE.

3.1.2 Waterborne Transport Route

The waterborne transport route follows the normal shipping lanes from PSNS & IMF in Sinclair Inlet, through Rich Passage, past Restoration Point, and northerly through the Puget Sound. The route is then westerly through the Strait of Juan de Fuca (staying south of the inbound Vessel Traffic System lane when transiting out the Strait of Juan de Fuca to remain in U.S. waters), around Cape Flattery, south along the Washington coast (outside the Olympic Coast National Marine Sanctuary Area to be Avoided) to the mouth of the Columbia River. The route is then up the Columbia River, following the shipping channel used for the regular transport of commercial cargo. The river route passes through the navigation locks at the Bonneville, The Dalles, John Day, and McNary dams to the Port of Benton at river mile 342.8. Figure 2.3 is a map showing the waterborne transport route.

The Olympic Coast National Marine Sanctuary, designated in 1994, spans 3310 square miles of marine waters off the Northern Washington State coast. The sanctuary was established to protect the marine resources in this area. Part of this protection involved working with the U.S. Coast Guard to request designation of an Area to be Avoided (ATBA) off the Olympic Coast National Marine Sanctuary. This ATBA was adopted in 1994 in order to reduce the risk of maritime casualty and resulting pollution and damage to the environment of the Olympic Coast National Marine Sanctuary. The ATBA went into effect in 1995 and advises operators of vessels carrying cargoes of oil or hazardous materials and all ships 1600 gross tons and above to maintain a 25-mile buffer from the coast.

The Columbia River and its tributaries are the dominant water system in the Pacific Northwest. Several large hydroelectric dams and navigation locks were constructed on the Columbia River and Snake River between the 1930s and 1970s. These dams provide flood control, irrigation, navigation and recreational benefits to the Pacific Northwest and are a significant part of the economics of the region.

The Army Corps of Engineers owns and operates 12 of the 14 major large scale hydropower projects in the Columbia River system and plays a key role in coordinating multiple-purpose use of the system. The U.S. Bureau of Reclamation owns and operates the remaining two projects in the Columbia River System. These agencies are responsible to provide for several uses of the water system, which may at times conflict with one another. A high priority is placed on measures to benefit species listed under the Endangered Species Act and includes implementing specific operations identified in the NMFS 2008 Biological Opinion. The Biological Opinion was issued May 5th, 2008, and titled “Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program (Revised and reissued pursuant to court order, *NWF v. NMFS,* Civ. No. CV 01-640-RE (D. Oregon)).” There are no anticipated changes to the operation of the Columbia River system as a result of this process that would affect reactor compartment package shipments via the normal shipping channel and navigation locks.

PSNS & IMF routinely coordinates with the Army Corps of Engineers to ensure water system controls are satisfactory for transporting reactor compartment packages. This process would continue for shipment of the ENTERPRISE packages with no significant changes expected.

The shallowest river depths encountered are about 5 meters (15 feet) near the barge slip at the Port of Benton. The depth of the barge slip can be adjusted through the control of river flow at the upstream dam (Priest Rapids Dam) and the pool height at the downstream dam (McNary Dam) for docking barges of different drafts. This is routinely done for docking barges for reactor compartment package shipments.

ENTERPRISE reactor compartment package shipments are a very small part of total waterborne shipments and marine traffic transiting into and out of the Puget Sound and Columbia River, and would not occur during the time of the spring flood when the barge slip is submerged and water level control is not possible. In addition, governing permits restrict activity at this time (section 4.3.2 of this Environmental Assessment relates). The restricted times coincide with peak migration of juvenile salmonids, outbound to the ocean, and thus the shipments and docking operations at the port avoid this event.

Overhead clearances have been evaluated along the waterborne transport route from PSNS & IMF to the Port of Benton at Richland, Washington. There are no overhead interferences on the Columbia River for ENTERPRISE reactor compartment package shipments.

The Hanford Reach is the only unimpounded stretch of the Columbia River in the United States. The Hanford Reach extends from Priest Rapids Dam downstream approximately 82 km (51 mi) to the southern part of the Hanford Site, north of Richland. It was incorporated into the land area established as the Hanford Reach National Monument described in Section 3.1.3.1. The Port of Benton is downstream of and not within the area of the Hanford Reach.

3.1.3 Land Disposal Site

3.1.3.1 Background

The Draft Tank Closure and Waste Management Environmental Impact Statement (DOE 2009) provides detailed discussion of the Hanford Site affected environment including flora, fauna, and cultural resources. The results of ongoing environmental compliance monitoring at onsite and off-site locations are published yearly (PNNL 2010). The Hanford Site is thus well characterized. Section 3.1.2 of this Environmental Assessment presents information relevant to the preferred alternative, summarized from the above documents.

The Hanford Site is located in southeastern Washington State along the Columbia River and is approximately 1517 square kilometers (586 square miles) in size. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities (PNNL 2005). The Saddle Mountains form the northern boundary of the site. The Columbia River flows through the northern part of the site and forms part of its eastern boundary. The Yakima River forms part of the southern boundary. The City of Richland bounds the site on the southeast. The Tri-Cities area southeast of the Hanford Site encompasses the cities of Richland, Kennewick, and Pasco and is the population center closest to Hanford. The combined incorporated population of these cities was 125,525 as of 2000 (PNNL 2004). About 486,294 people reside within 80 km (50 mi) radius of the center of the Hanford Site according to the 2000 census (PNNL 2004).

Several areas have been set aside for special uses at the Hanford Site. The Fitzner-Eberhardt Arid Lands Ecology Reserve Unit is on land between the southern boundary of the Hanford Site and State Route 240. On the north side of the site is the Saddle Mountain National Wildlife Refuge Unit. Approximately 4 kilometers northeast of the 400 Area is the Columbia Generating Station, a commercial power production reactor operated by Energy Northwest.
A portion of the Hanford Site was designated the Hanford Reach National Monument (65 FR 37253) in 2000. The Monument totals 792.6 square kilometers (306 square miles) and includes Fitzner-Eberhardt Arid Lands Ecology Reserve Unit, Saddle Mountain Wildlife Refuge Unit, McGee Ranch/Riverlands Unit, and land 0.40 kilometers (0.25 miles) inland from the mean high-water mark on the south and west shores of the 82 km (51 mi) long Hanford Reach of the Columbia River. It also includes the federally owned islands in the Hanford Reach and the sand dune area northwest of the Energy Northwest Site. USFWS manages the monument under existing agreements with DOE.

Under separate treaties signed in 1855 much of the land in what is now referred to as eastern Washington, eastern Oregon, and Idaho was ceded to the United States by a number of regional American Indian tribes. The land area includes land occupied by the Hanford Site. Under these treaties, the tribes retained the right to fish in usual and accustomed places. Tribal fishing rights are recognized on rivers within the ceded lands, including the Columbia River, which flows through the Hanford Site. In addition to fishing rights, the tribes retained under the treaties the privilege to hunt, gather roots and berries, and pasture horses and cattle on open and unclaimed lands.

The Hanford Site contains numerous, well-preserved archaeological sites representing both the prehistoric and historic periods. Gable Butte and Gable Mountain, located about 3 to 5 miles to the north and east of Trench 94, are some of the sites considered sacred to the Native Americans who originally inhabited the Hanford Site. However, no archaeological sites or areas of Native American interest are identified within the 200 East Area in the 2005 Hanford Site NEPA Characterization Document (PNNL 2005). Archaeological surveys have been conducted of all undeveloped portions of this area. Historic resources from the Manhattan Project and Cold War eras include buildings and structures within the 200 East Area. However, these buildings are not located within or adjacent to the 218-E-12B burial ground and Trench 94.

Most of Hanford is within the South-Central Washington Intrastate Air Quality Control Region No. 230, but a small portion of the site is in the Eastern Washington-Northern Idaho Interstate Air Quality Control Region No. 62. All of the areas within Hanford and its surrounding counties are designated as in attainment with respect to National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (40 CFR 81.348). Particulate matter (PM) concentrations can reach relatively high levels in eastern Washington State because of extreme natural events such as dust storms and large brush fires (DOE 2009). Dust storms are treated as uncontrollable natural events under EPA policy (EPA 1996). Accordingly, the air quality impact of such storms can be disregarded in determining whether an area is in attainment for atmospheric particulates.

3.1.3.2 Existing Land Use

Prior to 1988, the primary Hanford Site mission was the production of plutonium for national defense purposes. The current primary Hanford Site mission is environmental remediation and cleanup, including the remediation of contaminated areas and the decontamination and decommissioning of Hanford Site facilities (PNNL 2010).

Hanford contains a variety of widely dispersed facilities, including retired reactors, R&D facilities, and various deactivated production and processing plants. Preservation and Conservation are the predominant land uses at Hanford. The industrial buildings are interconnected by roads, railroads, and utilities such as electrical transmission lines.

The Hanford Site contains waste storage and waste disposal facilities. These facilities include buried tanks containing high-level radioactive waste (HLW) and disposal sites containing solid and radioactive wastes. The “Waste Treatment Plant” (WTP) is currently under construction within the 200 East Area that includes a number of facilities that would pre-treat and separate waste recovered from the 200 Area tank farms into HLW and low-activity waste (LAW) streams, vitrify the HLW stream, and vitrify or similarly immobilize the LAW stream (DOE 2009).

3.1.3.3 Low Level Waste Disposal Sites

There are two sites within the 200 East Area and six sites within the 200 West Area at Hanford used for land disposal . The combined area of these sites is about 220 hectares (544 acres). The 200 East Area is located near the center of the Hanford Site about 11 kilometers (seven miles) from the Columbia River. Located in the northeast corner of the 200 East Area is the 218-E-12B burial ground. The 218-E-12B burial ground began receiving waste in 1967 and covers 70.1 hectares (173.1 acres). Waste disposed of at 218-E-12B includes mixed waste, low-level waste, and transuranic waste.

Trench 94 is within the 218-E-12B burial ground and is used for the disposal of decommissioned, defueled reactor compartment packages from pre-LOS ANGELES Class submarines, LOS ANGELES Class submarines, OHIO Class submarines, and cruisers. Trench 94, which has been in operation since 1986, contained 122 reactor compartment packages as of April, 2010, specifically, 103 pre-LOS ANGELES Class, 3 LOS ANGELES Class, and 16 cruisers.

