FEASIBILITY STUDY FOR LEAD REMOVAL FROM AND STRUCTURAL RESTORATION OF CRUISER, OHIO, AND LOS ANGELES CLASS REACTOR COMPARTMENT DISPOSAL PACKAGES

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EXECUTIVE SUMMARY

The Navy has performed feasibility studies for the removal of permanently installed shielding lead from cruiser, LOS ANGELES, and OHIO class reactor compartments that are being considered for disposal at the Department of Energy's (DOE) Hanford site.

LOS ANGELES and OHIO Class submarines have one reactor compartment. Nuclear cruisers have two reactor compartments. It is estimated that the cost to remove the several hundred tons of shielding lead from these packages would be between $16 and $108 million per reactor compartment in fiscal 1994 dollars. The personnel who would perform this work at Puget Sound Naval Shipyard would be exposed to an additional radiation exposure of approximately 585 rem to 1065 rem per reactor compartment. For comparison, all other reactor compartment packaging work would not be expected to exceed 20 rem of radiation exposure per package. The total radiation exposure to the Shipyard workforce performing the lead removal operations is estimated at approximately 90,000 rem for the approximate 100 reactor compartments.

For comparison, this estimated radiation exposure (90,000 rem) is almost double the radiation exposure the entire Naval Nuclear Propulsion program received in the ten years from 1982 to 1992. Additionally, if a total radiation exposure of 90,000 rem were received over the span of a lead removal program, there might be an additional 36 fatal cancers in the lifetime of a typical group of 10,000 persons. This additional radiation induced cancer risk to the workers outweighs any potential environmental benefit in reusing part of the removed lead.

An equally important aspect in addition to the radiation exposure is that approximately 25% of the lead removed would remain radiologically controlled due to neutron activation of the impurities within the lead. This lead would have to be encapsulated and packaged for land disposal as mixed waste. The estimated quantities of shielding lead, costs for removal, and radiation exposure for shielding lead removal from the ship classes considered are summarized in Table A.1. Thus, both the expense and additional radiation exposure for shielding lead removal would be substantial and prohibitive. The subdivision alternative, unlike the preferred alternative, would not require the structural integrity of the reactor compartment to be maintained to meet shipping requirements, so it would result in easier lead removal.

1. INTRODUCTION

The Navy's 1984 Environmental Impact Statement (EIS) discussed the disposal of decommissioned, defueled naval submarine reactor plants. Since the disposal of lead was not controlled by Federal or State regulations at that time, disposal of lead radiation shielding was acknowledged without special precautions in the Navy's 1984 EIS.

Currently, the shielding lead in the submarine packages is not regulated under the Federal Resource Conservation and Recovery Act since the shielding is still serving its intended purpose and thus is not waste. In 1989, the State of Washington Department of Ecology determined that this lead is a regulated waste under the state's Hazardous Waste Management Act (RCW 70.105.050). This Act requires:

> Prior to disposal, or as part of disposal, all reasonable methods of treatment, detoxification, neutralization, or other waste management methodologies designated to mitigate hazards associated with these wastes shall be employed, as required by applicable federal and state laws and regulations.

In 1990, a shielding lead removal feasibility study provided information to the State of Washington on the disposal of the several hundred tons of permanently installed lead shielding that is contained within the welded steel plates and structure of each reactor plant packaged under the submarine disposal program described in the 1984 EIS.

The cruiser, LOS ANGELES, and OHIO class reactor compartment packages would continue to consist of the section of the ship containing the reactor compartment. For cruisers, the reactor compartment would be cut from the ship and a thick steel outer package installed around and welded to the reactor compartment to produce a strong, tightly sealed containment. The current submarine packaging methodology of closing the ends of the submarine hull with welded steel bulkheads would be applied to the LOS ANGELES and OHIO classes. The configurations of cruiser and submarine reactor compartment packages are essentially various sizes of vertical or horizontal cylinders respectively, with the exception of the USS LONG BEACH (CGN-9), which would be a rectangular box. The packaging for these reactor compartments would be designed to meet all regulatory requirements for transport of radioactive materials.

This report contains the results of the shielding lead removal feasibility study for reactor compartment packages from the cruiser, LOS ANGELES, and OHIO classes. The quantity of shielding lead involved, cost for removal, personnel radiation exposure, and occupational risks to workers performing the shielding lead removal tasks are presented.

2. DESCRIPTION OF SHIELDING LEAD CONTAINED IN REACTOR COMPARTMENT PACKAGES

2.1 Permanent Shielding Lead

Shielding is installed to satisfy three functions:

1. To reduce gamma and neutron radiation from the reactor and reactor coolant system to safe levels outside the reactor compartment during operation.

2. To reduce radiation from core fission products and primary shield activation to safe levels for access to the reactor compartment and system tanks after plant shutdown.

3. To reduce neutron activation of materials in the reactor compartment.

There are four separate permanent shielding systems installed on nuclear cruisers and LOS ANGELES and OHIO class submarines to accomplish the above functions:

1. The primary shield which encompasses the reactor vessel itself.

2. The secondary shield which encompasses the primary plant components and the majority of the associated piping (Figure A.1).

3. Primary and secondary shielding above and beneath the reactor vessel.

4. Individual component shielding.

Shielding design is generally the same for each class of surface ship or submarine reactor plant. Steel plates cover the shielding lead to maintain its position and prevent abrasion or damage. For further strength, the majority of shielding lead is permanently bonded to the structure and components during construction.

2.2 Miscellaneous Lead

Cruiser, LOS ANGELES, and OHIO class reactor compartment packages would contain relatively small quantities of lead bound in the matrices of paint, glass, adhesives, brass and bronze alloys and numerous other industrial materials used in the construction of components and equipment. The average quantity of lead in these reactor compartment packages is estimated at less than 450 kilograms (1,000 pounds) per package. Since this quantity of lead is small with respect to the total quantity of shielding lead in a reactor compartment package, it is not considered further in this study.

2.3 Considerations

In the development of methods for shielding lead removal, several requirements were given primary consideration, specifically maintaining the structural integrity of the existing ship's structure in order to facilitate conversion to a reactor compartment package, compliance to the Code of Federal Regulations transportation requirements of 10CFR71, and the long term integrity of the reactor compartment package for containing the radioactive and hazardous material. The removal of permanent shielding lead as described in this report would require the removal of a significant quantity of structural interferences. All critical structure to be removed is considered to be reinstalled to full strength.

A significant effect of shielding lead removal is the resultant increase in package exterior radiation levels. Calculations indicate that after the removal of shielding materials, localized contact radiation levels on the exterior of the reactor compartment package would be above the Code of Federal Regulations transportation limits, section 10CFR71.47. These localized high contact radiation levels could be reduced by installing additional steel shielding plates. Other package contact radiation levels, although increased because of shielding removal, would comply with the Federal transportation limits.

2.4 Assumptions

While this study evaluates the methods, costs, and radiation exposure required for a large scale lead removal program, it does not consider in detail some of the practical issues that actual implementation of such a program would entail. For example, lead removal work would occupy shipyard drydocks for long periods of time, which would displace other ship maintenance work. Significant shipyard labor force disruptions would be caused by the large increase in the number of lead and radiation workers combined with the reduction in ship maintenance work displaced by the lead removal work. The costs involved with issues such as training and qualification of new personnel and procurement of required materials and equipment, were incorporated into the overall shielding lead removal cost estimate. Table A.1 summarizes the result of these estimates for the nuclear cruiser, LOS ANGELES, and OHIO classes.

3. SHIELDING LEAD REMOVAL PREPARATIONS

3.1 Training

Puget Sound Naval Shipyard has considerable experience in removing small quantities of permanently installed shielding lead and employs a sufficient number of radiologically qualified lead workers to accomplish the shielding lead removal work. During current overhaul, reactor compartment packaging, and hull recycling work, this Shipyard processes an average of 45 tons of shielding lead using radiological controls. This process involves controlling the lead as a potentially radioactive material until an evaluation of the lead can be made to determine whether the lead can be released from radiological controls. The evaluation involves a combination of surface radiation and activity measurement and in some cases, internal activity determination by analyzing gamma radiation emission (requires reducing removed lead into relatively small chunks of 9 kilograms (20 lbs) or less). Due to the large quantity of shielding lead described in this report, the existing group of radiologically trained lead workers would be insufficient to undertake a shielding lead removal project of this magnitude.

In addition to basic skill qualification training, special mock-up training would be required prior to commencement of critical work evolutions in high radiation and shielding lead removal areas. This training, which utilizes mockups of the actual components and structures, has proven effective in reducing worker exposure to radiation and hazardous materials. Job skills, qualification testing, tooling, and instructions are rehearsed and verified before accomplishment of the actual work. The costs associated with this mockup training for shielding lead removal have been factored into the cost estimates, Table A.2.

3.2 Interference Removal

Naval ship design inherently attempts to minimize the overall size of the spaces within the ship. Designers attempt to utilize the available space to its maximum extent. Access to areas not requiring routine maintenance, in most cases, was a secondary consideration and in some cases, no access was provided. Permanently installed shielding lead is often located beneath interfering components (e.g., cabling, piping, deck gratings, hangers and equipment foundations) and large reactor plant equipment (e.g., steam generators, pressurizers, and reactor coolant pumps). Additionally, significant quantities of asbestos from ships constructed during the 1950's and 1960's and radioactively contaminated interferences would require removal. These latter interferences pose a significant personnel health hazard which will be discussed elsewhere in more detail. Interference removal therefore would be a major expense and has been factored into the shielding lead removal cost estimates of Table A.2.

3.3 Shielding Lead Removal Techniques

The following discussion describes the most practical method for Puget Sound Naval Shipyard to remove the permanently installed shielding lead (up to 99% removal) while attempting to minimize personnel exposure (lead and radiation). The discussion is general in nature but provides sufficient detail to establish an understanding of the magnitude of the work involved. Work prerequisites, such as standard interference removals, radiation containment tent installations, etc., are routinely accomplished in the Shipyard. They are not included in these descriptions unless necessary to emphasize the complexity of a particular task.

3.4 Removal of Shielding Lead Bonded to Structure

Shielding lead is generally metallurgically bonded to the reactor compartment structures in varying thicknesses and sizes and is covered by steel plate. In order to minimize structural degradation of the reactor compartment package, the following method of shielding lead removal was selected. The welds on the steel plate covers would be cut by carbon arc gouging and the plates removed. After the lead is exposed, it would be melted from the structure using hand torches in a controlled environment or enclosure to reduce lead and radioactive contamination to the workers. All removed materials would be transported to a controlled storage building for radiological survey and segregation and, if possible, released from radiological controls.

In some locations polyethylene neutron shielding is collocated with the lead shielding. For fire prevention, some of the polyethylene shielding will require removal before hot lead removal work can be done in the immediate vicinity.

Normal reactor compartment packaging work already removes some of the items interfering with access to shielding lead, therefore additional interference removal for shielding lead work in these areas would be minimized. However, removal of some additional piping and components adjacent to the reactor compartment structure would be required. Some of these systems are radioactively contaminated and require special controls during their removal.

The removal of shielding lead that is metallurgically bonded to structures is complicated when this lead is installed in geometrically complex arrangements, behind surfaces covered by asbestos thermal insulation, and in areas with loose and fixed radioactive contamination. Lead removal under these conditions would require an elaborate lead burning and radioactive contamination containment tent. Some items would be disassembled and disposed of separately, such as the reactor compartment leaded glass viewing window assembly by removing the shielding leaded glass from the Lucite and plate glass. In horizontal areas, the shielding lead would be removed by melting with hand torches and allowing the molten lead to drain through holes that are either melted or drilled through ship's structure. Collection pans would be placed directly beneath the drain holes to catch the molten lead or temporary troughs would be placed to direct the molten lead laterally into collecting pans. An elaborate scaffolding system would be required inside the reactor compartment to support the lead collection equipment, to allow adequate personnel access, and support the containments necessary for lead vapor control. After completion of shielding lead removal, residual shielding lead would be removed using chipping or grinding within containment tents. In order to restore integrity in some structures, key structural stiffeners would be repaired. This would necessitate lead free cleanliness requirements in localized areas prior to rewelding.

Some shielding lead was installed prior to the installation of major plant equipment. Removal of this equipment is impractical while maintaining the reactor compartment structural integrity. An elaborate combination of partial foundation removal, installation of temporary supports, and lead removal techniques would be required.

In order to maximize the advantages of the existing shielding lead in reducing personnel radiation exposure, some shielding lead removal operations would be deferred until relatively late in the packaging sequence, tending to increase costs due to re-setup of equipment and containments.

3.5 Removal of Component Shielding

Several components of reactor plants are shielded with a combination of portable and permanently installed shielding lead. To remove the components from the reactor compartment package for separate disposal, the portable shielding, which is an interference to the component's removal, would be removed first. The component would then be removed from the package and the component's permanent shielding lead removed using melting and/or chipping. For some components, residual amounts of internal fluids would also have to be removed or adsorbed prior to disposal.

Finally, some component foundations incorporate shielding lead which would require removal, or replacement, of the foundation in the reactor compartment package. Once removed, the foundation shielding lead can be further segregated prior to disposal

4. DISPOSAL OF REMOVED MATERIALS

The generation of radioactive waste is an unavoidable byproduct of the disposal work on Naval Nuclear reactor plants. Radioactive waste materials, generated by work on contaminated ship's systems or by removal of activated and/or contaminated components, would be containerized and shipped to licensed radioactive waste burial sites. Burial sites for low level wastes have limited capacity; therefore, every effort is made to ensure the volume of disposed radioactive waste is kept as small as practicable.

Puget Sound Naval Shipyard has established a solid waste minimization program to reduce the volume of radioactive waste. At the center of this program is the concept of waste segregation. Waste is segregated at the worksite into one of three categories: non-contaminated, potentially contaminated, or known contaminated. Radiological surveying resolves the potentially contaminated category by reclassifying it as either known contaminated or non-contaminated. All known contaminated waste would be disposed of as radioactive waste while non-contaminated waste would be disposed of in accordance with State and Federal regulations.

Waste quantity is also reduced by recycling materials to the maximum extent practicable. Recycling consists of techniques such as reusing tools and laundering anti-contamination clothing.

It is anticipated that over 75 % of the shielding lead removed from each reactor compartment package would be released from radiological controls and recycled through the Defense Reutilization and Marketing Office. However, some shielding lead may have impurities which have become activated due to neutron activation. Decontamination of this lead by removal of radioactive impurities would not be practicable because lead used in reactor shielding already is high purity lead which was refined an extra step to minimize impurities. This lead would need to be stored in accordance with the Site Treatment Plan as a mixed waste for eventual disposal, since, lead cannot be released from radiological controls. Radioactive lead must be disposed of as mixed waste, since shielding lead is also regulated as a dangerous waste by Washington State regulations. These regulations require that disposal of mixed waste be at an approved disposal site. There are presently no disposal sites authorized to accept mixed waste.

The fact that much of the lead would require radioactive disposal after removal from the reactor compartment eliminates much of the potential benefit of removing the lead. The shielding lead is well encapsulated in the reactor compartment package. Little is accomplished in removing the lead at considerable risk to workers and expense if much of the lead must then be reencapsulated and buried somewhere else.

5. PERSONNEL HEALTH AND SAFETY HAZARDS

5.1 Personnel Exposure to Lead

Pure lead is a solid heavy metal at standard atmospheric conditions. It can combine with various substances to form numerous lead compounds. Lead in its various forms may enter the body by being swallowed, inhaled, or absorbed through the skin.

Lead may be swallowed by eating contaminated foods, smoking or chewing contaminated tobacco products, licking of lips, or placing fingers in the mouth. Lead absorption can be the result of neglecting to cleanse the hands and/or face thoroughly before eating, drinking, or smoking. However, these pathways would not be considered common place based on the occupational safety controls employed at the Shipyard.

Lead may be inhaled as lead fumes from heated lead or leaded materials; as mists from lead-pigmented paints; as dust from abrasive blasting, caulking, machining, grinding, sawing, sanding, scraping, or filing of lead or leaded materials; or as vapors from volatile lead compounds such as tetraethylene lead or lead paint dryers. Lead exposure by inhalation of particles or vapors from the melting, chipping, and scraping removal process described in this report would be the most common form of exposure.

Lead workers and supervisors must be trained in work involving lead hazards, enrolled in Puget Sound Naval Shipyard's medical surveillance program, and be respirator qualified.

The highest level of lead in the air to which a worker may be exposed over an eight hour workday is 50 micrograms per cubic meter of air (50 $\mu g/m^3$) and is called the Occupational Safety and Health Act (OSHA) permissive exposure limit (PEL). Lead melting operations described in this study have produced unfiltered air concentrations up to 5500 $\mu g/m^3$ in an eight hour (time weighted average) period at Puget Sound Naval Shipyard. The use of protective clothing, air supplied respirators, engineered controls, and containment tents, allows Shipyard personnel exposures to be kept below the OSHA requirements when exposed to these airborne lead levels.

5.2 Personnel Exposure to Asbestos

In order to conduct shielding lead removal from reactor compartment packages, asbestos containing items, such as lagging, must first be removed as interference. Several controls are used to prevent personnel exposure to airborne asbestos during asbestos removal. First, asbestos removal operations are accomplished by employees of Puget Sound Naval Shipyard who are both medically qualified and trained in the proper asbestos handling and removal control processes. Second, to control the release of asbestos fibers, processes would be used that include engineered High Efficiency Particulate Air (HEPA) filtered negative exhaust ventilation systems, asbestos wetting, HEPA filtered industrial vacuum cleaners, containment tents, and containment glovebags. Third, following asbestos removal, Puget Sound Naval Shipyard's Occupational Safety and Health Office would conduct post clean-up certifications, including air sampling and visual inspections, prior to releasing the space for unprotected personnel access.

5.3 Personnel Exposure to Ionizing Radiation

Control of radiation exposure in the Naval Nuclear Propulsion Program has always been based upon the assumption that any radiation exposure, no matter how slight, involves some risk. However, radiation exposure within the accepted exposure limits, as promulgated by federal regulations, represents a small risk compared with the normal hazards of life.

Current federal regulations allow personnel beyond 18 years of age to receive a whole body penetrating radiation dose of 5 rem for each year of a persons life over age 18. The Navy has established more restrictive limits for individuals receiving radiation exposure from the Naval Nuclear Program. Normal local exposure control level for Shipyard personnel is 0.5 rem per calendar year. In some rare cases, it is necessary for selected personnel, due to their trade skills, to exceed this local control level. In these cases, local control levels may be incrementally increased up to but not exceeding 2 rem per calendar year. The Navy has established these limits as a commitment to maintain radiation exposure to personnel as low as reasonably achievable.

During reactor compartment package preparation work, exposure to gamma radiation is generally limited to the vicinity of the reactor plant. The principle source of this gamma radiation is Cobalt-60 activity. Cobalt-60 has a half-life of 5.27 years, which means that the total quantity of Cobalt-60 activity decreases by a factor of two every 5.27 years. Other radionuclides present in the compartments either do not emit gamma radiation, such as nickel-63 which emits a short range beta particle, or if gamma radiation is produced, the radionuclides are present in much smaller activities than Cobalt-60 and have much shorter half-lives.

In determining how to remove permanently installed shielding lead, techniques were primarily considered which would minimize personnel radiation exposure. This included sequencing shielding removal to utilize the benefits of the primary shield as long as possible. Because of the proximity to the reactor vessel during significant amounts of lead removal work, personnel exposure to high radiation fields will require restrictive radiological controls to ensure adequate protection. The amount of time workers can spend in high radiation fields of the magnitude expected and not exceed Shipyard control levels for radiation exposure is unacceptably short. To further complicate lead removal work, physical constraints can preclude the use of temporary shielding.

Immediate removal of all permanently installed shielding lead from the reactor compartment package and installation of a permanently installed steel shield package, to reduce package external radiation levels, would result in an estimated radiation exposure of approximately 585 rem to 1065 rem per package. This rem estimate is based upon; (1) reducing radiation levels within the reactor compartment during work by installing temporary shielding; and (2) applying the estimated mandays during which workers are subjected to this reduced exposure.

6. RADIOLOGICAL AND ENVIRONMENTAL CONTROL REQUIREMENTS

Because most work would be accomplished in radiation or high radiation areas, and some work would involve loose surface and/or fixed radioactive contamination, radiological controls would be required for the various shielding lead removal operations.

A large containment structure would be required to enclose each reactor compartment package. This structure would serve several functions. Work inside this structure would be accomplished primarily using smaller temporary containment structures with HEPA filtered exhausts to control radioactive contamination to ensure adequate personnel and environmental protection from the shielding lead removal operations. In addition, for work in a controlled surface contamination area, portable air samples would be taken at the start of work and every four hours thereafter until work is complete. The reactor compartment containment structure may consist of several smaller units since the largest single containment necessary would exceed 13 meters (42 feet) in height and 17 meters (55 feet) in length.

In addition to radioactive and hazardous material containment structures, support facilities and services (e.g., air conditioning, lead vapor filtration, negative ventilation, personnel changing and shower facilities, temporary controlled material storage facilities, separate controlled work areas that would allow segregation and disassembly of components removed from the reactor compartment, personnel access and weight handling support structures, etc.) would be required for this work. The specifics of these requirements are not discussed in this study, but have been factored into the cost estimates of Table A.2.

7. FINDINGS

7.1 Costs

The estimated shielding lead removal costs for the nuclear cruiser, LOS ANGELES, and OHIO classes, based on mandays for Puget Sound Naval Shipyard's organization, are summarized in Table A.1 and listed by each type of reactor compartment in Table A.2. The costs vary from $16 million for OHIO class submarines to $108 million for the cruiser USS LONG BEACH (CGN-9).

7.2 Radiation Exposure

Of greater importance than cost is the additional personnel radiation exposure of approximately 585 rem to 1065 rem per reactor compartment package. For comparison, all other reactor compartment packaging work combined is not expected to exceed 20 rem of radiation exposure per package. This large personnel radiation exposure for shielding lead removal could not be accommodated by the relatively small lead/hazardous materials qualified workforce available at Puget Sound Naval Shipyard. Retraining a large part of the Shipyard workforce for qualification in removing lead/hazardous materials is expected to increase the total number of Shipyard radiation workers. The lead workers would not be available for other radiation work due to these personnel reaching annual radiation exposure control levels.

A brief description of the effects of exposure to radiation would help understand why this is important. The total radiation dose received by the Shipyard workforce is estimated at 90,000 rem to support lead/hazardous material removal. To place this radiation exposure into perspective, the dose received by all Navy and civilian personnel associated with Naval Nuclear Propulsion in the ten years from 1982 to 1992 was approximately 50,000 rem. The combined total of Navy and civilian personnel monitored for radiation exposure for those ten years was slightly less than one million people. To comply with the maximum individual radiation exposure control level of 2.0 rem per year established by the Navy, Puget Sound Naval Shipyard would need a dedicated workforce of at least 4500 employees to support the lead/hazardous material removal effort for a 10 year program. This would be a significant portion of the entire shipyard production workforce presently employed at Puget Sound Naval Shipyard.

The risk associated with exposing these shipyard employees to radiation dose can be evaluated by utilizing risk assessment guidelines established by the International Commission on Radiation Protection. The Commission established a method to assess the risk by comparing exposure to only natural background radiation to exposure to additional industrial radiation. The average annual dose received by a member of the population in the United States from natural background radiation is approximately 0.3 rem, with a average annual collective dose of 69 million person-rem to the entire population.

In a typical group of 10,000 persons who are exposed only to natural background radiation, about 2000 (20 percent) will normally die of cancer. If each of the 10,000 persons received an additional 1 rem of industrial radiation exposure in their lifetime, an estimated 5 additional cancer deaths might occur (2005 total cancer fatalities).

To be consistent with the Commissions analysis, assume that this 90,000 rem is evenly distributed to a workforce of 10,000 employees (90,000 person-rem). The risk factor published by the Commission for fatal cancers to workers is 0.0004 per person-rem. Therefore, there might be an additional 36 fatal cancers in the lifetime of a typical group of 10,000 persons associated with a total radiation exposure of 90,000 rem.

The analysis of this feasibility study has focused on the costs and effects from lead removal activities performed shortly after the ship has been decommissioned, typically less than 5 years after decommissioning. The effects from delaying this work for an extended period of time after decommission, such as 5 years, 10 years, and 15 years, are briefly discussed here.

Worker radiation exposure for lead removal would result in increased worker dose for the preferred alternative but is already factored into the dose estimates for the subdivision alternative. The radiation levels within the reactor compartments should decrease by a factor of 2 every 5.27 years, based on the half-life of Cobalt-60. Worker radiation dose would be reduced by delaying operations. This effect is shown in Table A.1.

The cost of lead removal activities is also provided in Table A.1. Lead removal would be an added cost for the preferred alternative of land burial at Hanford but is already factored into the cost for the subdivision alternate. Delaying the work would not significantly affect the estimated man-hours utilized to determine the total cost in Table A.2 because the work would still require radiological controls and lead controls. However, the overall cost is expected to increase. The amount of increase is difficult to estimate but should be bounded on the lower end by the rate of inflation for the delay period.

The cost to remove lead in conjunction with the preferred alternative would be comparable to the cost to remove lead as an integral part of the subdivision alternative. The subdivision alternative, unlike the preferred alternative, would not require the structural integrity of the reactor compartment to be maintained to meet shipping requirements, so it would result in easier lead removal. However, the quantity of lead, its general configuration and the basic removal techniques would be the same in each case plus radiological controls and lead controls would still be required. These factors would result in similar costs. Radiation exposure to workers would also be comparable for the preferred alternative and the subdivision alternative for the same reasons.

8. CONCLUSION

The removal of several hundred tons of shielding lead from cruiser, LOS ANGELES, and OHIO class reactor compartment packages is estimated to cost in fiscal 1994 dollars between $16 million and $108 million per reactor compartment package.

The total radiation dose receiving by Shipyard personnel performing the lead/hazardous material removal operations is estimated to be up to 90,000 rem. This is almost double the radiation exposure received by all Navy and Shipyard personnel for the ten years from 1982 to 1992. It has been estimated that 90,000 person-rem might result in 36 additional fatal cancers in the lifetime of 10,000 people.

About 25% of the lead removed from the reactor compartment disposal packages would not be released from radiological controls, resulting in large quantities of mixed waste to be encapsulated and packaged for land disposal.

The costs, radiation exposure, and also environmental risks to personnel associated with the removal of shielding lead from cruiser, LOS ANGELES, and OHIO class reactor compartment packages are substantial and prohibitive. A similar conclusion was reached in 1990 for the pre-LOS ANGELES class reactor compartment packages prepared under the current submarine disposal program.

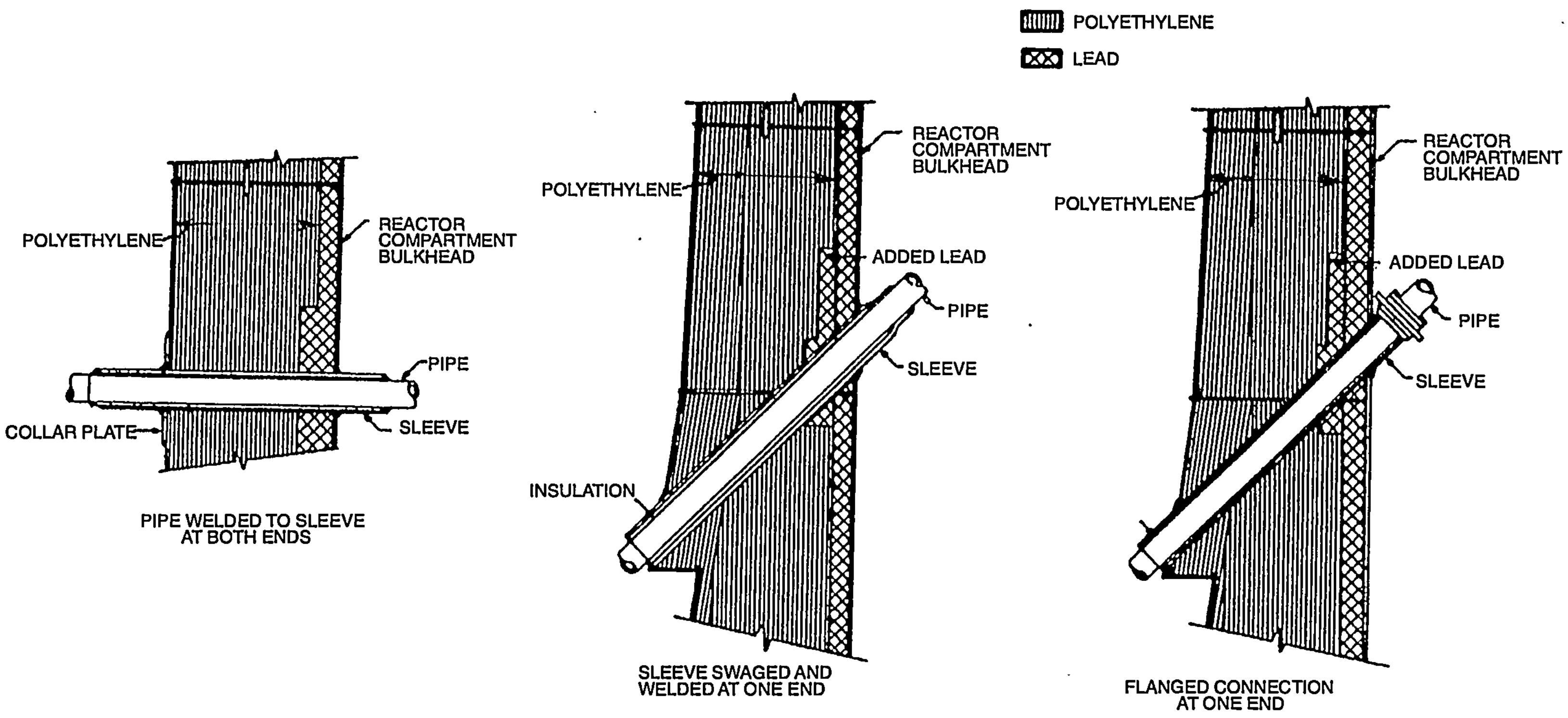

Figure A.1 Typical Small Piping Penetration

	LOS ANGELES CLASS SUBMARINES	OHIO CLASS SUBMARINES	D2G CRUISER[1]	LONG BEACH CRUISER
QUANTITY	>100 tons	>100 tons	>100 tons	>100 tons
COST	$18M	$16M	$29M	$108M
RADIATION DOSE (REM)				
No Delay	1065	585	680	750
5 year Delay	552	303	352	389
10 year Delay	286	157	183	201
15 year Delay	148	81	95	104

NOTE: The above estimates are based on an engineering evaluation of the required removal efforts. Cost and radiation dose estimates were developed from summaries of the required removal efforts. Radiation dose estimates were developed utilizing radiation fields expected to be typical of the reactor plant being evaluated. Costs are based on using Puget Sound Naval Shipyard's current (FY94) rates.

1: BAINBRIDGE, TRUXTUN, CALIFORNIA Class, and VIRGINIA Class

Table A.1 Lead Removal Estimate Summary (per reactor compartment)

D2G CRUISERS

Engineering Services	8,840
Radiological Control Services	6,234
Production Services	31,794
TOTAL Man-days	46,868
TOTAL COST (including material)	$28,840,300

1: BAINBRIDGE, TRUXTUN, CALIFORNIA Class, and VIRGINIA Class

LOS ANGELES CLASS SUBMARINES

Engineering Services	6,008
Radiological Control Services	4,005
Production Services	26,863
TOTAL Man-days	36,876
TOTAL COST (including material)	$18,300,000

OHIO CLASS SUBMARINES

Engineering Services	5,143
Radiological Control Services	3,396
Production Services	22,726
TOTAL Man-days	31,265
TOTAL COST (including material)	$15,600,000

LONG BEACH CRUISER

Engineering Services	27,418
Radiological Control Services	18,107
Production Services	89,904
TOTAL Man-days	135,429
TOTAL COST (including material)	$108,196,150*

* Magnitude of estimate due to extensive shielding of package

Table A.2 Lead Removal Cost Estimates (per reactor compartment)

EVALUATION OF SHALLOW LAND BURIAL OF DEFUELED NAVAL REACTOR COMPARTMENT PACKAGES AT HANFORD
(protection of the inadvertent intruder and the environment from radioactivity contained in irradiated structure)

Appendix B

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1. PURPOSE

The purpose of Appendix B is to demonstrate that the disposal of Naval Reactor Compartments at the 218-E-12B Low Level Waste Burial Ground at Hanford, WA, meets the performance objectives for intruder and environmental protection under 10CFR61 for shallow land burial.

2. BACKGROUND

2.1 Location and Nature of Reactor Compartment Radioactivity

Naval Reactor Compartment Disposal Packages encompass the Reactor Compartment, that portion of a ship which supports and contains the ship's nuclear reactor plant. The reactor plant consists of the reactor vessel and associated piping and components that transfer heat from the reactor vessel and generate steam to propel the ship. Figure B-1 provides a simplified layout of a naval reactor compartment. Figure B-2 provides a simplified cross section of the reactor vessel itself. When the reactor plant is operational, reactor fuel is held within the reactor vessel internal structure shown. Neutrons escaping the fuel and adjacent areas activate the reactor vessel internal structure and to a smaller extent the interior the reactor vessel and surrounding areas. Certain longer lived radionuclides are of primary significance in naval reactor plants due to a combination of half-life, type and energy of decay radiation produced, and quantity within the reactor vessel. Table B-1 provides relevant properties of these principle radionuclides. Reactor vessel internal structure and operational life varies from ship to ship with a resulting variance in activity. Once the reactor has been defueled and inactivated, activity ranges are typical of that presented in Table B-1. Additional analysis of longer lived radioactivity within the reactor vessel can be found in Appendix D.

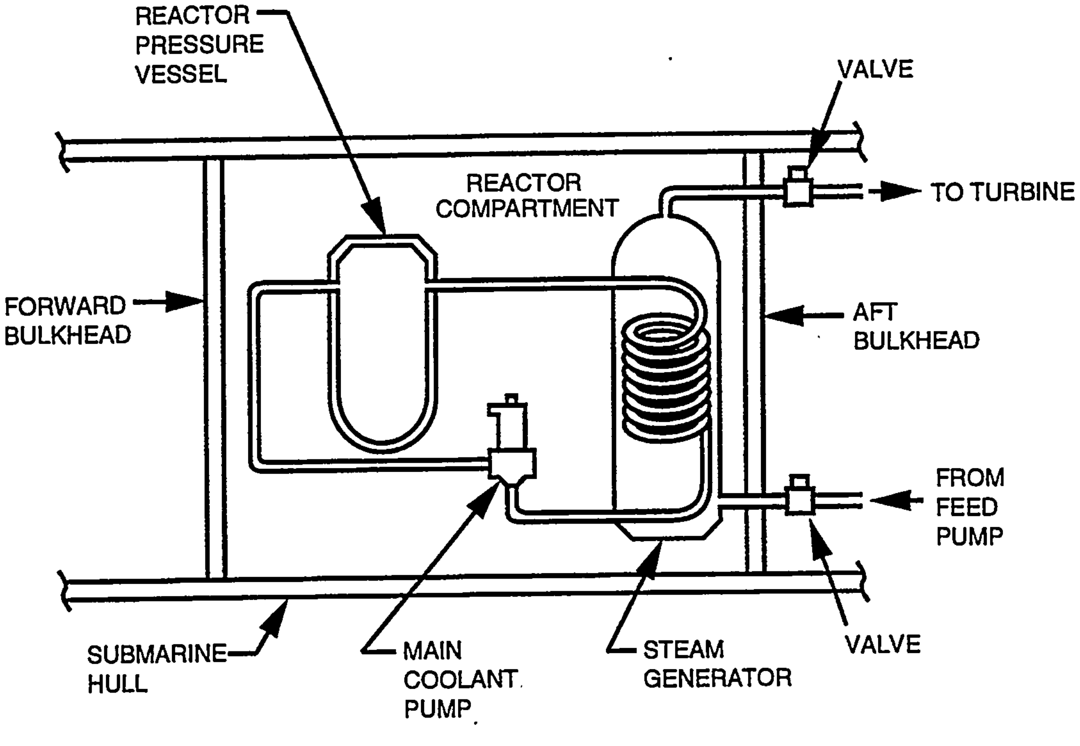

Figure B-1 Reactor Compartment Layout (conceptual)

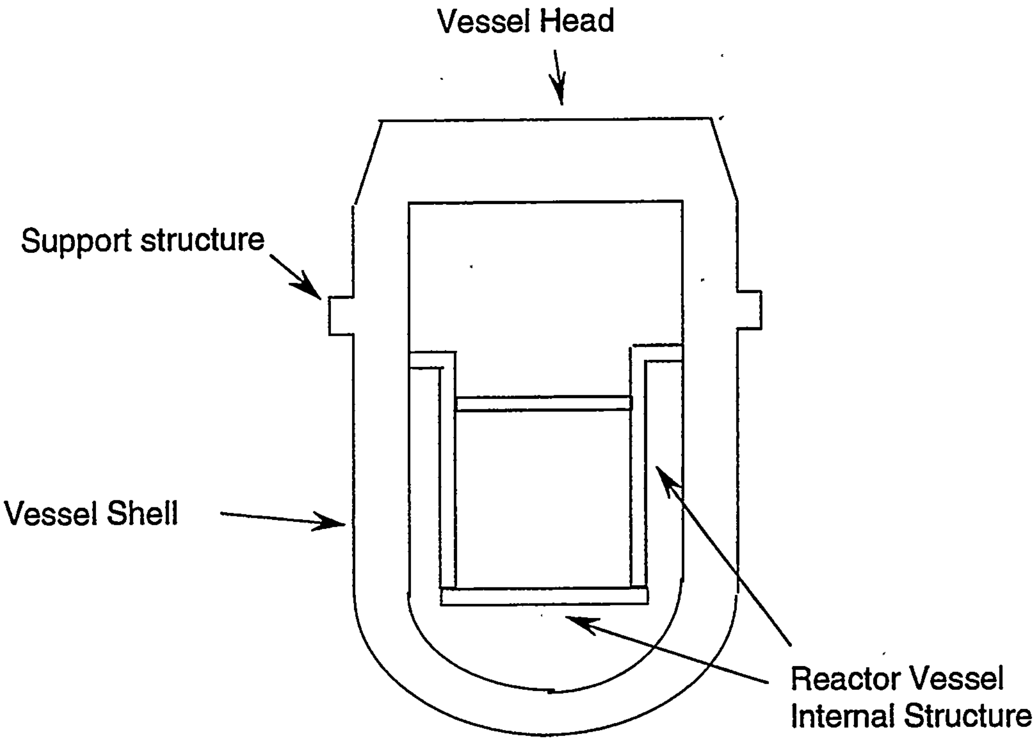

Figure B-2 Reactor Vessel (typical)

Radionuclide	Radiation	Gamma Ray Energy per Disintegration	Half-life (years)	Typical Quantity in Reactor Compartments (curies)
carbon-14	beta particle	no gamma	5730	0.5 - 15
nickel-59	X-ray	no gamma. X-ray energy typically less than 0.01 MeV.	75,000	100 - 300
nickel-63	beta particle	no gamma	100	10,000 - 30,000
niobium-94	beta particle and gamma ray	two in-series gammas: 0.87 MeV (100%) 0.70 MeV (100%)	20,300	0.5 - 1
technetium-99	beta particle	no gamma	213,000	0.01 - 0.03

Table B-1 Significant Longer Lived Reactor Compartment Radionuclides

3. EVALUATION OF REACTOR COMPARTMENTS

3.1 Structure and shielding

Reactor compartments are by nature massive, robust, integrated structures composed of interconnected structural containment walls, foundations, components, piping, and shielding, including the reactor vessel and its internals. These compartments, along with portions of adjacent spaces and tanks are sealed to form the disposal package by utilization of existing external ships structure such as submarine pressure hull and placement of external bulkheads and covers. Figure B-3 shows the external appearance of a typical submarine reactor compartment disposal package. The proposed LOS ANGELES and OHIO class packages would be somewhat larger than the current pre-LOS ANGELES reactor compartment packages but the basic configuration would remain the same. Submarine hulls are typically very high tensile strength (HY-80) alloy about two inches thick. External bulkheads would be installed for disposal and would be 3/4 inch steel plate.