A portion of 218-E-12B to the north of Trench 94 is available for use by the Navy. This area is not in a native condition, having been covered with excavation spoils from Trench 94 for a number of years. Surrounding areas to the south and west are also disturbed with backfilled trenches and spoil piles. A further detailed discussion of the 200 East Area ecology can be found in PNNL 2005.

3.1.3.4 Endangered Species

There are several species on the Hanford Site and in the Columbia River main stem flowing past the port of Benton and downstream along the waterborne transport route (of section 3.1.1) that are listed as endangered or threatened species by either the federal government under the ESA or by the State of Washington. These federally listed species are shown in Table 3.3. This table does not include the state listed species or Federal species of concern. The Draft Tank Closure and Waste Management Environmental Impact Statement (DOE 2009) contains a full listing and discussion of the federal and state listed species on the Hanford Site.

TABLE 3.3 FEDERALLY LISTED SPECIES
(Hanford Site and Columbia River along waterborne transport route)

Species	Group	Regulatory Agency	Status
Pygmy Rabbit	Mammals	USFWS	Endangered
Upper Columbia River ESU Steelhead	Fish	NMFS	Threatened
Upper Columbia River Spring-Run ESU Chinook Salmon	Fish	NMFS	Endangered
Bull Trout	Fish	USFWS	Threatened
Ute ladies'-tresses	Plants	USFWS	Threatened

Pygmy rabbit is restricted to a few small populations north of the Hanford Site in Grant and Adams counties. Biologists have searched for this species on the Hanford Site, but it has not been conclusively observed.

Upper Columbia River steelhead spawns in the Hanford Reach. Upper Columbia River spring chinook salmon do not spawn in the Hanford Reach, but adults pass through the Hanford Reach while migrating to spawning grounds. Bull trout have been observed in the Hanford reach on very rare occasions (PNNL 2005).

Ute ladies'-tresses is an orchid that occurs in undisturbed wetland and riparian habitats. There is no documented occurrence of Ute ladies'-tresses at the Port of Benton or Trench 94 and no suitable habitat appears to occur in these areas (USN 2005).

No federally or state-listed threatened or endangered species have been observed within, or in the immediate vicinity of the 200 Areas. However, some state-listed special status species have been found in the 200 Areas as detailed in the Draft Tank Closure and Waste Management Environmental Impact Statement (DOE 2009).

3.1.3.5 Floodplains/Wetlands

Based on the discussion in the Draft Tank Closure and Waste Management Environmental Impact Statement (DOE 2009), Trench 94 and the 218-E-12B burial ground do not meet the definition of wetlands or floodplains of 10 CFR 1022. The land transport route for the reactor compartment packages would not impact floodplains or wetlands. This route traverses dry, upland areas of the Hanford Site and would be the same route currently used for the pre-LOS ANGELES Class, LOS ANGELES Class, and cruiser reactor compartment packages.

3.1.3.6 Seismicity

Trench 94 is located on the Central Columbia Plateau. The seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is relatively low compared with other regions of the Pacific Northwest, the Puget Sound, and western Montana/eastern Idaho. The largest known earthquake in the Columbia Plateau occurred in 1936 near Milton-Freewater, Oregon. This earthquake had a Richter magnitude of 5.75 (DOE 2009). In the central portion of the Columbia Plateau, the largest earthquakes near the Hanford Site are two that occurred during 1918 and 1973. These two events were magnitude 4.4 and were located north of the Hanford Site near Othello (DOE 2009).

As part of the operating license review for Energy Northwest, the U.S. Nuclear Regulatory Commission (NRC) concluded that four Hanford earthquake sources should be considered for seismic design: the Rattlesnake-Wallula alignment, Gable Mountain, a “floating” earthquake in the tectonic province, and a swarm area. The Commission estimated a maximum earthquake magnitude of 6.5 for the Rattlesnake-Wallula alignment and 5.0 for Gable Mountain. The floating-earthquake design criterion was developed from the largest event located in the Columbia Plateau, the magnitude-5.75 Milton-Freewater earthquake (DOE 2009).

3.1.3.7 Geology/Groundwater

Trench 94 is underlain by the slightly alkaline gravelly sands, sands, and sandy gravels of the Hanford Formation. In general, groundwater occurs under the 200 East area in both unconfined and confined aquifers, with the confined (deeper) aquifers bounded above by relatively impermeable basalt layers and the unconfined (uppermost) aquifer lying at the interface between the Hanford Formation and the underlying basalt. The depth to the unconfined (uppermost) aquifer under the 200 East area is approximately 61 meters (200 feet), however, this aquifer is not present under Trench 94. The sandy gravely soil that predominates has a low moisture content (1-5% by weight). The soil also possesses low chloride levels and high resistivity. These conditions provide a corrosion resistant environment that inhibits the transport of metals from the trench. USN 1996, Section 3.1.3.7, provides additional discussion that remains valid for this Environmental Assessment.

3.1.3.8 Environmental Monitoring

Monitoring of the atmosphere, groundwater, Columbia River water, food and farm products, plants, animals, and soil is conducted routinely at locations on and off the Hanford Site by the Pacific Northwest National Laboratory. A detailed discussion of monitoring methods, locations, and collected data is provided in the Hanford Site Environmental Report which is published yearly. Results from the 2009 monitoring, with emphasis on the 218-E-12B burial ground and surrounding 200 East Area are discussed below (PNNL 2010).

Air monitoring in the 200 East Area showed detectable levels of uranium, americium-241, and cesium-137. One cesium-137 result at one air sampling location was greater than 10% of EPA's concentration value and was reported to the Washington State Department of Health. Plutonium 239/240 was detected at air sampling locations at the 200 North decontamination and demolition project and in the 200 West Area. During 2009, samples were collected at 42 continuously operating air monitoring locations: 23 onsite (site-wide), 11 perimeter locations, 7 in nearby communities, and 1 in a distant community. All sample results showed very low radiological concentrations. All radionuclide concentrations in air samples collected in 2009 were below levels comparable to the EPA Clean Air Act dose standard of 10 millirem/yr (40 CFR 61). Columbia River monitoring showed that concentrations of tritium and uranium were higher at locations downstream of the Hanford Site than upstream. Columbia River water samples were not collected for iodine-129 analysis in 2009 because the instrument was not operational. In previous years, higher concentrations of iodine-129 were found downstream of the Hanford Site than upstream and were determined to be statistically significant, indicating a Hanford Site source of iodine-129. The measured concentrations of these radionuclides in the river remained well below EPA and State of Washington drinking water standards.

Groundwater monitoring showed that tritium and iodine-129 is widespread through the 200 East Area at concentrations above federal drinking water standards. Technitium-99 and Strontium-90 have smaller plumes that exceed their drinking water standards in the 200 East Area. Cobalt-60, cesium-137, and plutonium exceed drinking water standards, but only in a few wells in the 200 East Area.

Groundwater monitoring identified four hazardous chemicals at Hanford at levels above applicable federal drinking water standards: nitrate, carbon tetrachloride, trichloroethene, and hexavalent chromium. Nitrate plumes are present under the 200 East Area, coincident with tritium plumes. The chlorinated organic compounds form distinct plumes under the 200 West Area as they are associated with production facilities in that area, but are not found under the 200 East Area. Local plumes of chromium contamination are present in the 200 Areas.

The reactor compartment packages at Trench 94 are not a current or historic source for any of the radionuclides or hazardous chemicals identified by Hanford monitoring. Trench 94 is open for inspection and the packages remain intact. From section 4.3.3.2.2 of this Environmental Assessment, the first potential generation of leachate from any reactor compartment package at Trench 94 would be at least 600 years after burial as a worst case and more likely, at least 2000 years or more.

The general direction of groundwater movement in the unconfined aquifer under the Hanford Site can be inferred from water-table elevations, barriers to flow, and the distribution of contaminants (e.g., tritium and nitrate plume maps). Groundwater enters the 200 East Area from the west and southwest. The flow of groundwater bypasses Trench 94 due to the subsurface basalt structure which rises above the water table, forming a divide that directs groundwater flow to the south of the trench. This effect was predicted in PNNL 1992 and USN 1996 as the water table dropped due to the halt of discharges into the nearby B-pond complex. DOE 2009 and PNNL 2010 confirm this area of subsurface basalt is now above the water table at Trench 94.

Radiation doses to the general public from Hanford operations during 2009 are calculated and discussed in the Hanford Site Environmental Report for Calendar Year 2009 (PNNL 2010). The maximally exposed individual is a hypothetical person who lives at a specific location and has a lifestyle that makes it unlikely any member of the public would have received a higher radiological dose from Hanford Site releases during 2009. The location of the maximally exposed individual can vary from year to year depending on the relative importance of the several sources of radioactive effluents released to the air and to the Columbia River from Hanford facilities. The dose assessment in 2009 determined that the maximally exposed individual was located across the Columbia River (east of the Hanford Site) at Sagemoor. It was assumed this individual had performed the following: inhaled and was immersed in airborne radionuclides, received external exposure to radionuclides deposited on the ground, ingested locally grown food products irrigated with Columbia River water and/or containing radionuclides deposited from the air, used the Columbia River near the Hanford Site for recreational purposes, and consumed locally caught Columbia River fish. The total dose to the maximally exposed individual in 2009 was calculated to be 0.12 millirem/yr. The collective dose to the population residing within an 80 kilometer (50 mile) radius of the site in 2009 was calculated to be 1 person-rem/yr. Both 2009 calculations were performed using GENII Software System, Version 2.0. The average individual dose from Hanford Site operations was approximately 0.002 millirem in 2009. This is based on the calculated 1 person-rem dose and a population of 486,000 within 80 kilometers (50 miles) of the site. This can be compared with the estimated annual individual dose of approximately 310 millirem from natural background sources (PNNL 2010). The reactor compartment packages in Trench 94 do not contribute to these doses.

PNNL 2010 states that the 486,000 population figure (within 50 miles of the site) originates from 2000 census data. Any increase in this population from 2010 census data that would be incorporated into the next yearly update of the PNNL report, would proportionally increase the collective dose, assuming that the estimated individual dose from Hanford operations is unchanged.

3.2 No-Action Alternative

PSNS & IMF is the only designated location on the west coast for storage of inactivated nuclear-powered ships. An existing facility on the east coast at Norfolk Naval Shipyard is not considered feasible for ENTERPRISE, given the size and deep draft of the ship (requiring 37 feet of depth), dredging required at Norfolk (minimum depths at the facility are under 20 feet), and the need to move the ship to PSNS & IMF for reactor compartment disposal.

The PSNS & IMF storage facility is located at Mooring Alpha, located within the CIA at PSNS & IMF and is one of several piers located on the north shore of Sinclair Inlet. See Section

3.1.1 for a description of PSNS & IMF and Sinclair Inlet. Mooring Alpha is a fixed pier that is approximately 1000 feet long and 20 feet wide. Mooring Alpha has several mooring fittings, several of which are located on two islands that are approximately 50 feet wide. Over the years various modifications and additional dolphins have been added in the vicinity of Mooring Alpha to increase its mooring capacity. NAVFAC 2009 provides details of the mooring fitting locations and capacities.

USN 1996, Section 3.2.1, describes that Mooring Alpha could be used to berth approximately 32 LOS ANGELES Class submarines with space for three larger ships, either cruisers or OHIO Class submarines or a combination of both. Space for cruisers would no longer be required once ex-LONG BEACH is dry docked for disposal, which is scheduled before ENTERPRISE arrives at PSNS & IMF. Moorage of ENTERPRISE would require the entire east or west side of Mooring Alpha depending on which option is pursued from the NAVFAC 2009 study (moorage on the west side is preferred as discussed in sections 2.2.1 and 4.4 of this Environmental Assessment). ENTERPRISE would leave space for 27 LOS ANGELES Class submarines at Mooring Alpha. One OHIO Class submarine can be berthed in place of two LOS ANGELES Class submarines.

Additional services are required to be installed at Mooring Alpha for berthing ENTERPRISE. (i.e. fire and flooding alarm systems, cathodic protection system, and electrical power).

4. ENVIRONMENTAL CONSEQUENCES

4.1 Radiation

The Navy's policy is to minimize occupational radiation exposure to personnel. The limits invoked to achieve this objective are 1/10th of the 5 rem/yr allowed by federal regulations for radiation workers (i.e., 0.5 rem/yr). Since 1980, no person has received more than 2 rem in one year from radiation associated with naval nuclear propulsion. The average occupational dose received by each person monitored at all naval shipyards was 0.041 rem in 2008. The average lifetime accumulated dose (since 1954) associated with naval nuclear propulsion is about 1 rem, corresponding to a 1 in 2500 chance of a cancer fatality. The average annual exposure to the general public by comparison from normal background radiation (sun, earth etc,) is 0.3 rem/yr, and is received every year over a lifetime (i.e., 15 rem over 50 years). The control of radiation exposure to Shipyard workers is further discussed in NNPP 2010. USN 1996, section 4.1, also provides additional discussion that remains applicable to reactor compartment disposal of ENTERPRISE.

No members of the general public have received measurable radiation exposure as a result of operations of the Naval Nuclear Propulsion Program. Procedures used by the Navy to control releases of radioactivity from navy nuclear powered ships and support facilities have been effective in protecting the environment and public health. The annual report NT-10-1, Environmental Monitoring and Disposal of Radioactive Wastes from US Naval Nuclear Powered Ships and their Support facilities" issued by the Navy (NNPP 2010a) provides details. USN 1996, section 4.1, also provides additional discussion that remains applicable to reactor compartment disposal of ENTERPRISE.

4.2 Potential Effects of Primary Hazardous Materials found in Reactor Compartments

4.2.1 Asbestos

Asbestos insulation is commonly found in older ships. Repair and ship hull recycle operations at PSNS & IMF routinely encounter and handle asbestos materials. Asbestos is regulated in the work place, in removal operations, and in the environment. 40 CFR 61 provides federal environmental regulations for asbestos work. Sealed containments, sealed worker suits (with air fed hoods), water damping/wiping are examples of methods employed to contain asbestos and protect workers and the environment. USN 1996, section 4.2.1, provides discussion of effects that remain applicable to ENTERPRISE reactor compartment disposal and remnant hull recycle.

4.2.2 Polychlorinated Biphenyls

Polychlorinated Biphenyls (PCB) are found shipboard, commonly in wool felt sound damping, electrical cable rubber, and in paint. Wool felt sound damping and electrical equipment containing liquid PCBs are removed and disposed of under 40 CFR 761. Sealed containments, sealed worker suits with air fed hoods, and surface cleaning with solvents (e.g., alcohol) are examples of methods employed to contain and remove PCBs and protect workers and the environment. The remaining PCBs in reactor compartment packages are in a solid, non-leachable form such as in rubber, plastic and paint, and are considered 'bulk product waste' under 40 CFR 761. 'Bulk product waste' does not require disposal in a TSCA chemical waste landfill, and can be disposed of in a municipal waste landfill. Disposal inside the reactor compartment package provides a level of protection superior to a municipal waste landfill. USN 1996, section 4.2, provides additional discussion that remains applicable to reactor compartment disposal of the ENTERPRISE and remnant hull recycle.

4.2.3 Lead

Lead is found shipboard primarily as canned (inside a metal jacket) radiation shielding, ballast, and also in paint. Repair and ship hull recycle work, as well as reactor compartment packaging work routinely involves lead removal. If ballast lead is found it, it will be removed from reactor compartment packages per agreement with the State of Washington. Some of the ship's radiation shielding lead has to be removed to allow for cutting and separating structures and welding new structure to form the package. The bulk of this lead remains in place in the reactor compartment package as radiation shielding and is regulated as a state-only dangerous waste under Washington State law (WAC 173-303). This shielding lead is not regulated as a hazardous waste under federal law (40 CFR). Sealed containments, respirators, and protective clothing are some examples of methods used to protect workers from lead exposure. Lead and lead paint are removed from areas prior to hot work (cutting or welding). Lead dust and debris is controlled and disposed of under applicable regulations. Lead removal workers have their blood tested to determine if lead has been absorbed into the body. USN 1996, section 4.2.3, provides discussion of effects that remain applicable to this Environmental Assessment.

4.3 Preferred Alternative – Disposal of the Entire Reactor Compartment at Trench 94 at the Department of Energy Hanford Site

4.3.1 Shipyard

PSNS & IMF and other navy shipyards routinely conduct ship overhaul and repair work including the docking and refueling of nuclear powered ships, or defueling and inactivation. PSNS & IMF also routinely decommissions and disposes of the reactor compartments from inactivated ships and recycles the remainder of the ship. 114 ships have undergone reactor compartment disposal and ship recycle at PSNS & IMF to date. ENTERPRISE would arrive at PSNS & IMF under Navy tow, already defueled and inactivated. PSNS & IMF would dispose of the reactor compartments and recycle the remnant sections of hull from the ship. ENTERPRISE is similar in size to other aircraft carriers that the shipyard has serviced and has a volume of metal to be processed for complete reactor compartment disposal and remnant hull recycle equal to about 18 submarines on average of the types typically disposed of at the Shipyard. Reactor compartment disposal and recycle of the remnant hull sections of ENTERPRISE is expected to occur over a six to eight year period with the bulk of the metal/material processing concentrated within a three to five year period. This work would represent less than historic peak work loads at PSNS & IMF, when up to ten submarines per year underwent reactor compartment disposal and remnant hull recycle. This work is expected to be performed within the shipyard's available resources (manpower, facilities, etc.) (section 4.3.6 relates). The eight ENTERPRISE reactor compartments, when packaged, would be of similar size, shape, weight and content to those from the ex-LONG BEACH, as analyzed in USN 1996.

Reactor compartment disposal and recycle of the remnant hull sections of ENTERPRISE would be performed within the controlled industrial area of PSNS & IMF, consistent with the current reactor compartment disposal and ongoing and past work at PSNS & IMF . Operations at PSNS & IMF, an industrial naval shipyard, are considered to be consistent to the maximum practical extent with local and state shoreline management requirements, and the Coastal Zone Management Act.

<u>Docking/Re-docking</u>

As discussed in section 2.1.1.3, ENTERPRISE would initially be placed in a large carrier servicing dry dock to remove structure on top of the ship and a section of the bow. To minimize the time required in the large aircraft carrier dry dock, interferences inside the ship in the way of the bow and deck cutting operations could be removed while ENTERPRISE is pier side. A barge may be positioned temporarily next to ENTERPRISE to aid in material removal while it is pier side. In the large carrier dry dock, the cut areas of hull would be resealed, external surfaces cleaned, and the ship then re-floated into a smaller dry dock better configured for reactor compartment disposal and remnant hull recycle. To facilitate this docking, a number of actions may be taken to guide the hull into the smaller dry dock, including installing bumpers or rollers in the dry dock, placing concrete or steel fender piles (overlaid with rubber) into the water at the dock entrance, or temporarily placing floating barges into place at the dock entrance until the docking is complete. These docking aids have been used in the past at PSNS & IMF and based on PSNS & IMF experience with docking ships, it is expected that this work can be conducted within a 'not likely to adversely affect determination' under the Endangered Species Act with no significant environmental impact.

<u>Work Process/Radiation Exposure</u>:

The reactor compartment packaging work would involve draining fluid systems, cutting and sealing piping, removal of components, and installation of packaging and handling fixtures similar to past reactor compartment disposals. For ENTERPRISE, the paired reactor compartments would also be separated by cutting through a structural space between the reactor compartments with attendant lead shielding removal and the removal of a primary plant component (one per plant) located in an auxiliary structure separated from the reactor compartment by a steel bulkhead. This work would not enter the interior of the reactor compartments where the reactor vessel is located. This separation will result in increased work adjacent to and on primary plant components as compared to typical reactor compartment disposals, resulting in a higher per package exposure as compared to more typical reactor compartment disposals. About 300 rem of collective radiation exposure (to the entire workforce involved) has been estimated to prepare the eight ENTERPRISE reactor compartment packages, or about 0.1 latent cancer fatalities total, based on one (1) latent cancer fatality per 2500 rem of worker exposure. For comparison, the disposal of the reactor compartments evaluated in USN 1996 was estimated to be 1500 rem, or 0.6 latent cancer fatalities total. History shows that actual exposure could be significantly lower than these estimates, especially as more reactor compartments are processed and process improvements are incorporated. USN 1996 estimated 25 rem of collective exposure among the shipyard workforce per cruiser reactor compartment package prepared, for a total of 400 rem of collective exposure for 16 cruiser reactor compartments. The actual collective exposure recorded for these 16 cruiser reactor compartment packages was less than 70 rem; a fraction of the original estimate, leaving more than 300 rem of collective exposure unused. Regardless, the 300 rem collective dose estimated for ENTERPRISE would be spread through the work force such that a workers exposure would be typically limited to 0.5 rem (0.0002 latent cancer fatalities) per year, and no more than 2 rem (0.0008 latent cancer fatality) in one year as a worst case. This can be compared with the estimated annual individual dose of approximately 0.3 rem (to members of the general public) from natural background sources (PNNL 2010).