T-stiffeners may project out from the plate as shown. Inside the end bulkheads, additional ship's bulkheads of at least 1/2 inch thickness steel enclose the reactor compartment. Entry to the reactor compartment would be blocked by the external bulkheads and one or more secured accesses. Ship's hull penetrations would be covered by welded plates.. Hull penetrations leading directly into the reactor compartment fall within two groups (1) holes 6 inches or less in diameter that would be covered by a minimum of 1/2 inch thick welded blanks which overlap the hull surface and (2) larger access cuts through the hull that would be restored with much thicker material, typically the same section of hull originally removed to create the access. High strength (HS/HT) carbon steel is typically found in ship's bulkheads and structure installed for disposal.

Figure B-4 shows the external appearance of the conceptual cruiser reactor compartment disposal package. Cruiser reactor compartments are located deep inside the ship. Existing ship's inner bottom structure would be incorporated into the foundation of the disposal package with high strength carbon steel containment structure installed up the side and over the top to form the package. This containment structure would be a minimum of 1.25 inches thick at the top of the package, and thicker at the bottom for added support. Inside this containment structure, an existing ship's 0.625 inch thick high strength carbon steel bulkhead would enclose the reactor compartment which has the same shape as the package. Support fixtures would be added to aid in transporting the package. The resulting disposal package would be as robust as the disposal packages for submarines.

Reactor plant design is similar between cruisers and submarines. The reactor vessel internal structure is nested inside the vessel and is composed typically of Inconel Alloy 600. An enclosed shield water tank structure of several inches of combined metal thickness surrounds most of the reactor vessel. The reactor vessel is constructed of alloy steels and varies in thickness from a minimum of approximately 3 inches to over 6 inches. The combined thickness of the reactor vessel and surrounding tank structure result in a minimum of about one half foot of steel preventing access to the reactor vessel internal structure.

Existing lead shielding in and around the reactor compartment provides gamma attenuation. The ship's bulkheads which enclose the reactor compartment are lined with solid lead shielding, bonded or cast in place and covered by 0.25 inch minimum metal canning plate. Additional canned lead is placed in various locations on reactor plant components and at various locations around the inside of the ship's hull where this structure forms part of the reactor compartment. Existing polyethylene shielding, for neutron attenuation, is also attached on the ship's bulkheads and on the reactor vessel itself.

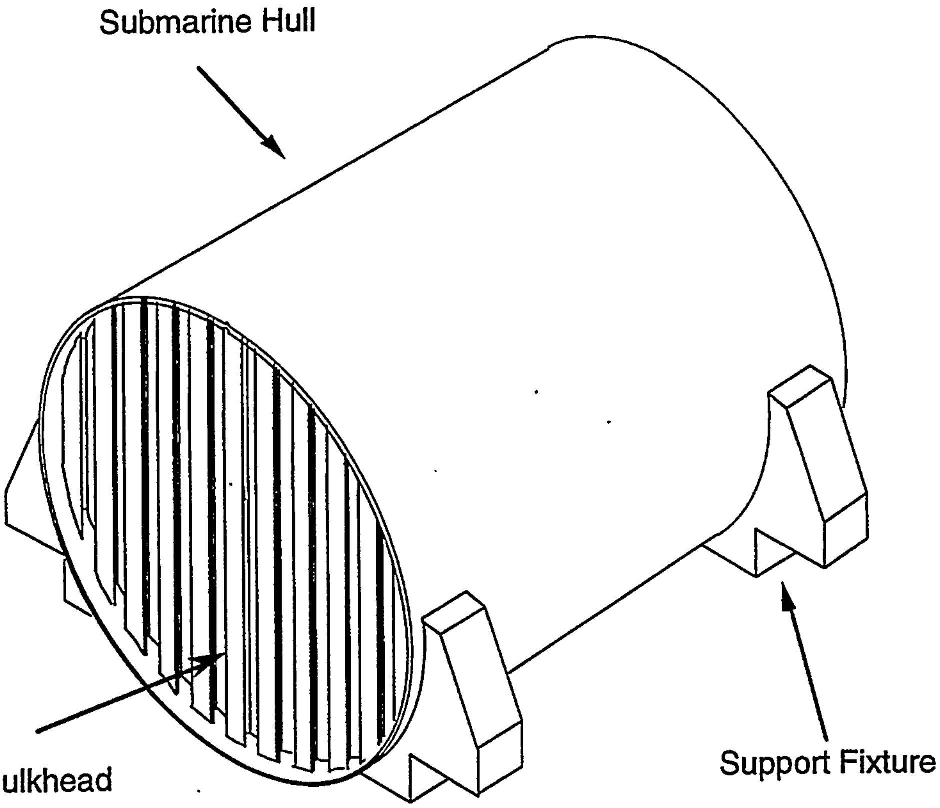

Figure B-3 Typical Submarine Reactor Compartment

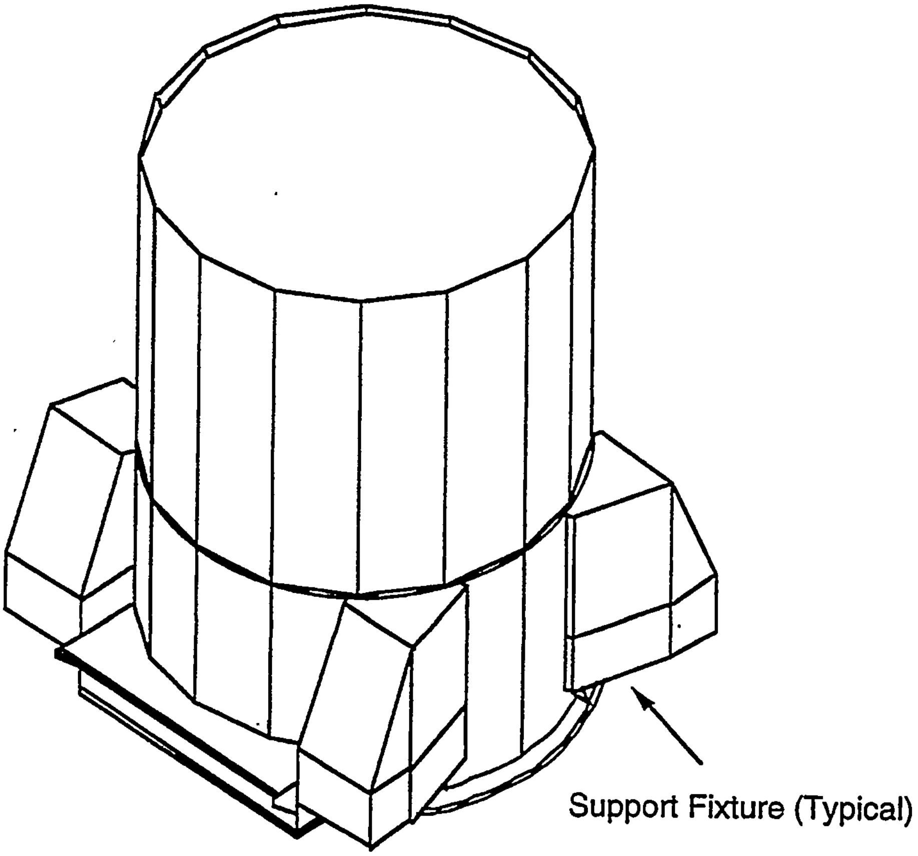

Figure B-4 Conceptual Cruiser Reactor Compartment

3.2 Disposal Site

The Hanford Site is a 560 square mile (1450 square kilometer), mostly undisturbed area of relatively flat shrub-steppe desert lying within the Pasco Basin of the Columbia Plateau, a semi-arid region in the rain shadow of the Cascade Mountain Range.

Pre-LOS ANGELES class reactor compartments are currently being disposed of at the 218-E-12B burial ground of the Hanford Site. This location is also the preferred alternative for disposal of cruisers and LOS ANGELES class and OHIO class submarines. Soil at the 218-E-12B burial ground is a typical mix of sandy-gravel, sand, and gravelly sand found in the Hanford Formation which underlies the burial ground. The soil is dry with a moisture content of less than 6% by weight, well drained, slightly alkaline with a pH of 8.2, and low in chlorides at 0.08 milligram equivalents per 100 grams soil or about 30 parts per million (NFESC 1993). Soil resistivity at the 218-E-12B burial ground is high, measured as greater than 30,000 ohm-cm. (NFESC, 1993). These conditions, coupled with the average rainfall of 6.3 inches per year are considered beneficial for minimizing corrosion.

The geology and hydrology under the 218-E-12B burial ground are described in detail in Estimation of the Release and Migration of Lead through Soils and Groundwater at the Hanford Site 218-E-12B Burial Ground (PNL, 1992). In general, groundwater occurs under the burial ground in both unconfined and confined aquifers, with the confined (deeper) aquifers bounded above by basalt layers and the unconfined (uppermost) aquifer lying at the interface between the Hanford Formation and the underlying bedrock Miocene basalts. The depth to the uppermost aquifer under the burial ground is approximately 200 feet from site surface and approximately 150 feet from the floor of the current excavation for reactor compartment disposal.

The unconfined aquifer receives little, if any, recharge directly from precipitation that falls on vegetated areas of the Hanford site because of a high rate of evapotranspiration from native soil and vegetation. Surface precipitation may contribute recharge where soils are coarse textured and bare of vegetation (PNL, 1994b). Recharge rates of 0.5 cm/yr and 5 cm/yr have been used at the Hanford Site to model recharge to the unconfined aquifer from the current arid climate and potentially wetter conditions, respectively, assuming no artificial surface barriers (DOE, 1987, DOE, 1989). These recharge rates have been applied specifically to the 218-E-12B burial ground for modeling the leaching of constituents from wastes (PNL, 1992, PNL, 1994a). Actual recharge at 218-E-12B, after closure, may be even lower for a substantial period of time due to the placement of an engineered cover which will result in over 5 meters of soil between the buried reactor compartments and the site surface.

Groundwater modeling conducted by Pacific Northwest Laboratory for the 218-E-12B burial ground (PNL, 1992, PNL, 1994a) suggests that under current climate conditions, in a natural state, the unconfined aquifer will recede southward and not be present under the burial ground. As artificial groundwater discharges in the area surrounding the 218-E-12B burial ground have diminished, aquifer wells adjacent to Trench 94 have been frequently dry.

Hanford formation sediments underlying the 218-E-12B burial ground exhibited a strong tendency to adsorb (immobilize) nickel and nickel radionuclides from groundwater in site specific testing (PNL, 1994a). Nickel solubility was also experimentally determined. Predicted migration times for nickel and nickel-59 from the burial ground to the aquifer varied from 800,000 years for the current climate down to 66,000 years for a postulated wetter condition modeled in which 10 times more water (recharge) is assumed to pass through the burial site than under the current climate condition.

3.3 Corrosion

High strength (HS/HT) carbon steel and very high tensile strength nickel alloyed (HY-80) steel typically form the exterior of reactor compartment disposal packages. Inconel Alloy 600 (a nickel-iron-chromium alloy) is present inside the reactor vessel as the reactor vessel internal structure. Stainless steels such as CRES 304 can also be found inside the disposal package. Site specific studies have been accomplished to determine the performance of reactor compartment disposal packages at the 218-E-12B burial ground. These studies showed that corrosion rates for carbon steels in the soil would be low, with an expected average general corrosion rate of 0.0002 inch per year and a corresponding maximum general corrosion rate of 0.0006 inch per year (DOE, 1992).

The actual general corrosion rates for compartment structure are expected to be less than these predictions. The studies were based on test data for open hearth carbon steel which is somewhat less corrosion resistant than the HY-80 and high strength carbon steel that forms the exterior of reactor compartments and much less corrosion resistant than the Inconel A600 alloy (or CRES 304).

The general corrosion rates for carbon steel at the 218-E-12B burial ground were based on a comparison to actual test data from underground storage tanks exhumed at the Hanford Site as well as available data from National Institute of Standards (NIST) test sites with soil conditions approximating those at Hanford. Pitting rates developed in this manner were converted to general corrosion rates by the use of a conservative conversion factor (DOE, 1992).

Upper limit corrosion rates expressed in milligrams of metal alloy weight loss per square decimeter of surface per year for CRES 304 and A600 Inconel alloys present in reactor compartments, were also estimated for the 218-E-12B burial ground (NFESC, 1993). These corrosion rates are as follows: for CRES 304 - 0.02 milligrams per square decimeter per year, and for Inconel Alloy 600 alloy - 0.01 milligrams per square decimeter per year.

3.4 Performance of Reactor Compartments

Based on the above corrosion rates, Table B-2 outlines the expected performance of a reactor compartment when buried at the 218-E-12B burial ground with respect to personnel access. Structural information and corrosion rates are summarized from previous discussions and used to estimate the time required for access to be gained inside structures as a result of corrosion. Soil pressure exerted on the disposal package exterior is also considered. From Table B-2 it can be seen that access inside the reactor compartment and to the more highly activated structure will require very long periods of time.

> Note: The term "access" is used in this evaluation to denote the physical entering of a space or area by a person's entire body (not just extremities). Access times provided in this section describe the time required for corrosion to allow access as defined above. These times do not imply that structure being accessed or structure through which access is gained is unrecognizable from surrounding soil or dispersible in surrounding soil. Access times also do not imply that a radiation dose exceeding the basis levels for the waste classification method of Title 10 "Energy" of the Code of Federal Regulations, Part 61 (10CFR61) will result from a person entering a space or area at the time provided (i.e. 500 mrem/yr for an intruder and 25 mrem/yr for the environment (NRC, 1982)). Radiation exposure rates associated

with accessing selected reactor compartment structures are discussed in section 3.5. Intruder and migration scenarios resulting in potential radiation dose are discussed in section 3.6.

	Personnel Access to Reactor Compartment	Personnel Access (entire body) to Reactor Vessel Internal Structure	Reactor Vessel Internal Structure
Limiting Barrier	Submarine End Bulkheads	Combination of Reactor Vessel and surrounding tank structure	NA
Thickness	0.75 inch	~ 1/2 foot	NA
Expected Corrosion Rate	0.0002 inch/year	0.0002 inch/year	NA
Expected Time to Access:	~2,000 years	~ 30,000 years	NA
Maximum Corrosion Rate	0.0006 inch/year	0.0006 inch/year	0.02 milligrams metal loss per square decimeter per year
Minimum Time to Access	~600 years	~ 10,000 years	>10,000,000 years (for complete corrosion)

Table B-2 Reactor Compartment Disposal Package Performance

For access to the reactor vessel internal structure, the limiting case considers both access from the inside of the reactor compartment once the endplates have been breached and access directly through the ship's hull under the reactor vessel. Breach of the endplates does not immediately provide access to the interior of the reactor compartment since a secured hatch would have to forcibly opened. However, no credit is taken in Table B-2 for the delaying effect of this hatch on access to the reactor compartment. Inside the reactor compartment, the reactor vessel internal structure is enclosed by a combination of the reactor vessel and a surrounding tank structure providing a series of nested metal structures. For access to the inside of the reactor vessel, corrosion is modeled as occurring in series through these nested structures from the outside to the inside of the reactor vessel.

For the corrosion life of the reactor vessel internal structure, this structure is modeled as a 0.5 inch thick plate with a 2 cubic meter volume. This produces a conservative surface area to volume ratio as the actual thickness and overall volume of this structure varies but is typically greater. The corrosion rate for the reactor vessel internal structure presented in Table B-2 reflects the occasional use of CRES 304 alloy vice the typical Inconel Alloy 600 which corrodes at a lower rate. The greater than 10,000,000 year period for complete corrosion of the reactor vessel internal structure is conservatively based on the CRES 304 corrosion rate multiplied by a factor of 10.

From Table B-2, greater than 10,000,000 years would be required to fully corrode the reactor vessel internal structure. Nearly all of the long-lived radioactivity in the reactor vessel internal structure will have decayed within the metal matrix before it is made available for migration by the extremely slow process of corrosion. Table B-3 provides an illustration of how little of the original inventory of long lived radionuclides could be released during the first 10,000 years of corrosion and over the entire period of corrosion.

3.5 Radiation Exposure

External radiation levels for reactor compartment disposal packages are essentially the result of Cobalt-60 activity contained within the reactor plant. This activity will decay by a factor of 2 every 5.3 years, thus in about 50 years, external radiation levels would be negligible at less than 0.1 mrem/hr on contact. Correspondingly, internal compartment radiation levels would be negligible at less than 0.1 mrem/hr and would remain low until the reactor vessel corrodes substantially exposing the reactor vessel internal structure and thus allowing exposure to gamma radiation from structural material containing niobium-94 inside the vessel.

Close proximity, and one meter distant radiation levels, have been estimated for a reactor vessel internal structure in a bare (exposed) condition and under fully corroded conditions representing the long term consequence of disposal by burial. These radiation levels were based on a 500 year decay period from the time of disposal. For exposed reactor vessel internal structure at 500 years, the radiation level would be a maximum of 11 mrem/hr at 1 meter. For a reactor vessel internal structure assumed to be completely reduced into a pile of corrosion products at 500 years, the radiation levels would be a maximum of 36 mrem/hr at 1 meter from this pile of corrosion products.

Radionuclide	Percentage of initial radionuclide inventory released during the first 10,000 years of corrosion	Percentage of initial radionuclide inventory ever released by corrosion
nickel-63	< 0.003%	<0.003%
carbon-14	<0.1%	<0.2%
niobium-94	<0.2%	<0.4%
nickel-59	<0.2%	<2%
technetium-99	<0.2%	<6%
Combined long lived radionuclides	<0.005%	<0.02%

Table B-3 Activity Released from Reactor Vessel Internal Structure via Corrosion

Table Note:

The 10,000 year period is provided for perspective. Corrosion will not likely initiate until the reactor vessel internal structure is exposed at ~ 10,000-30,000 years.

Different types of reactor vessel internal structures and varying operating times on these structures can be found among the reactor compartment classes considered. Maximum radiation levels presented are based on the combination of structure and operating time that results in bounding radiation levels for all of these classes.

95% of the radiation emitted from the reactor vessel internal structure at 500 years is from niobium-94 which produces gamma radiation with an activity half-life of 20,300 years. The remainder is mainly from nickel-59, which produces lower energy gamma/X-ray radiation with an activity half-life of 75,000 years. At 10,000 years, the minimum time predicted for corrosion processes to allow for whole body access to the reactor vessel internal structure, about 90% of this radiation would still be from niobium-94.

A 500 year decay period is overly conservative when considering the length of time required for corrosion processes at the Hanford Site to bring the reactor vessel internal structure into the exposed and corroded state. From Table B-2, a minimum decay period of greater than 10,000 years and an expected decay period of greater than 30,000 years would occur before the reactor vessel internal structure would potentially be exposed. Consequently, based on the minimum decay period of greater than 10,000 years, the resulting radiation levels at 1 meter would be reduced from the 500 year based 11 mrem/hr to about 8 mrem/hr as a maximum. Based on the expected decay period of over 30,000 years, the resulting radiation levels at 1 meter would be reduced from the 500 year based 11 mrem/hr to about 4 mrem/hr as an expected value.

By the time metallic debris surrounding the reactor vessel internal structure is transported away from the disposal site by corrosion and dissolution into groundwater, substantial activity decay would occur in the reactor vessel internal structure. The slow corrosion rate of the reactor vessel internal structure itself severely limits the amount of activity in this structure that could be released to the environment (e.g. less than 0.02% of total activity, less than 0.4% of niobium-94 activity, and less than 2% of nickel-59 activity, per Table B-3). Even these small percentages of the original reactor vessel internal structure's activity would not be found at any one time in the soil due to decay occurring both in the soil and in the structure as the slow corrosion process releases radionuclides.

The metal alloys of the reactor vessel internal structure are hard, difficult to machine or drill, and not prone to mechanical separation into the soil. The slow corrosion rate of the reactor vessel internal structure severely limits the amount of activity that could be released through corrosion. However, it is unrealistic to assume that a pile of corrosion products could remain exposed and undiluted in soil during and after the greater than 10 million year corrosion period predicted for the reactor vessel internal structure at the Hanford Site 218-E-12B burial ground. In any case, most internal activity in the structure would have decayed before a fraction of the structure could corrode. A very conservative very long term exposure scenario would be to assume that (1) over the greater than 10 million year corrosion life of the reactor vessel internal structure, 1% of niobium-94 and 5% of the nickel-59 activity in the reactor vessel internal structure has been released to the surrounding soil as corrosion products indistinguishable from soil and (2) that this released activity has mixed within a small volume of soil (a 10 by 10 by 10 foot box) and not decayed. The soil volume chosen is roughly 4-5 times the envelope volume of typical reactor vessel internal structure. The resulting radiation levels at 1 meter from the soil would be less than 0.5 mrem/hr. This does not account for the effect of residual metallic elements in the soil, which would add extra shielding benefits.

Table B-4 presents a summary of reactor compartment performance and resulting radiation levels associated with accessing the reactor vessel internal structure.

Minimum corrosion time for access to the reactor vessel internal structure (Table B-2)	Minimum predicted time for complete corrosion of the reactor vessel internal structure (Table B-2)	Percentage of initial radionuclide inventory released during the first 10,000 years of reactor vessel internal structure corrosion (Table B-3)	Percentage of initial radionuclide inventory released by the complete corrosion of the reactor vessel internal structure (Table B-3)	External Dose rate for reactor vessel internal structure when accessible (section 2.5)	External Dose rate for fully corroded reactor vessel internal structure in soil (section 2.5)
~ 10,000 yrs	>1.0 E +7 yrs	<0.005%	<0.02%	~ 8 mrem/hr at 1 meter (maximum) ~ 4 mrem/hr at 1 meter (expected)	< 0.5 mrem/hr at 1 meter

Table B-4 Reactor Compartment Evaluation Summary

3.6 Comparison of Reactor Compartment Disposal to Criteria/Assumptions Used in NRC Exposure Evaluations

3.6.1 Deliberate Intrusion

In the Final Environmental Impact Statement on 10CFR61, Volume 1 (NRC, 1982), the NRC stated that deliberate intrusion into a disposal facility cannot reasonably be protected against and is thus not considered further by the NRC in the development of 10CFR61. Nevertheless, upon closure of the 218-E-12B Low Level Waste Burial Ground at Hanford, WA, the reactor compartments would be buried more than 5 meters deep with an engineered cover placed over the buried compartments. The robust nature of the compartments and their durability in combination with the manner of their burial would discourage deliberate intrusion.

3.6.2 Inadvertent Intrusion

The NRC has based the waste classification method of 10CFR61 on assumptions of agricultural and construction related intruder scenarios where the activity from Class C wastes is, after 500 years, indistinguishably mixed with soil so that an intruder would not know that a waste site was being intruded upon. Limits for activity concentration in the waste were determined based on a 500 mrem/yr maximum exposure from these scenarios (NRC, 1982).

In 10CFR61 Part 56(b), waste stability is cited as a factor in limiting exposure to an inadvertent intruder, since the stability provides a recognizable and non-dispersible waste. The robust nature of the compartments and their durability in combination with the manner and depth of their burial at Hanford would prevent inadvertent intrusion involving the type of agricultural and construction scenarios evaluated by the NRC. Significant activity from the compartments would not be brought inadvertently upwards into the food chain at the land surface. From Table B-2, the reactor compartment, reactor vessel, reactor plant components and the reactor vessel internal structure itself will provide for physical remnants very distinguishable from surrounding soils for the foreseeable future. The reactor vessel internal structure disperses very slowly due to its long corrosion life. From Table B-3, the reactor vessel internal structure would release less than 0.02% of its activity to the soil and the structure itself would also remain essentially intact and distinguishable from soil for the foreseeable future.

Consequently, the only realistic intruder scenario that should be considered for disposal of reactor compartments is the intruder well penetrating through the 218-E-12B burial ground with a less probable hypothetical scenario wherein a person inadvertently manages to exhume a reactor compartment and enters it or inadvertently exhumes remnants of this reactor compartment at a very long time in the future.

3.6.2.1 Intruder Well

In the 10CFR61 Environmental Impact Statement (NRC, 1982), an intruder well scenario was evaluated for the current "no action" case of pre-10CFR61 disposal practices with a resulting maximum dose of about 11 mrem/yr to the thyroid from iodine-129 and a dose of less than 0.1 mrem/yr to the whole body. Iodine-129 Class-C limit based activity concentration fractions for reactor compartment reactor vessel internal structures are less than 0.000001 and thus thyroid dose would not be of concern. The remaining whole body dose as evaluated by the NRC is already well below the 500 mrem/yr basis for intruder scenarios or even the 25 mrem/yr basis for protection of the environment via migration pathways.

For buried reactor compartments, the long lived radionuclide inventory of niobium-94, nickel-63, and nickel-59 that control the waste classification are locked within the metal matrix of activated materials that will take greater than 10,000,000 years to fully corrode. A well drilled through the burial site would contact and be obstructed by high strength steels from the disposal package for thousands of years and from the reactor vessel for tens of thousand of years. This same well would be obstructed by non-activated CRES 304 and Inconel Alloy 600 from the reactor plant for as long as the life of the reactor vessel internal structure. In addition, Inconel Alloy 600 tends to work harden and is difficult to machine.

If the intruder well stops at the depth of the obstruction (the buried waste), the well should be dry. If the well continues to the bedrock below, the well should be dry under the current climate conditions at Hanford and if not, niobium-94 and nickel-59 should take a very long time to migrate to this depth.

Pacific Northwest Laboratory estimated the migration of nickel through soils and groundwater at the 218-E-12B burial ground from a group of 120 large metal components representing reactor compartments. A current climate condition was modeled and a postulated wetter condition with a recharge rate set at 10 times the rate used to model the present climate. Groundwater modeling conducted as part of this work suggests that under current climate conditions, in a natural state, the aquifer under the 218-E-12B burial ground will recede southward and not be present under the burial ground. Even under a postulated wetter condition modeled with a site recharge rate set at 10 times the rate used to model the present climate, the water table under the burial ground is still predicted to be about 40 meters (130 feet) below the bottom of the burial excavation.

Pacific Northwest Laboratory predicted very long times of over 66,000 years under the postulated wetter condition modeled and 800,000 years under the current climate condition for nickel-59 released from buried disposal packages to reach a well drilled 100 meters (330 feet) downstream of the site (PNL, 1994a). Transport time from the disposal packages to the bedrock directly under the disposal site occupied over 99% of these predicted times due to adsorption of nickel into the unsaturated soil. Nickel-63 decayed en-route and never reached an aquifer. Thus, nickel-63 from reactor compartment disposal packages would likely never enter an intruder well and nickel-59 would take 66,000 years, a very long time, to enter such a well.

An estimate of the time required for niobium-94 to migrate to the aquifer under the burial site can be made by use of retardation factors provided by the 10CFR61 EIS (NRC, 1982). Retardation factors account for the effects of adsorption in soil which delays the migration of radionuclides through the soil. The retardation factors provided in the NRC EIS essentially represent the relative time required for radionuclides to travel a given distance through soil compared to the time required for groundwater to travel the same distance. The higher the retardation factor, the slower the radionuclide moves. Niobium-94 retardation factors provided by the NRC are at least twice as large as for nickel-59, therefore, niobium-94 should take twice as long to transit a given depth of soil as for nickel-59. This is conservative in that niobium-94 concentration in reactor vessel internal structures is 2 orders of magnitude below nickel-59 concentration and is contained within the same corrosion resistant metal alloys as nickel-59. This would tend to increase transport times for niobium even further. The release rate of niobium-94 in curies per year per compartment would be 2 orders of magnitude lower than for nickel-59 initially, decreasing even further relative to nickel-59 as niobium-94 decays 3 times faster. Even though ingestion of niobium-94 at a given concentration would likely produce a higher exposure dose than ingestion of an equivalent concentration of nickel-59, this effect should be overcome by the lower release rate and longer migration time.

Pacific Northwest Laboratory (PNL, 1994a) predicted doses that would result under a maximally exposed individual scenario involving a person who uses water from an aquifer well 100 meters (330 feet) downstream of the burial site for all personal food production and consumption needs. This work, which used the GENII dose model (PNL, 1988), produced a dose from nickel-59 ingestion of less than 0.001 mrem/yr after a 66,000 year minimum migration time. A group of 120 large metal components representing reactor compartments was assumed to be buried at the site. Considering the placement of 220 reactor compartments at the burial site, niobium-94, and the location of the intruder well, this dose would not increase to the 500 mrem/yr intruder limit or even to the 25 mrem/yr release to the environment performance standard of Subpart C of 10CFR61.

3.6.2.2 Exhumation

External radiation levels on reactor compartment disposal packages are essentially the result of Cobalt-60 activity contained within the reactor compartments which will decay by a factor of 2 every 5.27 years. Thus, in about 50 years, external radiation levels would be negligible at less than 0.1 mrem/hr even on contact. Correspondingly, radiation levels inside the reactor compartment would be negligible at less than 0.1 mrem/hr and intruder exposure would remain very low until about 10,000 to 30,000 years have elapsed (Table B-2) at which point the reactor vessel has corroded sufficiently to allow intruder access (whole body) through the reactor vessel to the reactor vessel internal structure.

Based on a minimum 10,000 year access time for the reactor vessel internal structure, the maximum radiation level at 1 meter from an exposed reactor vessel internal structure would be 8 mrem/hr. At this radiation level, the intruder would have to spend 2.5 days at 1 meter from this structure to reach a 500 mrem/yr exposure.

Based on an expected 30,000 year access time for the reactor vessel internal structure, the expected radiation level at 1 meter from an exposed reactor vessel internal structure would be 4 mrem/hr. At this radiation level, the intruder would have to spend 5 days at 1 meter from this structure to reach a 500 mrem/yr exposure. However, direct or very close proximity contact with reactor vessel internal structure over a period of time necessary to reach the 500 mrem/yr basis is not considered plausible because the reactor vessel internal structure would likely never be actually exposed and unshielded to an inadvertent intruder.

Over the 10,000 to 30,000 year period required for corrosion to allow entire body access to the reactor vessel internal structure, the reactor compartment hull, being thinner than the reactor vessel, subject to external soil pressure, and supporting the compartment internals, would likely have collapsed downward bringing the compartment contents down on top of the reactor vessel. Lead shielding plates, corrosion resistant steels such as CRES 304 and Inconel Alloy 600 that comprise the reactor plant inside the compartment, remnant heavy steel framing from the hull, corrosion products, and polyethylene shielding from the reactor vessel and the remainder of the compartment would cover the reactor vessel remnant and the reactor vessel internal structure inside hindering access and providing shielding not considered in this analysis.

Greater than 100 tons of lead shielding is present in reactor compartment disposal packages with some of this lead being in a position to fall over the pressure vessel upon compartment collapse. Due to the very low solubility of lead predicted for the 218-E-12B burial ground environment (PNL, 1992) some shielding lead in reactor compartment disposal packages will continue to be present for perhaps as long as remnants of the reactor vessel internal structure remain. On average, over 90 metric tons (100 tons) of CRES 304 and/or Inconel Alloy 600 typically form the reactor plant which occupies the reactor compartment along with the reactor vessel. This material shares the same low corrosion rate discussed in section 2.3 as for the reactor vessel internal structure and remnants will last as long.

The volume of lead and corrosion resistant materials in the compartment is much greater than that of the reactor vessel internal structure. The volume of metal directly above the reactor vessel internal structure up to the top of the reactor compartment disposal package is typically much greater than that of the reactor vessel internal structure. Collapse of the compartment over the reactor vessel internal structure and the filling of void spaces remaining within the remnant compartment with soil should completely cover the reactor vessel internal structure producing a difficult to penetrate mound of debris that would provide some shielding benefit.

Eventually corrosion processes will remove the less corrosion resistant materials from the debris mound. Over the greater than 10 million years required to fully corrode the reactor vessel internal structure, less than 0.02% of total activity will be released to the soil due to decay. Correspondingly, less than 0.4% of niobium-94 activity and less than 2% of nickel-59 activity will be released to the soil. If this activity is very conservatively assumed to be released all at once into a cubic volume of soil 3 meters (10 feet) to a side or 27 cubic meters (1000 cubic feet) total, resulting radiation levels at 1 meter from this volume of soil would be less than 0.5 mrem/hr not accounting for self shielding effects in the soil resulting from residual metallic elements adsorbed onto soil particles. However, this exposure will not actually ever occur because the activity that is released into the soil is released so slowly that only a fraction of the 0.02% total released would be present at any one time in the soil. Ingestion of soil by the intruder sufficient to result in a significant intruder dose is not considered plausible due to the dilution provided by clean soil and the mass of corrosion products resulting from corrosion of the reactor compartment and the slow release of a small amount of activity over a long time.

Intruder doses under the scenario discussed above would not likely reach the 500 mrem/yr limit used by the NRC to develop the 10CFR61 waste classification method. Intruder dose for the intruder well scenario would also not reach the 500 mrem/yr limit. It should be noted that the long times required for radionuclides to be released into the soil from the reactor vessel internal structure are beyond the accepted time scale of human civilization on earth.

3.6.2.3 Groundwater

The only plausible exposure scenario to the general public from buried reactor compartments would involve the groundwater pathway tapped by a well. The depth and manner of burial of the compartments coupled with the free-draining arid nature of the Hanford Soils and the slow release of activity from the compartments inhibit the migration of activity upward from the compartments to the land surface.

As discussed previously in the intruder well evaluation, Pacific Northwest Laboratory (PNL, 1994a) predicted very long times of over 800,000 years under the current climate condition and over 66,000 years under the postulated wetter condition modeled for nickel-59 released from buried reactor compartment disposal packages to reach a well drilled 100 meters (330 feet) downstream of the burial site. Nickel-63 decayed en-route and never reached the site aquifer or a downstream well. As a result, "maximally exposed" individual doses calculated for a person using the 100 meter (330 feet) downstream well were less than 0.001 mrem/yr based on nickel-59 ingestion alone.

Other radionuclides are not present in sufficient quantity in the reactor compartments to add any significant dose under the groundwater migration pathway. Thus, maximally exposed individual doses for the groundwater pathway would not reach the 25 mrem/yr "release to the environment" performance standard of Subpart C of 10CFR61.