<u>Air Quality</u>

All PSNS & IMF work is conducted per the PSNS & IMF Air Quality Permit, which incorporates all USEPA, Washington State, and regional air pollution authority (Puget Sound Clean Air Agency) requirements applicable to shipyard operations. The Puget Sound Clean Air Agency currently prohibits the emission of any air contaminant for a period or periods of more than three minutes in any one hour which is darker in shade than 20% density, known as the ‘smoke opacity rule’. This rule is applied to the top of a dry dock as an emission source. Section 2.1.1.3 of this Environmental Assessment discusses the reduction and dismantlement of the ENTERPRISE in order to separate the reactor compartments and clear the dry dock for loading the reactor compartment packages. Extensive metal cutting would be required to reduce the ENTERPRISE for re-docking into the smaller dry dock and to separate the reactor compartments from the ship and recycle the remnant hull sections (to clear the dry dock and allow loading reactor compartment packages onto a transport barge). With ENTERPRISE rising above the top of both the larger carrier and smaller reactor compartment disposal dry docks, this cutting work could produce temporary smoke levels in the immediate vicinity of the ship that would present a challenge to maintaining the opacity requirement (if applied to the top of the dry dock without a mixing envelope allowed around the ship). This is not an entirely new issue and has been dealt with for reactor compartment disposal of cruisers and submarines with tall external structures (that also project above the top of dry docks although not as extensively as for ENTERPRISE). Lessons learned from these events would be applied to ENTERPRISE. Several methods could be employed to control opacity, including over the ship containments with controlled exhaust or using the external hull and top deck of the ship as a containment while gutting internal areas. Air would be drawn into this space for habitability and exhausted through a filtration process.

Shipyard operations would adhere to the PSNS & IMF air operating permit and it is expected that total emissions would be within historic norms for the Shipyard. As discussed at the beginning of section 4.3.1, the volume of metal to be cut and processed, the primary source of emissions during reactor compartment disposal and remnant hull recycle, is less (for ENTERPRISE over the time period through which the work would be concentrated) than historic peak workloads at PSNS & IMF. In addition, increased efficiency in the metal cutting processes, such as the increased use of mechanical saws vice cutting torches, reduces air emissions for the same volume of metal cut/processed as compared to the past. ENTERPRISE reactor compartment disposal would not be expected to result in a significant degradation of air quality in the areas surrounding PSNS & IMF. Current regional air quality is 'in attainment' and no formal conformity review is required.

Water Quality

All PSNS & IMF work is conducted per the PSNS & IMF Water Pollution Prevention and Control Plan. This local instruction promulgates the requirements of PSNS & IMF's National Pollutant Discharge Elimination System (NPDES) permit and the Washington State Waste Discharge Permit (SWDP). Best Management Practices (BMPs) have been developed to prevent or minimize "the generation of pollutants, their release, and potential release to waters of the United States through normal operation and ancillary activities" and "the introduction of pollutants into groundwater and the City of Bremerton's sanitary sewer system." ENTERPRISE reactor compartment disposal is not expected to significantly impact water quality.

Hazardous Material

PSNS & IMF routinely manages hazardous materials from ship repair, reactor compartment disposal, and ship recycle work. Similar materials would be encountered with ENTERPRISE, namely asbestos, PCB, and lead. All work involving hazardous materials would be carried out by trained people using appropriate personnel protective equipment per NAVOSH requirements. Hazardous materials would be properly disposed of in accordance with the PSNS & IMF Waste Management Plan (WMP). The WMP specifies procedures to properly dispose of hazardous materials that comply with applicable Federal, State, and local regulations.

Radioactive potassium chromate solution is removed from Navy reactor compartments, filtered to remove radioactivity, and either recycled into other Navy nuclear ships or, if not needed, treated and disposed of in accordance with 40 CFR. For ENTERPRISE, processing of this liquid is expected to involve evaporation to reduce volume, reduction of hexavalent chromium to trivalent chromium, and solidification of the residual liquid as a low level radioactive waste.

USN 1996 estimated that 57,400 cubic feet of mixed waste, primarily as radioactive potassium chromate solution, would be generated by disposal of the reactor compartments considered. This assumed no recycle of the solution and also ignored volume reduction in the treatment process. A majority of USN 1996 reactor compartments disposed of to date have had their potassium chromate solution recycled into other Navy nuclear powered ships such that disposal of the ENTERPRISE reactor compartments would be encompassed within the original 57,400 cubic feet analyzed (for generated waste), even if all the solution from ENTERPRISE was not recycled and was processed as mixed waste. ENTERPRISE would represent about 10% of the original 57,400 cubic feet analyzed (as generated waste). It is expected that at some point re-use (recycle) demand would drop and drained potassium chromate from reactor compartment disposal of ship classes considered in USN 1996 would be processed as waste. However, it is not expected that the 57,400 cubic feet of USN 1996 would be exceeded. These quantities are generated waste and not disposed of waste. Volume reduction of liquid and reduction of chromates during treatment of the generated waste results in much smaller quantities of disposed mixed waste, if any. Processing of the ENTERPRISE chromate solution is expected to result in a end product for disposal that is not a mixed waste.

<u>Additional Component/Material Shipment</u>

Separation of the paired ENTERPRISE reactor compartments would involve the removal of a component of the reactor plants that is placed outside the reactor compartments in an auxiliary structure. This work would not enter the interior of the reactor compartments where the reactor vessel is located. These components would be disposed of separately as radioactive waste, as is practiced at the Shipyard for other primary plant components removed from ships (for replacement) during maintenance, and associated tanks that require replacement or disposal. The total number of such components for ENTERPRISE would be eight.

In addition, four large tanks surrounding the reactor compartments may be disassembled and cleaned or shipped whole to a low level radioactive waste disposal site. The tanks are shaped somewhat like a thick book and weigh approximately 60,000 pounds each. Whole tank dimensions are too large for normal rail and truck shipment and would likely be shipped by barge via the Port of Benton barge slip to the US Ecology facility on the Hanford Site. If barged, the shipment would be done in the manner similar to reactor compartments as described in section 2.1.2 of this Environmental Assessment (e.g., back-up tug, escort, etc.) but would not have measurable radiation on the exterior of the shipment package(s). It may be possible to package all four tanks into one shipment container approximating a reactor compartment in size but much lighter in weight (~220,000 pounds). Thus between one to four such shipments would occur. PSNS & IMF has shipped other such large tanks of similar weight in the past to low level radioactive waste disposal sites but with dimensions small enough to allow rail transport.

The additional shipments described above would amount to less than 1% (less than 15) of the over 1500 such primary plant component shipments analyzed in section 2.3, 4.5, and Appendix E of USN 1996, under the subdivision and re-use alternative of that document. The ENTERPRISE component shipments would not represent a significant level of effort and effect associated with the subdivision and re-use alternative of USN 1996. Section 4.3.11.5 of this Environmental Assessment provides additional discussion.

4.3.2 Transport

Section 2.1.2 and 3.1.1 of this Environmental Assessment describes the transport route and process. ENTERPRISE reactor compartment package shipments would be conducted in the same manner and along the same route as for the current reactor compartment packages of USN 1996. Consequently, backup tugs, a naval escort, an emergency position indicator beacon (triggered when submerged) and salvage equipment for the package would be used. ENTERPRISE reactor compartment package shipments, eight shipments over an about two year period, would be consistent with the two to four shipments per year currently occurring in the reactor compartment disposal program and well within the historic peak of over ten shipments in one year. These shipments are a very small part of total waterborne shipments and marine traffic transiting into and out of the Puget Sound and the Columbia River. The only possible interaction between the ENTERPRISE package shipments and endangered species, other than incidental as a normal part of marine/river traffic, is upon docking at the port of Benton. The Port of Benton barge slip, used for off-loading all reactor compartment packages, would be used for ENTERPRISE. The Navy holds an Army Corps of Engineers permit for in-water maintenance and activity at this barge slip to support of reactor compartment package shipments. This permit is supported by a ‘not likely to adversely affect’ determination for relevant Endangered Species Act listings. This permit limits activity during the spring run-off when high river flows stimulate downstream migration of juvenile salmonids. The barge slip floods during this time and is not useable for reactor compartment package shipment. The barge slip has a compacted bottom typically 8-13 feet underwater (deeper in flood), is not quality aquatic habitat, and is not suitable for spawning. No additional listings or changes in listings relevant to operations at the barge slip that would affect the above determination have occurred to date.

As discussed in section 2.1.2, a modified transport barge to be used for the LONG BEACH reactor compartment package shipments would then be used for ENTERPRISE as well. An additional barge may be modified to provide flexibility in scheduling shipments of the ENTERPRISE reactor compartments. Although not required, this additional barge would thus be useful. This decision hinges on whether a suitable barge of sufficient size, design, and load capacity can be found at economic terms. It is likely though that the additional barge would be too wide to dock in the current barge slip and that modifications to the barge slip to remove part or all of the existing south jetty would be required if the additional barge were used. Based on PSNS & IMF experience with work conducted at the barge slip and Army Corps of Engineers experience with work of this type, it is expected that the slip modifications could be conducted within a ‘not likely to adversely affect determination’ under the Endangered Species Act with no significant environmental impact.

As discussed in section 2.1.2, ENTERPRISE reactor compartments, and possibly other heavier packages of USN 1996, may be off-loaded at the barge slip using a variation of the current method, where the package is moved off the barge to land and then loaded onto the transporter. This method may require a modification to the sheet pile structure and area at the head of the barge slip. The specific design of this work and the need for it cannot be fully evaluated at this time. If performed, the modification could involve replacing the soil in the sheet pile cell with concrete to provide additional strength with a barrier placed inside of the sheet pile wall between new concrete placement and the river in the slip. Based on PSNS & IMF experience with work conducted at the barge slip and Army Corps of Engineers experience with work of this type, it is expected that this work could be conducted within a ‘not likely to adversely affect determination’ under the Endangered Species Act with no significant environmental impact.