3.7 Compliance with 10CFR61 Subpart C Performance Objectives

3.7.1 Part 61.41 Protection of the Public from Releases of Radioactivity

Releases to the general environment shall not to exceed 25 mrem/yr to the whole body, 75 mrem/yr to the thyroid, and 25 mrem/yr to any other organ equivalent dose to the public (10CFR61.41)

As discussed in section 3.6.2, the only plausible exposure scenario to the general public from buried reactor compartments would involve the groundwater pathway tapped by a well. This type of pathway would not result in exposure doses exceeding 25 mrem/yr.

3.7.2 Part 61.42 Protection of Individuals from Inadvertent Intrusion

The 10CFR61 EIS (NRC 1982) indicates that the NRC in developing the waste classification method of 10CFR61 set a maximum 500 mrem/yr equivalent intruder dose as the basis for determining appropriate limits for activity.

As discussed in section 3.6 and section parts 3.6.1. and 3.6.2., the only plausible intruder scenarios for disposal of reactor compartments at the Hanford Site 218-E-12B burial ground involve an intruder well and a less probable exhumation of the compartment. Exposure doses from the intruder well would not reach 500 mrem/yr. Exposure dose from the exhumation scenario would not likely reach 500 mrem/yr. The depth and manner of burial of the reactor compartments, and the robust, long lived nature of the compartments, inhibits intrusion and limits exposure.

3.7.3 Part 61.43 Protection of Individuals During Disposal Site Operations

The Hanford Site, a Department of Energy managed facility, has adequate procedures and controls to accomplish this purpose. The reactor compartment disposal packages typically would have exterior radiation levels of less than 1 mrem/hr on contact at the time of disposal. Areas with higher radiation levels would be found under the compartment and would have standard radiation markings. Within 50 years of disposal, all exterior radiation levels would decay to negligible levels less than 0.1 mrem/hr.

3.7.4 Part 61.44 Stability of the Disposal Site After Closure

The Hanford Site has adequate procedures and controls to accomplish this purpose. The reactor compartments are strong and durable and would not cause any significant subsidence at the burial site surface upon burial and for at least 600 years afterwards. An engineered cover would be placed over the disposal site upon closure to add stability and limit moisture influx.

4. CONCLUSIONS

Disposal of Naval Reactor Compartments at the 218-E-12B Low Level Waste Burial Ground at Hanford, WA meets the performance objectives for intruder and environmental protection from 10CFR61. The requirements of Department of Energy Order 5820.2A "Radioactive Waste Management" (DOE, 1988) provide a similar level of protection equivalent to the NRC regulations of 10CFR61 and in many cases mirror the NRC regulations. Consequently, disposal of reactor compartments at the 218-E-12B burial ground, Hanford, WA is also consistent with the DOE order.

REFERENCES

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NFESC, 1993 Corrosion Behavior of HY-80 Steel, Type 304 Stainless Steel, and Inconel Alloy 600 at 218-E-12B Burial Ground, Hanford, WA, TR-2001-SHR, Naval Facilities Engineering Service Center, Port Hueneme, California, December 1993.

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PNL, 1988 GENII - The Hanford Environmental Radiation Dosimetry Software System, 1988, PNL-6584, Pacific Northwest Laboratory, Richland, Washington.

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REFERENCES (Continued)

10CFR61	Code of Federal Regulations Title 10 “Energy” Part 61.
10CFR61.41	Code of Federal Regulations Title 10 “Energy” Part 61.41.

COST ANALYSIS
for
FINAL ENVIRONMENTAL IMPACT STATEMENT
ON THE
DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO, AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

Appendix C

Table of Contents

List of Tables

1. INTRODUCTION

This appendix provides information on the estimated costs associated with the reasonable alternatives. Economic costs and radiation exposures are both considered. These factors are important to decide which alternatives should be considered further and which alternatives should be considered most appropriate for disposal of decommissioned, defueled reactor compartments from cruisers, LOS ANGELES, and OHIO Class submarines in a safe and environmentally acceptable manner.

The reasonable alternatives discussed in detail in this appendix are:

- Preferred alternative of land burial of the entire reactor compartment at the Department of Energy low level waste burial ground at Hanford, WA.
- No-Action alternative of protective waterborne storage for an indefinite period.
- Disposal and reuse of subdivided portions of the reactor plant alternative.
- Indefinite storage above ground at Hanford alternative.

Alternatives not discussed in detail because they are not considered reasonable are:

- Sea disposal alternative.
- Permanent above ground disposal at Hanford alternative.
- Land disposal at other sites alternative.

The costs associated with the preferred alternative of land burial of the entire reactor compartment at the Department of Energy low level waste burial ground at Hanford, WA. would include the shipyard efforts to prepare the reactor compartment disposal package for transportation and disposal, contractor services to transport the reactor compartment disposal package to Hanford, and the Hanford activities to accept the reactor compartment disposal package for disposal.

Indefinite waterborne storage would be an alternative to disposal, but does not provide an ultimate means of disposal. Maintenance of proper storage conditions during the indefinite waterborne storage period would incur significant costs. Storage would be in a naval inactive nuclear ship moorage facility at either Norfolk Naval Shipyard or Puget Sound Naval Shipyard. Indefinite waterborne storage would include those preparation actions necessary to assure storage in a safe and environmentally acceptable manner. Periodic actions required during storage would include monitoring the decaying radiation levels and maintenance of essential storage conditions.

For the disposal and reuse of subdivided portions of the reactor plant alternative the non-reusable material would be disposed of in a safe and environmentally acceptable manner. The options within this alternative vary depending on prompt action or delay to allow some radionuclides to decay away, thus reducing the general area radiation exposure levels. For this analysis a delay of 10 years was analyzed, consistent with the safe storage (SAFESTOR) alternative of commercial nuclear reactor plant studied by the NRC (NRC, 1988).

Indefinite storage above ground at Hanford would be an alternative to disposal, but as with waterborne storage, would not provide an ultimate means of disposal. The alternative would involve all the actions for packaging and transportation as described in the preferred alternative except for the disposal trench activities, which would be replaced with storage activities; such as, paint maintenance, etc.

2. BACKGROUND

The costs of disposal consist of two elements:

a. Radiation exposure to the general population, transport workers, and to shipyard workers.

b. Economic costs that would be incurred to accomplish the disposals.

As discussed in the body of this environmental impact statement, the estimated radiation dose that would be received by the general population and the hypothetical maximally exposed individual would be quite small when compared to natural background radiation for all of the reasonable alternatives evaluated. The estimated radiation dose to the shipyard workers from the subdivide and reuse alternative may be excessive when compared to the other alternatives. These estimated doses should be considered as a basis for selecting an alternative since they indicate that some of the alternatives can not adequately safeguard the worker from significant exposure.

The estimated economic costs range from a total program cost of about $1.53 billion for the preferred alternative to a total program cost of about $9.36 billion for the disposal and reuse of subdivided portions of the reactor plant alternative. The totals should be considered an effective basis for comparing relative cost of the alternatives.

3. DISCUSSION OF COST

Monetary values are in constant 1994 fiscal year dollars. These estimates are not budget quality, but rather a rough order-of-magnitude cost estimate based on experience, engineering concepts, or available data from a variety of technical sources. The values presented are for comparison purposes only, since the actual cost could be influenced by factors not foreseeable during development of this EIS; such as: (1) promulgation of changes to existing policies and/or regulations, (2) man-day rate changes, (3) new technological developments, (4) different environmental considerations, (5) work controls, (6) different occupational safety and health regulations, and (7) transportation requirements.

3.1 Preferred Alternative of Land Burial of the Entire Reactor Compartment at the Department of Energy Low Level Waste Burial Ground at Hanford, WA.

The most significant cost associated with this alternative would be the shipyard effort for preparation for disposal. Very little new capital equipment or other one-time items would be needed to support this alternative, except that overhead power lines on the Hanford Site transport route may need to be raised. The significant costs associated with this alternative are shipyard efforts to (1) remove residual liquids to the maximum extent practicable, (2) reactor compartment packaging for transportation and disposal, and (3) associated engineering and services. The engineering and services description encompasses a wide variety of shipyard related costs, such as; electrical services, industrial supplies, project management personnel, special tooling, etc. Table C-1 summarizes the significant costs associated with this alternative.

An additional cost could be incurred if the ships are temporarily stored pierside for an indefinite period of time. For an initial 15 year storage period, the total cost for the preferred alternative would be approximately $1.67 billion, a $140,000,000 increase.

Preferred Alternative of Land Burial of the Entire Reactor Compartment at the Department of Energy Low Level Waste Burial Ground at Hanford, WA.
(Per Reactor Plant)

TABLE C-1

	LOS ANGELES	OHIO	CRUISERS
DISPOSAL PREPARATIONS (1)			
• Engineering, Management, Labor, and Support Services	$6,876,000	$8,770,000	$27,945,000
• Water Removal	$1,310,000	$1,750,000	$1,980,000
• Packaging	$1,014,000	$1,217,000	$7,465,000
TRANSPORTATION	$480,000	$480,000	$480,000
TRENCH	$253,000	$253,000	$253,000
Per reactor plant	$9,933,000	$12,470,000	$38,123,000
Total per class	$615,846,000	$224,460,000	$686,214,000
Total program cost	$1,526,520,000 (2)		

(1) The cost to dispose of a LOS ANGELES Class reactor compartment was considered to be the same as the actual cost to dispose of the most common type pre-LOS ANGELES Class reactor compartment. This is because of similarity in size and configuration. The cost estimates for OHIO Class and cruiser reactor compartments were adjusted upward due to differences in size and plant configuration.

(2) The discounted amount would be 0.7 billion dollars based on a discount rate of 4.9% over a 32 year period beginning in 1997.

3.2 The "No-Action" Alternative - Protective Waterborne Storage for an Indefinite Period

The closest reasonable approach to the "No-Action" alternative would involve actions that would be considered prudent to provide protection of the public safety and to prevent unacceptable environmental consequences. This alternative would include the work which must be accomplished to prepare them for indefinite waterborne storage in a safe and environmentally acceptable manner. Preparation for storage would include removing fluids, removing strategic equipment, blanking sea connections, ensuring the preservation of containment barriers such as the hull, and installing fire and flooding alarms. Equipment and materials would be available for salvage. Periodically it would be necessary to move each ship into drydock for hull maintenance. Table C-2 summarizes the costs associated with this alternative.

The "No-Action" Alternative - Protective Waterborne Storage for an Indefinite Period

TABLE C-2

	Per Ship Cost for a 15 year cycle
WATERBORNE STORAGE PREPARATIONS	
• Hull Blanking	$715,000
• Hull preservation	$140,000
STORAGE	
• Maintenance	$750,000(1)
Total per ship cost	$1,605,000(2)
Total Program cost for first 15 years of storage	$142,845,000

(1) Based on $50,000 per year maintenance cost at Puget Sound Naval Shipyard.

(2) For additional 15 year storage periods the cost is estimated at $1.75 million per ship.

3.3 Disposal and Reuse of Subdivided Portions of the Reactor Plant

This alternative would include removal of reusable equipment; separating the reactor plant and reactor plant support systems from the ship; preparing the reactor plant and reactor plant support systems for disposal or storage; and, transportation to the disposal site.

The complete dismantlement of a nuclear reactor plant has been accomplished by the Department of Energy for the Shippingport Station. The Nuclear Regulatory Commission (NRC) also has studied the cost of decommissioning commercial nuclear reactor plants and published that information in a Generic Environmental Impact Statement, (NRC, 1988). The Navy utilized both the estimated and actual cost information published on the Shippingport decommissioning and the generic costs outlined by the NRC to decommission a commercial nuclear reactor plant to establish a baseline for dismantlement of naval nuclear reactor plants.

The NRC in 10CFR50.75 provides the following equation to determine the minimum amounts required to demonstrate reasonable assurance of funds for decommissioning by reactor type and power level, P (in MWt), of commercial nuclear power plants. The NRC limits the usage of the equation to plants with a power level between 1200 and 3400 MWt; for plants smaller than 1200 MWt, the NRC specifies using 1200 MWt for P. The maximum thermal output of a naval nuclear propulsion is below 1200 MWt; therefore:

$$\begin{aligned}\text{Cost} &= 75 + 0.0088P \quad \text{(in millions of January 1986 dollars)}\\ &= \$85.56 \text{ million per reactor plant}\end{aligned}$$

The estimated cost to dismantle approximately one hundred reactor plants is about $8.5 billion based on the NRC equation. However, it is important to note that there is a large uncertainty associated with the actual cost to dismantle a reactor plant.

The NRC, in NUREG-0586 (NRC, 1988), studied the technology, safety, and cost of decommissioning a commercial pressurized water reactor plant. The DECON (immediate dismantlement of the plant) alternative studied by the NRC is comparable to subdividing naval nuclear reactor plants. The NRC estimated that immediate removal and disposal of all radioactivity to release of the commercial nuclear reactor plant complex for unrestricted use would cost, in 1986 dollars, between $88.7 million (for utility staffing) and $103.5 million (for utility plus contractor staffing). The NRC estimating method is based on the guidance provided by the NRC in NUREG-CR-0130, (NRC, 1978).

The NRC method provides a basis for comparison, but may not be directly applicable to dismantlement of naval nuclear reactor plants due to the differences in reactor plant construction techniques; such as: large and spread out complex (commercial) versus small and compact compartment (naval), concrete secondary containment structure (commercial) versus metal secondary containment structure (naval). Furthermore, the NRC estimate is based on several factors which are not included in the other cost estimates in this appendix, such as: spent fuel removal and management; Nuclear Insurance; etc. To be consistent with the other cost estimates in this appendix in terms of scope of work, $21.22 million (23.92%) has been subtracted from the $88.7 million for an estimated total cost per reactor plant of $67.48 million in 1986 dollars. Adjusting to 1994 dollars, results in an estimated per reactor plant total of $82.19 million and $8.22 billion for the approximately one hundred reactor plants.

A reasonable comparison can be made to the Department of Energy's decommissioning of the Shippingport Atomic Power Station. The total cost for the Shippingport Atomic Power Station decommissioning project was $91.3 million. However, this included activities not included in the other alternatives, such as: Decommissioning Operations Contractor Fee; Home office Support costs; etc: To be consistent with the other cost estimates in this appendix in terms of scope of work, $7.223 million (7.91%) has been subtracted from the $91.3 million for an estimated total cost per reactor plant of $84.08 million in 1989 dollars. Adjusting to 1994 dollars, results in an estimated per reactor plant total of $93.63 million and $9.36 billion for the approximately one hundred reactor plants. The discounted amount for 100 reactor compartments would be 4.3 billion dollars based on a discount rate of 4.9% over a 32 year period.

3.4 Indefinite Storage Above Ground at Hanford

This alternative would include the same operations as the preferred alternative excluding the burial operations, but includes cost such as paint maintenance. Storage costs would depend ultimately on the length of spent time in storage; however, the additional cost to store the packages would likely be less than 1% of the total program.

4. DISCUSSION OF RADIATION DOSE

The preferred alternative estimates are based on historical measurements made during pre-LOS ANGELES Class submarine disposals adjusted for the plant types and if temporary water-borne storage is utilized. The land disposal and reuse of subdivided portions of the reactor plant alternative estimated dose values are based on the values determined by the Nuclear Regulatory Commission for decommissioning commercial nuclear power plants and experience from Shippingport Atomic Power Station. The Indefinite on Surface Storage at Hanford alternative would incur the same exposure as the preferred alternative without temporary waterborne storage; therefore, a table listing exposure estimates for this alternative is not provided. Furthermore, the "No-Action" alternative would not result in any significant exposure to the workers or the the public; therefore, a table listing exposure estimates for this alternative is also not provided.

Preferred Alternative of Land Burial of the Entire Reactor Compartment at the Department of Energy Low Level Waste Burial Ground at Hanford, WA, Exposure Estimates (rem)

TABLE C-3

	LOS ANGELES	OHIO	CRUISERS
DISPOSAL PREPARATIONS • Water Removal • Packaging • Services	 8 0.4 4.6	 9 0.4 4.6	 20 3 2
Total per reactor plant	13	14	25
Total per class of ship	806	252	450
Total program dose	1,508		
Latent fatal cancers			
Per class of ship	0.32	0.1	0.18
Total Program	0.6		

Subdivision Option
On-Site Occupational Exposure Estimates (rem)
Shippingport Based Estimate/Immediate

TABLE C-4A

	LOS ANGELES	OHIO	CRUISERS
DISPOSAL PREPARATIONS - Subdivision Operations	230	230	230
Total per reactor plant	230	230	230
Total per class of ship	14,260	4,140	4,140
Total program exposure	22,540		
Latent fatal cancers Per class of ship	5.7	1.7	1.7
Total Program	9.1		

Subdivision Option
On-Site Occupational Exposure Estimates (rem)
Shippingport Based Estimate/10 Year Deferral

TABLE C-4B

	LOS ANGELES	OHIO	CRUISERS
DISPOSAL PREPARATIONS - Subdivision Operations - Maintenance Operations	61.7 0.3	61.7 0.2	61.7 1.2
Total per reactor plant	62.0	61.9	62.9
Total per class of ship	3,844	1,114	1,132
Total program exposure	6,090		
Latent fatal cancers Per class of ship	1.5	0.4	0.5
Total Program	2.4		

Subdivision Option
On-Site Occupational Exposure Estimates (rem)
NRC Based Estimate/Immediate Disposal

TABLE C-4C

	LOS ANGELES	OHIO	CRUISERS
DISPOSAL PREPARATIONS • Subdivision Operations[1]	1,115	1,115	1,115
Total per reactor plant	1,115	1,115	1,115
Total per class of ship	69,130	20,070	20,070
Total program exposure	109,270		
Latent fatal cancers Per class of ship	27.7	8.0	8.0
Total Program	43.7		

[1] Occupational exposure estimates are based on NUREG-0586, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Table 4.3-2.

Subdivision Option
On-Site Occupational Exposure Estimates (rem)
NRC Based Estimate/10 Year Deferral

TABLE C-4D

	LOS ANGELES	OHIO	CRUISERS
DISPOSAL PREPARATIONS • Subdivision Operations[1]	338	338	338
Total per reactor plant	338	338	338
Total per class of ship	20,956	6,084	6,084
Total program exposure	33,124		
Latent fatal cancers Per class of ship	8.4	2.4	2.4
Total Program	13.2		

[1] Occupational exposure estimates are based on NUREG-0586, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Table 4.3-2.

REFERENCES

NRC, 1978	Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station, U.S. Nuclear Regulatory Commission, NUREG/CR-0130.
NRC, 1988	Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, U.S. Nuclear Regulatory Commission, nureg-0586, August 1988.

LONG LIVED RADIONUCLIDES IN IRRADIATED STRUCTURE WITHIN CRUISER, LOS ANGELES, AND OHIO CLASS REACTOR PLANTS

Appendix D

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List of Illustrations

List of Tables

1. INTRODUCTION

Because of the various materials used in a reactor plant that can become activated during its operation, cruiser, LOS ANGELES, and OHIO class reactor plants contain a variety of radionuclides. The radionuclides include small quantities of long lived radionuclides. These radionuclides, with half-lives ranging from several thousand to several million years, are primarily in structure located within the reactor vessel that has been irradiated and subsequently activated. Less than 0.1% of the long lived activity is freed from this structure and transported out of the reactor vessel as wear product, a negligible amount. This appendix discusses the type, distribution, and amount of long lived radioactivity found within the irradiated structure of cruiser, LOS ANGELES, and OHIO Class reactor plants, and the methods used to calculate long lived activity within these structures. Specifically, the long lived radionuclides carbon-14, iodine-129, nickel-59, niobium-94, selenium-79, and technetium-99 are considered. Nickel-63, with a half-life of 100 years, is also considered in this appendix due to the presence of many thousands of curies of this radionuclide in activated structure within the reactor vessel.

2. BACKGROUND

2.1 Nature of Reactor Compartment Radioactivity

Naval Reactor Compartment Disposal Packages encompass the Reactor Compartment, that portion of a ship which supports and contains the ship's nuclear reactor plant. The reactor plant consists of the reactor vessel and associated piping and components that transfer heat from the reactor vessel and generate steam to propel the ship. Figure D-1 provides a simplified conceptual layout of a naval reactor compartment. Figure D-2 provides a simplified conceptual cross section of the reactor vessel showing the conceptual arrangement of the internal structure within the vessel. Neutrons escaping the fuel activate the reactor vessel internal structure and, to a smaller extent, the interior of the reactor vessel and associated structure. Table D-1 provides relevant properties of long lived radionuclides produced by this irradiation. From Figure D-2, the reactor vessel internal structure is essentially cylindrical and primarily composed of Inconel Alloy 600. Five types of this structure would exist for the cruiser, LOS ANGELES, and OHIO class reactor plant designs. Table D-2 provides the volumes occupied by these reactor vessel internal structures (i.e. volume based on the exterior dimensions of the cylindrical structure). Structure #1 is the most commonly found and would represent about 60% of the reactor plants being evaluated. Structures #2, #3, #4, and #5 would represent about 20%, 14%, 4%, and 2% of these plants, respectively.

3. LONG LIVED ACTIVITY

3.1 Long Lived Curie Content of Reactor Vessel Internal Structure

Since the exact design and operational life of reactor vessel internal structure varies between ship classes, activity will also vary. Estimates of long lived radionuclide activity in reactor vessel internal structure are presented in Table D-3. These estimates are based on a decay period of 1 year after final reactor shutdown of the cruiser, LOS ANGELES, and OHIO class reactor

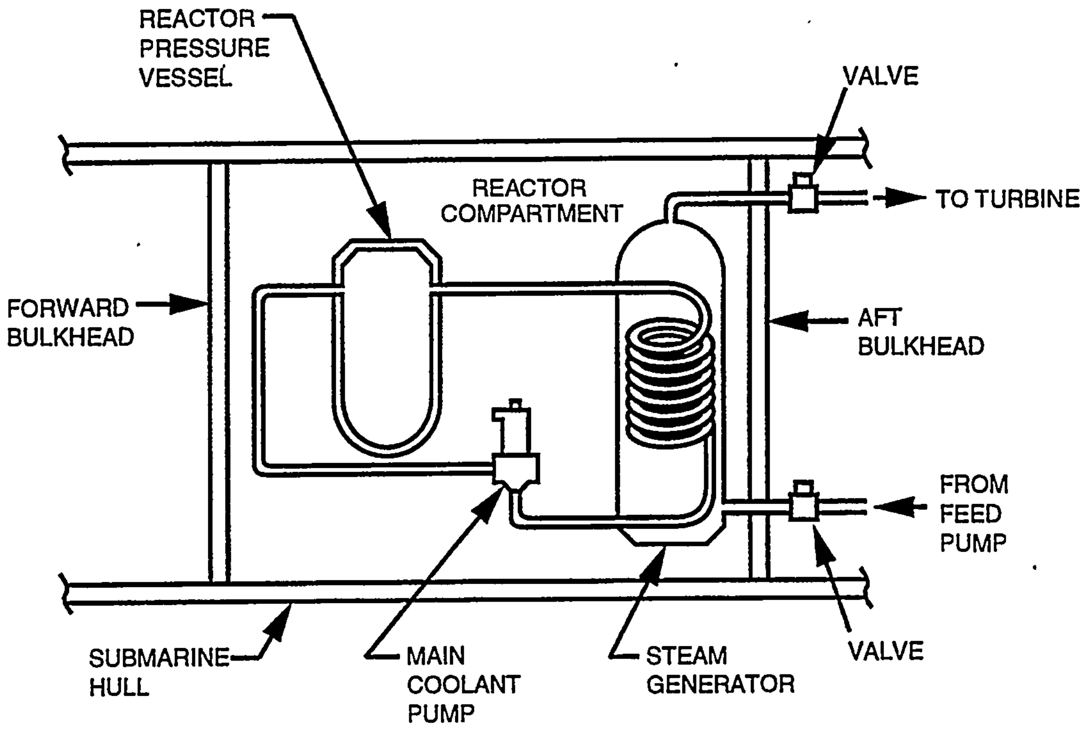

Figure D-1. Reactor Compartment Layout (conceptual)

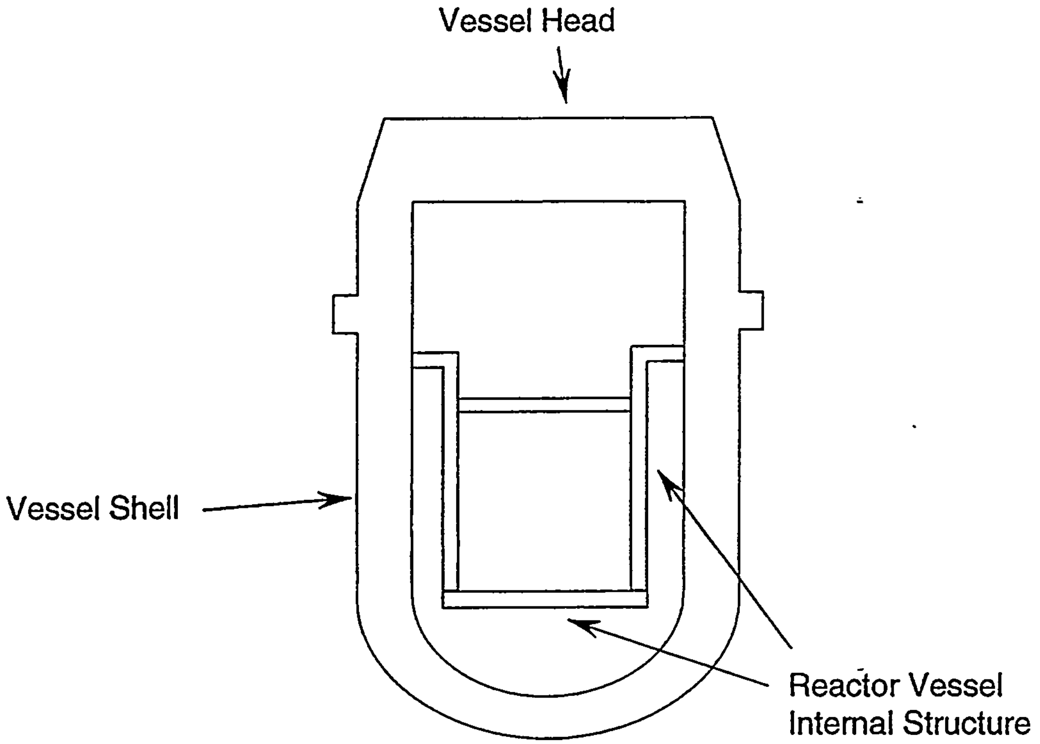

Figure D-2. Reactor Vessel with Internal Structure (conceptual)

Radionuclide	Radiation Emitted[1]	Energy per Disintegration[1]	Half-life (years)[1]
nickel-63	beta particles	maximum beta 0.066 MeV	100
carbon-14	beta particles	maximum beta 0.156 MeV	5,730
niobium-94	gamma rays beta particles	two in-series gammas: 0.87 MeV (100%) 0.70 MeV (100%) maximum beta 0.47 MeV	20,300
selenium-79	beta particles	maximum beta 0.15 MeV	65,000
nickel-59	X-rays e^-	less than 0.01 MeV less than 0.01 MeV	75,000
technetium-99	beta particles	maximum beta 0.29 MeV	213,000
iodine-129	X-rays beta particles e^-	less than 0.04 MeV maximum beta 0.15 MeV less than 0.04 MeV	15,700,000

1: KOCHER, 1981.

Table D-1, Long Lived Radionuclides in Activated Structure

Structure Type:	#1	#2	#3	#4	#5
Volume (m^3):	11.0	19.2	11.0	11.0	24.0

Table D-2, Reactor Vessel Internal Structure Volume

Radionuclide	Decay period (yr)[a]	Structure Type #1 (curies)	Structure Type #2 (curies)	Structure Type #3 (curies)	Structure Type #4 (curies)	Structure Type #5 (curies)
nickel-63	1 500 2000	24,000 751 0.023	12,600 394 0.012	18,000 563 0.017	35,900 1,120 0.034	7,420 232 0.007
carbon-14	1 500 2000	1.20 1.13 0.942	0.621 0.585 0.488	13.5 12.7 10.6	26.9 25.3 21.1	0.396 0.373 0.311
niobium-94	1 500 2000	0.770 0.757 0.719	0.522 0.513 0.488	0.645 0.634 0.602	1.29 1.27 1.20	0.142 0.140 0.133
selenium-79	1 500 2000	2.22×10^{-5} 2.21×10^{-5} 2.17×10^{-5}	1.14×10^{-5} 1.13×10^{-5} 1.12×10^{-5}	6.15×10^{-5} 6.12×10^{-5} 6.02×10^{-5}	1.23×10^{-4} 1.22×10^{-4} 1.20×10^{-4}	3.34×10^{-6} 3.32×10^{-6} 3.27×10^{-6}
nickel-59	1 500 2000	219 218 215	116 115 114	156 155 153	311 310 305	63.5 63.2 62.3
technetium-99	1 500 2000	0.0287 0.0287 0.0285	0.0115 0.0115 0.0114	0.0143 0.0143 0.0142	0.0286 0.0286 0.0284	0.00348 0.00347 0.00346
iodine-129	1 500 2000	2.01×10^{-10} 2.01×10^{-10} 2.01×10^{-10}	3.04×10^{-9} 3.04×10^{-9} 3.04×10^{-9}	8.45×10^{-8} 8.45×10^{-8} 8.45×10^{-8}	1.69×10^{-7} 1.69×10^{-7} 1.69×10^{-7}	4.36×10^{-8} 4.36×10^{-8} 4.36×10^{-8}

a: 1 year after final shutdown, 500 years and 2,000 years later;
Decay constant = 0.693/(half-life of radionuclide in year).

Table D-3, Reactor Vessel Internal Structure Curie Content

plants. Five hundred and 2000 year decay estimates are provided for comparison. Further discussion of the calculation method and statistical uncertainty in the quantities presented is provided in section 5 of this appendix.

3.2 Long Lived Curie Distribution in Reactor Vessel Internal Structure

Long lived activity is primarily found in the reactor vessel internal structure. Carbon-14 and iodine-129 are concentrated towards the inside of the structure while the other Table D-3 radionuclides are more generally distributed through the structure. Niobium-94 can be predominately found in weld materials used within the reactor vessel internal structure. This material is fused with surrounding base metal and is thus an intrinsic part of the overall structure.

3.3 Long Lived Curie Content in the Reactor Vessel

Neutrons that penetrate through the internal structure can activate atoms in the reactor vessel. This results in the long lived radionuclides of Table D-1, but to a much lesser extent than for the internal structure. For estimating long lived activity contained in the reactor vessel, the curie contents provided in Table D-3 for reactor vessel internal structure can be increased by a scaling factor to include long lived curies found in the reactor vessel materials. Scaling factors for this purpose range from 1.05 to 1.20, depending on the reactor vessel internal structure type. Scaling factors were developed by estimating the nickel-59, nickel-63, and niobium-94 quantities expected in the most highly activated regions of the reactor vessel. Of these three radionuclides, the greatest amount of activation in the reactor vessel, on a percentage basis compared to the internal structure, was for niobium-94. The niobium-94 reactor vessel activities were rounded upwards to produce conservative scaling factors and the resulting niobium-94 based scaling factors were used. Differences in scaling factors between internal structure types result from a number of factors including expected operating life of the reactor plant and design of the internal structure.

4. SUITABILITY OF REACTOR VESSEL INTERNAL STRUCTURE FOR SHALLOW LAND BURIAL AT HANFORD SITE

4.1 Hanford Site Activity Concentration Limits

The Department of Energy Hanford Site Solid Waste Acceptance Criteria Document (WHC, 1993) provides activity concentration limits for the Hanford Site. Hanford Category 3 limits are intended to be functionally equivalent to 10CFR61 Class C limits, developed by the Nuclear Regulatory Commission (NRC), in defining a waste suitable for land burial. Both the Hanford and NRC limits are based on a maximum radiological dose to an intruder of 500 mrem/yr. The NRC limits allow for surface oriented agricultural and construction related intruder scenarios (NRC, 1982). The Hanford limits consider site specific characteristics, which eliminates all plausible intruder scenarios except well-drilling (WHC, 1993). Table D-4 presents Hanford activity concentration limits for the radionuclides considered in this appendix, in curies per cubic meter. For comparison to these limits, Table D-4 also presents activity concentration fractions. The curie contents provided in Table D-3 for a 1 year decay period are divided by the structure volumes of Table D-2 to produce activity concentrations in curies per cubic meter. These concentrations are then divided by the Hanford Category 3 limits provided in Table D-4 to produce the decimal fractions shown. Activity concentrations for the entire reactor compartment could be similarly calculated based on reactor vessel volume and the radionuclide content of the vessel. These activity concentrations would be lower than those for the internal structure in Table D-4 due to the much larger exterior volume of the reactor vessel compared to the internal structure.

		Activity Concentration Limit Fractions for Internal Structure				
Radionuclides	Hanford Category 3 limit (Ci/m^3) [a]	Type # 1	Type # 2	Type # 3	Type # 4	Type # 5
nickel-63	170,000	0.0128	0.0039	0.0096	0.0192	0.0018
carbon-14	91	0.0012	0.0004	0.0135	0.0269	0.0002
niobium-94	0.56	0.125	0.0485	0.105	0.209	0.0106
selenium-79	83	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
nickel-59	8,300	0.0024	0.0007	0.0017	0.0034	0.0003
technetium-99	1.2	0.0022	0.0005	0.0011	0.0022	0.0001
iodine-129	0.59	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

a: Limit for radionuclide in activated metal.

Table D-4, Activity Concentration Fractions for Long Lived Activity Based on Hanford Category 3 Limits (WHC, 1993)

4.2 10CFR61 Activity Concentration Limits

In 10CFR61, the Nuclear Regulatory Commission (NRC) established activity concentration limits for radioactive materials being disposed of at NRC licensed sites. These limits are not directly applicable to Department of Energy sites (Hanford) but are presented in Table D-5 for the radionuclides considered in this appendix for comparison. Table D-5 presents activity concentration limits for activated metals for Class C waste, in curies per cubic meter. No limit for selenium-79 is found in 10CFR61. Table D-5 also presents activity concentration fractions. The curie contents provided in Table D-3 for a 1 year decay period are divided by the structure volumes of Table D-2 to produce activity concentrations in curies per cubic meter. These concentrations are then divided by the 10CFR61 Class C limits provided in Table D-5 to produce the decimal fractions shown.

From Table D-5, activity concentrations are well below 10CFR61 Class C limits for the radionuclides listed. As stated previously, activity concentrations would be reduced further if the reactor vessel internal structure and the less activated reactor vessel were considered together as a whole.

The disposal of cruiser, LOS ANGELES, and OHIO class reactor compartments at the Hanford 218-E-12B burial ground would also meet the intruder and environmental protection standards of 10CFR61 (for radiological dose). Appendix B provides a more detailed discussion of this condition.

		Activity Concentration Limit Fractions for Internal Structure				
Radionuclides	Class C limit (Ci/m³) [a]	Type # 1	Type # 2	Type # 3	Type # 4	Type # 5
nickel-63	7000	0.312	0.0938	0.234	0.466	0.0442
carbon-14	80	0.0014	0.0004	0.0153	0.0306	0.0002
niobium-94	0.2	0.350	0.136	0.293	0.586	0.0296
nickel-59	220	0.0905	0.0275	0.0645	0.129	0.0120
technetium-99	3	0.0009	0.0002	0.0004	0.0009	<0.0001
iodine-129	0.08	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

a: Limit for radionuclide in activated metal.

Table D-5, Activity Concentration Fractions for Long Lived Activity based on 10CFR61 Class C Limits

4.3 Uncertainty in Activity Concentration Fractions

Section 5 discusses the calculation of activity in reactor vessel internal structure and conservatisms or uncertainty in the calculation method. In summary, the curie contents presented in Table D-3 are considered reasonably accurate. This accuracy results from assumptions employed in the calculation process. Validation has confirmed the accuracy of the calculation method with measured activities predicted to within plus and minus 30% (e.g., see SHURE, 1967). Reactor vessel internal structure volumes are also based on accurate construction drawings. The resulting degree of uncertainty in activity concentration fractions would not be sufficient to alter the conditions discussed in the previous sections.

5. CALCULATION OF ACTIVATION PRODUCT CURIES

Neutrons interact with nonradioactive atoms (target isotopes) that are found within reactor materials, causing these atoms to become activated to radionuclides. This process is modeled by an equation which relates the flux of neutrons generated by the fuel to properties of the material being irradiated and reactor operation/shutdown times. Neutrons are produced with a range of energies which also must be considered in the model. The basic model equation is thus repeated for different neutron energy groups to sum the contributions of all neutrons to the activation process.

5.1 Equation

The following equation is used to calculate curie contents resulting from the activation of material.

$$A(t_o, t_s) = [\, P\, V\, f\, N\, \sigma\, \phi\, f_c\, (1 - e^{-(\lambda\, t_o)})\, e^{-(\lambda\, t_s)}\,] / 3.7 \times 10^{10}$$

t_o = the operating time for the reactor.

t_s = the shutdown time; the time between the end of the operating period t_o and the time at which the activity is determined (e.g., if the reactor is shut down in year X and the curie content is evaluated for year X+Y, then t_s [shutdown time] is Y years.

$A(t_o, t_s)$ = the number of curies of activity contained in a volume of material due to a specific radionuclide for a particular operating time (t_o), and shutdown time (t_s).

P = the fraction of full power of reactor operation during the period t_o.

V = the volume of material activated (cm^3).

f = the target isotope's abundance in the activated material relative to the abundance of the target isotope's element (the number of atoms of the target isotope per atom of the element).

N = the atom density (atoms/barn-cm) of the target isotope's element in the material activated (e.g., if niobium-93) is the target isotope then niobium is the target isotope's element so the atom density of niobium in the activated material is used).

σ = the target isotope's microscopic activation cross section (barns).

ϕ = the full power value of the activating neutron flux assigned to the volume (V) of the material [neutrons/(cm^2-sec)].

f_c = a neutron spectrum correction factor that is consistent with flux and cross section used.

λ = the activated radionuclide's decay constant (0.693 divided by the half-life of the radionuclide).

3.7×10^{10} = 37,000,000,000; the number of disintegrations per second for one curie of activity.

Note: In the equation, the exponential term using t_s can be approximated by 1 for long lived radionuclides. The exponential term using t_o is subtracted from 1 and thus this combination approaches zero for very long lived radionuclides but can vary by orders of magnitude depending on λ. For long lived radionuclides, curies increase essentially linearly with increasing t_o.

5.2 Quantifying Variables

When using the equation to estimate a radionuclides activity, the following considerations govern values assigned to variables in the equation.

5.2.1 Target Isotope Abundance (f)

Table D-6 provides the target isotopes for the long lived radionuclides of Table D-1 and values for the target isotope's abundance, the variable (f), used in the basic equation. Isotopic abundance is given in % of atoms of the element that are the target isotope. For example, nickel-62 is the target isotope for nickel-63 production and 3.59 percent of the nickel atoms present are assumed to be nickel-62.

Table D-1 Radionuclide	Target Isotope	Isotopic Abundance of Target Isotope (%)	Concentration of Target Isotope's Element in Inconel Alloy 600 (weight %)[a]
carbon-14	carbon-13 nitrogen-14 oxygen-17	1.10 99.63 0.04	0.10 [b] 0.013 [c] 0.04 [c]
nickel-63	nickel-62	3.59	80 [b]
niobium-94	niobium-93	100	0.070 [c]
selenium-79	selenium-78	23.6	7.0×10^{-5} [c]
nickel-59	nickel-58	68.27	80 [b]
technetium-99	molybdenum-98	24.13	0.30 [c]
iodine-129	tellurium-128	31.7	9×10^{-7} [c,d]

a. Basis for atomic density (N).

b. Upper end of material specification range.

c. From material testing.

d. A significantly higher tellurium concentration of 0.005 wt% is found in Inconel Alloy X-750 which is also present in the internal structure but in much smaller quantity than Alloy 600.

Table D-6 Target Isotopes, Isotopic Abundances, and Target Isotope Element Concentrations Used for Activity Calculation

5.2.2 Atom Density (N)

Atom density is based on the concentration of the element in the material being irradiated. Table D-6 presents element concentrations for Inconel Alloy 600, the primary alloy found in reactor vessel internal structure. Based on results from detailed chemical composition measurements, concentrations for important trace elements have been compiled primarily for use in curie calculations. This work represents an increased level of effort and provides a higher degree of accuracy compared to more common methods for determining element concentrations. In the cases where the material specification required a concentration range for an element, the upper end of the specification range is used. For example, nickel-62 is the target isotope for nickel-63. Nickel would thus be the target isotope's element. For Inconel Alloy 600 in reactor plants, the material specification is 72-80% nickel, thus 80% is selected as the element concentration and the atom density corresponding to this higher content is used. This results in a maximum (N) value being used vice an average value.

5.2.3 Cross Section (σ)

Neutron energies are divided into three groups: thermal (energy less than 0.625 electron-volts), epithermal (energy greater than 0.625 electron-volts), and fast (energy over 1 million electron-volts). The equation (section 5.1) is used to calculate the activity generated by each of these groups. Resulting curie contents are then summed to obtain a total activity. The appropriate cross section (σ) used in the equation varies for the different neutron energy groups. Thermal, resonance integral, and fission spectrum values for (σ) are used for thermal, epithermal, and fast neutrons, respectively. Standard published cross section values are used such as those from Chart of the Nuclides and Isotopes (CHART, 1989).

5.2.4 Neutron Flux (ϕ) and Flux Spectrum Correction Factor (f_c)

Neutron fluxes are determined for the three energy groups and coupled to appropriate values for the other variables of the equation to assess the effect of the different neutron energy groups on the production of activated radionuclide. Conservative assumptions on the design and performance of the fuel result in estimated neutron fluxes which are considered conservative. The effects of variations in fuel on neutron fluxes outside the fuel assembly over the fuel assembly life are considered. Flux spectrum correction factors are provided in the ORIGEN (Oak Ridge National Laboratory Isotope Generation) computer program which is used to assist in curie calculations. This program is discussed further in section 5.3.

5.2.5 Refined Method for Neutron Reaction Rate

The equation of section 5.1 is repeated for each of the three neutron energy groups in order to account for activation produced by each group. For each energy group, average values for variables are used. The combined terms ($N\ f_c\ \sigma\ \phi$) essentially represent a neutron activation reaction rate. This rate for the thermal neutron energy group normally controls the total amount of activity produced (the curie contribution from higher energy neutrons is not significant). However, for some radionuclides, reactions with epithermal and fast neutrons produce significant amounts of activity relative to thermal neutrons. For these radionuclides, when using the equation of section 5.1, the use of average values for the ($N\ f_c\ \sigma\ \phi$) variables can generally lead to over predicting activity. To remedy this situation, the epithermal and fast neutron energy groups are divided up into numerous sub groups according to energy level and the effects summed together. This more refined treatment generally results in more realistic calculated activities. Niobium-94 activity is calculated in this manner. For Table D-1 radionuclides, the refined method could potentially be of benefit for selenium-79, technetium-99, and iodine-129 activity. However, this method was not used for Table D-3 because the predicted concentration of these radionuclides was relatively small in comparison to the standards discussed and use of average reaction rate terms generally over predicts activity.

5.3 Computer Assistance for Calculations

The ORIGEN (Oak Ridge National Laboratory Isotope Generation) computer program applies the equation to the different energy groups of neutrons produced by the reactor. The effects of each group are summed and the additional activation that occurs from secondary reactions and decay processes is included. Complex reactor power histories are accounted for. Other programs are available for use in this application, such as SPAN5 and CINDER, however, results are relatively insensitive (± 10 percent) to the calculation method when the atom density of the target isotope's element (N), the activation cross section (σ), and the neutron flux (ϕ) are known. The considerations discussed previously for quantifying these variables ensure that conservatively accurate values of the variables are used.

5.4 Uncertainty/Conservatism in Curie Calculations

No explicit conservatism factors are applied to predicted activities. These activities are considered to be reasonably accurate because of the selection of values for variables and the conservative analysis models used for predicting neutron flux. Several comparisons of activity calculations to actual measurements have been made to qualify the method described in this section. These comparisons have shown that measured activities can be predicted to within plus or minus 30%, with a majority of predictions being much closer to measured values (e.g., see SHURE, 1967).

6. CONCLUSION

Long lived activity in cruiser, LOS ANGELES, and OHIO class reactor plants is concentrated in the reactor vessel internal structure. This activity is not in a quantity or form that would cause the reactor compartments to be unsuitable for shallow land burial either under Hanford Site of NRC criteria. The methods used to estimate this activity are reasonably accurate and any uncertainty would not be large enough to affect the aforementioned conclusion.

REFERENCES

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10CFR61	Code of Federal Regulations Title 10 "Energy", Part 61.

EVALUATION OF THE HEALTH RISK TO THE PUBLIC AND WORKERS ASSOCIATED WITH THE SHIPMENT OF DEFUELED REACTOR COMPARTMENTS FROM CRUISERS AND LOS ANGELES CLASS AND OHIO CLASS SUBMARINES

Appendix E

Table of Contents

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LIST OF TABLES

1. INTRODUCTION

This appendix presents an evaluation of the health risks to the public and occupational workers associated with the transportation of defueled reactor compartments fro decommissioned U.S. Navy nuclear-powered cruisers and submarines. It is applicable to the cruisers USS LONG BEACH (CGN 9), USS BAINBRIDGE (CGN 25), USS TRUXTUN (CGN 35), the two cruisers of the USS CALIFORNIA Class (CGN 36 and CGN 37), the four cruisers of the USS VIRGINIA Class (CGN 38, CGN 39, CGN 40, CGN 41), USS LOS ANGELES Class submarines, and USS OHIO Class submarines. BAINBRIDGE, TRUXTUN, and CALIFORNIA Class cruisers were not analyzed individually and are considered to be equivalent to VIRGINIA class cruisers for purposes of this evaluation due to similarity of reactor plant design. Shipments from either Puget Sound Naval Shipyard (PSNS) or Norfolk Naval Shipyard (NNSY) to either the Hanford disposal site or Savannah River disposal site are covered. For the shipment of reactor compartments from PSNS to Hanford, the reactor compartments are assumed to be shipped whole or subdivided into smaller packages. For all other cases, the reactor compartments are assumed to be subdivided into smaller packages. Whole reactor compartment shipments from NNS or to the Savannah River disposal site are not possible due to physical limitations such as the depth of the river and overhead obstructions due to bridges.

2. SHIPMENTS EVALUATED

The package origin/destination options and the modes of transportation considered for various package types are summarized in Table E-1.

3. TECHNICAL APPROACH - GENERAL

The general approach taken to evaluate the radiological health risks (i.e., increase in potential of cancer fatalities) associated with the transport of the subject reactor compartment packages is described as follows. First, the radiological risks to the general population, to the transport crew, and to hypothetical maximum exposed individuals are evaluated for gamma radiation emanating directly from the package for normal transport (i.e., incident-free) conditions. Next, the radiological risks to the general population for accident scenarios resulting in corrosion product release to the atmosphere are evaluated based on a conditional probability for occurrence of accidents with various severity. To upper bound the significance of an accident, the radiological consequences assuming a severe accident has occurred are also evaluated for hypothetical maximum exposed individuals and the general population. In conjunction with these incident-free and accident radiological evaluations, non-radiological risks to the population are presented from causes associated with vehicular exhaust emissions and transportation accidents.

3.1 Computer Codes

Several computer codes were used in the analyses. Specifically, the RADTRAN 4 computer code, developed by Sandia National Laboratories, was used to calculate the radiological risk for both the incident-free and accident risk scenarios (SNL, 1992 and SNL, 1993). For this evaluation, RADTRAN was determined not to be appropriate for the consequence analyses or assessment of maximum exposed individuals (MEI).

The RISKIND computer code, developed by Argonne National Laboratory, was used to calculate the maximum radiological consequences to the general population and to individuals for postulated accident condition (ANL, 1993). For this evaluation, RISKIND was determined not to be appropriate for the risk analyses aspect or incident-free evaluation.

Table E-1 Package Origin/Destination and Transport Mode

ITEM		MODE			ORIGIN		DESTINATION	
	Package Type	Truck	Rail	Barge/ Transporter	PSNS	NNS	Hanford	Savannah River
A	Whole Reactor Compartment			●	●		●	
B	Miscellaneous Components	●			●	●	●	●
C	Reactor Pressure Vessel			●	●	●	●	●
D	Steam Generator	(a)	(b)		●	●	●	●
E	Pressurizer		●		●	●	●	●

(a) Steam generators from cruisers assumed to be shipped by truck.
(b) Steam generators from submarines assumed to be shipped by rail.

Several other codes were used to provide input for the RADTRAN 4 and RISKIND computer codes. These codes include INTERLINE, HIGHWAY, and SPAN 4.

The INTERLINE computer code, developed by Oak Ridge National (ORNL) Laboratory, was used to evaluate rail routes for particular shipments and provides mileage and population densities in the rural, suburban and urban segments of the route (ORNL, 1993a). INTERLINE is an interactive computer program designed to simulate routing using the U.S. rail system. The INTERLINE code used is the latest available from ORNL and contains the 1990 census data.

The INTERLINE database consists of networks representing various competing rail companies in the U.S. The routes used in this evaluation use the standard assumptions in the INTERLINE model which simulates the selection process that railroads would use to direct shipments of the items under consideration. The code is updated periodically to reflect current track conditions and has been benchmarked against reported mileage and observations. INTERLINE also provides the weighted population densities for rural, suburban, and urban populations averaged over all states along the shipment route and the percentage of mileage traveled in each population density. The distance traveled, weighted population density, and percentage of distance in each population density are input variables in the RADTRAN 4 code.

The HIGHWAY computer code also developed by ORNL, was use to evaluate the truck routes excluding the partial routes by truck (transporter) for the whole reactor compartment and reactor pressure vessel (ORNL, 1993b). HIGHWAY is an interactive computer code designed to simulate routing using the U.S. highway system.

The HIGHWAY code used in this evaluation is the latest available from ORNL. The code is updated periodically as new roads are added. The routes used for this study use the standard assumptions in the highway model. HIGHWAY provides the distance between the origin and destination, the weighted population densities along the routes and the percentage of distance traveled in each population density, which are all input variables for the RADTRAN 4 computer code.

The SPAN 4 computer code (Bettis, 1972) was used to perform gamma exposure rate calculations for the various shipping containers to assess the effect of increased distance from the source on exposure. SPAN 4 is a point kernel code where appropriate exponential kernels are integrated over a source distribution. SPAN 4 was developed by the Bettis Atomic Power Laboratory specifically for naval spent nuclear fuel and associated reactor components.

3.2 Conversion to Fatality Rates

The radiological impacts are first expressed as the calculated total effective exposure (person-rem) for the exposed population, transportation crew, and the maximum exposed individuals. The calculated total exposures are then used to estimate the hypothetical health effects, expressed in terms of estimated cancer fatalities. The health risk conversion factors used in this evaluation are taken from the International Commission on Radiological Protection (ICRP, 1991) which specifies 0.0005 latent cancer fatalities per rem for members of the public and 0.0004 latent cancer fatalities per rem for workers. These conversion factors assume no radiological threshold occurs. Therefore, upon interpreting the results, the risks associated with population exposure (person-rem) and maximum exposed individual (rem) are equivalent for equal exposure levels. For example, the risk associated with 0.1 rem exposure to a population of 10 persons (1.0 person-rem) is equivalent to the risk from exposure of 1 rem to 1 individual (1 person-rem).

Non-radiological risks related to the transportation of naval reactor compartments are also estimated. The non-radiological risks are those resulting from vehicle exhaust emission for incident-free transportation and fatalities resulting from transportation accidents for accident risk assessment. The non-radiological risks associated with shipments required to return empty containers to the origin are also included. Risk factors for exhaust emissions and state level fatality rates (Saricks, 1994, SNL, 1982 and SNL, 1986) are summarized in Table E-2.

Table E-2 Fatality Rates for Non-Radiological Risks

	RAIL	TRUCK	WATERWAY
Fatalities/km due to Pollutants	1.3×10^{-7}	1.0×10^{-7}	0.0
Fatalities/km due to Accidents in Washington State	*2.82×10^{-8}	1.47×10^{-8}	NA
Fatalities/km due to Accidents as a National Average	2.82×10^{-8}	5.82×10^{-8}	NA
Fatalities/km due to Accidents for the Pacific Coast	NA	NA	3.2×10^{-9}
Fatalities/km due to Accidents for the Atlantic Coast	NA	NA	3.2×10^{-9}
Fatalities/km due to Accidents for the Inland Waterways	NA	NA	7.3×10^{-9}

* Not readily available so national average was used.

4. TECHNICAL APPROACH FOR THE ASSESSMENT OF INCIDENT-FREE TRANSPORTATION

4.1 General Population Exposure and Transportation Crew Exposure

To assess the health risk associated with incident-free transportation of naval reactor compartments, the RADTRAN 4 computer code was used to calculate the external radiological exposure to the general population and the transportation crew. Exposures received during incident-free transport are attributed to gamma radiation emanating mainly from activated structures (Cobalt-60) within the reactor compartment package.

Included in the RADTRAN 4 computer code incident-free risk calculations for transport are models predicting:

(1) Exposure to persons within about one-half mile of each side of the transport route (off-link exposures).

(2) Exposures to persons (e.g., passengers on passing trains or vehicles) sharing the transport route (on-link exposures).

(3) Exposures to persons at stops (e.g., residents or rail and truck crew not directly involved with the shipment).

(4) Exposures to transportation crew members.

The exposures calculated for the three groups, (off-link, on-link and crew) were added together to obtain the general population exposure estimates. On-link was not included in the transporter shipment of whole reactor compartments and pressure vessels because it is assumed that access controls to the highway would be imposed.

The exposure calculated for the crew was assigned to occupational exposure.

The transportation crew exposure is associated with exposure directly from the package during transit and/or inspection periods. For truck/transporter shipments, RADTRAN assumes crew exposure is entirely from exposure during the transit period and no inspections occur. For both waterway and rail shipments, RADTRAN assumes crew exposure is from exposure during periods of package inspections and negligible during the transit time due to relatively long separation distances and massive shielding of intervening structures. This RADTRAN model was concluded to be reasonable for both truck and rail shipments but not for the treatment of the waterway shipments of interest.

For reactor compartment waterway shipment RADTRAN crew exposure predictions were concluded not to be applicable since no package inspections are performed (the package is welded to the barge) and intervening distances during transit is not always sufficient to entirely preclude crew exposure. Therefore, reasonable conservative hand calculations were performed to account for waterway crew exposures during transit using equivalent point source formulas (similar to the first formula presented in Section 5.2.) together with the data presented in Table E-7.

4.2 Maximum Exposed Individuals

To estimate the maximum radiological exposure to occupational and non-occupational individuals during routine transport of reactor compartments, various scenarios were hypothesized.

For exposure to the general population during rail shipments, three scenarios were assumed:

(1) A rail yard worker who was assumed to be working at a distance of ten meters from the package for two hours.

(2) A resident who was assumed to live 30 meters from the rail line while the package was being transported.

(3) A resident who was assumed to be living 200 meters from a rail stop where the reactor compartment package was sitting for 20 hours.

The maximum occupational exposure during rail shipments was assumed to be that occurring from inspections of the package as calculated by RADTRAN.

For truck shipments, the maximum exposed individual (general population) was hypothesized to be:

(1) A person who is caught in traffic and located 1.0 meters away from the reactor compartment package for one half hour.

(2) A resident assumed to be living 30 meters from the highway while the package was being transported.

(3) A service station worker who was assumed to be working at a distance of 20 meters from the package for 2 hours.

The maximum exposed occupational worker was assumed to be the driver of the truck as calculated in RADTRAN.

For the waterway shipments, the scenarios for the maximum exposed individual were:

(1) A bridge workman located 10 meters above the centerline of the package for 2 hours while stopped, and

(2) a motorist is disabled on a bridge above the water route during the total time the package is being transported and is positioned a distance above the water route equivalent to the package radius plus 10 meters.

The maximum exposed occupational worker was assumed to be a ship crew member during transit.

For predicting radiological exposure to persons at a fixed distance (the maximum exposed individual) from the package during a stop, the following formula was used.

Exposures to a person at a fixed distance from the container:

$$E = T \times K \times TI/D^2 \qquad \text{Formula (1).}$$

where:

E = exposure
T = total exposure time
K = shipment external dose rate to exposure conversion factor based on package size
TI = shipment external dose rate at one meter from the package surface
D = average distance from centerline of container to exposed person

The maximum exposed individual is assumed to be the same individual for all shipments of the same type.

Exposure to individuals at a fixed distance from the transport route was calculated using the following formula for a moving radiation source traveling with a fixed velocity, V. All other terms are the same as described for Formula (1).

$$E = (\pi \times K \times TI)/(V \times D) \qquad \text{Formula (2)}$$

5. TECHNICAL APPROACH FOR POSTULATED ACCIDENTS

5.1 General Population and Risk

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

(1) Direct radiation exposure from the damaged package.

(2) Inhalation exposure from the plume of radioactive material released from the damaged package.

(3) Direct radiation exposure from immersion (cloudshine) in the plume of radioactive material released from the damaged package.

(4) Direct radiation exposure from ground deposition of the radioactive material released from the damaged package.

(5) Inhalation exposure from resuspension of the radioactive material deposited on the ground.

(6) Ingestion exposure from food products grown on the soil contaminated by ground deposition of radioactive material released from the damaged package.

For each pathway, a specific formula is used to determine an estimate of the radiological exposure from that particular pathway with the total radiation exposure equal to the sum of the exposure for each pathway. The internal pathways (inhalation and ingestion) exposures are based on a committed effective dose to the body over a 50-year period. The total accident radiation exposure accounts for the probability f an accident occurring and the probability of a accident of a particular severity. The general equation for the population risk from all pathways is:

$$DR = \Sigma_{c,r} L_c P_r \times \Sigma_{i,j,k} (P_j \times RF_j \times D_{i,j,k})$$

where:

DR = population exposure risk from the accident
L_c = shipment distance (Table E-3)
P_t = probability of traffic accidents per unit distance (Accident Probabilities, Table E-8)
P_r = probability of accident severity category (Severity Fractions, Table E-9)
RF_j = fraction of curies released from shipping container by severity category j (Corrosion Product Release Fractions, Table E-10)
$D_{i,j,k}$ = radiation exposure commitment resulting from accident severity category j through pathway i in population density zone k.

Because it is impossible to predict the specific location of a transportation accident, neutral weather conditions (Pasquill Stability Class D) were assumed (Pasquill, 1974). Since neutral meteorological conditions are the most frequently occurring atmospheric conditions in the United States, these conditions are most likely to be present in the event of a transportation accident.

5.2 Maximum Consequence to Individual and Population

In addition to the estimation of the accident risk described above, the accident consequence was evaluated assuming an accident of the highest severity occurs. The consequence, expressed as radiological exposure, is calculated for the maximum exposed individual (MEI) and the general population. Exposures to the general population are calculated for each of the three population density regions (rural, suburban, and urban) over a 50-mile radius.

A fraction of the total corrosion product inventory in the package can be released to the atmosphere assuming a severe accident occurs. This release fraction was conservatively estimated to be 32% to 40% for whole reactor compartment shipments and varying amounts for subdivided shipments and was used in the consequence and risk analysis.

The RISKIND computer code, modified to accept the inventory associated with naval reactor compartment corrosion products was used to calculate the exposure. The pathways evaluated by RISKIND for the general population are identical to those used in the RADTRAN 4 computer code for the risk evaluation.

The MEI exposure includes the contributions from inhalation, groundshine and cloudshine. No food ingestion pathway to an individual is considered because it was assumed that radioactive contamination from plausible accidents would be cleaned up promptly and, therefore would not enter the food chain. Direct radiation exposure from the damaged package to the MEI and maximum exposed population would be less that 0.1% of the exposure from inhalation, groundshine, and cloudshine which would occur at 160m to 400m from the package. It was assumed that the MEI would be exposed unshielded during the passage of the plume of radioactive material released from the accident under worst (stable) atmosphere conditions.

Remedial actions following an accident would significantly reduce the consequences of an accident; however, no credit was taken in the risk or maximum consequence evaluations.

5.2.1 Probability Cutoff Criterion. Consistent with the U.S. Department of Energy's, Office of Environmental Management and Idaho National Engineering Laboratory, Environmental Waste Management Programs Environmental Impact Statement (DOE, 1995), a conservative severe accident probability cutoff criterion of one in ten-million (1×10^{-7}) was selected for excluding improbable accidents from the maximum consequence evaluation.

To determine the overall severe accident probability, the probability of an accident times the severity fraction times the fraction of travel in each population area times the probability of the meteorological conditions was calculated.

The probability of the accident per year was calculated by multiplying the accident probability rates times the distance traveled in each state times the maximum number of shipments per year. The number of shipments per year was conservatively assumed to be 8 complete reactor compartment shipments (except 2 for the LONG BEACH) for purposes of determining this cutoff probability. This was done for each combination of origin and destination and ship class.

To calculate the probability of the meteorological conditions, the established criteria for assigning atmospheric stability classes (Pasquill, 1974) was used. Pasquill Class D was considered to be equivalent to 50% meteorology; that is 50% of the time conditions are expected to be more severe, and 50% of the time conditions are expected to be less severe. Pasquill Class F was considered to be equivalent to 95% meteorology; that is 5% of the time it is more severe and 95% of the time it is less severe. Analyses performed by the National Oceanic and Atmospheric Administration (NOAA, 1976) confirm that this assumption is reasonable.

Upon comparing the resultant probabilities to the 1×10^{-7} per year criterion, the most severe atmospheric (Pasquill Class F) results were presented if warranted by the cut-off. If the probability was less than the 1×10^{-7} cutoff, the consequences resulting from release of 1% of the corrosion products (Pasquill Class D) would be presented at the minimum. This later case never occurred. This method of determining the atmospheric condition and corresponding release fraction is consistent with the U.S. Department of Energy's, Office of Environmental Management and Idaho National Engineering Laboratory, Environmental Waste Management Programs Environmental Impact Statement (DOE, 1995).

Careful attention was paid to ensure that the probabilities were not calculated for such small categories that the resulting probabilities were less than the criterion and results would inadvertently present less severe consequences.

6. ROUTING ANALYSIS

In order to assess the radiological risk associated with transportation, it was necessary to determine route characteristics based on the origin and destination of each shipment as well as the method of shipment.

For naval reactor compartment shipments, the origin is the shipyard location where the reactor compartment has been removed form the ship. In this analysis, the two possible points of origin are Puget Sound Naval Shipyard (PSNS) and Norfolk Naval Shipyard (NNSY). The destination is one of two burial sites, the Savannah River Site or the Hanford Site.

The method of shipment for each package type is shown in Table E-1. For the large packages (whole reactor compartments and reactor pressure vessels), the package is transported via barge over an ocean leg and a river leg, and then via transporter for land transport. The estimated mileage for each part of the shipment of the large packages is given in Table E-3

For the rail and truck shipment of the subdivided reactor compartment, INTERLINE and HIGHWAY were used to generate routing data.

7. INPUT PARAMETERS AND ASSUMPTIONS

The major input parameters and assumptions used to evaluate the radiological risks associated with the shipments identified in Table E-1 are provided in this section. A number of the input parameters were developed for these particular shipments while others are standard RADTRAN 4 computer code values. The standard RADTRAN 4 default values are provided in Table E-4. Exceptions to the default values are identified in Table E-4 and further discussed below. These are representative values for purposes of evaluation and may vary in actual practice.

Table E-3 Distance (km) for the Transportation of Large Packages

	OCEAN BARGE		RIVER BARGE	TRANSPORTER
PSNS to Hanford	Sound & Strait	241	Vancouver to Port of Benton	Port of Benton to Site
	Ocean	261		
	River	166		
	TOTAL	668	386	42
PSNS to Savannah River	Sound & Strait	241	Savannah to Barge Wharf	Barge Wharf to Site
	Ocean	12,260		
	Panama Canal	82		
	Savannah River	0		
	TOTAL	12,583	253	16
NNS to Hanford	Elizabeth River	48	Vancouver to Port of Benton	Port of Benton to Site
	Ocean	12,884		
	Panama Canal	82		
	Columbia River	166		
	TOTAL	13,180	386	42
NNS to Savannah River	Elizabeth River	48	Savannah to Barge Wharf	Barge Wharf to Site
	Ocean	885		
	Savannah River	0		
	TOTAL	933	253	16

7.1 Incident-Free Transportation

This section provides the input parameters and assumptions used to determine the radiological impacts associated with routine, incident-free (i.e., no accident) transportation of all of the package types under consideration.

7.1.1 Planned Shipments. Table E-5A provides a list of whole reactor compartment shipments (estimated size and estimated number of packages) that are possible from PSNS to the Hanford Site. Table E-5B provides a summary of shipments for the subdivided alternative from either of the two origins and to either of the two proposed destinations (estimated size and estimated number of packages).

Table E-4 Default Values for RADTRAN 4 Input Parameters

	RADTRAN 4 Input Parameter	Truck	Rail	Barge
1	Fraction of Travel in Rural Zone	0.90	0.90	0.90
2	Fraction of Travel in Suburban Zone	0.05	0.05	0.09
3	Fraction of Travel in Urban Zone	0.05	0.05	0.01
4	Velocity in Rural Zone (km/hr)	88.49	64.37	16.09*
5	Velocity in Suburban Zone (km/hr)	40.25	40.25	8.06*
6	Velocity in Urban Zone (km/hr)	24.16	24.16	3.2*
7	Number of Crew on Shipment	2.00	5.00	2.00*
8	Average Distance from Radiation Source to Crew During Shipment (meters)	3.10	152.40	45.70*
9	Number of handlings per shipment	0.0	2.00*	2.00*
10	Stop Time for Shipment (hr/km)	0.011	0.033	0.01*
11	Minimum stop time per trip (hr)	0.0	10.00	10.00*
12	Distance Independent Stop Time per Trip (hr)	0.0	60.0	0.0
13	Minimum number of Rail Inspections or Classifications	0.0	2.00	0.0
14	Number of Persons Exposed During Stop	50.0	100.0	50.0
15	Average Exposure Distance When Stopped (meters)	20.0	20.0	50.0
16	Storage Time per Shipment (hr)	0.0*	4.00*	24.00*
17	Number of Persons exposed During Storage	100.0*	100.0*	100.0*
18	Average Exposure Distance During Storage (Meters)	100.0*	100.00*	100.00*
19	Number of Persons per Vehicle Sharing the Transport Link	2.0	3.00	0.0
20	Fraction of Urban Travel During Rush Hour	0.08	0.0	0.0
21	Fraction of Urban Travel on City Streets	0.05	1.0	0.0
22	Fraction of Rural and Urban Travel on Freeways	0.85	0.0	0.0
23	One-Way Traffic Count in Rural Zones	470.00	1.00	0.0
24	One-Way Traffic Count in Suburban Zones	780.00	5.00	0.0
25	One-Way Traffic Count in Urban Zones	2,800	5.00	0.0

* Default values not used.

Table E-5A Package Data for Whole Reactor Compartments

Package Type	LA Class	OHIO Class	VIRGINIA Class	LONG BEACH Class
Whole Reactor Compartment via ocean barge, river barge, and transporter	42' long x 33' diam 62 pkgs	55' long x 42' diam 18 pkgs	37' high x 31' diam 16 pkgs	37' x 38' x 42' 2 pkgs

7.1.2 Package Size. The package sizes used in RADTRAN 4 are shown in Table E-6. The reasonability of the package sizes selected for this evaluation were confirmed using an independent computer code (SPAN4) having the explicit package dimensions modeled to calculate radiation levels. The SPAN4 calculated dose falloff was compared to that produced using RADTRAN 4 to confirm the reasonability on the package size input to RADTRAN 4.

7.1.3 Shipment External Dose Rate. The maximum gamma radiation level measured at one meter from the surface of the package is directly proportional to the incident-free predicted exposure. For the subdivided alternative, the shipment external dose rate was assumed to be 2.0 mrem/hr which is consistent with conservatisms achieved in design practice. For shipment of whole reactor compartments, the shipment external dose rate was assumed to be 2.8 mrem/hr based on historical data.

Table E-5B Packages Data for Subdivided Reactor Compartments

Package Type	LA Class	OHIO Class	VIRGINIA Class	LONG BEACH Class
Misc Components via Truck	8'x10'x40'	8'x10'x40'	8'x10'x40'	8'x10'x40'
Reactor Pressure Vessels via Barge	21' long x 11' diam	20' long x 15' diam	26' long x 12' diam	27' long x 15' diam
Steam Generators via Rail	14'x7'x19'	16'x8'x21'	NA	NA
Steam Generators via Truck	NA	NA	23' long x 5' diam	27' long x 6' diam
Pressurizers via Rail	23' long x 7' diam	28' long x 7' diam	25' long x 5' diam	28' long x 7' diam
Total Number of Packages	854	444	196	43

7.1.4 Transportation Distance and Population Densities. Section 7 provided a description of the general methodology used for determining transportation distances and the population densities along the transportation routes. In the analysis done for the U.S. Department of Energy's, Office of Environmental Management and Idaho National Engineering Laboratory, Environmental Waste Management Programs Environmental impact Statement (DOE, 1995), historical data were obtained on the distance traveled for shipments from the shipyards and prototype sites to the Expended Core Facility at the Idaho National Engineering laboratory. These data were averaged by origin and compared to the value calculated by INTERLINE. The actual data were approximately 11% higher than the distance predicted by INTERLINE on average. Therefore, consistent with the Environmental Waste Management Programs Environmental Impact Statement (DOE, 1995), INTERLINE distances in each populations density were increased by 11%.

Table E-6 Effective Diameter/Package Size for RADTRAN 4

Package Type	LA Class	OHIO Class	VIRGINIA Class	LONG BEACH Class
Whole Reactor Compartment	10.0 m	12.8 m	9.4 m	11.3 m
Miscellaneous Components	3.0 m	3.0 m	3.0 m	3.0 m
Reactor Pressure Vessel	3.4 m	4.6 m	3.7 m	4.6 m
Steam Generator	2.1 m	2.4 m	1.5 m	1.8 m
Pressurizer	2.1 m	2.1 m	1.5 m	2.1 m

Similarly, historical data for Navy shipments indicates that the distance traveled for highway shipment is typically 3% greater than that predicted by HIGHWAY. Therefore, the percentage of distance traveled in each population density calculated in HIGHWAY were increased by 3%.

7.1.5 Radiation Exposure Decreased Due to Distance. The RADTRAN 4 computer code calculates the gamma and neutron radiation exposure decrease based on distance from the package and package size. (Neutron calculations do not apply for defueled reactor compartment shipments because there is no neutron source.) For gamma radiation, the RADTRAN 4 computer code distance falloff calculations was consistent with the falloff predicted by SPAN 4 in free space.

7.1.6 Shipment Storage Time. Shipments of naval radioactive material would not be stored while in the process of being shipped; therefore there was no shipment storage time associated with any of the shipments.

7.2 Train Shipments

7.2.1 Train Velocity. The RADTRAN 4 computer code provides standard values for train speeds that are dependent on the population density. These default values were applied to the shipment of the smaller packages.

7.2.2 Train Stop Time. The RADTRAN 4 computer code provides standard values for train stop times that were used in this evaluation.

7.2.3 Number of Train Crew Members. The RADTRAN 4 computer code value for the number of train crew members is five. Although the items would be radioactive, they would not contain spent fuel and would not be considered to be a special shipment; therefore, the default value for the train crew is considered to be adequate. In the RADTRAN 4 computer code, exposure to the crew is not calculated.

7.2.4 Train Stop Shield Factors. For train stops, the standard RADTRAN 4 computer code gamma shield factor is 0.1. This value assumes the presence of substantial rail yard structures equivalent to approximately four inches of steel. Four inches of steel reduces gamma radiation exposure by more than a factor of ten. Therefore, a shield factor of 0.1 is considered to be reasonable.

7.2.5 Distance from the Source to the Crew. The RADTRAN 4 default of 152.4 meters was used for train shipments.

7.3 Truck and Transporter Shipments

7.3.1 Truck Velocity. For truck shipments, the RADTRAN 4 defaults were used in all three population density zones. For the transporter segment of large package shipment, the velocities are summarized in Table E-7.

7.3.2 Truck Transportation Crew. The RADTRAN 4 computer code default values for the truck crew were used for the truck shipments for the smaller packages. For the larger packages (whole reactor compartment or reactor vessel pressure vessel), the number of persons to be included in the transporter transportation crew is summarized in Table E-7.

7.3.3 Number of Truck Inspection Inspections. The shipments are inspected prior to leaving the shipyard. Otherwise, it is assumed that there are no inspections during transport.

7.3.4 Truck Stop Time. The RADTRAN 4 default values for the truck stop times were used for the evaluation of the smaller packages. For the shipment of the whole reactor compartments and reactor pressure vessels, the transporter stop time is summarized in Table E-7.

7.3.5 Distance from the Source to the Crew. The crew is assumed to be located 3.1 meters from the outside of the packages for the truck and the transporter.

7.4 Waterway Shipments

The standard RADTRAN values for waterway (i.e., barge) shipments were replaced by the values in Table E-7 as discussed below.

Table E-7 RADTRAN 4 Parameters for Waterway Shipments

Input Parameter	Ocean Barge	River Barge	Transporter
Velocity for rural areas	12.8 km/hr	13.1 km/hr	8 km/hr
Velocity for suburban areas	12.8 km/hr	13.1 km/hr	8 km/hr
Velocity for urban areas	12.8 km/hr	13.1 km/hr	8 km/hr
Stop and storage time	2.3 hours	29.0 hours	2.0 hours
Distance from the outside of the package to the crew	a) through the sound, the strait and the ocean, 221 meters b) through the mouth of the Columbia River, 51 meters	21 meters	3.1 meters*
Number of crew members	6	12	4

*RADTRAN 4 default

7.4.1 Barge Transportation Crew. The barge transportation crew numbers (ocean and river) are summarized in Table E-7. These crew members are actually not for the barge but occupy the tugboat.

7.4.2 Barge Stop Time. Barge stop times are summarized in Table E-7. The stop time for the river barge includes the time required to pass through the locks on the Columbia River for transport to the Hanford Site and the time to transfer the package from the barge to the transporter.