Land transport of the ENTERPRISE reactor compartment packages would be conducted along the same route that is used for the current reactor compartment packages of USN 1996 (Figure 2.4). Either a towed multi piece trailer or a self propelled trailer would be used. Self propelled trailers are used to move heavy large loads and have an advantage of a more compact design and maneuverability. Periodic maintenance, gravel addition, blading, and asphalt repair, occur along the route. In addition the route is modified to strengthen road surfaces or re-align curves and slopes, as needed to facilitate continued use of the route to transport reactor compartment packages. A portion of the route, just inside the Hanford Site border, north of the barge slip, is a gravel road that skirts an area that is a buffer around locations where Native American human remains were found. The transport route within this area may require periodic addition of gravel and maintenance but would not require widening into the buffer area.

It is expected that shipment of the eight ENTERPRISE reactor compartment packages would occur over a two (2) to 2 ½ year period, consistent with the current expected average of four shipments per year over the next five years, and historic peak production of ten shipments per year. Disposal and shipment of reactor compartments from other ships may be deferred during the time that PSNS & IMF is processing the ENTERPRISE. Effects to the environment from transport, such as from emissions from vessels and vehicles participating in the transport, would be no different than current transport and negligible as a part of the overall ocean, river, and road traffic at the time of transport.

4.3.3 Hanford Site

The use of Trench 94 to dispose of Navy reactor compartment packages is consistent with the Department of Energy Draft Tank Closure and Waste Management EIS (DOE 2009), and a related legal settlement agreement between the State of Washington and the Department of Energy allowing for continued disposal of Navy reactor compartments at Hanford (Bodman 2006). USN 1996 provides a cumulative analysis of 220 reactor compartment packages at Trench 94. This analysis encompasses the ENTERPRISE reactor compartments because these compartments are similar in content to reactor compartments already evaluated and do not cause the total number within the trench to exceed 220. Radioactivity contained within Trench 94 poses no significant cumulative effect relative to Hanford Site wastes discussed in DOE 2009.

4.3.3.1 Extreme Natural Phenomena

ENTERPRISE reactor compartment packages would be constructed of steel about two inches thick, with additional layers of steel inside comprised of the ships bulkheads and reactor plant structures. The packages would weigh over 4,000,000 pounds and be placed on a foundation structure on the trench floor designed for this purpose. Extreme natural phenomena are not expected to affect these packages at Hanford. USN 1996, section 4.3.3.1 provides additional analysis of potential phenomena that remains applicable to ENTERPRISE reactor compartment packages.

4.3.3.2 Radiological Effects

4.3.3.2.1 External Radiation Upon Disposal

Radiation levels outside the reactor compartment packages are well below federal limits and pose little risk to the general public. Typical contact radiation levels outside the cruiser reactor compartment packages of USN 1996 are less than 0.1 millirem/hr (0.0001 rem/hr) on the accessible sides and top of the package and less than 1 millirem/hr at a point on the bottom of the package that is not accessible during transport or at the trench. One hour of contact with the bottom of the package would result in typical exposure of less than 1 millirem (0.001 rem), as compared to an average of 300 millirem per year (0.3 rem/yr) of natural source exposure from cosmic rays, rocks, etc. The ENTERPRISE reactor compartment packages are expected to be similar to the cruiser packages in this regard and likely will have even lower external radiation levels because they are expected to have less radioactivity than the cruiser reactor compartment packages and a larger mass of shielding structure. Section 4.3.3.2.1 of USN 1996 provides additional details valid for all Navy reactor compartments.

4.3.3.2.2 Corrosion Performance

The ENTERPRISE reactor compartment packages would exhibit the same corrosion performance as discussed in section 4.3.3.2 and Appendix B of USN 1996. The first potential generation of leachate from any reactor compartment package at Trench 94 would be at least 600 years after burial as a worst case and more likely, at least 2000 years or more. The ENTERPRISE reactor compartment packages are more robust than the reactor compartment package structure responsible for the 600-2000 year limiting case. Virtually all (99.9%) of long lived radioactivity is inside the reactor vessel structure. Between 10,000-30,000 years would be required for corrosion to access the surfaces that contain this radioactivity. Corrosion of these surfaces containing the long lived radioactivity and subsequent release of this radioactivity would be much slower, at about 0.01 milligrams of metal/sq dm/yr (a sq dm is a 10 centimeter square area) as a worst case for the alloys commonly used. It is also possible that these alloys may not corrode at all at Trench 94, because of the high resistivity, low chloride and sulfate content, and aridity of the soil at this burial site. In any case, significant decay of even the longest lived radioactivity occurs due to the very slow corrosion based release mechanism.

4.3.3.3 Site Specific Migration Studies

The ENTERPRISE reactor compartment packages would exhibit the same performance after burial as discussed in section 4.3.3.2, 4.3.3.3, and Appendix B of USN 1996. Studies conducted in support of USN 1996 assessed the release and migration of nickel, nickel-63, and nickel-59, and lead through the vadose zone and into the groundwater under Trench 94 for reactor compartment packages at Trench 94 (PNNL 1992, PNNL 1994). The PNNL studies are based on soil characteristics at Trench 94, as determined from trench soil samples in laboratory testing. The studies modeled reactor compartment packages such that they would be interchangeable from various ship classes as long as they fit within the grid area assumed per reactor compartment (1650 square foot), are composed of similar metal alloys having similar corrosion rates, contain long lived radioactivity in these corrosion resistant alloys and in quantity bounded by the quantities assumed for the reactor compartments in the PNNL studies, and perform similarly under corrosion and burial as described in USN 1996. All of these conditions are met by the ENTERPRISE reactor compartment packages.

Sections 4.3.3.2.1.3 and 4.3.3.3.2 of USN 1996 discusses how the PNNL studies are applied to a cumulative total of 220 reactor compartment packages at Trench 94, placed in a close pack array that would allow the existing trench to accommodate 220 reactor compartment packages without need for new land commitment. This analysis encompasses the ENTERPRISE reactor compartment packages because they are similar in content to the reactor compartment packages of USN 1996 and would result in less than 220 reactor compartment packages placed at the trench. Thus, the PNNL studies (PNNL 1992, PNNL 1994) and the application of these studies to a 220 RC trench from USN 1996 remains valid for this Environmental Assessment.

The PNNL studies modeled a ‘current’ climate case of 0.5 cm/yr recharge into the vadose zone (from surface precipitation after surface evaporation and plant uptake) and a ‘wetter’ climate case of 6 cm/yr recharge. For the current climate case, the studies predict that groundwater would not be present under Trench 94 as the water table would drop below the subsurface basalt under the trench due to the halt of discharges into the nearby B-pond complex. DOE 2009 and PNNL 2010 confirm this area of subsurface basalt is now above the water table at Trench 94. For the wetter climate case, the PNNL studies predict that groundwater would be present under Trench 94, and move north to northwestward away from the trench.

The PNNL studies predict a 50 year transit time for recharge at Trench 94 to migrate down through the vadose zone under the trench to the subsurface basalt, under the 6 cm/yr recharge case. Table N-2 (Appendix N) of DOE 2009 estimates a vadose zone transit time of 115 years at the 200 East area for a 5 cm/yr recharge. Similarly, the PNNL studies predict a 500 year transit time for a 0.5 cm/yr recharge, with DOE 2009 estimating 1240 years for a 0.35 cm/yr recharge .

Upon reaching the aquifer, recharge passing through Trench 94 is modeled (in the PNNL studies) as entering a ‘stream tube’ which does not allow dilution with surrounding waters. This model is useful as a screening tool to estimate how fast a contaminant could travel and a maximum concentration that could be encountered in the aquifer.

From PNNL 1994 and USN 1996, under the ‘current’ climate case, about 800,000 years would be required for nickel-59 to reach the aquifer, and about 66,000 years under the ‘wetter’ climate case. Dissolved nickel and other metallic radionuclides would adsorb onto the soil particles under the trench and thus travel through the soil slower than the recharge transit time. A maximally exposed individual utilizing a well near the trench as a sole source of water would receive a dose from the nickel-59 of less than 1 millirem/yr. Nickel-63 would decay prior to reaching the aquifer.

From PNNL 1992 and USN 1996, under the ‘current’ climate case, about two million years would be required for lead to reach the aquifer, and about 240,000 years under the ‘wetter’ climate case. Dissolved lead would adsorb onto the soil particles under the trench and thus travel through the soil slower than the recharge transit time. Maximum lead concentration in the stream tube would be about four parts per billion under the current (dry) climate case and 43 parts per billion under the wetter climate case. By comparison, a five part per billion ‘action level’ from 40 CFR 141 triggers source monitoring for lead in public water systems. Even if such a system were located adjacent to Trench 94, the predicted result for the wetter climate case represents ten times the current recharge assumed, requires several hundred thousands of years to develop, and assumes that no dilution will occur along the stream tube.

The adsorption of lead (and other metallic elements) onto soil is described by the use of a distribution coefficient (Kd). To characterize this effect under the trench, samples of soil from the trench were used and soil logs from adjacent monitoring wells were considered to determine if any unexpected condition may exist subsurface. As described in PNNL 1992 and PNNL 1994, tests were conducted on the collected soil to determine the solubility of lead and nickel in water exposed to trench soil, and the Kd of the dissolved lead and nickel in contact with the soil. For lead, a range of Kd was found (after 7-10 days of contact in water with the trench soil) of 13,000 – 79,000 ml/g. Kd decreased as lead concentration in solution increased (very small amounts of lead in the water adsorbed more completely that larger amounts). This data allowed Kd to be predicted at the solubility limit for lead in the water. Thus a Kd of 1200 ml/g was chosen for a ‘conservative’ case based on the assumption that lead would dissolve to the maximum extent possible in groundwater under the trench (i.e. at the solubility limit). A ‘best estimate’ case with a Kd of 10,000 ml/g represented the low end of the experimental results (the soil adsorbed lead so efficiently that equilibrium concentration was below the solubility limit). To assess performance under stressed conditions, leaded water was dripped through columns of trench soil under gravity flow. These tests verified the adsorption predicted. Use of the 1200 ml/g Kd resulted in the 240,000 year time frame for lead migration to the aquifer under the 'wetter' climate case (and 2.2 million years under the 'current' climate case). Use of the 'best estimate' Kd (10,000 ml/g) would result in longer transit times. Similarly, use of the vadose zone transit times from DOE 2009, coupled to the Kd from the PNNL studies, would result in longer transit times.