7.4.3 Barge Velocity. The barge velocity for rural, suburban and urban population zones are summarized in Table E-7.

7.4.4 Barge Distance from the Shore. RADTRAN 4 assumes a distance of 200 meters from the barge to the shore. For river transport, this is considered to be adequate. However, the ocean barge would be from 5 to 15 nautical miles offshore during the ocean leg of the transport of the large packages, resulting in off-link incident-free population exposure of zero for that link. An independent analysis that included an evaluation of population exposure at long distances confirms this conclusion. Therefore, for the portion of the route where the barge is in the ocean (versus the sound, the strait or the river) off-link exposure is considered to be zero.

7.4.5 Distance from the Source to the Crew. For the transport of the barge with an ocean tugboat through the sound, the strait, and the ocean, the distance is 221 meters; for the transport of the barge with an ocean tugboat through the mouth of the river, 51 meters, and for the transport of the barge up the river using a river tugboat, 21 meters, This summarized in Table E-7. These distances were used in estimating exposure to crew members during shipment.

7.4.6 Shield Factor. A shield factor of 0.5 was applied to account for structural bulkheads between the crew and the package during transport.

7.5 Other Standard RADTRAN 4 Computer Code Values Used

The following standard RADTRAN 4 computer code values were reviewed and were determined to reflect the best estimate of current practices:

(1) Number of people per vehicle sharing the transport route (on-link).

(2) Traffic count passing a specific point - rural, suburban and urban zones.

(3) Average exposure distance when stopped.

(4) Persons exposed when stopped.

(5) Fraction of travel during rush hour, on city streets, and on freeways.

7.6 Exposure to Handlers

Handlers are defined to include all workers involved in the transfer of packages from one mode or location to another. Exposure to handlers is not included in this evaluation.

7.7 Accident Model for Transportation of Naval Reactor Compartments

This section provides the input parameters and assumptions used to determine the radiological impact for postulated accidents during transportation of the reactor compartments. The planned shipments, transportation distances, population densities, and the percentages of travel in each population density described in Section 7.1 were used in the accident analysis. Unless otherwise described in this section, the standard values provided by the RADTRAN 4 and RISKIND computer codes were used.

7.7.1 Accident Probability. The probability of an accident by transportation mode was obtained from a report submitted to the U.S. Department of Energy's Reactor Technology and Transportation Division (Saricks, 1994). For the shipments from PSNS to Hanford, accident rates for the States of Washington were used. Otherwise, the U.S. averages were employed. The employed accident probabilities are presented in Table E-8 and are the same for rural, suburban, and urban areas except as noted.

The truck accident rates for shipments from PSNS to Hanford are best estimate rates based on the State of Washington Federal-Aided Interstate Urban and Rural accident rates (FAI-U and FAI-R) provided in the report (Saricks, 1994). Use of this state-specific FAI data is considered consistent with the HIGHWAY routing analysis which showed interstate to be the primary highway traveled from Bremerton to Hanford. For all other destination/origin combinations, the truck accident rates are based on the national average Federal-Aided Primary (FAP) highway accident rates provided in the report (Saricks, 1994). This simplified treatment of combining statewise accident rates and ensured a conservative model (FAP national rates are about 10% to 60% greater than corresponding FAI-R and FAI-U national rates).

Table E-8 Accident Probabilities

Transport Mode	National Average Probability (Accidents/km)	Washington State Probability (Accidents/km)
Truck	3.94×10^{-7}	2.50×10^{-7} (Rural) 1.61×10^{-7} (Urban) 1.61×10^{-7} (Suburban)
Rail	5.57×10^{-8}	3.49×10^{-8}
Pacific Ocean	1.7×10^{-6}	Same as national average
Atlantic Ocean	5.46×10^{-6}	NA
Inland Waterways	3.82×10^{-6}	Same as national average

7.7.2 Severity Fractions. Accidents in which a shipment is subjected to various degrees of forces are assigned to an accident severity fraction category. In order to calculate the probability of a severe accident, the accident probability is multiplied by the severity fraction.

For purposes of determining the accident severity probability for reactor compartment shipments, a two category scheme was used. Category I applies to the probability of accidents which do not exceed the 10CFR71 limits and Category II applies to those which have a probability of severe accidents exceeding the limits with subsequent corrosion product release.

For the rail and truck shipments, the employed accident severity probabilities are same as those used for the "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement" (DOE, 1995) for corrosion products release. That study conservatively identifies that for truck and rail accidents, a 99.4% probability exists for accident conditions that do not exceed the 10CFR71 criteria (i.e., category I). The remaining 0.7% and 0.6% are the Category II severe accident probabilities which result in release of corrosion products. DOE, 1995 also identifies a third category where there is a corrosion product release and fission product release. For these reactor compartments there is no fission product source or release and therefore a two-category release scheme for corrosion products is appropriate.

For the barge shipments a 99.65% probability of an accident not exceeding 10CFR71 was assumed for this evaluation. This is based on the values presented in Table 5-7 of the "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes" (NRC, 1977) for the sum of minor and moderate accident severity fractions. The source document (NRC, 1977) identifies 99.65% of all waterway accidents are minor or moderate type with release levels depending on container strength. However, evidence obtained after publication of the source document (NRC, 1977) and presented in a U.S. Department of Energy Environmental Assessment (DOE, 1994a) showed that no release can occur for Type B packages for these types of accidents. This 99.65% probability is also consistent with the U.S. Department of Energy's Environmental Assessment (DOE, 1994a) which employs 99.7% to be the Category I non-release probability for maritime shipments.

The overall resulting severity fractions that were use in the analyses are summarized in Table E-9.

Table E-9 Accident Severity Fractions

Category	Truck/Transporter Shipments	Rail Shipments	Barge Shipments
I	0.9940	0.9940	0.9965
II	0.0060	0.0060	0.0035

As stated above, the product of the accident probability and the severity fraction gives the severe accident probability. For barge shipments along the Pacific Coast and Atlantic Coast the severe accident probability per distance traveled is 5.95×10^{-9}/km (i.e., 1.704×10^{-6} accidents/km x 0.35×10^{-2} severity fraction) and 1.9×10^{-8}/km, respectively. These values are reasonably conservative when compared the severe accident in domestic waterborne barge probabilities presented in an Atomic Energy Commission survey of radioactive material transportation (AEC, 1972)(i.e., 1.9×10^{-9}/km).

7.7.3 Package Release Fractions. The release fraction represents the fraction of the corrosion product inventory in the package that would be released into the atmosphere for a severe accident. The corrosion product release model accounts for all activated corrosion products which adhered to all wetted surfaces inside the reactor vessel and coolant system over plant life. Additionally, the corrosion products in the purification system components were assumed to be part of the reactor compartment shipment. Most of the corrosion product is strongly adherent and only a small fraction would realistically be released if a severe accident were to occur. In developing a model of the activity released for a severe accident, it was conservatively assumed that 50% of the loose activity in the steam generators, and 10% of the loose activity in all other components (except purification filters and ion exchangers) are released from the package. The amount of loose activity is assumed to be 33% of the total corrosion product activity for all components based on an upper limit estimate from oxide film analysis of surveillance coupons from the S3G prototype reactor coolant system. The corrosion products released from the purification components were conservatively assumed to be 100% of the total available in the resin bed during shipment. This overall approach was derived from the model presented in "Final EIS on the Disposal of Defueled Naval Submarine Reactor Plants, Vol. 1, 1984" (USN, 1984). Application of this model results in about 32% to 40% release of the corrosion products from a whole reactor compartment for use in a severe accident scenario.

The severe accident release fractions employed in this evaluation by component are summarized in Table E-10. The corresponding whole reactor release fractions resulting from applying the Table E-10 values are 0.38. 0.32, 0.36 and 0.40 for the LOS ANGELES, VIRGINIA, OHIO, and LONG BEACH class ships, respectively.

7.7.4 Corrosion Product Activity. The corrosion product activities employed in the accident analyses were derived based on formulas that predict corrosion product deposition levels from reactor plant pipewall dose rate measurements with Cobalt-60 being the dominant radioisotope (Cobalt-60 contributes over 95% to the accident total exposure levels). The corrosion product activity estimates were calculated for the earliest time after reactor compartment shutdown for which disposal shipment could occur. The activities used in the risk analyses are projected end-of-life plant values based on the average over all ships of the same class with the first reactor core installed except for the USS LONG BEACH which is based on the last core. In the consequences analyses, the highest projected activity (peak) of all ships in the same class was used.

Table E-10 Corrosion Product Release Fractions

Category	Truck	Rail	Barge
I	0.0	0.0	0.0
Misc II	0.033	NA	0.033
Resin II	1.0	NA	1.0
Reactor Pressure Vessel II	0.033	NA	0.033
Steam Generator II	0.167	0.167	0.167
Pressurizer II	NA	0.033	0.033

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

7.7.6 Direct Exposure from a Damaged Package. The radiation level following an accident was assumed to be at the 10CFR71 regulatory limit of one rem at one meter from the component surface.

7.7.7 Food Transfer Factors. The food transfer factors for the RADTRAN 4 assessment were developed using the same method as the "Environmental impact Statement on Environmental Restoration and Waste Management Activities at the Idaho National Engineering Laboratory" (DOE, 1995). For shipments from PSNS to Hanford, the Washington State food transfer factors were used. For all other shipments, the food transfer factors were those that represented the U.S. average.

7.7.8 Distance from the Accident Scene to the Maximum Exposed Individual. An assumption was made that the maximum exposed individual would be unshielded for the time that the plume passes by. The location of maximum exposure was also assumed to be at the location for which maximum exposure would occur (160 m to 400 m from the accident site). This location was determined using RISKIND based on the assumed atmospheric stability and plume release height.

7.7.9 RISKIND Population Density. The standard national average for each population density from the RADTRAN 4 computer code was used for the RISKIND maximum consequence assessment. The assessment considers the population within 80 km (50 miles) of the site under both neutral and stable weather conditions. The population ranged from 1.5 million (urban) to 2,600 (rural).

8. SUMMARY OF RESULTS

The results of the evaluation for shipment of 100 reactor compartments are summarized in Table E-11. Under incident-free conditions the whole reactor compartment shipment from PSNS is expected to have a lower risk of cancer fatalities than the subdivided alternative for any other origin/destination combination. Furthermore, the predicted health risk for incident-free shipments is greater than the predicted health risk due to an accident during shipment. This is because there is a low probability of a severe accident for the various transportation modes of interest. The health risk in the event that an accident does occur is evaluated as the maximum consequence to an individual and to the general public in rural, suburban, and urban population zones and is discussed separately.

The maximum consequences of an accident assuming a severe accident occurs have been evaluated for whole reactor compartment shipment and the subdivision alternative. The results are tabulated in Table E-12. Accident results are presented for both the maximally exposed individual and the general population. The transportation crew is considered to be part of the general population under accident conditions, so a member of the transportation crew could be the maximally exposed individual.

Table E-11 Shipment of 100 Reactor Compartments

	No. of Pkgs.	General Population (RADTRAN 4)				Transporatation Crew (RADTRAN 4)		MEI General Population (Formulas (1) and (2) Paragraph 4.2 scenarios)		MEI Occupational (Paragraph 4.2 scenarios)		Non-Radiological	
		Incident Free		Hypothetical Accident		Incident Free		Incident Free		Incident Free		Incident Free	Hypothetical Accident
		Exposure (Person-Rem)	Cancer Fatalities	Exposure (Person-Rem)	Cancer Fatalities	Exposure (Person-Rem)	Cancer Fatalities	Exposure (Person-Rem)	Cancer Fatalities	Exposure (Person-Rem)	Cancer Fatalities	Fatalities	Fatalities
Whole:													
PSNS to Hanf.	100	5.81 X 10^{+0}	2.91 X 10^{-3}	8.38 X 10^{-1}	4.19 X 10^{-4}	5.79 X 10^{+0}	2.32 X 10^{-3}	1.22 X 10^{-1}	6.11 X 10^{-5}	6.36 X 10^{-1}	2.54 X 10^{-4}	4.18 X 10^{-5}	9.47 X 10^{-4}
Subdivided:													
PSNS to Hanf.	1571	1.10 X 10^{+1}	5.51 X 10^{-3}	3.98 X 10^{-2}	1.99 X 10^{-5}	1.17 X 10^{+1}	4.66 X 10^{-3}	1.28 X 10^{+0}	6.41 X 10^{-4}	5.11 X 10^{-0}	2.04 X 10^{-3}	3.10 X 10^{-3}	2.71 X 10^{-2}
PSNS to SRS	1571	1.08 X 10^{+2}	5.42 X 10^{-2}	6.20 X 10^{-1}	3.10 X 10^{-4}	9.35 X 10^{+1}	3.74 X 10^{-2}	1.28 X 10^{+0}	6.38 X 10^{-4}	4.72 X 10^{+1}	1.88 X 10^{-2}	2.56 X 10^{-2}	7.56 X 10^{-1}
NNS to Hanf.	1571	1.19 X 10^{+2}	5.97 X 10^{-2}	7.52 X 10^{-1}	3.76 X 10^{-4}	9.63 X 10^{+1}	3.86 X 10^{-2}	1.28 X 10^{+0}	6.38 X 10^{-4}	4.80 X 10^{+1}	1.92 X 10^{-2}	3.34 X 10^{-2}	7.81 X 10^{-1}
NNS to SRS	1571	1.75 X 10^{+1}	8.72 X 10^{-3}	1.14 X 10^{-1}	5.72 X 10^{-5}	1.78 X 10^{+1}	7.09 X 10^{-3}	1.73 X 10^{+0}	8.61 X 10^{-4}	8.53 X 10^{-0}	3.41 X 10^{-3}	4.39 X 10^{-3}	1.18 X 10^{-1}
Comparison:													
Whole: PSNS to Hanf. versus Subdivided:													
PSNS to Hanf.	6.4%		52.8%		1280%		49.8%		9.5%		12.5%	1.3%	3.5%
PSNS to SRS	6.4%		5.4%		194%		6.2%		9.6%		1.4%	0.2%	0.1%
NNS to Hanf.	6.4%		4.9%		175%		6.0%		9.6%		1.3%	0.1%	0.1%
NNS to SRS	6.4%		33.4%		845%		32.7%		7.1%		7.4%	1.0%	0.8%

"PSNS" = "Puget Sound Naval Shipyard", "NNS" = "Norfolk Naval Shipyard, "Hanf." = "Hanford Site", "SRS" = "Savannah River Site"

Table E-12 Summary of Maximum Consequences Assuming an Accident Occurs

	Maximum Exposed Individual (Riskind)		Rural (Riskind)		Suburban (Riskind)		Urban (Riskind)	
	Exposure (rem)	Cancer Fatalities	Collective Dose (person-rem)	Cancer Fatalities	Collective Dose (person-rem)	Cancer Fatalities	Collective Dose (person-rem)	Cancer Fatalities
Whole Reactor Compartment	2.57	1.29×10^{-3}	4.41×10^{2}	2.20×10^{-1}	5.06×10^{3}	2.53	8.16×10^{3}	4.08
Subdivided Reactor Compartment	9.73×10^{-1}	4.86×10^{-4}	1.67×10^{2}	8.34×10^{-2}	1.91×10^{3}	9.57×10^{-1}	1.03×10^{4}	5.14

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DISTRIBUTION

Appendix F

1. BACKGROUND

During the scoping process for this EIS, the Navy actively solicited comments from a wide group of interested parties. The Navy published a Notice of Intent (NOI) to prepare an Environmental Impact Statement for Disposal of Decommissioned Defueled Cruiser, Ohio and Los Angeles Class Naval Reactor Plants as required by the National Environmental Policy Act. The NOI included a schedule for conduct of five public scoping meetings as well as an address for submittal of written comments. The NOI was published in the Federal Register (59 F.R. No.37; Feb. 24, 1994; p. 8915) and in newspapers serving the affected regions (Bremerton, WA; Seattle, WA; Richland, WA; Portland, OR; and Norfolk, VA). In addition, the NOI was mailed directly to agencies, organizations and individuals likely to have an interest in the EIS. Written comments, as well as oral comments from 5 public scoping meetings, were provided to the Navy in response to the announcement. Provision was made at the scoping meetings for individuals to request copies of the draft EIS.

As a result of the scoping process the Navy developed a list of potentially interested parties for the initial distribution of the EIS. The list includes individuals who requested copies of the draft EIS at the scoping meetings or in writing and those parties to whom the draft EIS is to be made available for review and comment. The list will be updated based on responses to the Notice of Availability for the draft EIS. A copy of the most current version of the distribution list can be obtained from the following Navy point-of-contact for the EIS:

Mr. John Gordon
Puget Sound Naval Shipyard
1400 Farragut Ave., Code 1160
Bremerton, Washington 98314-5001
Telephone (360) 476-7111

Libraries

Oregon

Periodical Section, Multnomah County Library

Virginia

Main Branch, Portsmouth Public Library

Washington

Main Branch, Kitsap Regional Library

Public Reading Room for US DOE - RL, Washington State University, Tri-Cities

Suzallo Library, University of Washington

Federal Agencies

Mr. A. Forester Einerson, Acting Chief, Office of Environmental Policy (CECW-AO), Army Corps of Engineers

Mr. Russell George, North Pacific Division, Army Corps of Engineers

Mr. Kevin Heanue, Director, Office of Environment and Planning, Federal Highway Administration

Ms. Marilyn Klein, Environmental Policy Advisor, Office of Policy, Federal Railroad Administration

Commander Davis, Marine Safety Center, United States Coast Guard

Captain H. H. Dudley, 13th District, United States Coast Guard

Rear Admiral J. W. Lockwood, 13th District, United States Coast Guard

Mr. David Reese, Chief, Environmental Planning and NEPA Section (G-ECV-IB), Headquarters, United States Coast Guard

Mr. Paul Dunigan, Richland Operations Office, United States Department of Energy

Mr. Mark French, Richland Operations Office, United States Department of Energy

Mr. Ron Izatt, Richland Operations Office, United States Department of Energy

Ms. Joan Cabreza, Region 10, United States Environmental Protection Agency

Mr. G. Haselberger, Region 10, United States Environmental Protection Agency

Ms. Catherine Massimino, Region 10, United States Environmental Protection Agency

Mr. Richard Sanderson, Director, Office of Federal Activities, United States Environmental Protection Agency

Ms. E. Ramona Travota, Director, Office of Radiation and Indoor Air, United States Environmental Protection Agency

Mr. David Tetta, Federal Facility Compliance Coordinator, Region 10, United States Environmetal Protection Agency

Field Supervisor, United States Fish and Wildlife Service

Ms. Liz Block, United States Fish and Wildlife Service

Mr. Dave Goeke, United States Fish and Wildlife Service

Public Affairs Office, Naval Submarine Base, Bangor, United States Navy

Mr. R. Cathcart, Special Agent in Charge, Naval Investigative Service, United States Navy

Captain Gibbs, Commander, Naval Undersea Warfare Center, Keyport, United States Navy

Ms. Dolline Pryer, Public Affairs Office, Naval Base Norfolk, United States Navy

Captain Robert White, Commander, Naval Base Seattle, United States Navy

Mr. Robert M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, United States Nuclear Regulatory Commission

Indian Tribes

Hanford Project Coordinator, Confederated Tribes of the Umatilla Indian Reservation

Hanford Project Manager, Nez Perce Tribe

Mr. Tony Forsman, Acting Tribal Administrator, Suquamish Tribe

Mr. Phill Meyers, Suquamish Tribe

Mr. John Brodeur, Yakama Indian Nation

Ms. Augustine Howard, Yakama Indian Nation

Mr. Russell Jim, Manager, Environmental Restoration Waste Management Program, Yakama Indian Nation

Elected Officials

Oregon

The Honorable John Kitzhaber, Governor, State of Oregon

The Honorable Mark O. Hatfield, Member, United States Senate

The Honorable Robert W. Packwood, Member, United States Senate

The Honorable Elizabeth Furse, Member, United States House of Representatives

The Honorable Wes Cooley, Member, United States House of Representatives

The Honorable Ron Wyden, Member, United States House of Representatives

The Honorable Peter A. DeFazio, Member, United States House of Representatives

The Honorable Jim Bunn, Member, United States House of Representatives

Virginia

The Honorable George F. Allen, Governor, Commonwealth of Virginia

The Honorable John W. Warner, Member, United States Senate

The Honorable Charles S. Robb, Member, United States Senate

The Honorable Herbert H. Bateman, Member, United States House of Representatives

The Honorable Owen Pickett, Member, United States House of Representatives

The Honorable Robert C. Scott, Member, United States House of Representatives

The Honorable Norman Sisisky, Member, United States House of Representatives

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The Honorable Thomas J. Bliley, Jr., Member, United States House of Representatives

The Honorable James P. Moran, Member, United States House of Representatives

The Honorable Rick Boucher, Member, United States House of Representatives

The Honorable Frank R. Wolf, Member, United States House of Representatives

The Honorable Thomas M. Davis, Member, United States House of Representatives

The Honorable William E. Ward, Mayor, City of Chesapeake

The Honorable James L. Eason, Mayor, City of Hampton

The Honorable Barry E. Duval, Mayor, City of Newport News

The Honorable Mason Andrews, Mayor, City of Norfolk

Mr. C. W. McCoy, City of Portsmouth

The Honorable Gloria O. Webb, Mayor, City of Portsmouth

The Honorable S. Chris Jones, Mayor, City of Suffolk

The Honorable Meyera E. Oberndorf, Mayor, City of Virginia Beach

Washington

The Honorable Mike Lowry, Governor, State of Washington

The Honorable Slade Gorton, Member, United States Senate

The Honorable Patty Murray, Member, United States Senate

The Honorable Rick White, Member, United States House of Representatives

The Honorable Jack Metcalf, Member, United States House of Representatives

The Honorable Linda Smith, Member, United States House of Representatives

The Honorable Richard 'Doc' Hastings, Member, United States House of Representatives

The Honorable George R. Nethercutt, Jr., Member, United States House of Representatives

The Honorable Norman D. Dicks, Member, United States House of Representatives

The Honorable Jim McDermott, Member, United States House of Representatives

The Honorable Jennifer Dunn, Member, United States House of Representatives

The Honorable Randy Tate, Member, United States House of Representatives

The Honorable Lynn Horton, Mayor, City of Bremerton

State/Local Agencies

Oregon

Ms. Mary Shaver, Co-Chair, Transport Committee, Oregon Hanford Waste Board

Ms. Norma Jean Germond, Oregon Hanford Waste Board, Public Involvement Committee, Chair

Administrator, Facility Regulation Division, Oregon State Department of Energy

Mr. David A. Stewart-Smith, Oregon State Department of Energy

Virginia

Mr. Edgar E. Maroney, City Manager, City of Newport News

Ms. Marilee Hawkins, Director of Housing and Emergency Services, City of Portsmouth

Mr. Keith J. Buttleman, Department of Environmental Quality, Commonwealth of Virginia

Director, Division of Intergovernmental Coordination, Virginia Department of Environmental Quality

Washington

Mr. B. Bennett, Port of Benton

Mr. James L. Nolan, Puget Sound Air Pollution Control Agency

Mr. Bob Atwood, Washington State Association of Health Office

Ms. Joy Kinmark, Washington State Department of Ecology

Ms. Barbara J. Ritchie, Environmental Review Section, Washington State Department of Ecology

Mr. Rundlett, Washington State Department of Ecology

Mr. Roger Stanley, TPA Implementation Director, Washington State Department of Ecology

Mr. Terry R. Strong, Director, Division of Radiation Protection, Washington State Department of Ecology

Mr. Mike Wilson, Washington State Department of Ecology

Mr. Joseph Witczak, Manager, Nuclear Waste Program, Regulatory and Technical Support Unit, Washington State Department of Ecology

Mr. Randy S. Acselrod, Washington State Department of Health

Mr. John Blacklaw, Washington State Department of Health

Mr. Ray Lasmanis, Washington State Department of Natural Resources

Mr. John A. Hall, Washington State Department of Wildlife

Staff Director, Energy and Utilities Committee, Washington State House of Representatives

Staff Director, Energy and Utilities Committee, Washington State Senate

Public

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Mr. Wayne Bloomster

Nevada

Ms. A. A. Francis, CEM, Emergency Management Services

Oregon

Mr. Ross Tewksbury

Mr. Tom Cropper, Eastside Democratic Club

Ms. Paige Knight, Hanford Watch

Ms. Paige Knight, Nuclear Free Port Coalition

Tennessee

Mr. Harry A. Bryson, Senior Project Engineer, CHMM

Utah

Mr. Donald E. Evett

Virginia

Mr. James D. Bailey

Mr. David Baker

Ms. Margy Baker

Ms. Joanne Bentley

Mr. Stephen P. Bergfield

Mr. Tom Cadorette

Ms. Sylvia Clute

Ms. Roberta Hodgen

Ms. Nancy M. Poarch

Ms. Priscilla C. Wash

Minister Rafiq Zaidi, President, Black Concerned Citizens

Ms. A. T. Boush, Secretary, Chesapeake Association of Family, Community and Education

Mr. James Hartley, IFPTE Local No.1

Mr. Drew Terry, IFPTE Local No. 1

Mr. Alan E. Gollihue, Olde Towne Civic League

Mr. Robert Deegan, Sierra Club, Virginia Chapter, Nuclear Waste Issues Chair.

Mr. Edward R. Baird, Jr., Willcox & Baird, Attorneys at Law

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Mr. Walter D. Blair

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Ms. Maron Wang

Mr. Kip Wilson

Mr. S. A. Martinelli, P. E., Ecology and Environment, Inc.

Mr. Gerald Pollet, Heart of America Northwest

Ms. Cynthia Sarthou, Heart of America Northwest

Ms. Pat Herbert, Herbert and Associates

Ms. Beverly Kincaid, Kitsap County Central Labor Council

Mr. Norm Buske, SEARCH

Mr. Harry Wilson, Sierra Club

Mr. Dave Davison, Union River Basin Protection Association

Ms. Elaine Manheimer, Union River Basin Protection Association

COMMENTS AND RESPONSES

Appendix G

Table of Contents

1. Introduction

This Appendix did not appear in the Draft Environmental Impact Statement (DEIS). It has been added to the Final Environmental Impact Statement (FEIS) to present comments received following distribution of the DEIS together with the Navy's responses to those comments. In cases where the text of the FEIS has been changed from the DEIS, a sidebar has been placed in the margin of the FEIS adjacent to the revised text.

On August 9, 1995 the Navy began distribution of the DEIS. The period for comment began with publication of the Notice of Availability in the Federal Register (60 FR 43147-01) on August 18, 1995 and remained open for 53 days, ending on October 10, 1995. The Notice of Availability announced that during the comment period public hearings would be held at Bremerton, Washington; Portland, Oregon; Seattle, Washington and Richland, Washington. In addition to the Federal Register Notice, 12 public notices were printed among the newspapers Bremerton Sun, Tri-City Herald, Oregonian and Seattle Post-Intelligencer, which have a collective distribution of over 650,000. Also, the Tri-Party Agreement Publications, which have a distribution over 1,000, identified the time and place of the public hearings. Over 160 notices and DEISs were distributed by the Navy to individuals and organizations that have expressed an interest in the disposal of defueled Navy reactor compartments.

A total of fifteen written statements and five oral statements were received as follows:

	Written	Oral
Federal Agencies	2	0
State Agencies	3	1
Local Groups	6	2
Individuals	4	2

2. Comment Letters and Records of Public Hearings

This chapter incorporates comment letters and records of public hearings. Unique identification numbers have been assigned to each letter and statement. The identification numbers correspond to the sequence in which the material was received by the Navy and, therefore, approximate a chronological correlation. An exception to this chronological order occurs where a respondent provided more than one exhibit. In these cases the identification number for the first submittal was assigned in order and suffix letters have been used with the initial identification number to differentiate submittals.

Exhibits have been sidebarred to identify issues which have been numbered according to the order in which they are presented in the Navy's responses to issues from public review. The analyses and responses to issues can be located in chapter 3.

An Exhibit Index is provided at the end of this chapter. The index is comprised of listings of three associated identifiers: (1) name of commenter or organization, (2) identification number assigned to the associated letter or statement, and (3) the page number where the letter or statement begins. The Exhibit Index lists each letter or statement by numerical sequence of identification number. The Exhibit Index provides a cross reference for readers to readily locate exhibits of a known commenter and to relate exhibits of specific interest to respective commenters.

#1

Mr. John Gordon
Puget Sound Naval Shipyard
Code 1160
Bremerton, WA 98314-5001

August 18, 1995

Dear Mr. Gordon:

This serves as my comment upon the DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS, AND LOS ANGELES CLASS NAVAL REACTOR PLANTS.

1.7 I guess I'm real disappointed about our having to decommission another set of nuclear-powered ships. With the last environmental impact statement on submarines in which ten reactors were supposed to be decommissioned, we've found that there has been many more reactor cores buried at Hanford. So, I'm worried on one level that Washington state may be in for more than what this draft statement is telling us.

And then again we will be considering the radiation, lead, and PCB's which will be buried with them and be dumped into the soil and then into the aquifers and underground rivers into the Columbia River. I find it strange that the government is currently intently involved with spending millions to clean up the underground rivers and soils in the 100 areas eventually where the pollutants from these very cores along with others will also end before going into the Columbia River. Somehow knowing whether the cores are buried aboveground or underground doesn't really solve the enormous problems we will
2.5 be faced with in these ensuing burials. And, we will have permits given out by the Department of Ecology on wastes which if they were anywhere else in this state but Hanford would not be permitted.

And yet, I do feel Hanford is probably the best place to bury these cores. They can be removed at the shipyard where the workers have plenty of experience, where the equipment is sufficient, where the safety precautions are well known, and where it is relatively close to the burial site which is also experienced with reactor cores.

1.9 I guess what really bothers me is the enormous amounts of money being spent in such wasteful ways when so many people are unemployed and job development for all of us has deteriorated. At a time when this country should be developing decent well-paying jobs for everyone, we see the majority of money being spent for defense and defense-related projects of which this is one.

What can we do together to insure we dispose of these cores in an environmentally-conscious manner and still realize that a peaceful society spends its' money on projects which give the optimum peace to all? It seems to me we should be most concerned with
the way we spend billions to build a force of nuclear ships and submarines which is too 1.9
large for the threat we are allegedly seeing in the world. We have seen such waste in the past and are still seeing waste in projects which are basically unreal. We build too many nuclear vessels, we spend too much on burials and cleanup, we lie to the public after hearing their concerns. When is this going to end? Certainly not in my generation. What are we giving our children but bills and problems with undereducated peers many of whom today are barely able to survive. Doesn't this bother you? We've spent all of this month informing people of the tortures and injustices of World War II while we are currently doing the same thing to just as many people in our own country.

Well, thank you for allowing me to comment.

Sincerely,

Pat Herbert

Pat Herbert
P.O. Box 95966
Seattle, WA 98145

#2

Donald Eugene Evett
3106 South 975 East
Bountiful, Utah 84010

September 18,1995

Mr. John Gordon
Public Affairs Officer
Puget Sound Naval Shipyard
1400 Farragut Avenue
Bremerton, WA 98314-5001

RE: **DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS, AND LOS ANGELES CLASS NAVAL REACTOR PLANTS**

Dear Mr. Gordon:

I have carefully reviewed the August 1995 impact study and I concur with the Navy's report on th impact of burial of the applicable reactors at the Hanford Site. The impact study is very thorough i that it covers all of the major aspects of concerns to the public. Hanford appears to be the best suite site for burial of the reactors and the report indicated that Hanford will be an indefinite burial si lasting for many years.

I wish to thank you for having the opportunity to review the study and to submit my comments. It i a very comprehensive study and in my opinion all safety factors have been carefully studied an explained in the report and the entire process of dismantling, transport and burial will be safe to th general public for now and in the distant future.

Sincerely,

Donald E. Evett

COPY

PROCEEDINGS

PUBLIC HEARING
DRAFT ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

Performing Arts Center
Bremerton High School
Bremerton, Washington 98310

BAYSIDE REPORTERS
4041 Ruston Way
Suite 1-D
Tacoma, Washington 98402

REPORTED BY PAMELA J. FRANZ
September 18, 1995

INDEX

ATTENDANCE

MR. DICK SHIPLEY - Director of Environment, Safety, and Health, Puget Sound Naval Shipyard, presiding officer.

MR. JIM WRZESKI - Navy's reactor compartment disposal manager.

MR. MARK FRENCH - Department of Energy

The Assembly of the Public Hearing regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants convened on the 18th of September, 1995, at the Performing Arts Center, 1500 13th Street, Bremerton, Washington, beginning at the hour of 7:00 p.m., Mr. Shipley presiding.

* * * * * * *

MR. SHIPLEY: Good evening, ladies and gentlemen. Thank you for coming. My name is Dick Shipley, and I'm the director of Environment, Safety, and Health at Puget Sound Naval Shipyard. Tonight, I'm serving as the presiding officer for this public meeting.

With me this evening is Mr. Jim Wrzeski, the Navy's reactor compartment disposal manager. Also with us tonight from the Department of Energy is Mr. Mark French. The Department of Energy is a cooperating agency in the development of the Environmental Impact Statement.

On August 15th, 1995, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, what we call the Draft EIS, on the disposal of decommissioned, defueled reactor plants from cruisers and the OHIO Class and LOS ANGELES

Class submarines. The Navy, in cooperation with the Department of Energy, has prepared this Draft EIS to focus on the potential for significant environmental impacts and to consider reasonable alternatives.

The management of spent fuel is not the subject of this EIS. The disposition of spent fuel was addressed in the Department of Energy EIS, identified on this slide, with the Navy as the cooperating agency.

The Navy's Federal Register announcement scheduled public meetings at various locations in order to provide organizations and individuals with an interest in this matter with an opportunity to present their views. We are here this evening to conduct one of these scheduled public meetings.

Tonight's meeting is being held as part of the decision-making process required by the National Environmental Policy Act called NEPA. NEPA is our basic national charter for protection of the environment. NEPA procedures ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

The Draft EIS was developed based on public input received during the scoping phase of the NEPA process.

Tonight we are here to listen to what you have to say. We will not be directly responding to questions tonight. The purpose of tonight's meeting is to receive your input so that it can be addressed in the development of the Final EIS. The purpose is not to engage in debate.

It is my responsibility to receive statements so that they can be considered in preparing the final EIS. For that reason, this meeting is being recorded.

Copies of the agenda for tonight's meeting are available on the table at the back. It explains the order of our meeting this evening and will consist of a presentation by Mr. Wrzeski on the alternatives evaluated in the Draft EIS.

This presentation will last approximately 20 minutes and will be followed by the formal comment period. The comment period is the time we listen to you. Responses to each individual comment or question will be in the Final EIS.

After all comments have been given, we will conclude the meeting with closing remarks. I will afford an opportunity to those individuals and organizations who wish to speak. I would appreciate it if anyone wishing to speak would fill out a registration form over by the door.

To get everyone's comment, I will ask that long statements be summarized to five minutes with the

written statement submitted for the record.

Whether or not you speak this evening, you may also provide written comments to me or leave them with the staff at the registration table. Oral and written input will be considered equally in the development of the Final EIS.

If you desire to provide written comments at a later time, they should be sent to: Mr. John Gordon, Puget Sound Naval Shipyard, 1400 Farragut Avenue, Code 1160, Bremerton, Washington 98314-5001.

Written comments postmarked by October 10th, 1995 will be considered in preparation of the Final EIS. Comments postmarked after that date will be considered to the extent practical.

Before we begin receiving public input, I would like to introduce Mr. Wrzeski, who will provide a general overview of the alternatives which have been evaluated in the DEIS.

Mr. Wrzeski.

* * * * * * * * *

PRESENTATION

MR. WRZESKI: Thank you, Mr. Shipley. Good evening, ladies and gentlemen.

By the 1980s, many of the Navy's submarines were reaching the end of their useful life. At that time, the Navy prepared an Environmental Impact Statement to evaluate various disposal methods for the radioactive components associated with the nuclear power plants on these submarines.

In the 1984 Record of Decision, the Navy selected land burial of the reactor compartment as the disposal method for these components. Since then, the Navy has completed 50 successful shipments under the 1984 program.

Now, in the 1990s, recent changes in the national defense structure have resulted in downsizing of the fleet,. including nuclear-powered combatants. Because of this downsizing, the Navy will soon need to address disposal of the reactor compartments associated with cruisers, OHIO Class submarines and LOS ANGELES Class submarines.

This EIS has been prepared because the approximately 100 reactor compartments from these classes of ships were not covered under the 1984 EIS.

This figure shows the location of the reactor compartments on the typical Navy cruiser and submarine.

The functional design of the ship's reactor compartment makes it an ideal disposal package. The compartment is completely enclosed by structural walls known as bulkheads and, in the case of a submarine, part

of the enclosure is the ship's pressure hull.

The bulkheads contain lead shielding to protect the crew during reactor operation. The bulkheads are designed to meet the shocks and stresses of a military ship under combat conditions.

These features make the reactor compartment a superior transportation and disposal package that is far stronger than typical industry containers used to dispose of low-level radioactive waste.

The remainder of the ship is recycled to reuse the metals.

Tonight I will first discuss the alternatives the Navy considered for disposal of the reactor plant. Later in my presentation, I will cover the potential environmental consequences. In all of the alternatives considered, the spent fuel would be removed before initiating disposal.

The Navy evaluated several alternatives in this EIS. Land burial of the entire reactor compartment at Hanford, Washington is our preferred alternative. We also looked at waterborne storage of the ship, which is the no-action alternative. We evaluated subdivision of the reactor compartment. This alternative disassembles the reactor plant and disposes of the components separately. Finally, we looked at above-ground storage of the reactor compartments at Hanford.

Now I would like to describe our preferred alternative. In the interest of time tonight, my presentation will focus mainly on the preferred alternative, even though the Draft EIS analyzes the others in considerable detail.

As discussed earlier, the reactor compartment makes an ideal disposal package. For this and other reasons that I'll discuss, the Navy has determined that burial of the entire reactor compartment at Hanford is the preferred alternative.

This is the same basic method as our current disposal program, which has been demonstrated to be safe, effective, and is accomplished with no significant impact to workers, the public, or the environment.

As I discuss the preferred alternative, I will be using slides taken from the Navy's current disposal program to illustrate the proposed method.

The reactor compartment would be separated from the rest of the ship and placed on a barge for waterborne transport. The sealed package would meet all Department of Transportation and Nuclear Regulatory Commission requirements. The barges used would all meet the United States Coast Guard and Navy requirements.

The inset shows the transportation route proposed

for all of the alternatives that take an entire reactor compartment to Hanford. The shipments would leave from Puget Sound Naval Shipyard, proceed along the Washington coast, up the Columbia River to the Port of Benton near the Hanford site. This is the same route taken under the current disposal program.

I would like to go into some detail on the safety features we would use for waterborne transport of the reactor compartment.

We designed the waterborne transport system conservatively. This means the transport system is capable of safely handling conditions much worse than we actually expect.

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subdivision alternative, rather than remain whole, the reactor compartment would be disassembled.

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The amount of smaller components to be processed and transported would be significantly greater under this alternative. This alternative requires 15 times more shipments than the preferred alternative.

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Our evaluation was broken down into three segments that reflect where potential impacts would take place: at shipyards, along the transportation route, and at the disposal site.

For each of these segments, I will discuss the results of the environmental studies that were performed. Several of the studies were performed by independent, technical organizations outside the Navy, such as Pacific Northwest Laboratory.

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We determined that the principle effect is that shipyard workers would receive some exposure to radiation. Personnel radiation exposures are maintained as low as reasonably achievable and would be kept within the guidelines set by the Nuclear Regulatory Commission. Total exposure is expected to be much higher in the subdivision alternative than if the reactor compartment were left whole.

The industrial procedures used to prepare reactor compartments for disposal would be the same as these

currently used at the shipyard. These procedures are in compliance with Navy Occupational Safety and Health requirements. These requirements are designed to protect workers from industrial hazards associated with their work.

The measures used by the Navy to protect its own workers from potential hazards during disposal work would protect the surrounding public and the environment as well.

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In the extremely unlikely event that a barge did sink and water entered the reactor compartment, no significant environmental impact would occur. Now, this is because 99.9 percent of the radioactivity in the reactor compartment is part of the reactor plants' metal components and can only be released through corrosion. The remaining radioactivity is contained within the sealed reactor plant systems.

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It is important to point out a couple of areas where the studies assumed unfavorable conditions. Making these assumptions mean the study results are worse than we actually expect.

Hanford has an arid climate with only about 6 inches of rainfall per year. The study assumed that there is ten times more moisture in contact with the buried compartments than is expected under current conditions.

The migration study also assumed that the hazardous materials were exposed and immediately available for movement through the ground. When, in fact, the corrosion study determined that the reactor compartments are so robust that they will contain these materials for at least 600 years.

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The study determined that it would take over 700,000 years for lead to reach the Columbia River. Most of the radioactive material would decay away before being released. Radioactive nickel would make up the bulk of what is released and this nickel would take over 200,000 years to reach the river.

For all substances considered in this evaluation, concentrations would not exceed current groundwater protection standards.

Because these results are based on the unfavorable assumptions, we expect the actual movement of radioactive and other hazardous materials to take much longer and result in even lower concentrations.

Now I would like to discuss the potential impact of radiation exposure to workers and the public.

The health concern of low-level exposure to radiation is the potential to induce cancer over time, referred to as latent cancer. Many studies have been done to determine the effect radiation would have on the chance of a person developing cancer.

Our studies determined the potential radiation exposures for all the alternatives evaluated. We then used conversion factors approved by the International Council on Radiological Protection to determine the number of potential latent cancer fatalities.

First, let's look at the analysis of impacts to shipyard workers.

To dispose of the entire reactor compartment, no more than .6 additional latent cancer fatalities are projected among shipyard workers. This is for disposal of all 100 reactor compartments.

The subdivision alternative involves significantly more work. Because of this, shipyard workers would receive more radiation exposure than if the reactor compartment were left whole. Depending on whether subdivision occurred at the time of ship decommissioning or was delayed ten years, 13 to 44 additional latent cancer fatalities are projected among shipyard workers.

The impact on shipyard workers is a key discriminator between land burial of the entire reactor compartment and the subdivision alternative.

For the general public, we looked at the effects of transporting the reactor compartment to the burial site. The general public population in the vicinity of the transport route is about 200,000 people. As you can see in this table, there would be virtually no effect to dispose of all 100 reactor compartments regardless of the alternative selected.

There are projected to be no more than .003 total additional cancer fatalities as a result of the land

burial alternative. Now, what this number really means is that the effect of land burial of all 100 reactor compartments at Hanford is insignificant when compared to the chance of being struck by lightning.

We concluded that all of the alternatives evaluated would have minimal impact on the general public and the environment.

For workers, however, land burial of the entire reactor compartment at Hanford would result in a much lower potential for latent cancer fatalities as compared to the subdivision alternative.

And finally, land burial of the entire reactor compartment at Hanford also has the advantage of being a permanent solution.

I thank you all very much for your courtesy and attention.

Mr. Shipley.

MR. SHIPLEY: Ladies and gentlemen, it's important that all of those who wish to speak are provided with an opportunity to do so.

Do we have any cards that were filled out for registration?

Out of courtesy, I intend to recognize representatives of government organizations and then individual citizens.

I request your cooperation and courtesy tonight while people are speaking. It's important to provide comments within the time limit so that we may be certain that all who wish to speak have an opportunity to do so.

To allow time for everyone's comments, statements should be summarized to five minutes with written statements submitted for the record.

This lighting system will be used to monitor time available to speakers. The green light will initially be illuminated, the yellow light will indicate when 60 seconds remain, and the red light will indicate when your time has expired.

The procedure for public comment will be as follows: I will announce each registered speaker; when called, please proceed to and use one of the two microphones provided; please state your name for the record; if you are representing an organization, please also give the name of the organization as well; and all of your comments should be directed to me.

* * * * * * * * *

PUBLIC COMMENT PERIOD

MR. SHIPLEY: We are pleased to have as our first speaker — Is it Mr. Henrik —

MR. LANGHJEM: Yes.

MR. SHIPLEY: — Langhjem?

MR. LANGHJEM: That's right.

MR. SHIPLEY: Thank you.

MR. LANGHJEM: Yes, Mr. Shipley. What I'd like to say first is I'm pretty disappointed at the turnout, considering, you know, what all of this does for the community. #3

The next thing I'd like to ask is when you're talking about storage, of waterborne storage, we're kind of doing that now and have been doing it for many years. Do we not need to look the public in the eye and tell them what we're doing with that and how we're maintaining the integrity of these older vessels? 4.7

We've got numerous of them parked out on the waterfront. It's very much a concern. And how long are we going to continue maintaining these on the waterfront? I know we're talking about a different class of submarines, but it's still a valid point.

Another thing I'm concerned with is when it comes to you're talking workers, I agree with you. The burial is the best method. And I've been involved directly, in some cases, in some of the design applications for the 25-35 sub for incapsulation of the reactor compartments at the shipyard.

What I'm concerned about is the work for the recycling end of things. We are hurting workers when 4.8

4.8 we're doing this type of work. We are not giving the workers the right to know. We are producing emissions that the public are unaware of.

There's a report that I asked for a copy of, and I have it over at the seat there. It's called a Toxic Release Information Summary Report. I believe it's publication No. 95-417 and it's put out by the State Department of Ecology.

There is not one single entry for this entire county in that report but yet we are doing airborne and waterborne emissions. We're trying to do our best, obviously, to limit them, but there are certain emissions that I'm concerned with. Evolutions where we're doing arc weld processes over lead canning and ballast tanks, using torches to cut through copper, 4.9 antifouling paint. We're bringing in boats to work on right now that we do not have the material safety data sheets available for.

Case in point, the 597, the worker on that particular project asked his supervisor, you know, what am I working with. And under federal law we have what we call the right to know, okay? Right to know means not right to ask but right to know. These people are supposed to be told up front what they're working with.

These particular material and safety data sheets that I have possession of right now took a week to get. I had to go to Washington to get them and find out who the manufacturer of the material was, who the applicator was, what particular facility applied it. And we're dealing with some pretty nasty materials.

4.9

Some of these sheets reflect, how should you say it, concerns over pregnancy, birth defects and whatnot. We've got a couple of pregnant women down on the dry dock working on these things. I'm very concerned about it.

I think that in view of the estimates that we've provided to NAVSEA and what it would cost to cut up these boats and what we're actually cutting them up for and the profits that we've made in this last year -- As you know, we've just received an American citation medal for the shipyard based on our comearound against our AOR. I believe what it was is $180 million deficit. We've now gone into the black. But what I don't see is improvements in the work processes against this recycling effort.

2.4 People have to understand and the public should know that to recycle these boats, there is a lot more than just how we deal with the reactor part and whether we bury them or not. We're stripping the rest of the boat down.

4.10

We have boats lined up, you know, funded for years to come that we're going to be working on. I would like to know what kind of process improvements are going to be made, you know, as far as the environment, workers safety, that type of thing. Are we going to roll back some of those funds that we've been, you know, putting against our AOR into improved processes for the workers? Thank you.

MR. SHIPLEY: Thank you very much.

4.11

MR. LANGHJEM: Oh, one last thing. We say that we're 99.9 percent defueled. I'm speaking now because I understand we don't have a great drove of people.

MR. SHIPLEY: Go right ahead.

MR. LANGHJEM: The materials inside these reactor compartments are, in a sense, exposed to neutron flux. They're activated in themselves. Themselves being a source of energy of sorts. We're talking of all of the materials within the reactor compartment are subject to that and we check for it.

Is the public aware that — I don't know if that 99.9 percent is really an accurate figure. Maybe you can come back at me on that one. Thank you.

MR. SHIPLEY: Thank you very much, sir.

MR. WRZESKI: Just to clarify the 99.9 percent figure, that's —

4.11

MR. LANGHJEM: I'm sorry?

MR. WRZESKI: Just to clarify the 99,9 percent figure, to clarify that referring out of my presentation, that was how much radioac-- Of the radioactivity in the reactor compartment when we ship it, that's how much of it is contained in the solvent medal pieces that we ship. All of the fuel has been removed from the reactor compartment when we ship.

MR. LANGHJEM: Okay. Looking at it the other way is just a little bit misleading because people don't understand, when you're talking about the public in general. You're saying that all of the fuel is out with the exception of one-tenth of one percent, but we're not making that statement for the medal itself because the medal itself is inherent with energy.

It emits energy because it's been exposed to neutron flux, correct?

MR. WRZESKI: Yes. That's correct.

MR. LANGHJEM: Thank you.

#4

MR. SHIPLEY: Mr. Roy Hocker. Is that pronounced correctly?

MR. HOCKER: Hocker. Close enough.

MR. SHIPLEY: Thank you.

MR. HOCKER: I think you've done a good job of covering the different things.

1.8

Kind of going on with what the previous speaker had to say, I'm only concerned about one thing, and I'm not going to speak to individual issues or any of that. I work in the shipyard and I see an increasing effort and I think it's a good faith effort to contract out things that we can get done more cheaply other ways, but my concern is the process controls are not in place the same way they are for the shipyard workers for contractors.

I have personal knowledge, I've got background in training in QA, and now I work on the waterfront, and I see that the contractors are not constrained by the same process controls that we are.

It's really nice to say that this is what the environmental impact is going to be for us disposing of the reactor compartments, but in the worst-case scenario, from my standpoint, I'm a civil servant, should contractors come in, someone from another shipyard or another entity of some type, and commence to disposing of nuclear vessels?

I have absolutely zero confidence that any of this would mean anything. I have seen the lack of process controls and I have addressed them directly myself through the system in the shipyard and the bottom line comes down to they play off of a different sheet of

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1.8

music. They have controls that they're constrained by, yes, but they're not anything that's even vaguely similar to what we have to deal with as shipyard workers in civil service, as far as NAVSEA is concerned.

And so the one question I have - I know it's not a question-and-answer period tonight - but my concern, as a citizen living in the city, is if someone other than us, shipyard workers working for the civil service, if someone other than us does this job, is this EIS still valid?

MR. SHIPLEY: Thank you very much, sir.

Ladies and gentlemen, I have no further registrations. Has anyone registered to speak that I have not given the opportunity to?

I want to thank all of you on behalf of the United States Navy for taking the time to participate in the hearing tonight. We appreciated the opportunity to hear your comments, and we will work to make sure that they're addressed in the Final EIS.

This meeting is adjourned.

HEARING CONCLUDED: 7:30 p.m.

C-E-R-T-I-F-I-C-A-T-E

STATE OF WASHINGTON)
) ss.
COUNTY OF PIERCE)

I, PAMELA J. FRANZ, a duly authorized Notary Public in and for the State of Washington, do hereby certify that this is a true transcript of the Public Hearing regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants; that the minutes of said meeting were recorded in shorthand and later reduced to typewriting; and that the above and foregoing is a true and correct transcript of said meeting.

I do further certify that I am not a relative of, employee of, or counsel for either of said parties or otherwise interested in the event of said proceedings.

I HAVE HEREUNTO set my hand and affixed by official seal this 22nd day of September, 1995.

PAMELA J. FRANZ
STATE OF WASHINGTON
NOTARY — • — PUBLIC
My Commission Expires 8-11-96

Pamela J. Franz
Pamela J. Franz, Notary Public in and for the State of Washington, residing at Tacoma.
CSR #: FRANZ*PJ085P8

#4a

DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED, CRUISER, OHIO CLASS AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

COMMENT FORM

Name: Roy Hocker

Organization/Agency: PSNS - Representing Myself

Please check type of organization:

Federal Agency X State Agency ___ Local Group ___ Individual X

Mailing Address:

Street: 3311 Rodgers

City: Bremerton State: Wa Zip: 98312 Telephone: 377-5917

You may turn your comment in at the close of the hearing in the comment box located in the lobby or send it to the address at the bottom of this sheet. Written comments may also be submitted in letter or other format.

I'm confident the professionals at PSNS working as civil servants can and will comply with the requirements of the EPA.

However, the increasing "contracting out" of our functions I'm skeptical. Contractors are not required to meet our standards. I have no confidence the standards we maintain will be applicable, much less upheld. 1.8

Mail to: Mr. John Gordon
Puget Sound Naval Shipyard
1400 Farragut Ave., Code 1160
Bremerton, Washington 98314-5001

COPY

P R O C E E D I N G S

PUBLIC HEARING
DRAFT ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

Red Lion Hotel-Jantzen Beach
Glisan Room
909 North Hayden Island Drive
Portland, Oregon 97217

BAYSIDE REPORTERS
4041 Ruston Way
Suite 1-D
Tacoma, Washington 98402

REPORTED BY PAULA SOMERS
September 19, 1995

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APPEARANCES

MR. DICK SHIPLEY - Director of Environment, Safety, and Health, Puget Sound Naval Shipyard

MR. JIM WRZESKI - Reactor Compartment Disposal Manager, U.S. Navy

MR. MARK FRENCH - Department of Energy

The Assembly of the Public Hearing, regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants, convened on the 19th of September, 1995, at the Red Lion Hotel-Jantzen Beach, Glisan Room, 909 North Hayden Island Drive, Portland, Oregon 97217, beginning at the hour of 7:06 p.m., Mr. Shipley, presiding.

* * * * * * *

MR. SHIPLEY: Good evening. Thank you for coming. My name is Dick Shipley. I'm the Director of Environment, Safety, and Health at Puget Sound Naval Shipyard. Tonight I'm serving as a presiding officer for this public meeting.

With me this evening is Mr. Jim Wrzeski, the Navy's reactor compartment disposal manager. Also with us tonight from the Department of Energy is Mr. Mark French. The Department of Energy is a cooperating agency in the development of the Environmental Impact Statement.

On August 15th, 1995, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, which we call the Draft EIS, on the disposal of decommissioned, defueled, reactor plants from cruisers, OHIO Class and LOS ANGELES

Class submarines. The Navy, in cooperation with the Department of Energy, has prepared this Draft EIS to focus on the potential for significant environmental impacts and to consider reasonable alternatives.

Spent fuel is not the subject of this EIS. The disposition of spent fuel was a draft in the Department of Energy Environmental Impact Statement identified on this slide with the Navy as a cooperating agency.

The Navy's Federal Register announcement scheduled public meetings at various locations in order to provide organizations and individuals with an interest in this matter with an opportunity to present their views. We are here this evening to conduct one of these scheduled public meetings.

Tonight's meeting is being held as part of the decision-making process required by the National Environmental Policy Act called NEPA. NEPA is our basic national charter for the protection of the environment. NEPA procedures ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

The Draft EIS was developed based on public input received during the scoping phase of the NEPA process.

Tonight we are here to listen to what you have to say. We will not directly be responding to questions.

The purpose of tonight's meeting is to receive your input so it can be addressed in the development of the final EIS. The purpose is not to engage in debate.

I'm going to wait just a minute until our latest person is seated, so we'll proceed then.

It's my responsibility to receive statements so they can be considered in preparing a Final EIS. For that reason, this meeting is being recorded.

Copies of the agenda for tonight's meeting are available on the table in the back. It explains that the order of our meeting this evening will consist of a presentation by Mr. Wrzeski on the alternatives evaluated in the Draft EIS.

This presentation will last approximately 20 minutes and will be followed by the formal comment period. This comment period is the time we listen to you. Responses to each individual comment or question will be in the Final EIS.

After all comments have been given, we will conclude the meeting with closing remarks. I will afford an opportunity to those individuals and organizations who wish to speak. I would appreciate it if anyone wishing to speak would fill out a registration form at the door.

To get everyone's comments, I will ask that long

statements be summarized to five minutes with the written statement submitted for the record.

Whether or not you speak this evening, you may also provide written comments to me or leave them with the staff at the registration table. Oral and written input will be considered equally in the development of the EIS.

If you desire to provide written comments at a later time, they should be sent to: Mr. John Gordon, Puget Sound Naval Shipyard, 1400 Farragut Avenue, Code 1160, Bremerton, Washington 98314-5001.

Written comments postmarked by October 10th, 1995, will be considered in preparation of the Final EIS. Comments postmarked after that date will be considered to the extent practical.

Before we begin receiving public input, I would like to introduce Mr. Wrzeski, who will provide a general overview of the alternatives which have been evaluated in the Draft EIS.

Mr. Wrzeski.

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PRESENTATION

MR. WRZESKI: Thank you, Mr. Shipley. Good evening, ladies and gentlemen.

By the 1980s many of the Navy's submarines were reaching the end of their useful life. At that time, the Navy prepared an Environmental Impact Statement to evaluate disposal methods for the radioactive components associated with the nuclear power plants on these submarines.

In the 1984 Record of Decision, the Navy selected land burial of the reactor compartment as the disposal method for these components. Since then, the Navy has completed 50 successful shipments under the 1984 program.

Now, in the 1990s, recent changes in the national defense structure have resulted in downsizing the fleet, including nuclear-powered combatants. Because of this downsizing, the Navy will soon need to address disposal of reactor compartments associated with cruisers, OHIO Class submarines, and LOS ANGELES Class submarines.

This EIS has been prepared because the approximately 100 reactor compartments from these. classes of ships were not covered under the 1984 EIS.

This figure shows the location of reactor compartments on a typical Navy cruiser and submarine.

The functional design of the ship's reactor compartment makes it an ideal disposal package. The compartment is completely enclosed by structural walls known as bulkheads and, in the case of a submarine, part

of the enclosure is the ship's pressure hull.

The bulkheads contain lead shielding to protect the crew during reactor operation, and the bulkheads are designed to meet the shocks and stresses of the military ship under combat conditions.

These features make the reactor compartment a superior transportation and disposal package that is far stronger than typical industry containers used to dispose of low-level radioactive waste.

The remainder of the ship is recycled to reuse the metals.

Tonight I will first discuss the alternatives the Navy considered for disposal of the reactor plant. Later in my presentation, I will cover the potential environmental consequences. In all of the alternatives considered, the spent fuel will be removed before initiating disposal.

The Navy evaluated several alternatives in this EIS. Land burial of the entire reactor compartment at Hanford, Washington, is our preferred alternative. We also looked at waterborne storage of the ship, which is the no-action alternative. We evaluated subdivision of the reactor compartment. This alternative disassembles the reactor plant and disposes of the components separately. Finally, we looked at above-ground storage of the reactor compartment at Hanford.

Now I'd like to describe our preferred alternative. My presentation tonight will focus mainly on the preferred alternative, even though the Draft EIS analyzes others in considerable detail.

As discussed earlier, the reactor compartment makes an ideal disposal package. For this and other reasons that I'll discuss, the Navy has determined that land burial of the entire reactor compartment at Hanford is the preferred alternative.

This is the same basic method as our current disposal program, which has been demonstrated to be safe, effective, and is accomplished with no significant impact to workers, the public, or environment.

As I discuss the preferred alternative, I will be using slides taken from the Navy's current disposal program to illustrate the proposed method.

The reactor compartment would be separated from the rest of the ship and placed on a barge for waterborne transport. The sealed package would meet all Department of Transportation and Nuclear Regulatory Commission requirements. The barges used would meet all the United States Coast Guard and Navy requirements.

The inset shows the transportation route proposed for all alternatives that take an entire reactor

compartment to Hanford. The shipments would leave from Puget Sound Naval Shipyard, proceed along the Washington coast, up the Columbia River to the Port of Benton near the Hanford Site. This is the same route taken under the current disposal program.

I'd like to go into some detail on the safety features we would use for waterborne transport of the reactor compartment.

We designed the waterborne transport system conservatively. This means the transport system is capable of safely handling conditions that are much worse than we actually expect.

As you can see in this picture, the barges are designed with multiple tanks and watertight bulkheads between them. The barge will remain stable under storm conditions even if two of these tanks are damaged and completely flooded. Even more damage and flooding could be sustained and still the barge would remain floating.

Safety is further assured by not shipping in bad weather. We use only experienced towing contractors and always use a back-up tug that follows the shipment.

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At the Port of Benton, the reactor compartment would be off-loaded from the barge, hauled over land, and placed in a burial trench similar to what's shown in this picture.

The proposed burial site for reactor compartments is the low-level burial grounds located near the center of the Hanford Site. These burial grounds are well suited to the permanent disposal of reactor compartments. The arid climate, plus existing soil characteristics, are beneficial for waste disposal. In addition, the site is accessible by barge with a short overland haul.

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There would be no environmental consequences from other hazardous substances. This is because most are solids and would, therefore, not be released to surrounding waters.

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This slide summarizes the results of the migration study.

The study determined that it would take over 700,000 years for lead to reach the Columbia River.

Most of the radioactive material would decay away before being released from the reactor compartments. Radioactive nickel would make up the bulk of what is released and this nickel would take over 200,000 years to reach the river.

For all the substances considered in this evaluation, concentrations would not exceed current groundwater protection standards.

Because these results are based on the unfavorable assumptions, we expect the actual movement of radioactive and other hazardous materials to take much longer and result in even lower concentrations.

Now I'd like to discuss the potential impact of radiation exposure to workers and the public:

The health concern of low-level exposure to radiation is the potential to induce cancer over time, referred to as latent cancer. Many studies have been done to determine the effect radiation would have on the chance of a person developing cancer.

Our studies determined the potential exposures for all the alternatives evaluated. We then used conversion factors approved by the International Council on Radiological Protection to determine the number of potential latent cancer fatalities.

First, let's look at our analysis of the impacts to shipyard workers.

To dispose of the entire reactor compartment, no more than .6 additional latent cancer fatalities are projected among shipyard workers. This is for disposal of all 100 reactor compartments.

The subdivision alternative involves significantly more work. Because of this, shipyard workers would receive more radiation exposure than if the reactor compartment were left whole. Depending on whether subdivision occurred at the time of decommissioning or was delayed ten years, 13 to 44 additional latent cancer fatalities are projected among shipyard workers.

This impact on shipyard workers is a key discriminator between land burial of the entire reactor compartment and the subdivision alternative.

For the general public, we looked at the effects of transporting the reactor compartments to the burial site. The general public population in the vicinity of the transport route is about 200,000 people. As you can see in this table, there would be virtually no effect to dispose of all 100 reactor compartments regardless of the alternative selected.

There are projected to be no more than .003 total additional cancer fatalities as a result of the land

burial alternative. What this number really means is that the effect of land burial of all 100 reactor compartments at Hanford is insignificant when compared to the chance of being struck by lightning.

We concluded all the alternatives evaluated would have minimal impact on the general public and the environment.

For workers, however, land burial of the entire reactor compartment at Hanford would result in a much lower potential for latent cancer fatalities as compared to the subdivision alternative.

And finally, land burial of the entire reactor compartment at Hanford also has the advantage of being a permanent solution.

I thank you for your courtesy and attention.

Mr. Shipley.

* * * * * * *

MR. SHIPLEY: Thank you.

Ladies and gentlemen, it's important that all who wish to speak are provided with an opportunity to do so.

I request your cooperation and courtesy tonight while people are speaking. It is important to provide comments within the time limits.

To allow time for comments, statements should be summarized to five minutes with written statements submitted for the record.

This lighting system will be used to monitor time available to speakers. The green light will initially be illuminated. The yellow light will indicate when 60 seconds remain. The red light will indicate when your time has expired.

The procedure for public comment will be as follows: I will announce each registered speaker; when called, please proceed to and use one of the microphones provided; please state your name for the record; if you are representing an organization, please give the name of the organization as well; and all comments are to be directed to me.

We are pleased to have as our first speaker, Mr. Doug Stewart-Smith.

Mr. Smith.

* * * * * * *

PUBLIC COMMENT PERIOD

#5

MR. STEWART-SMITH: Good evening. For the record, my name is David A. Stewart-Smith. I'm the administrator of the Facility Regulation Division for the Oregon Department of Energy, 625 Marion Street, Northeast, Salem, Oregon.

We will provide written comments prior to the October 10th deadline.

The first point I'd have is that we appreciate the Navy conducting this series of hearings and, in particular, holding a hearing in Oregon on the issue. But we would suggest that in the future, that as the state agency responsible for issues involving nuclear disposal and transportation, that you work with us on setting up this kind of a public meeting.

We have a number of contacts. We'd like to help you get public notice out, and we think we could help you have perhaps a more meaningful discussion with members of the public if we were involved a little bit earlier.

Specifically, with respect to your proposal, our recent experience with the submarine reactor compartment shipments has been uniformly positive. The Oregon Health Division, the state's radiation control agency, has inspected several of the shipments of the 50 that you mentioned for the existing campaign, and it's found them to be well in compliance with all applicable regulations.

The Oregon-Hanford Waste Board's nuclear transportation committee - the Oregon-Hanford Waste Board is a citizen advisory commission set up to advise both the governor and the legislature assembly of issues related to Hanford - was given a thorough briefing on the existing reactor compartment disposal shipment campaign at the Puget Sound Naval Shipyard and found the operation to be well run.

Our agency has been given sufficient notice prior to each shipment, and we continue to appreciate that. So I guess my point is as long as the Navy continues a second disposal program, as you are proposing, in the same manner as our experience has indicated with the current one, we believe these shipments can be conducted safely.

Thank you.

Any questions of me?

MR. WRZESKI: Thank you very much.

* * * * * * *

MR. SHIPLEY: Thank you very much.

Ladies and gentlemen, I have no further registrations. Has anyone registered to speak that I've not given the opportunity to?

I want to thank you all on behalf of the United States Navy for taking the time to participate in the hearing tonight. We appreciated the opportunity to hear your comments and will work to make sure they are addressed in the Final EIS.

This meeting is adjourned. Thank you very much.

HEARING CONCLUDED: 7:27 p.m.

C-E-R-T-I-F-I-C-A-T-E

STATE OF WASHINGTON)
) ss.
COUNTY OF KING)

I, PAULA SOMERS, a duly authorized Notary Public in and for the State of Washington, do hereby certify that this is a true transcript of the Public Hearing regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants; that the minutes of said meeting were recorded in shorthand and later reduced to typewriting; and that the above and foregoing is a true and correct transcript of said meeting.

I do further certify that I am not a relative of, employee of, or counsel for either of said parties or otherwise interested in the event of said proceedings.

I HAVE HEREUNTO set my hand and affixed my official seal this 27th day of September, 1995.

Paula Somers

Paula Somers, Notary Public
in and for the State of
Washington, residing at Renton.
CSR #: 299-06

#5a

Oregon

DEPARTMENT OF
ENERGY

October 3, 1995

Mr. John Gordon
Puget Sound Naval Shipyard
Code 1160
Bremerton, Washington 98314-5001

Dear Mr. Gordon:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class and Los Angeles Class Naval Reactor Plants. The following comments are submitted on behalf of the Oregon Department of Energy. The Oregon Department of Energy has lead responsibility for the safe transport of radioactive waste through Oregon.

Our recent experience with the Navy's submarine reactor compartment shipments has been positive. The Oregon Health Division has inspected some shipments and found them well in compliance with all applicable regulations. The Oregon Hanford Waste Board's Transport Committee (an advisory group to our agency) was given a thorough briefing on the shipments at Puget Sound Naval Shipyard and found the operation to be very well run. Our agency is also given sufficient notice prior to each shipment.

So long as the Navy continues the disposal program in the same manner as it has in the past, we believe the shipments can be conducted safely. Should the Navy plan any major changes from that program, such as using only one tug instead of two, or not allowing state inspections, then we would have to re-assess the program.

While we are pleased that the Navy conducted a public meeting in Oregon on this issue, in the future, we ask that you work with our agency on schedule, location, and meeting publicity so that we can help you have a meaningful discussion with interested Oregonians. We believe the fact that no members of the public turned out for your Portland meeting is more an indication of your lack of sufficient publicity, rather than a lack of public interest.

Sincerely,

David A Stewart-Smith

David A. Stewart-Smith, Administrator
Facility Regulation Division

John A. Kitzhaber
Governor

625 Marion Street NE
Salem, OR 97310
(503) 378-4040
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COPY

P R O C E E D I N G S

PUBLIC HEARING
DRAFT ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

Jackson Federal Building
915 Second Avenue
Seattle, Washington 98104

BAYSIDE REPORTERS
4041 Ruston Way
Suite 1-D
Tacoma, Washington 98402

REPORTED BY KAREN M. RUSK, CSR
September 20, 1995

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ATTENDANCE

MR. DICK SHIPLEY - Director of Environment, Safety, and Health, Puget Sound Naval Shipyard

MR. JIM WRZESKI - Reactor Compartment Disposal Manager, U.S. Navy

MR. MARK FRENCH - Department of Energy

The Assembly of the Public Meeting regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants convened on the 20th of September, 1995, at the Jackson Federal Building, 915 Second Avenue Seattle, Washington, beginning at the hour of 7:00 p.m., Mr. Shipley presiding.

* * * * * * *

MR. SHIPLEY: Good evening, ladies and gentlemen. Thank you for coming tonight. My name is Dick Shipley, and I am the Director of Environment, Safety, and Health at Puget Sound Naval Shipyard. Tonight, I am serving as the presiding officer for this public meeting.

With me this evening is Mr. Jim Wrzeski, the Navy's reactor compartment disposal manager. Also with us tonight from the Department of Energy is Mr. Mark French. The Department of Energy is a cooperating agency in the development of the Environmental Impact Statement.

On August 15th, 1995, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, which we call the Draft EIS, on the disposal of decommissioned, defueled reactor plants from cruisers and OHIO and LOS ANGELES Class

submarines. The Navy, in cooperation with the Department of Energy, has prepared this Draft EIS to focus on the potential for significant environmental impacts and to consider reasonable alternatives.

The management of spent fuel is not the subject of this EIS. The disposition of spent fuel was addressed in the DOE Environmental Impact Statement identified on this slide, with the Navy as a cooperating agency.

The Navy's Federal Register announcement scheduled public meetings at various locations in order to provide organizations and individuals with an interest in this matter with an opportunity to present their views. We are here this evening to conduct one of these scheduled public meetings.

Tonight's meeting is being held as part of the decision-making process required by the National Environmental Policy Act called NEPA. NEPA is our basic national charter for protection of the environment. NEPA procedures ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

The Draft EIS was developed based on public input received during the scoping phase of the NEPA process.

Tonight we are here to listen to what you have to say. We will not be directly responding to questions tonight. The purpose of tonight's meeting is to receive your input so that it can be addressed in the development of the final EIS. The purpose is not to engage in debate.

It is my responsibility to receive statements so that they can be considered in preparing the Final EIS. For that reason, the meeting is being recorded.

Copies of the agenda for tonight's meeting are available on the table in the back. It explains the order of our meeting this evening and will consist of a presentation by Mr. Wrzeski on the alternatives evaluated in the Draft EIS.

This presentation will last approximately 20 minutes and will be followed by the formal comment period. This comment period is the time that we listen to you. Responses to each individual comment or question will be in the Final EIS.

After all comments have been given, we will conclude the meeting with closing remarks. I will afford an opportunity to those individuals and organizations who wish to speak. I would appreciate if anyone wishing to speak would fill out a registration form at the door.

Whether or not you speak this evening, you may also provide written comments to me or leave them with the

staff at the registration table. Oral and written input will be considered equally in the development of the Final EIS.

If you desire to provide written comments at a later time, they should be sent to: Mr. John Gordon, Puget Sound Naval Shipyard, 1400 Farragut Avenue, Code 1160, Bremerton, Washington 98314-5001.

Written comments postmarked by October 10th, 1995, will be considered in the preparation of the Final EIS. Comments postmarked after that date will be considered to the extent practical.

Before we begin receiving public input, I would like to introduce Mr. Wrzeski, who will provide a general overview of the alternatives which have been evaluated in the Draft EIS.

Mr. Wrzeski.

* * * * * * *

PRESENTATION

MR. WRZESKI: Thank you, Mr. Shipley. Good evening, ladies and gentlemen.

By the 1980's, many of the Navy's submarines were reaching the end of their useful life. At that time, the Navy prepared an Environmental Impact Statement to evaluate various disposal methods for the radioactive components associated with the nuclear power plants on these submarines.

In the 1984 Record of Decision, the Navy selected land burial of the reactor compartment as the disposal method for these components. Since then, the Navy has completed 50 successful shipments under the 1984 program.

Now, in the 1990s, recent changes in the national defense structure have resulted in the down-sizing of the fleet, including nuclear-powered combatants. Because of this down-sizing, the Navy will soon need to address disposal of the reactor compartments associated with cruisers, OHIO Class submarines and LOS ANGELES Class submarines.

This EIS has been prepared because the approximately 100 reactor compartments from these classes of ships were not covered under the 1984 EIS.

This figure shows the location of the reactor compartments on a typical Navy cruiser and submarine.

The functional design of the ship's reactor compartment makes it an ideal disposal package. The compartment is completely enclosed by structural walls known as bulkheads and, in the case of a submarine, part of the enclosure is the ship's pressure hull.

The bulkheads contain lead shielding to protect the crew during the reactor operation. The bulkheads are

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designed to meet the shocks and stresses of a military ship under combat conditions.

These features make the reactor compartment a superior transportation and disposal package that is far stronger than typical industry containers used to dispose of low-level radioactive waste.

The remainder of the ship is recycled to reuse the metals.

Tonight I will first discuss the alternatives the Navy considered for disposal of the reactor plant. Later in my presentation, I will discuss the potential environmental consequences. In all of the alternatives considered, the spent fuel would be removed before initiating disposal.

The Navy evaluated several alternatives in this EIS. Land burial of the entire reactor compartment at Hanford, Washington, is our preferred alternative. We also looked at waterborne storage of the ship, which is the no-action alternative. We evaluated subdivision of the reactor compartment. This alternative disassembles the reactor plant and disposes of the components separately. Finally, we looked at above-ground storage of the reactor compartments at Hanford.

Now I would like to describe our preferred alternative. My presentation will focus mainly on the preferred alternative, even though the Draft EIS analyzes the others in considerable detail.

As discussed earlier, the reactor compartment makes an ideal disposal package. For this and other reasons that I'll discuss, the Navy has determined that burial of the entire reactor compartment at Hanford is the preferred alternative.

This is the same basic method as our current disposal program, which has been demonstrated to be safe, effective and is accomplished with no significant impact to workers, the public, or environment.

As I discuss the preferred alternative, I will be using slides taken from the Navy's current disposal program to illustrate the proposed method.