DOE 2009 uses an 81 ml/g Kd for lead. Soil that has been acidified and /or contaminated by prior chemical releases and liquid waste streams of complex content or containing chelating agents, could result in a reduced lead adsorption capacity. Trench 94 should be considered separately. Kd derived from experiments on Trench 94 soil were several orders of magnitude higher and show a strong adsorption capacity.

4.3.3.4 Other Radioactive Corrosion Products Available for Migration

Niobium-94 and carbon-14 are present in very small quantities within reactor compartments and would release very slowly due to the slow corrosion of the alloys within the reactor vessel. Additionally, niobium-94 would be adsorbed onto soil particles. Section 4.3.3.2.1.4 of USN 1996 provides additional detail that remains applicable to ENTERPRISE reactor compartment packages.

4.3.3.5 Population Radiation Dose

Section 4.3.3.2.1.5 of USN 1996 discusses the results of a collective population dose calculation for a hypothetical three million person future population within a 50 mile radius of Hanford over 10,000 years. This calculation is based on the amount of long lived radioactivity that could be released by the 220 reactor compartment packages at Trench 94, and encompasses ENTERPRISE reactor compartment packages at Trench 94.

In summary, the maximum collective dose to the future population over 10,000 years was estimated at 0.001 person-rem, or about 0.0000005 latent cancer fatality (lcf) for nickel-59, and bounded by (less than) 0.003 lcf for niobium-94 and less than 0.00012 lcf for carbon-14. Total latent cancer fatalities would be less than one for the three million person population over the 10,000 year period, an insignificant result compared to cancer fatalities from natural background radiation and other causes.

4.3.3.6 Other Constituents Available for Migration

<u>PCB</u>

Navy reactor compartment packages, including those from the ENTERPRISE, would be considered 'PCB bulk product waste' under 40 CFR 761. These packages contain PCBs in solid formulation within materials that do not readily break down and/or leach PCB to water, such as rubber, dried glue and paint, and plastic. 'PCB bulk product waste' of the types found in the reactor compartment packages may be disposed of in solid waste (municipal) landfills. Disposal in a reactor compartment package at Trench 94 provides a level of containment and protection superior to that of a municipal solid waste landfill. All liquid (mobile) PCBs are removed from the reactor compartment packages. For example, wool felt sound damping material is removed from submarine reactor compartments. This material contains an oily/waxy substance containing PCB that does not meet the criteria for PCB bulk product waste under 40 CFR 761. The ENTERPRISE reactor compartments are not expected to contain the wool felt sound damping, but this material would be removed if found.

Even if the PCB within the bulk product waste was assumed to leach into water, at the maximum solubility expected in water, PCB concentration in the aquifer downstream of the trench would be less than the 0.5 part per billion maximum contaminant level provided in 40 CFR 141 for PCBs. This level is the maximum allowed in a public use water system. Section 4.3.3.3 of USN 1996 provides additional details.

<u>Chromium</u>

Metallic chromium in corrosion resistant alloys within the reactor compartments would be released very slowly as the metals corrode. Alkaline soil and groundwater conditions at Trench 94, and the presence of large amounts of iron corrosion product (from steel) would result in chromium corrosion product being in a trivalent form, that is strongly bound into the soil and not mobile. Trivalent chromium does not act on the body as hexavalent chromium would. Hexavalent chromium is considered harmful and is regulated. A Navy reactor compartment, including those from the ENTERPRISE, may contain up to two pounds at most of hexavalent chromium, permanently bound into a liquid absorbent material such as diatomaceous earth. The Washington State Administrative Code Dangerous Waste Regulations (section 173-303-090) set a 5 mg/L limit for chromate under the Toxicity Characteristic Leaching Procedure (TCLP) . This is equivalent to 0.01% of the weight of the waste for a readily leachable material such as potassium chromate. This limit would allow over 200 pounds of potassium chromate in the reactor compartment packages of Figure 2.1 of this Environmental Assessment. Section 4.3.3.4.1 of USN 1996 provides additional detail.

4.3.3.7 Land Commitment

No additional land commitment is required for disposal of the ENTERPRISE reactor compartment packages at Trench 94. Trench 94 would accommodate the 220 reactor compartment packages currently considered, including ENTERPRISE.

4.3.4 Cumulative Effects

As discussed in section 4.3.1 of this Environmental Assessment, about 300 rem of collective radiation exposure (to the entire workforce involved) has been estimated to prepare the eight ENTERPRISE reactor compartment packages, or about 0.1 latent cancer fatalities total, based on one (1) latent cancer fatality per 2500 rem of worker exposure. However, history shows that such estimates have been improved on significantly, by lowered collective exposure. In addition, these doses would be spread through the work force such that a workers exposure would be limited to 0.5 rem (0.0002 latent cancer fatalities) per year.

In the short term (next 10-15 years), ENTERPRISE can be considered to substitute for other USN 1996 class reactor compartment disposals that may be deferred to accommodate the ENTERPRISE work. Both tempo and intensity of work would remain within historic norms for environmental effects to the Shipyard. ENTERPRISE reactor compartment packages would be within the size, shape, weight, and content of those defined in USN 1996, and would be prepared and transported similarly, with the number of shipments per year and timing of shipments being comparable to past years and within historic peak workloads. The ENTERPRISE reactor compartment packages would be as robust as other Navy reactor compartment packages and transported using similar processes and methods that have safely transported over 120 reactor compartment packages to Hanford. Reactor compartment disposal and remnant hull recycle would involve a quantity of metal and material, including hazardous material removal and disposal, equivalent to other periods of history in the Shipyard when this work occupied a significant portion (about ½) of the work force in the 1990's. Opacity issues would be managed to maintain permitted requirements (see the discussion of section 4.3.1 for details). With these controls no significant impacts to the local environment at PSNS & IMF and along the transport route are seen.

At the disposal site, radiation levels outside and inside the reactor compartment package would be cut in half for every five years elapsed after disposal, and drop to negligible levels, even inside the reactor compartment, at fifty years after disposal (excluding the inside of piping and components that are not normally accessible). Several thousand years after disposal, it becomes possible that small amounts of dissolved lead could exit the compartment package, if moisture was available, but be immediately trapped in soils underneath the compartment. Even under the much wetter climate scenario envisioned, hundreds of thousands of years would be required for this lead to enter the groundwater under Trench 94 and only at low levels of parts per billion.

All short lived radioactivity inside the reactor compartment would decay prior to the reactor compartment package being breached by corrosion. Table 1.2 of this Environmental Assessment shows that total ENTERPRISE reactor compartment long lived activity represents from < 1% to 3 % of the total long lived radioactivity added by the 100 reactor compartments of USN 1996. Appendix B of USN 1996 discusses the release of long lived radioactivity from Navy reactor compartments. This discussion remains valid for inclusion of the ENTERPRISE reactor compartments at Trench 94. In summary, long lived radioactivity would not be released in more than negligible quantity until the reactor vessel itself was breached by corrosion, at 10,000-30,000 years. Even then, the release of such activity would be controlled by the slow corrosion of the internal structure of the reactor vessel, over the 10 million year time required to fully corrode this structure when buried at Trench 94. Thus, in-situ decay of long lived radioactivity is substantial. Table B-3 of USN 1996 shows < 0.1% of the original carbon-14 content (and <

0.2% of technetium-99) in a reactor compartment is released over a 10,000 year time frame starting after the internal structure of the reactor vessel is accessed. This 10,000 year time frame starts after the 10,000 – 30,000 years required for corrosion to access the internal structure of the reactor vessel. Table B-3 of USN 1996 also shows that < 0.2 % of the original carbon-14 content (and < 6 % of technetium-99) in a reactor compartment is ever released before in-situ decay removes this activity.

Figure M-6 of DOE 2009 provides estimates of past releases from tank farms in the 200 East area. Figure M-10 of DOE 2009 provides estimates of past releases from cribs and trenches. The B, BX, and BY cribs and trenches of this figure are in the 200 East area. Figures M-48 through 71 of DOE 2009 provide estimates of future releases from the 200 East area under different waste management alternatives including assumptions of off-site waste disposal. For carbon-14, Figures M-6 and M-10 combined estimate over 10 curies of carbon-14 released. Off site waste disposal alternatives from figures M-48 through 71 potentially add a thousand curies of carbon-14 released. In comparison, applying the discussion of the previous paragraph, less than 0.005 curies of carbon-14 would be released from the ENTERPRISE reactor compartments (all of them combined), and less than 1 curie from Trench 94 entirely, over a 10,000 year time frame starting after the internal structure of the reactor vessel is accessed. For technetium-99, Figures M-6 and M-10 combined estimate over 100 curies of technetium-99 released. Off site waste disposal alternatives from figures M-48 through 71 potentially add a thousand curies of technetium-99 released. In comparison, less than 0.0002 curies of technetium-99 would be released from all the ENTERPRISE reactor compartments, and less than 0.02 curies from Trench 94 entirely, over the same 10,000 year time span starting after the internal structure of the reactor vessel is accessed (as discussed for carbon-14).

4.3.5 Air Effects

As discussed in section 4.3.1-4.3.3, ENTERPRISE reactor compartment disposal should not result in a significant change to air quality both at and around the shipyard and from shipment and disposal at Hanford. ENTERPRISE reactor compartment disposal would not represent a new or significantly different line of work for the Shipyard, with different effects on the environment, but rather a continuation of a long term, ongoing program, with minimal surrounding effect. Transient emissions from transport vehicles and vessels (tugboats) are a very small part of overall river and road traffic.

4.3.6 Socioeconomics and Environmental Justice

ENTERPRISE reactor compartment disposal involves no socioeconomic change in any of the involved regions because it continues the type and volume of reactor compartment disposal work already on-going, and limits this work to within historic peaks at the shipyard. Significant changes in workforce due to ENTERPRISE are not expected as the work would occur within the fixed capacity of the Shipyard given other on-going repair work, and expected attrition through retirement and resignation, balanced by normal make-up hiring.

ENTERPRISE reactor compartment disposal would not require land expansion of the shipyard and would not affect the status-quo that has existed for many decades of the shipyard safely performing Navy nuclear repair work with reactor compartment disposal and ship hull recycle within the greater Bremerton area. The presence of PSNS & IMF provides a significant stimulation to the local economy that affects both neighborhoods close and far from the shipyard, while not resulting in any significant environmental impact outside the shipyard boundary.