The reactor compartment would be separated from the rest of the ship and placed on a barge for waterborne transport. The sealed package would meet all Department of Transportation and Nuclear Regulatory Commission requirements. The barges used would meet all United States Coast Guard and Navy requirements.

The inset shows the transportation route proposed for all the alternatives that take an entire reactor compartment to Hanford. The shipments would leave from Puget Sound Naval Shipyard, proceed along the Washington coast, up the Columbia River to the Port of Benton near

the Hanford site. This is the same route taken under the current disposal program.

I would like to go into some detail on the safety features we would use for waterborne transport of the reactor compartment.

We designed the waterborne transportation system conservatively. This means the transport system is capable of safely handling conditions much worse than we actually expect.

As you can see in this picture, the barges are designed with multiple tanks and watertight bulkheads between them. The barge will remain stable under storm conditions even if two of these tanks are damaged and completely flooded. Even more damage and flooding could be sustained and still the barge would remain floating.

Safety is further assured by not shipping in bad weather. We use only experienced towing contractors and always use a backup tug that follows the shipment.

In addition, the Navy designs the reactor compartment package with a number of engineered features that would facilitate location and salvage.

At the Port of Benton, the reactor compartment would be off-loaded from the barge, hauled over land and placed in a burial trench similar to what is shown in this picture.

The proposed burial site for the reactor compartments is the low-level burial grounds located near the center of the Hanford site. These burial grounds are well suited to the permanent disposal of reactor compartments. The arid climate, plus existing soil characteristics are beneficial for waste disposal. In addition, the site is accessible by barge with a short overland haul.

Now I'd like to briefly describe the other alternatives.

The no-action alternative we evaluated is protective waterborne storage of the ship for an indefinite period. The locations considered for waterborne storage of the ship are Puget Sound Naval Shipyard in Bremerton, Washington and at Norfolk Naval Shipyard in Portsmouth, Virginia.

While the impacts are very small during storage, the no-action alternative does not provide for a permanent solution. The effort for final disposition would have to be undertaken sometime in the future.

In contrast to land burial of the reactor compartment package, in the subdivision alternative, rather than remain whole, the reactor compartment would be disassembled.

Because of the reactor compartment's rugged nature,

the disassembly effort requires extensive structural work. This work would involve rigorous environmental protection techniques to remove the radioactive components.

Packaging of the large components would require that special shipping containers be designed and built for their disposal. Many would be large enough that shipment by truck or rail would not be feasible. These components would be disposed of at the Department of Energy sites such as Hanford or Savannah River.

The amount of smaller components to be processed and transported would be significantly greater under this alternative. This alternative requires 15 times the number of shipments as the preferred alternative.

The Navy also evaluated storing the reactor compartments above ground for an indefinite period. The location considered for storage is the Department of Energy site at Hanford.

Similar to the no-action alternative, the impacts are very small during storage. However, this alternative also does not provide for a permanent solution and some future action would be required.

Now I am going to talk about the environmental consequences of the alternatives we considered.

Our evaluation was broken down into three segments that reflect where potential impacts would take place: at shipyards, along the transportation route, and at the disposal site.

For each of these segments, I will discuss the results of the environmental studies that were performed. Several of the studies were performed by independent, technical organizations outside the Navy, such as Pacific Northwest Laboratory.

The environmental areas we studied for shipyards are summarized on this slide. We looked at the possible effects from industrial work such as welding, sandblasting, and hazardous material removal.

We determined that the principal effect is that shipyard workers would receive some exposure to radiation. Personnel radiation exposures are maintained as low as reasonably achievable and kept within guidelines set by the Nuclear Regulatory Commission. Total exposure is expected to be much higher in the subdivision alternative than if the reactor compartment were left whole.

The industrial procedures used to prepare reactor compartments for disposal would be the same as those currently used at shipyards. These procedures are in compliance with Navy Occupational Safety and Health requirements. These requirements are designed to

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protect workers from industrial hazards associated with their work.

The measures used by the Navy to protect its own workers from potential hazards during disposal work would protect the surrounding public and the environment as well.

The environmental areas we studied for transportation are summarized on this slide. The potential health effects to the general population and the transport crew were evaluated for normal conditions of transport and accident scenarios. The potential impacts from the transport were found to be very low for all scenarios considered.

In the extremely unlikely event that a barge did sink and the water entered the reactor compartment, no significant environmental impact should occur. This is because 99.9 percent of the radioactivity in the reactor compartment is part of the reactor plants' metal components and can only be released through corrosion. The remaining radioactivity is contained within the sealed reactor plant systems.

There would be no environmental consequences from other hazardous substances. This is because nearly all are solids and would, therefore, not be released to the surrounding waters.

The environmental areas we studied at the burial site are summarized on this slide. The focus of our analysis was the movement of radioactive and other hazardous materials from the disposal site. We call this process migration.

It is important to point out a couple of areas where studies assumed unfavorable conditions. Making these assumptions mean the study results are worse than we actually expect.

Hanford has an arid climate with only 6 inches of rainfall per year. The study assumed that there is ten times more moisture in contact with the buried compartments than is expected under current conditions.

The migration study also assumed that the hazardous materials were exposed and immediately available for movement through the ground. When in fact, the corrosion study determined that the reactor compartments are so robust that they will contain these materials for at least 600 years.

This slide summarizes the results of the migration study.

The study determined that it would take over 700,000 years for lead to reach the Columbia River. Most of the radioactive material would decay away before being released from the reactor compartments.

Radioactive nickel would make up the bulk of what is released and this nickel would take over 200,000 years to reach the river.

For all of the substances considered in this evaluation, concentrations would not exceed current groundwater protection standards.

Because these results are based on the unfavorable assumptions, we expect the actual movement of radioactive and other hazardous materials to take much longer and result in even lower concentrations.

Now I would like to discuss the potential impact of radiation exposure to workers and the public.

The health concern of low-level exposure to radiation is the potential to induce cancer over time, referred to as latent cancer. Many studies have been done to determine the effect radiation would have on the chance of a person developing cancer.

Our studies determined the potential radiation exposures for all of the alternatives evaluated. We then used conversion factors approved by the International Council on Radiological Protection to determine the number of potential latent cancer fatalities.

First, let's look at our analysis of impacts to the shipyard workers.

To dispose of the entire reactor compartment, no more than .6 additional latent cancer fatalities are projected among shipyard workers. This is for disposal of all 100 reactor compartments.

The subdivision alternative involves significantly more work. Because of this, the shipyard workers would receive more radiation exposure than if the reactor compartment were left whole. Depending on whether subdivision occurred at the time of decommissioning or was delayed ten years, 13 to 44 additional latent cancer fatalities are projected among shipyard workers.

This impact on shipyard workers is a key discriminator between land burial of the entire reactor compartment and the subdivision alternative.

For the general public, we looked at the effects of transporting the reactor compartment to the burial site. The population in the vicinity of the transport route is about 200,000 people. As you can see in this table, there would be virtually no affect to dispose of all 100 compartments regardless of the alternative selected.

There are projected to be no more than .003 total additional cancer fatalities as a result of the land burial alternative. What this number really means is that the effect of land burial of all 100 reactor compartments at Hanford is insignificant when compared

to the chance of being struck by lightning.

We concluded that all of the alternatives evaluated would have minimal impact on the general public and the environment.

For workers, however, land burial of the entire reactor compartment at Hanford would result in a much lower potential for latent cancer fatalities as compared to the subdivision alternative.

And finally, land burial of the entire reactor compartment at Hanford also has the advantage of being a permanent solution.

I thank you for your courtesy and attention.

Mr. Shipley.

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MR. SHIPLEY: Ladies and gentlemen, it is important that all of those who wish to speak are provided with an opportunity to do so.

Out of courtesy, I intend to recognize representatives of government organizations and then individual citizens.

I request your cooperation tonight while people are speaking.

The procedure for public comment will be as follows: I will announce each registered speaker; when called, please proceed to and use one of the microphones provided; please state your name for the record; if you are representing an organization, please give the name of the organization as well; please direct all of your comments to me.

* * * * * * *

PUBLIC COMMENT PERIOD

MR. SHIPLEY: We are pleased to have as our first speaker tonight Cynthia Sarthou. Cynthia?

#6

MS. SARTHOU: My name is Cynthia Sarthou. I'm the staff attorney for Heart of America Northwest, 1305 Fourth Avenue, Suite 208, Seattle, Washington 98102. We are an organization of 15,000 members located in the City of Seattle. Our members are throughout the state of Washington and Oregon, and we are interested in this issue.

I brought some comments that I would like to read, and then I have, I guess, one or two little things to add to the presentation.

4.12

1) The Draft Environmental Impact Statement professes to reveal and discuss all possible environmental impacts attendant to decommissioning and transportation of the specified nuclear naval reactor plants. The Navy has been reluctant, however, to allow the public to verify the validity of the information provided within the EIS.

In fact, recently, the Navy has requested that Restricted Area 2 in Sinclair Inlet be deemed entirely off-limits to public access. In so doing, the Navy is suggesting to the public that it is unwilling to disclose or hold up to objective scrutiny the environmental impacts of decommissioning and transportation operations in Puget Sound. 4.12

4.13

2) The reactor compartments contain lead- and PCB-laden materials. Although deemed a low-level burial ground, the area slated for disposal is, in effect, a system of large trenches with minimal protections against leaching of contaminants. It is imperative that the EIS address the potential environmental impacts of these materials in the absence of institutional controls.

Equally importantly, these materials, if disposed of at the Hanford low-level burial grounds, must be subject to regulation under the Washington State Dangerous Waste Regulations to minimize the effect of disposal of these materials.

4.14

3) The Navy has recently instructed the Department of Energy to bar public and press viewing of burial grounds containing naval reactor compartments during USDOE tours of the Hanford Nuclear Reservation. By this action, the Navy is implicitly stating that it is

4.14 unwilling to open its disposal practices to public scrutiny. This is objectionable. There is no national security justification for denying the public scrutiny of burial practices, and therefore they should not be barred from seeing these practices.

4) The EIS predicts the need for four hectares, or ten acres, for disposal of the compartments addressed by this EIS. Approximately four hectares, or ten acres, has already been used for the Pre-LOS ANGELES Class compartments, and additional lands will be required for reactor compartments of subsequent classes of vessels slated for decommissioning.

4.15 The Navy should minimize its use of Hanford lands for disposal of these materials. The public does not consider Hanford a sacrifice zone and objects to the continual use of large areas of Hanford for Navy and DOE waste disposal. Moreover, the cost of Hanford lands should be included in any analysis of the fiscal cost of this alternative.

3.1 5) The EIS also refers to the production of 1,625 cubic meters of mixed waste. The EIS does not appear to address disposal of these materials. It is evident that Hanford's low-level burial ground is not appropriate for disposal of these low-level mixed wastes. Accordingly, the EIS must address a site for disposal of these

3.1 materials and the environmental impacts attendant thereto.

4.16 The production of mixed waste should also be minimized and materials recycled where possible. The EIS should consider inclusion of recyclable materials within the proposed United States Department of Energy Recycle program or policy, known as Recycle 2000. This would minimize the amount of land needed for disposal of this material.

4.17 The other comment I have from this basic presentation was that I was somewhat disturbed by the calculations of transportation time of contaminants from the burial ground. I would just like the EIS to possibly consider that more fully.

I am not sure, but I'm pretty sure that those are based upon USDOE calculations. And in the past ten years, we have been shown that the USDOE's calculations are erroneous and overestimate the travel time by a significant amount, especially if you look at tritium quantities that were estimated not to be reaching the Columbia River for hundreds of years which are now reaching the Columbia River. So we would suggest that you maybe more carefully scrutinize that.

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MR. SHIPLEY: Thank you very much, Ms. Sarthou.

Ladies and gentlemen, I have no further registrations. Is anyone registered to speak to whom I have not given the opportunity?

I'd like to thank you all on behalf of the United States Navy for taking the time to participate in the hearing tonight. We appreciated the opportunity to hear your comments, and we'll work to make sure they are addressed in the Final EIS.

This meeting is adjourned.

HEARING CONCLUDED: 7:25 p.m.

C-E-R-T-I-F-I-C-A-T-E

STATE OF WASHINGTON)
) ss.
COUNTY OF PIERCE)

I, KAREN M. RUSK, a duly authorized Notary Public in and for the State of Washington, do hereby certify that this is a true transcript of the Public Hearing regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants; that the minutes of said meeting were recorded in shorthand and later reduced to typewriting; and that the above and foregoing is a true and correct transcript of said meeting.

I do further certify that I am not a relative of, employee of, or counsel for either of said parties or otherwise interested in the event of said proceedings.

I HAVE HEREUNTO set my hand and affixed my official seal this 27th day of September, 1995.

KAREN M. RUSK
3-13-98

Karen M. Rusk

Karen M. Rusk, Notary Public in
and for the State of Washington,
residing at Tacoma.
CSR #: RUSK*KM416SR

#6a

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"Advancing our region's quality of life."

COMMENTS OF HEART OF AMERICA NORTHWEST ON THE NAVY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OF DECOMMISSIONED, DEFUELED, CRUISER, OHIO CLASS AND LOS ANGELES CLASS SUBMARINE NAVAL REACTOR PLANTS

1. Although the Navy in its Draft Environmental Impact Statement professes to reveal and discuss all possible environmental impacts attendant to decommissioning and transportation of the specified Naval Reactor Plants, the Navy has been reluctant to allow the public to verify the validity of the information provided within the EIS. In fact, recently, the navy has requested that Restricted Area 2 in Sinclair Inlet be deemed entirely off-limits to public access. In so doing, the navy is suggesting to the public that it is unwilling to disclose or hold up to objective scrutiny the environmental impacts of decommissioning and transportation operations in Puget Sound. **4.12**

2. The reactor compartments contain lead and PCB laden materials. Although deemed a "low level burial" ground. The area slated for disposal is in effect a system of large trenches with minimal protections against leaching of contaminants. It is imperative that the EIS address the potential environmental effects of these materials in the absence of institutional controls. Equally importantly, these materials, if disposed of at the Hanford Low Level Burial Grounds, must be subject to regulation under the Washington State Dangerous Waste Regulations, to minimize the effect of disposal of these materials. **4.13**

3. The Navy has recently instructed the Department of Energy to bar public and press viewing of the burial grounds containing naval reactor compartments during USDOE tours of the Hanford Nuclear Reservation. By this action, the Navy is implicitly stating that it is unwilling to open its disposal practices to public scrutiny. This is objectionable. There is no national security justification for deny the public scrutiny of burial practices. **4.14**

4. The EIS predicts the need for 4 hectares (or 10 acres) for disposal of the compartments addressed by this EIS. Approx. 4 hectare (or 10 acres) has already been used for the Pre-Los Angeles Class compartments and additional lands will be required for reactor compartments of subsequent Classes of Vessels slated for decommissioning. The Navy should minimize its use of Hanford Lands for Disposal of these materials. The public does not consider Hanford a "sacrifice zone" and objects to the continual use of Hanford large areas of the Hanford Nuclear Reservation for Navy and DOE waste disposal. Moreover, the cost of Hanford Lands should be included in any analysis of the fiscal cost of this alternative. **4.15**

5. The EIS also refers to the production of 1625 cubic meters of mixed waste. The EIS does not appear to address disposal of these materials. It is evident that Hanford's Low Level Burial Ground is not appropriate for disposal of these materials. Accordingly, the EIS must address a site for disposal of these materials and the environmental impacts attendant thereto. **3.1**

recycled paper

The production of mixed waste should be minimized and materials recycled where possible. The EIS should consider inclusion of recyclable materials within the proposed United States Department of Energy Recycle Policy/Program (Recycle 2000). This would minimize the amount of land needed for disposal of this material. **3.1**

COPY

P R O C E E D I N G S

PUBLIC HEARING
DRAFT ENVIRONMENTAL IMPACT STATEMENT ON DISPOSAL OFF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

Shilo Inn-Rivershore
International 1 Room
50 Comstock Street
Richland, Washington 99352

BAYSIDE REPORTERS
4041 Ruston Way
Suite 1-D
Tacoma, Washington 98402

REPORTED BY PAULA SOMERS
September 21, 1995

INDEX

APPEARANCES

MR. DICK SHIPLEY - Director of Environment, Safety, and Health; Puget Sound Naval Shipyard

MR. JIM WRZESKI - Reactor Compartment Disposal Manager, U.S. Navy

MR. MARK FRENCH - Department of Energy

The Assembly of the Public Hearing, regarding the Draft Environmental Impact Statement on the disposal of decommissioned, defueled cruiser, OHIO Class and LOS ANGELES Class naval reactor plants, convened on the 21st of September, 1995, at the Shilo Inn-Rivershore, International 1 Room, 50 Comstock Street, Richland, Washington 99352, beginning at the hour of 6:59 p.m., Mr. Shipley presiding.

* * * * * * *

MR. SHIPLEY: Good evening, ladies and gentlemen. Thank you for coming. My name is Dick Shipley. I'm the Director of Environment, Safety, and Health at Puget Sound Naval Shipyard. Tonight I'm serving as the presiding officer for this public meeting.

Also with me this evening is Mr. Jim Wrzeski, the Navy's reactor compartment disposal manager. With us tonight from the Department of Energy is Mr. Mark French. The Department of Energy is a cooperating agency in the development of the Environmental Impact Statement.

On August 15th, 1995, the Navy announced in the Federal Register the availability of the Draft Environmental Impact Statement, which we call the Draft EIS, on the disposal of decommissioned, defueled,

reactor plants from cruisers, OHIO Class and LOS ANGELES Class submarines. The Navy, in cooperation with the Department of Energy, has prepared this Draft EIS to focus on the potential for significant environmental impacts and to consider reasonable alternatives.

The management of spent fuel is not the subject of this EIS. The disposition of spent fuel was addressed in the Department of Energy Environmental Impact Statement identified on this slide, with the Navy as a cooperating agency.

The Navy's Federal Register announcement scheduled public meetings at various locations in order to provide organizations and individuals with an interest in this matter with an opportunity to present their views. We are here this evening to conduct one of these scheduled public meetings.

Tonight's meeting is being held as a part of the decision-making process required by the National Environmental Policy Act called NEPA. NEPA is our basic national charter for protection of the environment. NEPA procedures ensure that environmental information is available to public officials and private citizens before decisions are made and before actions are taken.

The Draft EIS was developed based on public input received during the scoping phase of the NEPA process.

Tonight we are here to listen to what you have to say. We will not be directly responding to questions tonight. The purpose of tonight's meeting is to receive your input so that it can be addressed in the development of the Final Environmental Impact Statement. The purpose is not to engage in debate.

It's my responsibility to receive statements so that they can be considered in preparing the Final EIS. For that reason, the meeting is being recorded tonight.

Copies of the agenda for tonight's meeting are available on the table in the back. It explains that the order of our meeting this evening will consist of a presentation by Mr. Wrzeski on the alternatives evaluated in the Draft EIS.

This presentation will last approximately 20 minutes and will be followed by the formal comment period. This comment period is the time when we listen to you. Responses to each individual comment or question will be in the Final Eis.

After all comments have been given, we will conclude the meeting with closing remarks. I will afford an opportunity to those individuals and organizations who wish to speak. I would appreciate it if anyone wishing to speak would fill out a registration form at the door.

Whether or not you choose to speak this evening, you may also provide written comments to me or leave them with the staff at the door. Oral and written input will be considered equally in the development of the Final EIS.

If you desire to provide written comments at a later time, they should be sent to: Mr. John Gordon, Puget Sound Naval Shipyard, 1400 Farragut Avenue, Code 1160, Bremerton, Washington 98314-5001.

Written comments postmarked by October 10th, 1995, will be considered in preparation of the Final EIS. Comments postmarked after that date will be considered to the extent practical.

Before we begin receiving public input, I would like to introduce Mr. Wrzeski, who will provide a general overview of the alternatives which have been evaluated in the DEIS.

Mr. Wrzeski.

* * * * * * *

PRESENTATION

MR. WRZESKI: Thank you, Mr. Shipley. Good evening, ladies and gentlemen.

By the 1980s, many of the Navy's submarines were reaching the end of their useful life. At that time, the Navy prepared an Environmental Impact Statement to evaluate various disposal methods for the radioactive components associated with the nuclear power plants on these submarines.

In the 1984 Record of Decision, the Navy selected land burial of the reactor compartment as the disposal method for these components. Since then, the Navy has completed 50 successful shipments under the 1984 program.

Now, in the 1990s, recent changes in the national defense structure have resulted in downsizing of the fleet, including nuclear-powered combatants. Because of this downsizing, the Navy will soon need to address disposal of the reactor compartments associated with cruisers, OHIO Class submarines, and LOS ANGELES Class submarines.

This EIS has been prepared because the approximately 100 reactor compartments from these classes of ships were not covered under the 1984 EIS.

This figure shows the location of reactor compartments on a typical Navy cruiser and submarine.

The functional design of the ship's reactor compartment makes it an ideal disposal package. The compartment is completely enclosed by structural walls known as bulkheads and, in the case of the submarine, part of the enclosure is the ship's pressure hull.

The bulkheads contain lead shielding to protect the crew during reactor operation. The bulkheads are designed to meet the shocks and stresses of a military ship under combat conditions.

These features make the reactor compartment a superior transportation and disposal package that is far stronger than typical industry containers used to dispose of low-level radioactive waste.

The remainder of the ship is recycled to reuse the metals.

Tonight I will first discuss the alternatives the Navy considered for disposal of the reactor plant. Later in my presentation, I will cover the potential environmental consequences. In all of the alternatives considered, the spent fuel would be removed before initiating disposal.

The Navy evaluated several alternatives in this EIS. Land burial of the entire reactor compartment at Hanford, Washington, is our preferred alternative. We also looked at waterborne storage of the ship, which is the no-action alternative. We evaluated subdivision of the reactor compartment. This alternative disassembles the reactor plant and disposes of the components separately. Finally, we looked at above-ground storage of the reactor compartments at Hanford.

Now we'd like to describe our preferred alternative. Our presentation will focus mainly on the preferred alternative, even though the Draft EIS analyzes the others in considerable detail.

As discussed earlier, the reactor compartment makes an ideal disposal package. For this and other reasons that I'll discuss, the Navy has determined that burial of the entire reactor compartment at Hanford is the preferred alternative.

This is the same basic method as our current disposal program, which has been demonstrated to be safe, effective, and is accomplished with no significant impact to workers, the public, or environment.

As I discuss the preferred alternative, I will be using slides taken from the Navy's current disposal program to illustrate the proposed method.

The reactor compartment would be separated from the rest of the ship and placed on a barge for waterborne transport. The sealed package would meet all Department of Transportation and Nuclear Regulatory Commission requirements. The barges used would meet all the United States Coast Guard and Navy requirements.

The inset shows the transportation route proposed for all the alternatives that take an entire reactor compartment to Hanford. The shipments would leave from

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Puget Sound Naval Shipyard and proceed along the Washington coast, up the Columbia River to the Port of Benton, near the Hanford Site. This is the same route taken under the current disposal program.

I would like to go into some detail on the safety features we would use for waterborne transport of the reactor compartment.

We designed the waterborne transport system conservatively. This means the transport system is capable of safely handling conditions that are much worse than we actually expect.

As you can see in this picture, the barges are designed with multiple tanks and watertight bulkheads between them. The barge will remain stable under storm conditions even if two of these tanks are damaged and completely flooded. Even more damage and flooding could be sustained, and still the barge would remain floating.

Safety is further assured by not shipping in bad weather. We use only experienced towing contractors and always use a backup tug that follows the shipment.

In addition, the Navy designs the reactor compartment package with a number of engineered features that would facilitate location and salvage.

At the Port of Benton, the reactor compartment would be off-loaded from the barge, hauled over land,

and placed in a burial trench similar to what is shown in this picture.

The proposed burial site for reactor compartments is the low-level burial grounds located near the center of the Hanford Site. These burial grounds are well suited to the permanent disposal of reactor compartments. The arid climate, plus existing soil characteristics, are beneficial for waste disposal. In addition, the site is accessible by barge with a short overland haul.

Now I'd like to briefly describe the other alternatives.

The no-action alternative we evaluated is protective waterborne storage of the ship. The locations considered for waterborne storage of the ship are Puget Sound Naval Shipyard in Bremerton, Washington, and Norfolk Naval Shipyard in Portsmouth, Virginia.

While the impacts are very small during storage, the no-action alternative does not provide for a permanent solution, and the effort for final disposition would have to be undertaken sometime in the future.

In contrast to land burial of the reactor compartment package in the subdivision alternative, rather than remain whole, the reactor compartment would be disassembled.

Because of the reactor compartment's rugged nature, this disassembly effort requires extensive structural work. This work would involve rigorous environmental protection techniques to remove the radioactive components.

Packaging of the large components would require that special shipping containers be designed and built for their disposal. Many would be large enough that shipment by truck or rail would not be feasible. These components would be disposed of at Department of Energy sites such as Savannah River or Hanford.

The amount of smaller components to be processed and transported would be significantly greater under this alternative. This alternative requires 15 times the number of shipments as the preferred alternative.

The Navy also evaluated storing the reactor compartments above ground for an indefinite period.

The location considered for storage is the Department of Energy site at Hanford.

Similar to the no-action alternative, the impacts are very small during the storage. However, this alternative also does not provide for a permanent solution, and some future action would be required.

Now I'm going to talk about the environmental consequences of the alternatives we considered.

Our evaluation was broken down into three segments that reflect where potential impacts would take place: at shipyards, along the transportation route, and at the disposal site.

For each of these segments I will discuss the results of the environmental studies that were performed. Several of these studies were performed by independent technical organizations outside the Navy, such as Pacific Northwest Laboratory.

The environmental areas we studied for shipyards are summarized on this slide. We looked at the possible effects from industrial work such as welding, sandblasting, and hazardous material removal.

We determined that the principal effect is that shipyard workers would receive some exposure to radiation. Personnel radiation exposures are maintained as low as reasonably achievable and would be kept within the guidelines set by the Nuclear Regulatory Commission. Total exposure is expected to be much higher in the subdivision alternative than if the reactor compartment were left whole.

The industrial procedures used to prepare reactor compartments for disposal would be the same as those currently used at shipyards. These procedures are in compliance with Navy Occupational Safety and Health

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requirements. These requirements are designed to protect workers from industrial hazards associated with their work.

The measures used by the Navy to protect its own workers from potential hazards during disposal work would protect the surrounding public environment as well.

The environmental areas we studied for transportation are summarized on this slide. Potential health effects to the general population and the transport crew were evaluated for normal conditions of transport and accident scenarios. The potential impacts from transport were found to be very low for all the scenarios considered.

In the extremely unlikely event that a barge did sink and water entered the reactor compartment, no significant environmental impact would occur. This is because 99.9 percent of the radioactivity in the reactor compartment is part of the reactor plant's metal components and can only be released through corrosion. The remaining radioactivity is contained within the sealed reactor plant systems.

There would be no environmental consequences from other hazardous substances. This is because nearly all are solids and would, therefore, not be released to surrounding waters.

The environmental areas we studied at the burial site are summarized on this slide. The focus of our analysis was the movement of radioactive and other hazardous materials from the burial site. We call this process migration.

It's important to point out a couple areas where the studies assumed unfavorable conditions. Making these assumptions mean the study results are worse than we actually expect.

Hanford has an arid climate with only about 6 inches of rainfall per year. The study assumed that there is ten times more moisture in contact with the burial compartments than is expected under current conditions.

The migration study also assumed that the hazardous materials were exposed and immediately available for movement through the ground, when, in fact, corrosion studies determined that the reactor compartments are so robust that they will contain these materials for at least 600 years.

This slide summarizes the results of the migration study.

The study determined that it would take over 700,000 years for lead to reach the Columbia River.

Most of the radioactive material would decay away before being released from the reactor compartments. Radioactive nickel would make up the bulk of what is released, and this nickel would take over 200,000 years to reach the river.

For all substances considered in this evaluation, concentrations would not exceed current groundwater protection standards.

Because these results are based on the unfavorable assumptions, we expect the actual movement of radioactive and other hazardous materials to take much longer and result in even lower concentrations.

Now I'd like to discuss the potential impact of radiation exposure to workers and the public.

The health concern of low-level exposure to radiation is the potential to induce cancer over time, referred to as latent cancer. Many studies have been done to determine the effect radiation would have on the chance of a person developing cancer.

Our studies determined the potential radiation exposures for all the alternatives evaluated. We then used conversion factors approved by the International Council on Radiological Protection to determine the number of potential latent cancer fatalities.

First, let's look at our analysis of impacts to shipyard workers.

To dispose of the entire reactor compartment, no more than .6 additional latent cancer fatalities are projected among shipyard workers. This is for disposal of all 100 reactor compartments.

The subdivision alternative involves significantly more work. Because of this, shipyard workers would receive more radiation exposure than if the reactor compartment were left whole. Depending on whether subdivision occurred at the time of decommissioning or was delayed ten years, 13 to 44 additional latent cancer fatalities are projected among shipyard workers.

This impact on shipyard workers is a key discriminator between land burial of the entire reactor compartment and the subdivision alternative.

For the general public, we looked at the effects of transporting the reactor compartments to the burial site. The population in the vicinity of the transport route is about 200,000 people. As you can see in this table, there would be virtually no effect to dispose of all 100 reactor compartments regardless of the alternative selected.

There are projected to be no more than .003 total additional cancer fatalities as a result of the land burial alternative. Now, what this number really means

is that the effect of land burial of all 100 reactor compartments at Hanford is insignificant when compared to the chance of being struck by lightning.

We concluded all of the alternatives evaluated would have minimal impact on the general public and the environment.

For workers, however, land burial of the entire reactor compartment at Hanford would result in a much lower potential for latent cancer fatalities as compared to the subdivision alternative.

And, finally, land burial of the entire reactor compartment at Hanford also has the advantage of being a permanent solution.

I thank you for your courtesy and attention.

Mr. Shipley.

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MR. SHIPLEY: Ladies and gentlemen, it is important that all who wish to speak tonight are provided with an opportunity to do so.

Out of courtesy, I intend to recognize representatives of government organizations and then individual citizens.

I request your cooperation and courtesy tonight while people are speaking.

The procedure for public comment will be as follows: I will announce each registered speaker; when called, please proceed to and use one of the microphones provided; please state your name for the record; if you are representing an organization, please give the name of the organization as well; all comments should be directed to me.

We are pleased to have as our first speaker tonight, Mr. Dave Dillman of TRIDEC.

Mr. Dillman.

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PUBLIC COMMENT PERIOD

#7

MR. DILLMAN: Good evening. Thank you. My name is Dave Dillman. I'm Senior Vice President, Economic Transition, for TRIDEC, 901 North Colorado, Kennewick, Washington 99336.

What I'd like to do is - I've already submitted written comments - I'd just like to paraphrase those, if I could.

TRIDEC is the Tri-Cities' community not-for-profit Tri-Cities Industrial Development Council, representing approximately 600 businesses and agencies throughout the mid-Columbia region.

The purpose of our organization for the past 30 years has tried to look at the potential industrial recruitment for the Tri-Cities community as it relates

to bringing all the economic development bodies together. Representing the port, the cities, all those respective chambers of each of the communities, and trying to create a community one-voice agenda relative to the economic transition for the Tri-Cities, specifically tonight, relating to the Hanford Site.

Because of the uniqueness of Hanford - particularly in the last eight months, with the Congressional budget reductions, the work force reduction of approximately 4700 workers in 1995 - the role and mission of Hanford and how the Tri-Cities relates to that transition has changed significantly. And, in that, the past has been somewhat not much of a concern for the Tri-Cities community relating to what was being done or shipped to the Hanford Site.

That role and mission has been changed significantly in that as we proceed forward to try to do industrial recruitment both on the business side, the tourism side, relating to the development of agribusiness in our community, we feel there is definitely economic adverse effects. That is not really part of the Draft EIS at this point. What we're formally requesting is that the record of decision in this matter that the U.S. Navy address the issue of an advice on how to propose to work with the community in

4.18

4.18

mitigating the adverse impacts of the reactor burial.

TRIDEC does not express objections for a preferred alternative. We believe that further examination of the alternative is required from the standpoint of an economic and social impact upon the community. With that, to clarify what's the reasoning behind TRIDEC's agenda on this issue - as we have done over the last couple years - we are finding that as we are trying to diversify our economic base, it is very difficult for us to recruit businesses when we have the issue of both Hanford attached to any potential recruitment.

As part of that, there's been enough publicity throughout the region that any time you have Hanford relating to a particular issue, whether it's transportation, bringing waste into the Hanford Site, or Hanford hits the paper in any reason, we have a great difficulty in trying to work with the business constituency of saying: "Come to the Tri-Cities. Hanford is not in issue." And yet the perception is that this continues to be moving forward as: "Hanford: The nuclear waste site capital of the world."

So we would like to have an opportunity to have the Navy look into the Draft EIS, of saying, how can we help mitigate — How can we help the Tri-Cities community in working through some type of economic and social impact

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4.18

process that would be supportive of the Tri-Cities community and help us in this diversity project that we have going on.

I appreciate the confidence, and hopefully the Tri-Cities community can work with the United States Navy and the Department of Energy.

Thank you.

* * * * * * *

MR. SHIPLEY: Thank you very much, Mr. Dillman.

Ladies and gentlemen, I have no further registrations. Has anyone registered to speak to whom I have not given the opportunity?

I want to thank you all on behalf of the United States Navy for taking the time to participate in the hearing tonight. We appreciated the opportunity to hear your comments and will work to make sure they are addressed in the Final EIS. Thank you.

This meeting is adjourned.

HEARING CONCLUDED: 7:27 p.m.

C-E-R-T-I-F-I-C-A-T-E

STATE OF WASHINGTON)
) ss.
COUNTY OF KING)

I, PAULA SOMERS, a duly authorized Notary Public in and for the State of Washington, do hereby certify that this is a true transcript of the Public Hearing regarding the Draft Environmental Impact Statement on Disposal of Decommissioned, Defueled Cruiser, OHIO Class and LOS ANGELES Class Naval Reactor Plants; that the minutes of said meeting were recorded in shorthand and later reduced to typewriting; and that the above and foregoing is a true and correct transcript of said meeting.

I do further certify that I am not a relative of, employee of, or counsel for either of said parties or otherwise interested in the events of said proceedings.

I HAVE HEREUNTO set my hand and affixed my official seal this 27th day of September, 1995.

Paula Somers

Paula Somers, Notary Public
in and for the State of
Washington, residing at Renton.
CSR #: 299-06

#7a

TRIDEC
TRI-CITY INDUSTRIAL DEVELOPMENT COUNCIL
901 N. Colorado • Kennewick, WA 99336-7885 U.S.A. • (509) 735-1000 • FAX (509) 735-6609 • 1-800-TRI-CITY

COMMENTS OF THE
TRI-CITY INDUSTRIAL DEVELOPMENT COUNCIL
IN RESPONSE TO THE DRAFT
ENVIRONMENTAL IMPACT STATEMENT
ON THE DISPOSAL OF DECOMMISSIONED DEFUELED CRUISER
OHIO CLASS AND LOS ANGELES CLASS NAVAL REACTOR PLANTS
SEPTEMBER 21, 1995 - RICHLAND, WASHINGTON

Thank you for the opportunity to provide these comments on behalf of the Tri-City Industrial Development Council. TRIDEC is a not for profit, private-sector organization representing nearly 600 business organizations throughout the Mid-Columbia Region. Our mission is to achieve economic stability and balanced development of the Mid-Columbia Region for the benefit of its citizens and businesses.

We respectfully request that in the Record of Decision in this matter, the U.S. Navy address the issue and advise how it proposes to work with the community in mitigating the adverse impacts of the reactor burial. 4.18

As the draft environmental impact statement notes, the Department of Energy Hanford Site adjacent to the Tri-Cities has in recent years been the recipient of pre-Los Angeles class submarine reactor compartments which have been shipped by barge from the Puget Sound Naval Shipyard in Bremerton, up the Columbia River for disposal at Hanford.

As we understand it, the present proposal would result in the burial of approximately 100 reactor compartments from cruisers, Los Angeles and Ohio class submarines, plus a volume of mixed waste estimated to be in the range of 57,400 cubic feet. The total estimated cost of the preferred alternative-meaning burial at the low-level waste site at Hanford is estimated to be $1.5 billion dollars.

While we do not express objection to the preferred alternative, we believe that further examination of the alternative is required from the standpoint of economic and social impacts upon the community. 4.18

As you are aware, the Department of Energy's Hanford site is presently in the midst of a down-sizing which over time will result in the elimination of 14,000 jobs as the environmental remediation effort is concluded at the Hanford site.

Because of the projected job loss, this region is actively involved in a significant economic transition project which has its foundation in a variety of economic development strategies two of which are industrial recruitment and tourism. 4.18

Our industrial recruitment strategy seeks to leverage the remarkable assemblage of assets at the Hanford site along with the attributes of the Pacific Northwest Laboratory, Washington State University, and many other features to provide an attraction for the establishment or relocation of a broad array of industrial clients. Indeed our community is presently involved in a significant Strengths, Weakness, Opportunities and Threats Analysis to determine the particular industrial targets which should be pursued as a result of our effort. On the basis of information previously developed (or provided to us) there is a well established perception in the minds of many potential clients that this area represents a "nuclear waste dump" and is therefore an undesirable potential site.