4.3.7 Additional Supporting Analysis

4.3.7.1 Cost

The preferred alternative can be estimated at about $400-500 million in 2010 dollars by two methods. USN 1996 estimated $1.5 billion for the preferred alternative. By comparison, the ENTERPRISE displacement at 76,000 tons empty is 15% of the total displacement of all ships considered in USN 1996. Adjusting the $1.5 billion to 15% and escalating 1996 dollars to 2010 dollars yields about $400 million. Alternatively, ENTERPRISE disposal is roughly expected to require 850,000 man-days of work at PSNS & IMF for a total cost between $300 million and $500 million assuming man-day rates of $400 to $500 per day.

4.3.7.2 Lead Removal

The Navy has studied the cost and associated radiation exposure of removing all shielding lead from reactor compartment packages to eliminate the need to dispose of such lead. This was by request of the State of Washington, as federal law does not regulate the disposal of this lead because the lead is serving its useful purpose as radiation shielding. The subject studies concluded for pre-LOS ANGELES Class, LOS ANGELES Class, and cruisers (including LONG BEACH), that cost and in particular radiation exposure to the workforce is prohibitive and external radiation levels are similarly significantly increased. The shielding lead is built into the ship when constructed, sealed into voids and spaces with welded metal plate, and often poured or hammered into place such that removal would require melting, chipping, and cutting, with significant lead exposure to the workforce. Radiation exposure would increase by the action of removing the material designed into the ship to reduce radiation exposure. Radiation exposure would be much reduced at 50 years after disposal, but is of concern at disposal. Disposal of this lead at Trench 94 within the robust reactor compartment package has been demonstrated by the supporting studies to USN 1996 and permit application documents submitted to the State of Washington, to be protective to the environment for very long times approaching geologic age. This conclusion encompasses the ENTERPRISE reactor compartment packages.

Separation of the paired ENTERPRISE reactor compartments would involve increased cutting and removal of shielding lead vice more typical package work; however, lead shielding was cut and removed similarly for the TRITON paired reactor compartment preparation. For ENTERPRISE, the scale of this work would be larger than for TRITON, but would still represent the removal of a fraction of the total amount of lead shielding found around the reactor compartments. The reactor compartment separation involves cutting through a structural space between the reactor compartments and removal of lead shielded structure from a space that is separated from the reactor compartments by a steel bulkhead. This work would not enter the interior of the reactor compartments where the reactor vessel is located. This separation and removal is reflected in the about 300 rem total exposure estimate for the reactor compartment disposal of ENTERPRISE (discussed in section 4.3.1).

Appendix A, Table A.1 of USN 1996 presents estimated cost and worker radiation exposure for the removal of all lead from the two LONG BEACH packages. These packages are similar to those formed by separating the ENTERPRISE reactor compartments. Based on the LONG BEACH data, removal of all lead from the ENTERPRISE reactor compartments would result in a collective worker exposure at least four times higher than estimated for the reactor compartment disposal alone (an increase to 1200 rem or greater), and an estimated cost double that estimated for the reactor compartment disposal alone (an increase to $800 - $1000 million).

4.3.7.3 Long Lived Radioactivity

Table 1.2 provides a comparison of long lived radioactivity in ENTERPRISE reactor compartments to that found in reactor compartments analyzed in USN 1996. Virtually all (99.9%) of this radioactivity is in irradiated structure in the reactor vessel. ENTERPRISE long lived radioactivity is at the low end of the ranges provided in Table 1.2 (of this Environmental Assessment) for the USN 1996 reactor compartments. ENTERPRISE reactor compartments would be well below Class C limits for radioactivity concentration fractions from 10 CFR 61. Appendix D of USN 1996 provides further discussion of the formation, location and calculation of long lived radioactivity in Navy reactor compartments. This discussion remains applicable to the ENTERPRISE.

4.3.7.4 Shallow Land Burial

Appendix B of USN 1996 evaluates the amount of long lived radioactivity released from buried reactor compartment packages and related reasonable intruder scenarios. This analysis encompasses the ENTERPRISE as all Navy reactor compartment packages share common burial performance characteristics (i.e., similar construction, alloys, corrosion performance, content, location and quantity of long lived radioactivity). In summary, a minimum of 600 years and likely 2,000 years or more would be required for corrosion and soil overburden pressure to breach the reactor compartment packages and allow access inside. A minimum of 10,000 years and likely 30,000 years would be required for corrosion to breach the thick reactor vessel and allow access to the long lived radioactivity. Table B-3 of Appendix B of USN 1996 provides percentages of initial long lived radioactivity that are released to the environment by corrosion after decay in-situ. These percentages are very low because corrosion of the alloys involved is so slow that even long lived radioactivity decays in-situ. Less than 0.02% (0.0002 of 1) of combined nickel-63, nickel-59, niobium-94, carbon-14, and technetium-99 are released, and most of the nickel and niobium radioactivity is bound into the soil. Even for very long lived technetium-99, less than 6% is released and this quantity is very low, given a total of 0.06 curies for all eight of the ENTERPRISE reactor compartment packages (6% of this would be 0.004 curies), as compared to hundreds of curies already released from the tank farms of Hanford and nearer to a thousand curies predicted to be released as a result of all future radioactivity at Hanford, per DOE 2009.

Appendix B of USN 1996 discusses plausible intruder scenarios. Exhumation of Navy reactor compartment packages, including ENTERPRISE, at sufficient future time to allow access into the reactor vessel would not likely result in exceeding a 500 millirem/yr inadvertent intruder exposure limit of 10 CFR 61. Groundwater effects from a well located downstream of the site are already discussed previously and would be far below the 25 millirem/yr limit of 10 CFR 61.

The 10 CFR 61 Subpart C performance objectives would be met by disposal of ENTERPRISE reactor compartment packages in Trench 94. Specifically, during site operations, external radiation would be minimal, the disposal site and waste would remain stable during and well after closure of the site, eventual releases to the general environment would not exceed 25 millirem/yr, and eventual equivalent intruder dose would not exceed 500 millirem/yr.

4.3.7.5 Transportation Risk

Appendix E of USN 1996 analyzes health risk to the public and workers associated with shipment of Navy reactor compartment packages to Hanford. Only the case of shipment of a whole reactor compartment from PSNS & IMF to Hanford by the same route of current shipments is considered for ENTERPRISE. The reactor compartment packages for ENTERPRISE would be represented in size and shape by those of the ex-LONG BEACH. From Table E-11 of USN 1996, for 100 shipments, incident free transportation results in less than 0.003 latent cancer fatalities for a general population or transportation crew. For eight ENTERPRISE reactor compartment package shipments, latent cancer fatalities would be correspondingly lower, at less than 0.0003.

As noted in section 4.3.1 of this Environmental Assessment, the shipments of eight ENTERPRISE primary plant components and several tank sections as radioactive waste would amount to less than 1% of the shipments analyzed in Appendix E of USN 1996 for the subdivide and re-use alternative. Table E.11 of USN 1996 shows 0.005 latent cancer fatalities for the PSNS to Hanford subdivide alternative for the about 1500 shipments resulting from 100 subdivided reactor compartments. Less than 1% of these shipments would amount to less than 0.00005 latent cancer fatalities, which would be added to the 0.0003 latent cancer fatalities above.

A hypothetical accident scenario from section 7.7 of Appendix E of USN 1996 results in less than 0.0005 latent cancer fatalities. This scenario would include the ENTERPRISE reactor compartment packages and involve a barge transport accident penetrating the reactor compartment package. This penetration would penetrate the shell of a relatively small component inside the reactor compartment that contains ion exchange resin with cobalt-60, a short lived (5.27 year half-life) but potent gamma emitter. All of this ion exchange resin is then conservatively assumed to come out through the side of the reactor compartment package (this small component is not to be confused with the eight components of the previous paragraph that are removed and shipped separately and the components to be shipped separately do not contain this ion exchange resin).

Penetration through the side of the reactor compartment package and release of any internal radioactivity is highly unlikely because several inches of steel typically surround the reactor compartment and the reactor plant is designed to withstand shock/impact during battle and still remain operational. The reactor vessel itself, which contains virtually all of the radioactivity, including long lived radioactivity, has additional multiple layers of steel and nickel-steel alloy which is more than six inches thick in most places.

4.4 No-Action – Indefinite Waterborne Storage at Puget Sound Naval Shipyard and Intermediate Maintenance Facility

No major modifications in the current facilities at the PSNS & IMF waterborne storage facility for nuclear-powered ships are expected to be required to moor ENTERPRISE. Existing structures at Mooring Alpha have adequate capacity and the mooring fittings are well placed to moor ENTERPRISE. Mooring ENTERPRISE would require the entire east or west side of Mooring Alpha depending on which option is pursued from the NAVFAC 2009 study. This leaves space for 27 LOS ANGELES Class submarines on the other side of Mooring Alpha. One OHIO Class submarine can be berthed in place of two LOS ANGELES Class submarines.

Figure 4.1 shows a conceptual mooring layout for indefinite waterborne storage at PSNS & IMF with ENTERPRISE located on the west side of Mooring Alpha. As discussed in section 2.2.1, this option is preferred by PSNS & IMF. The west side of Mooring Alpha has been surveyed and the water depths found to be acceptable. No dredging would be required for this option. Another advantage to this option is that ships presently at Mooring Alpha would not have to be relocated.

It is also possible to moor ENTERPRISE on the east side of Mooring Alpha, however, this option is not preferred because it would require relocating ships moored on the east side over to the west side and would require that bottom depths in the unsurveyed area be verified. The presence of numerous moored vessels in this area prevents an exact confirmation of water depth. Because surrounding areas have acceptable water depth and no submerged obstacles, dredging would be considered as not likely to occur and should be, if required, of a limited nature with

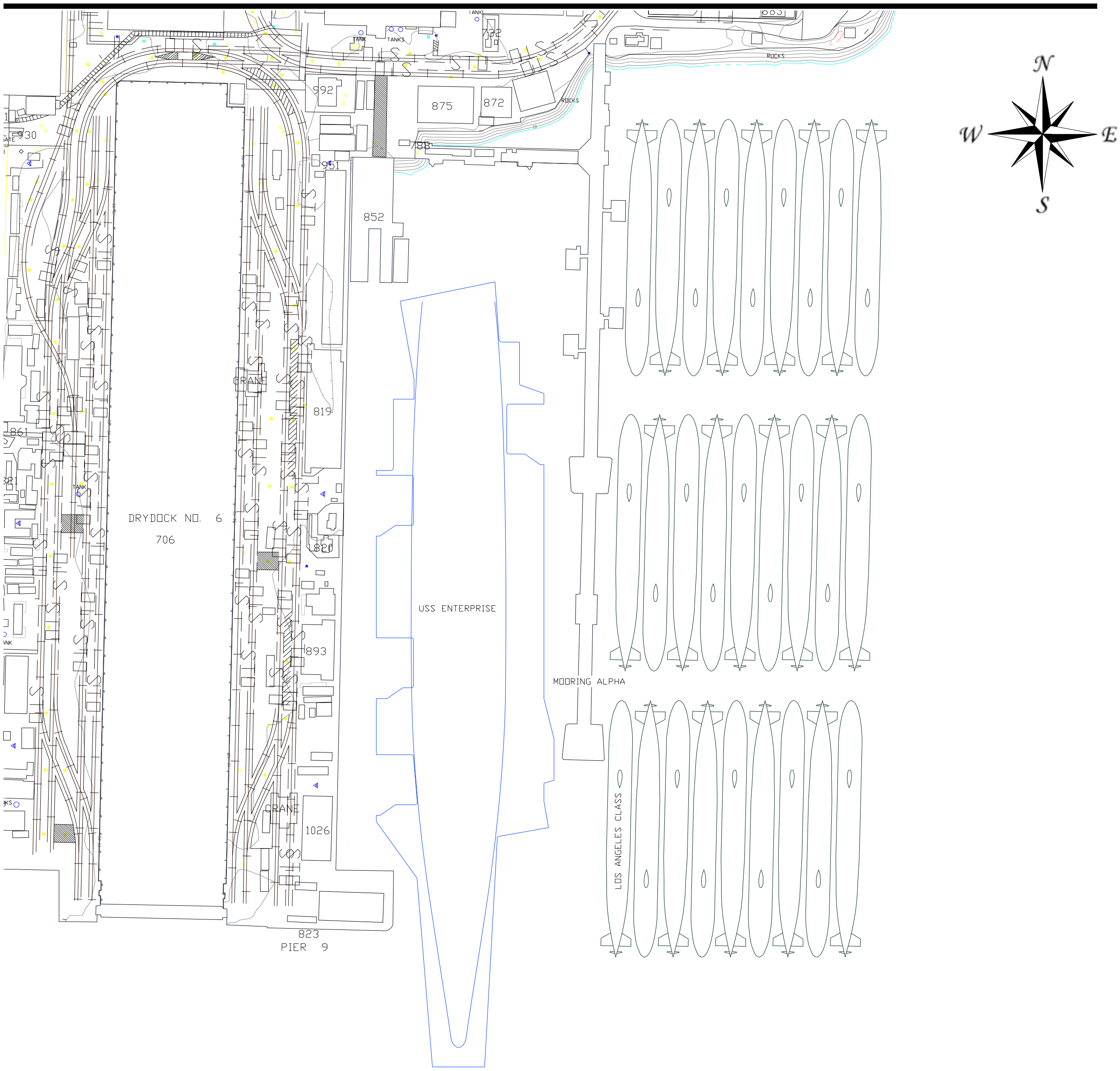


Figure 4.1. PSNS & IMF Conceptual ENTERPRISE Mooring Arrangement

only local disturbance. However, enough uncertainty exists such that the potential effects of using this area cannot be fully defined at this time. Any such dredging would be accomplished as described in the 'Dredging and Disposal' discussion of section 4.3.2.1 of Volume 1 of the Navy's Pacific Fleet CVN Homeport EIS (USN 1999).

At Mooring Alpha, in very extreme low water events, (for west or east side moorage), the stern of ENTERPRISE may settle slightly into the sediment. The sediment at the site tends to be very soft so it is reasonable to allow the ship to sit slightly on the seafloor without impact to the hull structure.

PSNS & IMF lies within the usual and accustomed fishing area of the Suquamish Tribe. A floating port security barrier cordons off the controlled industrial area from waters outside that are fished. The ENTERPRISE can be moored within the existing location of the security barrier (for west or east side moorage).

Additional services would be required to moor ENTERPRISE at Mooring Alpha. Fire and flooding alarm systems, a dehumidification system, cathodic protection and lighting would be required for the ship. Expansion of these services for ENTERPRISE are an extension of what currently exists and would have no significant impact to the environment.

Hull preservation would be accomplished at about 15 year intervals. The process would involve grit blasting and repainting the hulls with antifouling paint. This is a normal industrial operation and there are procedures in place at PSNS & IMF properly accomplish this while protecting the environment.

4.4.1 Socioeconomic Effect of the No-Action Alternative

A change in the PSNS & IMF workload normally results in a redistribution of work and reassignment of the existing workforce to other Shipyard work with no significant socioeconomic impact. It is possible for the Shipyard's disposal workload to decrease under the No-Action Alternative where ENTERPRISE is placed in waterborne storage. It is also possible for the decrease to be great enough that redistribution of work is not sufficient and jobs are lost. In this case, there could be socioeconomic impact to the local population, housing, school districts, other employment, and local governments. The degree of this impact would be related to how much other work would become available to substitute for the ENTERPRISE disposal, and this would be related to future unidentified budgetary and military needs.

4.4.2 Extreme Natural Phenomena

PSNS & IMF is located in an area which experiences relatively few extreme natural phenomena. The methods used to moor ships at PSNS & IMF allow for natural events such as winter storms with wind and wave. The system of straits and inlets leading into and surrounding Puget Sound dampens the propagation of large distantly generated tsunamis. A large earthquake of local origin (e.g., magnitude 7 on the Seattle Fault) is estimated to produce a tsunami of about 1.5 meters (5 feet) on the Bremerton waterfront. This tsunami would be directed towards the head of Sinclair inlet with the shipyard waterfront to the side (90 degrees) of the primary wave fronts (KOSHIMURA 2005). Even if this wave occurred at high tides, the wave should not be sufficient to lift the ENTERPRISE with its 33 foot draft onto land. Grounding in shallow water near shore and adjacent pier damage could result if the ship broke free from its moorings. Shaking as a result of such a quake or from a more distant but stronger subduction zone earthquake (e.g. Cascadia Subduction Zone) would not be expected to result in significant damage to the ship itself. Pier and mooring damage could occur and near shore grounding of the ship is possible. No damage to the reactor plant would be expected given that the plant is designed to withstand battle shocks.

4.4.3 Radiological Effects

The radiation exposure rate at the surface of the ENTERPRISE hull is generally below one millirem per hour. However, localized spots of elevated rates (less than 10 millirem per hour) could exist. The designated storage area would be within fenced and guarded area so entry into the storage area would be strictly controlled. PSNS & IMF personnel would be monitored for radiation exposure if entering radiation areas aboard the ship. Radiation levels above background levels would not be detected at the fence to the storage area or at the PSNS & IMF boundary.

The radioactivity contained in defueled ENTERPRISE is in the form of solid activated metal corrosion products and solid activated metal contained within the reactor plant. Initially the primary source of radiation is from solid activated metal corrosion products; but after an extended period of waterborne storage (over 20 years) the solid activated metal would become predominant. The solid activated metal corrosion products consist primarily of the relatively short lived, high energy emitting radionuclide cobalt-60 (5.27 year half-life, gamma emitter); while the solid activated metal is primarily long lived, low energy radionuclides such as nickel-59 and nickel-63 (nickel-59, 76,000 year half-life, X-rays; nickel-63, 100 year half life, beta emitter). The radioactivity would not be readily releasable under the No-Action Alternative because it is an integral part of the metal in the reactor compartment or is contained within the reactor plant. The general public could not be exposed to radioactivity under the No-Action Alternative.

The radiation exposure dose to the general public is expected to be zero for this alternative. There is essentially no risk of radiation exposure to anyone in the general public as a result of waterborne storage of ENTERPRISE since the radiation dose rate outside the reactor compartments would be well below the federal transportation limits specified in Part 173 of Title 49, Code of Federal Regulations (49 CFR 173). Additionally, the designated storage area would be fenced and within the security confines of PSNS & IMF.

4.4.4 Hazardous Material Effects

The inactivated, defueled, and decommissioned ENTERPRISE is expected to contain regulated quantities of lead shielding, asbestos, and solid PCBs which would be contained within the ship's hull. Sea connections would be blanked and fire and flooding alarms installed, ensuring the preservation of containment barriers such as the hull. The designated storage area would be within the fenced and guarded area of PSNS & IMF such that entry into the storage area would be strictly controlled. The general public is not expected to experience any exposure to hazardous materials from the No-Action Alternative because the hazardous material would be contained by the ship's hull. Periodic preservation of the ship's hull would be performed to maintain the containment barriers.

4.4.5 Potential Air and Water Quality Effects

Operations that would be conducted in connection with the No-Action Alternative would not be expected to have a significant impact on air resources. Work practices and precautions at PSNS & IMF would be in accordance with applicable PSNS & IMF directives to minimize discharge of air pollutants. Work associated with the No-Action Alternative would be performed within the terms and conditions of the air operating permit issued by the Puget Sound Clean Air Agency.

Operations that would be conducted in connection with the No-Action Alternative would not be expected to have a significant impact on water resources. PSNS & IMF operations would be performed under a National Pollutant Discharge Elimination System (NPDES) permit. Procedures used by the Navy to control releases of radioactivity from U.S. Naval nuclear-powered ships and their support facilities have been effective in protecting the environment. Periodic preservation of the ship's hull and methods used for securing ships would maintain the containment barrier to keep contaminants out of the environment.

As discussed in section 4.4, dredging is not required to moor ENTERPRISE on the west side of Mooring Alpha. This is the preferred option for mooring ENTERPRISE. Use of the east side of Mooring Alpha is possible but not preferred, and may require limited dredging if an unexpected rise in the bottom contour is discovered upon removal of the existing moored ships. When moored, the stern of the ship may settle slightly into the sediment (for west or east side moorage). However, since the sediment is very soft at this site, the settling should not have an impact on the hull structure.

4.4.6 Other Facilities

An existing facility on the east coast at Norfolk Naval Shipyard is not considered feasible for ENTERPRISE, given the size and deep draft of the ship (requiring 37 feet of depth), dredging required at Norfolk (minimum depths at the facility are under 20 feet), and the need to move the ship to PSNS & IMF for reactor compartment disposal.

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