For many there is a similar perception with respect to the development of the Mid-Columbia region and the Tri-Cities to the premier agricultural production region and as a tourism destination. Frequently adverse press coverage regarding the transporting of submarine reactor compartments is seen in Seattle, Portland and other major metropolitan areas from which tourists could be expected to travel to the Tri-Cities.

For these reasons we in the community believe that there is an adverse impact resulting from the transportation and storage of those reactor compartments at the Hanford site and that an appropriate means of mitigation is necessary to assist our communities in demonstrating to our industrial recruitment clients, tourists and agricultural customers that despite possible perceptions, there are no demonstrable human health and safety effects as a result of the reactor disposal.

We look forward to working with the U.S. Navy in assessing the negative impacts of the burial program and developing an appropriate means of resolving this issue.

We will provide a copy of these comments for the record along with other supportive materials and thank you for the opportunity to appear before you.

#8

September 27, 1995

Mr. John Gordon
Puget Sound Naval Shipyard
Code 1160
Bremerton, Washington 9B314-5001

SUBJECT: COMMENTS ON: DRAFT EIS ON THE DISPOSAL OF DECOMMISSIONED, DEFUELED CRUISER, OHIO CLASS, AND LOS ANGELES CLASS NAVAL REACTOR PLANTS

A permanent solution not another temporary storage location is needed. It is recommended the preferred alternative - land burial of the entire reactor compartment at the Department of Energy (DOE) low level waste burial grounds at the Hanford site in Washington State - be the selected option. This option is contingent on the following all activities leading up to and the preparation for shipment from Puget Sound Naval Shipyard oversight be provided by the following organizations: 2.3

Department of Energy, Richland Office, Environment, Safety, and Health Division.

Washington Department of Ecology, Kennewick, Washington Office.

Hanford Site Contractor responsible for low-level burial grounds.

Walter D. Bl

Walter D. Blair, Member
Hanford Advisory Board
Health Safety Waste Management Committee

Mailing Address: Walter D. Blair, B1-12
Hanford Advisory Board
P.O. Box 1970
Richland, WA 99352

cc: P. W. Kruger A5-54
W. A. Hamilton T3-01

#9

Robert F. Deegan
Sierra Club Virginia Chapter
340 Ramapo Road
Virginia Beach, VA 23462

VIRGINIA CHAPTER
SIERRA CLUB

> "When we try to pick out anything by itself,
> we find it hitched to everything else in the universe."
> John Muir

October 9, 1995

Mr. John Gordon
Puget Sound Naval Shipyard
Code 1160
Bremerton, Washington 98314-5001

Re: Draft Environmental Impact Statement (EIS) on the Disposal of Naval Nuclear Reactor Plants

Dear Mr. Gordon:

Thank you for this opportunity to comment on the Navy's August 1995 Draft EIS on the Disposal of Decommissioned, Defueled Naval Reactor Plants. These comments supplement my letter to you of August 17, 1995 to which you replied on Sept. 18, 1995. These comments are on behalf of the 10,000 members of our environmental group throughout Virginia.

The Draft EIS is manifestly inadequate because it does not address the full scope of environmental impacts of disposal of defueled naval reactor plants. Rather, the Draft EIS improperly seeks to "segment" this environmental problem by only considering the future disposal of certain classes of ships. The Draft EIS must include the reactor compartments of all nuclear ships in existence or planned by the U.S. government. The courts have rejected similar government attempts to "segment" the scope of EIS's. As we urged at the scoping hearing for this EIS, the scope of the EIS must include the reactor plants of all nuclear aircraft carriers, as well as the reactor plants of Seawolf Class and "New Attack" Class submarines. The EIS must also cover the reactor plant of Nuclear Ship Savannah, controlled by the U.S. Maritime Administration. 1.4

The Draft EIS is also inadequate in treating the "Protective Waterborne Storage" alternative as a "no action" alternative. The sites chosen for the protracted waterborne storage of the reactor plants would clearly have environmental impacts from this. The custodians of the ships, and nearby residents and workers, would clearly incur a risk of exposure to radiation. Moreover, the mere presence of the added ships would have environmental impacts. 1.5

Robert F. Deegan
Robert F. Deegan
Nuclear Waste Issues Chairman

Robert F. Deegan
Sierra Club Virginia Chapter
340 Ramapo Road
Virginia Beach, VA 23462

#10

N
Nuclear
M Military Monitoring

"...the truth is leaking out."

1995.OCT.10

Mr. John Gordon
PSNS Public Affairs
1400 Farragut Ave., Code 1160
Bremerton, WA 98314-5001

Re: Comments: DEIS on Disposal of Decommissioned, Defueled ... Naval Reactor Plants

John,

This letter provides comments on the DEIS you sent me for comment.

(1) NMM supports the decommissioning and permanent disposal of all naval nuclear reactors, and the Preferred Alternative approach is endorsed.

(2) Despite this endorsement of the Navy's overall objective and approach, the DEIS is so seriously flawed, technically as to suggest PSNS likely will not be able to complete the anticipated decommissioning of about 100 naval nuclear reactors without one or more serious nuclear accidents occurring. **1.1**

This fundamental criticism notes the history of probabilistic risk assessment regarding nuclear reactors, from the groundbreaking Rasmussen report (WASH-1400, NUREG 75/014) to the 1992 report of the New Zealand Special Committee on Nuclear Propulsion, "The Safety of Nuclear Powered Ships" (ISBN 0-477-001628-6). That era opened with great hope that quantification of nuclear risks would allow reduction of those risks and ended with an emerging realization that quantification reveals a sad curiosity of nuclear reactors: that the overall hazard of nuclear reactor operations (a) is attributable to extremely rare, catastrophic accidents and (b) is unacceptably large. With this realization, reactor operators such as PSNS have retreated to reliance on their generally favorable track records.

From the standpoint of probabilistic risk assessment, this means that PSNS has acquired an *it's-safe-because-there's-been-no-accident* mindset that ***invites*** a major nuclear accident at the shipyard. The development of this mindset as revealed by the DEIS is surely technically negligent, and it appears to be grossly negligent in the legal sense as well. **1.2**

The concern for accidents is obviously one of the greatest concerns for both safety and environmental consequences of the proposed decommissioning and disposal activities. Yet in the DEIS, the only assessment of Hypothetical Accident Conditions (Sec.2.1.5.3) addresses one type of transportation accident. In particular, the decommissioning activities at PSNS are taken as risk free. **2.2**

This outlook to risk issues seems to pervade the modern nuclear Navy and PSNS in particular. But history has shown that in an atmosphere of disregard for risks, accident frequencies mushroom. With nuclear reactor and/or weapons activities, this institutionalized disregard for risks leads inexorably to TMI and Chernobyl sorts of occurrences. **1.2**

Finally, I notice that after two years of NMM studies proximate to PSNS, the shipyard still does not address criticism of its nuclear attitude and radiological data.

(3) The DEIS is essentially *reactor shield paint* -- what used to be called boiler plate. It is unclear whether the DEIS superficiality serves to deflect public suspicions or is a consequence of ongoing loss of Navy perspective. For example, the second paragraph of the Background (Sec.1) mentions some of the power plant components which are of concern for decommissioning and disposal with special flagging of neutron activation of impurities in the 100+ tons of lead shielding around a reactor. But this flag is disappointing. The description of hazards of elemental lead in Sec.4.2.3 is unrelated, and the curie contents of the reactor vessel internal structures tabulated in Appendix D are not broken out by components. This leaves the reviewer in doubt whether the information is being withheld from the public for some reason or whether the Navy is unaware of the requisite radiological details. If the former is correct, one worries about the Navy's motives for disinformation. If the latter is correct, one worries that the shipyard workers will be exposed to toxic materials, radiation, and hazardous situations because PSNS is technically undiscriminating in technical issues related to safety. **1.3**

Such examples abound in the DEIS.

(4) The thrust of Comments (2) and (3) is that the DEIS does not provide an adequate technical basis for the proposed disposal of the decommissioned naval reactor plants. Yet that disposal is endorsed despite the Navy's lack of technical foundation, because the hazards presently posed by naval nuclear reactors and operational naval nuclear weapons are so very much greater.

Any questions or comments are welcome. Please note the change of NMM address.

Sincerely,

Norm Buske

#11

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600 • (206) 407-6000 • TDD Only (Hearing Impaired) (206) 407-6006

October 10, 1995

Mr. John Gordon
Puget Sound Naval Shipyard
1400 Farragut Ave Code 1160
Bremerton WA 98314-5001

Dear Mr. Gordon:

Thank you for the opportunity to comment on the draft environmental impact statement (DEIS) for the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants. The Washington Department of Ecology's Nuclear Waste Program has reviewed the DEIS and offers the following comments. We appreciate the Navy's presentation of the analyses in a compact form.

Ecology recognizes that the preferred alternative is based on nearly ten years experience with pre-Los Angeles class submarine reactor compartments. The Navy has worked with Ecology to comply with hazardous and radioactive waste disposal requirements, and has demonstrated that the disposal can be done without measurable contamination of the environment.

The Navy has also worked with appropriate agencies in both Washington and Oregon to assure safe and uneventful transport of the reactor compartments from Bremerton to Hanford. So long as present procedures for notification, inspection and escort continue, we believe that the transportation risks are acceptable.

The State of Washington believes in shared responsibility among the states. Disposal of naval reactor compartments ought to be considered in the context of disposal of other radioactive and hazardous wastes left over from the Cold War era. Washington citizens will be willing to consider the preferred alternative for reactor compartment disposal on the merits so long as other states accept other nuclear waste disposal burdens. **1.6**

We would recommend that the final EIS provide data that would help the public evaluate a modified waterborne storage ("no action") alternative. Section 4.4 of the Draft EIS does not indicate the decrease in worker and transport exposure that would result from deferring the preferred method of disposal for **4.6**

fifteen years. It may be that this alternative would that significantly reduce worker exposures, exposures in transport, and, therefore, the costs associated with disposal. **4.6**

If you have any questions, please call Mr. Max Power with our Nuclear Waste Program at 360-407-7118.

Sincerely,

Rebecca J. Inman

Rebecca J. Inman
Environmental Review Section

RI:
95-6203

cc: Max Power, Nuc Waste
Geoff Tallent, Nuc Waste

#12

Dakota Creek Industries Inc.
820 Fourth Street P.O. Box 218 Anacortes, Washington 98221
Telephone (360) 293-9575 FAX (360) 293-6432

October 10, 1995

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. John Gordon
Puget Sound Naval Shipyard
1400 Farragut Avenue, Code 1160
Bremerton, WA 98314-5001

Subject: Comments on the Navy's "Draft Environmental Impact Statement (DEIS) on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class and Los Angeles Class Naval Reactor Components" dated August 1995

Dear Mr. Gordon,

We have taken the opportunity to review the subject DEIS and we would like to submit the following comments as a part of the public review process.

Item 1 - Consideration of Private Shipyard Facilities - The preferred alternative expressed in the Navy's Draft Environmental Impact Statement is for removal 100 nuclear submarine and cruiser reactor compartments using facilities at the Government owned and operated Puget Sound Naval Shipyard (PSNS) at Bremerton, WA, with subsequent barge transportation of reactor compartments to the Port of Benton for land burial facilities at the Hanford Nuclear Reservation (HNR). The DEIS, page 2-42, states that the land burial facilities at the Savannah River Site (SRS) are not adequate to support the proposed work and that "the Hanford site is the only site available for land disposal of the entire reactor compartment." It would therefore be inferred that the controlling factor for the reactor compartment disposal program is the access and availability of HNR to support land burial and that PSNS becomes the logical currently nuclear certified facility with drydocking capability to support the disposal work because of its close proximity to HNR. The DEIS does not address alternatives to allow the use of private shipyards in the Puget Sound area or along the Columbia - Willamette Rivers which could be certified to accomplish reactor compartment disposal work. It is requested that the DEIS be revised to establish the criteria which a privately owned shipyard would have to meet in order to become certified for performance of reactor compartment disposal work. **4.1**

There are existing shipyard facilities located both on Puget Sound and along the Columbia-Willamette River systems which have the physical capability to support work operations as described in the DEIS. It should be noted that ship repair facilities located along the Columbia and Willamette Rivers have a significant advantage for shipment of reactor compartments because: **4.2**

(1) The shipping distance becomes about 250 miles, all within protected waters. This approach eliminates the open ocean transport of the barge shipment which occurs in the shipping lanes of Puget Sound and along the Washington coast. As noted in the DEIS, the potential for a barge shipping accident is directly proportional to the distance shipped. Although the potential for a barge shipping accident is low, shipping from PSNS (a distance of 800 miles from HNR) would have 3.2 time the accident potential as a shipping from a site along the Columbia River with a shipping distance of 250 miles. In actuality, the highest accident potential exists during the open ocean transportation portion of the barge shipment and consequently, the accident potential would be reduced even further than the direct proportioning by distance. **4.2**

(2) The DEIS notes that the Navy does not make barge shipments to HNR during the winter months due to the inclement weather off the Washington coast. A site on the Columbia-Willamette river system could be operated year around due to the elimination of the open ocean shipping portion of the travel.

(3) The potential severity of a barge accident is reduced when shipments are made from the Columbia - Willamette river system as compared to shipments from PSNS. As noted in the DEIS, the reactor compartment shipping packages will have a crush depth if about 300 feet; this being the point when the closure bulkheads would fail. During shipments from PSNS, over 70% of the ocean transit is in waters exceeding 300 feet and a barge collision resulting in a sinking would very likely breach the package boundaries, with potential release of radioactivity to the environment and would result in substantial cost to recover the reactor compartment, For shipment from the Columbia-Willamette river systems, the channel depth is maintained at 40 feet to the Portland area and at 14 feet from Portland to the off-loading site at the Port of Benton, consequently, a barge sinking accident on the Columbia River would not result in a breach of the reactor compartment and recovery actions would be considerably less expensive.

Dakota Creek Industries is a complete ship building and ship repair facility located at Anacortes, Washington, approximately 50 miles north of Seattle. Over the past few years, we have made substantial capital investment in our facilities which we believe makes our shipyard a well qualified facility to assist in the Navy's reactor compartment disposal program. Our major facilities include a 306-ft by 75-ft Syncrolift shiplift with a 5,000 ton lifting capacity and a 9,000 ton drydock with a length of 314-ft, with a clear width of 90-ft between wing walls. Our shiplift is certified for use by US Navy ships in accordance Mil Std 1625B, and our drydock is suitable for certification under Mil Std 1625B. The shiplift was constructed in 1987 and did not exist in 1984 when the Navy prepared the FEIS for the reactor compartment removal on the pre-Los Angeles class submarines. We are currently seeking additional drydocking capacity through acquisition of a longer drydock with a capacity of at least 15,000 tons. Additionally, we have pier side and industrial shop facilities which could be effectively used to support the Navy's reactor compartment disposal and ship recycling programs. Our existing and planned facilities in Anacortes have the capacity to perform the following operations for the Navy:

(1) Perform hull recycling work on defueled, decommissioned nuclear submarines which have had their reactor compartments removed; several ships in this status are currently in waterborne storage at Puget Sound Naval Shipyard. These boats could be used to refine hull dismantlement and recycling procedures prior to assignment of a defueled, decommissioned boat for reactor compartment removal. **2.1**

4.1

(2) Perform reactor compartment removal on Los Angeles and pre-Los Angeles nuclear submarines, using our shiplift or drydock facilities. Figure 1 shows the general layout of the Dakota Creek facilities. The shiplift can also be used as a waterborne berth for Los Angeles Class submarines for preparatory work such as asbestos removal, making the hull cuts for equipment removal and removal of interferences in way of reactor compartment circumferential hull cuts. At least two pre-Los Angeles or Los angeles Class defueled submarines could be transferred land side for reactor compartment removal and submarine hull recycling. Each reactor compartment would be transferred to a disposal barge and the loaded barge would then be placed into the water using the shiplift. We believe that a level of four reactor compartment removal operations per year could be easily achieved at Dakota Creek Industries, Inc.

(3) With acquisition of increased drydocking capability, Dakota Creek Industries will have the capability to drydock defueled, decommissioned nuclear cruisers and Ohio Class submarines.

Recommendation - There currently exists substantial shipyard capacity in the Puget Sound area and along the Columbia - Willamette River systems to perform work operations on defueled, decommissioned naval nuclear powered ships. The Navy's preferred alternative should be modified to include the technical and administrative requirements which need to be met by private industrial facilities to obtain radiological work certification for performance of reactor compartment removal work on defueled, decommissioned naval ships.

C.1

Item 2 - Cost Data - Table C-1, Appendix C, Page C-3, provides a cost projection for accomplishing the reactor compartment disposal operations on cruiser, Ohio and Los Angeles class submarines. The Table footnotes indicate that the "costs are based on actual costs to prepare a pre-Los Angeles class submarine reactor compartment adjusted for the level of effort required for the larger packages." Paragraph 3, Page C-2, indicates that the monetary values are based on 1994 fiscal dollars, but the data does not indicate an average man day rate for the work.

Recommendation: In order to make a comparison more understandable, it is requested that Table C-1 be revised to show the actual cost data for a pre-Los Angeles class submarine and that the table also be revised to show the number of man days of shipyard effort required to accomplish the various phases of work (engineering, management, labor and support services, water removal and packaging) for pre-Los Angeles submarines, cruisers, Ohio and Los Angeles class submarines.

The Navy's reactor compartment disposal program has been a highly successful program and Dakota Creek Industries is very excited about the opportunity to present our capabilities to support this important effort. We are committed to providing high quality, cost effective services in support of the reactor compartment disposal program. At your convenience, we would be happy to arrange a tour of our facilities to provide additional information. Thank you for the opportunity to participate in the public comment portion of the environmental review process.

Sincerely,
Dakota Creek Industries, Inc.

Richard N. Nelson
President

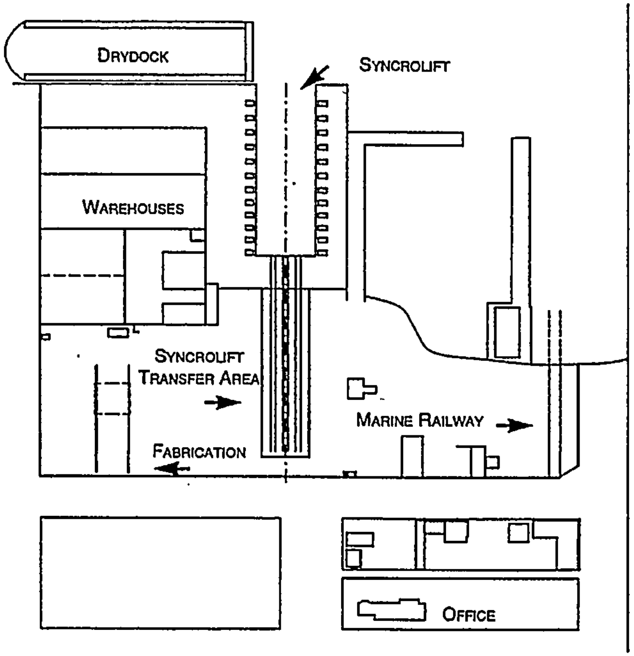

Figure 1 - Shipyard Layout for Dakota Creek Industries, Inc

#13

COMMONWEALTH *of* VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

Peter W Schmidt
Director

P O Box 10009
Richmond Virginia 23240 0009
(804) 762-4000

October 10, 1995

Mr. John Gordon
Puget Sound Naval Shipyard
Code 1160
Bremerton, Washington 98314-5001

Dear Mr. Gordon:

This is in response to your request for comments on the <u>Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants</u>. The Department of Environmental Quality is responsible for coordinating Virginia's review of federal environmental documents and responding to appropriate federal officials on behalf of the Commonwealth. The Hampton Roads Planning District Commission, the Department of Health's Bureau of Radiological Health and the Department of Environmental Quality's Tidewater Regional Office took part in this review.

The preferred alternative is to continue disposal of these reactor plants at the Department of Energy's Hanford, Washington site. The Commonwealth is in agreement with this option.

The no action alternative involves protective storage of these ships and reactor plants at other facilities, including Norfolk Naval Shipyard in Portsmouth, Virginia. Protective storage at the Norfolk Naval Shipyard appears to be a viable short-term option from an environmental standpoint. However, there is relatively limited areas available for storage of a significant number of decommissioned and defueled ships and reactors.

The Department of Environmental Quality will coordinate the Commonwealth's review and response on the final environmental impact statement for this proposal. Correspondence should be addressed to: Director, Office of Environmental Impact Review, Department of Environmental Quality, P. O. Box 10009, 629 East Main Street, Richmond, Virginia 23240-0009.

Thank you for this opportunity to comment on the draft document. If you need further information, please contact Tom Felvey, (804) 762-4315, of my staff.

Sincerely,

Michael P. Murphy
Director, Grants Management
and Intergovernmental Affairs

cc: V. Wayne Orton, City of Portsmouth
John M. Carlock, Hampton Roads PDC
Tony R. Watkinson, VMRC
Leslie P. Foldesi, VDH

#14

City of Portsmouth, Virginia

Office of the Mayor
P. O. Box 820
Established 1752 Portsmouth, Virginia 23705-0820 (804)-393-8746

October 9, 1995

Mr. John Gordon
Puget Sound Naval Shipyard
Code 1160
Bremerton, Washington 98314-5001

Dear Mr. Gordon:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class and Los Angeles Class Naval Reactor Plants. I simply wish to comment on some presumptions contained in the No Action Alternative. This alternative would involve long term storage of defueled cruisers and later class submarines at the Norfolk Naval Shipyard in Portsmouth.

Initial dredging of 165,000 cubic yards of material would be required, according to the E.I.S. Additionally, maintenance dredging every 15 years would be necessary. This draft document states that this material will be dumped at Craney Island. This City has serious objections to dumping this material at Craney Island. Craney Island is reaching capacity, and the City strongly opposes any proposed expansion. Efforts to force this expansion could be bolstered by this added dredging requirement. 4.3

Further, the storage of these ships, with the associated danger of contamination, albeit small, and the associated dredging inure no economic benefit to the City of Portsmouth. 4.4 Finally, the draft E.I.S. notes that our geographic location "does not lie in the principal storm tracks" for hurricanes. We have in fact been in the middle of the expected landfall area several times in recent years. I request that you clarify our potential for experiencing a hurricane in the final form of this document. 4.5

Thank you again for the opportunity for comment.

Sincerely,

Gloria O. Webb

Gloria O. Webb
Mayor

cc: Members of Council

#15

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
500 NE Multnomah Street, Suite 600
Portland, Oregon 97232-2036

IN REPLY REFER TO:

October 16, 1995

ER 95/641

John Gordon
Public Affairs Officer
Puget Sound Naval Shipyard
1400 Farragut Ave., Code 1160
Bremerton, Washington 98314

Dear Mr. Gordon,

The Department of the Interior (Department) has reviewed the Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class and Los Angeles Class Naval Reactor Plants. The Department does not have any comments to offer.

We appreciate the opportunity to comment.

Sincerely,

For Charles S. Polityka
Regional Environmental Officer

#16

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

Reply To
Attn of: WD-126

December 1, 1995

John Gordon
Public Affairs Officer
Puget Sound Naval Shipyard
1400 Farragut Avenue, Code 1160
Bremerton, WA 98314

Dear Mr. Gordon:

Re: DEIS on Disposal of Decommissioned Naval Reactor Plants

The Environmental Protection Agency has reviewed the draft Environmental Impact Statement (DEIS) on proposed alternatives for disposing of nuclear fuel plants on Ohio Class and Los Angeles Class vessels. Our review was conducted in accordance with the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. Our comments are offered to assist in the preparation of the final EIS.

We have given the DEIS an LO-1 rating (Lack of objections; sufficient information). The major issues of long-term nuclear waste storage are being addressed in Department of Energy documents under NEPA, which we are currently reviewing. We believe that you have adequately and thoroughly addressed the remaining major issues of personnel safety, public safety and transportation in this DEIS. Our potential concerns specific to your document and their resolution are enumerated below.

We support your preferred alternative of permanent storage of entire, defueled and processed, nuclear reactor compartments at the Hanford site. The other alternatives of indefinite storage or subdivision and reuse of components do not seem to be comparable. The latter alternative can be ruled out on estimated costs alone.

The DEIS addressed shielding lead issues (not regulated by EPA under RCRA) according to the Hazardous Waste Management Act, administered by the Washington State Department of Ecology. Appropriate training procedures for personned have been identified. Removal of all materials, including radioactive, will be conducted under the PSNS solid waste minimization program. Worker exposure to lead, asbestos and radioactive materials has been adequately addressed in accordance with OSHA and other federal regulations (Appendix A).

Waterborn transport out of the Sound and straits, on the ocean and on the Columbia River is thoroughly discussed (4-7 through 4-9, and E-9). Appropriate precautions and mitigation measures have been observed. A risk analysis of radiation exposure associated with transportation was conducted.

C.2

The cost analysis of alternatives does not indicate that future values have been discounted to present value, although there is reference to 1994 FY dollars. Since completion of this program will be spread out over 15 to 20 years, time values are an important consideration. The President's Office of Management and Budget (OMB) currently recommends an 8.1% nominal rate for 30 year projects (Circular A-94). Even though the cost estimates are "orders of magnitude" (C-2), it would be helpful to have some further explanation of the treatment of cost over time.

We hope these comments will be useful as you prepare the final EIS. Thank you for working with us during reorganization and other delays to our preparing a timely response. If you have any questions about our comments, please contact Doug Woodfill at (206) 553-4012.

Sincerely,

Richard B. Parkin

Richard B. Parkin, Manager
Geographic Implementation Unit

EXHIBIT INDEX

3. Responses to Issues from Public Review

This chapter presents responses to 35 issues identified during the public review period for the Draft Environmental Impact Statement (DEIS). These issues were received in letters and in statements made at the public hearings as recorded in Chapter 2. The issues are identified where they appear in Chapter 2 by a sidebar and are given a serial number consisting of a subsection letter and number, such as 1.5 or 4.3, which relates the issue to the subsection of this chapter where the response is provided.

SECTION 1

This Section contains issues related to the Environmental Impact Statement as a whole, to the Summary and to Chapter 1.

1.1 Summary of Issue

The Draft Environmental Impact Statement is flawed because it does not include a probabilistic assessment for reactor operations, such as the Rasmussen report or the New Zealand report on "The Safety of Nuclear Powered Ships." Such reports have shown that most of the risk from nuclear reactor operations comes from severe accidents, and this risk is unacceptably large.

Those Identifying Issue	**Identification Number**
Nuclear Military Monitoring - Norm Buske	10

Response

The subject of this Environmental Impact Statement is disposal of defueled reactor plants, that is, reactor plants from which the nuclear fuel has been removed. Therefore, probabilistic risk assessments of operating reactors with nuclear fuel are beyond the scope of this Environmental Impact Statement. It should be noted that the New Zealand report cited by the commenter concluded that "The presence in New Zealand ports of nuclear powered vessels of the navies of the United States and the United Kingdom would be safe. The likelihood of damaging emission or discharge of radioactive material from nuclear powered vessels is so remote that it cannot give rise to any rational apprehension."

1.2 Summary of Issue

The Draft Environmental Impact Statement reveals a mindset at Puget Sound Naval Shipyard that things are safe because there has been no accident. The development of this mindset as revealed by the Draft Environmental Impact Statement is surely technically negligent and it appears to be grossly negligent in the legal sense as well.

Those Identifying Issue	**Identification Number**
Nuclear Military Monitoring - Norm Buske	10

Response

The commenter offers no specific examples in the Draft Environmental Impact Statement to support his claim of a flawed and negligent mindset. To the contrary, the outstanding radiological safety record at Puget Sound Naval Shipyard, as well as throughout the Naval Nuclear Propulsion Program, derives in a great part from the careful attention to detail and the prevention of problems at their source.

1.3 Summary of Issue

The Draft Environmental Impact Statement is inadequate in its description of the radionuclide content of the lead shielding and the individual components of the reactor vessel internal structure.

Those Identifying Issue	Identification Number
Nuclear Military Monitoring - Norm Buske	10

Response

The Draft Environmental Impact Statement included specific radionuclide information in several sections. Section 1.2 described how 99.9% of the radioactivity is an integral part of activated metals, while the remaining 0.1% is radioactive corrosion and wear products deposited on the internal surfaces of piping systems. Table 1.1 provided the radionuclide breakdown for various classes of reactor plants. Appendix D provided a detailed discussion of how the radioactivity content was calculated for the activated structural material. Table D-3 provided a breakdown of the long-lived radionuclide content.

Appendix B discusses the long term performance of the reactor compartment packages in the burial environment, and how even the long-lived radionuclides are greatly limited in their release by the slow process of corrosion. Section 4.3.3.2.1.4 discusses analysis of the radiological significance of long term radionuclide release in the burial ground. Since all of the reactor vessel internal structure is conservatively assumed to be corroding slowly at the same time, the overall radionuclide content of this structure and its corrosion rate determines the release of radioactivity. A more detailed breakdown of components would not provide any additional information on potential environmental impacts.

The neutron activation of trace metals in the lead shielding makes an insignificant contribution to the overall radioactivity content of the reactor compartment package. The fact that such neutron activation occurs was discussed in the Draft Environmental Impact Statement to make clear the point that even if one went to the considerable expense and occupational radiation exposure to remove all of the lead shielding, much of this lead would have to be disposed of as radioactive waste anyway.

1.4 Summary of Issue

The Draft Environmental Impact Statement is inadequate because it "segments" the environmental problem by only considering the disposal of certain classes of ships. The Environmental Impact Statement should include analysis of all nuclear powered aircraft carriers, SEAWOLF Class submarines, the new attack class, and the nuclear ship Savannah.

Those Identifying Issue	Identification Number
Sierra Club, Virginia Chapter - Robert F. Deegan	9

Response

As discussed on page S-1, the Draft Environmental Impact Statement included all types of nuclear powered ships which are expected to be decommissioned in the next 20 years. Since the Navy is not faced with a decision on other classes of nuclear powered ships within this time period, there is no need to evaluate them at this time. Neither the Navy nor the Department of Energy is responsible for the nuclear ship Savannah, which is defueled and in floating storage as a museum at Charleston, South Carolina.

1.5 Summary of Issue

The Draft Environmental Impact Statement is inadequate in treating the floating storage alternative as a "no action" alternative. This alternative would clearly have risks and impacts for workers and nearby residents.

Those Identifying Issue	Identification Number
Sierra Club, Virginia Chapter - Robert F. Deegan	9

Response

The Council on Environmental Quality regulations for implementing the National Environmental Policy Act require the evaluation of the environmental impacts of a "no action" alternative. The "no action" alternative does not always result in "no impacts", because failure to take action can result in impacts. The environmental impacts associated with the "no action" waterborne storage alternative were fully discussed in Section 4.4 of the Draft Environmental Impact Statement.

1.6 Summary of Issue

Disposal of reactor compartments ought to be considered in the context of other radioactive and hazardous wastes left over from the Cold War era. Washington citizens will be willing to consider the preferred alternative for reactor compartment disposal on the merits so long as other states accept other nuclear waste disposal burdens.

Those Identifying Issue	Identification Number
Washington Department of Ecology - Rebecca J. Inman	11

Response

The disposal of other nuclear wastes derived from defense activities of the Cold War era is beyond the scope of this Environmental Impact Statement. The Navy notes that this Washington State policy has been stated in the course of negotiations between the States and the Federal Government as part of the Federal Facilities Compliance Act process. Issues of equity among the States have been a key part of the waste treatment and disposal agreements reached as part of this process.

1.7 Summary of Issue

The commenter expressed disappointment about having to "decommission another set of nuclear powered ships" and commented that "With the last environmental impact statement on submarines in which ten reactors were supposed to be decommissioned, we've found that there has been many more reactor cores buried at Hanford." The commenter also expressed concern that "Washington State may be in for more than what this draft statement is telling us."

Those Identifying Issue	Identification Number
Pat Herbert	1

Response

The Navy's Final Environmental Impact Statement on the Disposal of Defueled Naval Submarine Reactor Plants issued in May of 1984 stated "The most immediate concern and the action to which this statement is directed is the disposal of the reactor plants from the approximately 100 nuclear submarines that may be decommissioned during the remainder of this century." (USN, 1984a, Chapter 1, para I.A). In addition, Figure 1-1 of that EIS showed that the potential number of decommissioned submarines would be 50 to 85 by 1995.

It must be noted that the proposed action does not involve disposal of reactor cores. The core is the fuel-bearing part of the reactor and would be removed prior to disposal of the reactor compartment.

1.8 Summary of Issue

Contractors are not constrained by the same process controls as Naval Shipyard workers. Will the Environmental Impact Statement still be valid in the event that someone other than Naval Shipyard workers does the work?

Those Identifying Issue	Identification Number
Roy Hocker	4, 4a

Response

The Environmental Impact Statement would be valid regardless of whether public employees or private employees performed the work because the same technical requirements would be enforced for all work on Naval nuclear propulsion plants. For a more detailed discussion of these technical requirements, see the response to Issue 4.1.

1.9 Summary of Issue

A large amount of money to build a force of nuclear warships which is too large for the threat and too much money is spent on burials and cleanup.

Those Identifying Issue	Identification Number
Pat Herbert	1

Response

The Congress, by law, establishes the national defense structure and the level of spending for defense. This subject is outside the scope of this Environmental Impact Statement. Even though nuclear powered warships represent about forty percent of the Navy's major combatants, the handling and disposal of the resultant radioactive waste, including reactor compartment disposal, is only about 0.1% of the Navy budget (U.S. General Accounting Office report GAO/NSIAD-92-256, "Nuclear-Powered Ships Accounting for Shipyard Costs and Nuclear Waste Disposal Plans").

SECTION 2

This Section contains issues related to the Summary and
Chapter 2 of the Environmental Impact Statement

2.1 Summary of Issue

Private Shipyards in the Puget Sound area could perform recycling of ships from which the reactor compartments already have been removed.

Those Identifying Issue	Identification Number
Dakota Creek Industries Inc. - Richard N. Nelson	12

Response

The Navy has an existing recycling program for the nonradioactive sections of nuclear powered ships for which an Environmental Assessment and Finding of No Significant Impact have been issued. Recycling of nonradioactive ship sections is beyond the scope of this Environmental Impact Statement.

2.2 Summary of Issue

In the Draft Environmental Impact Statement, the only assessment of hypothetical accident conditions is in Section 2.1.5.3 and addresses one type of transportation accident. In particular, the decommissioning activities at PSNS are taken as risk free.

Those Identifying Issue	Identification Number
Nuclear Military Monitoring - Norm Buske	10

Response

The discussion in Section 2.1.5.3 of the Draft Environmental Impact Statement involves the hypothetical accident conditions for which shipping containers of radioactive materials must be designed. These hypothetical accident conditions are quite severe, including a 30 foot drop onto an unyielding surface, a drop onto a steel bar, immersion in a hot fire, and submergence in water. Packages designed to these standards are extremely robust packages.

In addition to discussion of how the reactor compartment packages meet these stringent safety requirements, the Draft Environmental Impact Statement included a discussion of several other potential accident scenarios. Section 7.7 of Appendix E discussed the analysis of potential accidents scenarios for both the barge shipment of reactor compartments as well as truck and rail shipments of subdivided components. This analysis included consideration of accident scenarios even more severe than the package design requirements. Even the extreme case of sinking in deep water where the package would be breached by sea pressure was evaluated in Section 4.3.2.3. Extreme natural phenomena such as catastrophic breach of the Grand Coulee dam were discussed in Section 4.3.3.1.

The severe transportation accidents analyzed represent the worst case condition that this radioactive material might experience. The shipyard preparation work would present less risk of a severe accident since the radioactive material would be handled under controlled conditions, by trained personnel, with onsite emergency response capability, without the element of fast moving vehicles or ships, and at a greater distance from the public than during transportation.

With regard to decommissioning activities at PSNS, this Environmental Impact Statement evaluates the alternatives for the disposal of defueled, decommissioned reactor compartments. That is, the reactor fuel was removed and the ship decommissioned prior to activities covered by this EIS. Defueling nuclear powered ships at PSNS or at any other Navy shipyard licensed to perform nuclear work has been safely conducted for many years. Defuelings have been done to support refuelings as well as decommissionings. All work is done to detailed work procedures and stringent safety practices. Conducting nuclear work in a manner that protects the environment, workers and the general public is among the Navy's highest priorities.

2.3 Summary of Issue

The commenter supports the preferred alternative contingent on oversight by the Department of Energy Richland Office, and the Washington State Department of Ecology.

Those Identifying Issue	Identification Number
Hanford Advisory Board - Walter D. Blair	8

Response

As discussed in Section 2.1.5.4, disposal of the reactor compartment packages is regulated by the Washington State Department of Ecology due to the quantity of permanent lead shielding present. The Department of Energy is a cooperating agency for this Environmental Impact Statement. The Department of Energy Richland Operations Office and the Hanford Site burial grounds contractor would fully participate in the reactor compartment disposal process if the preferred alternative were selected.

2.4 Summary of Issue

Disposition of the non-reactor compartment portions of ships is a significant part of the work that the public should know about.

Those Identifying Issue	Identification Number
Henrik Langhjelm	3

Response

The Navy's, June 1993 Environmental Assessment of the Submarine Recycling Program at Puget Sound Naval Shipyard provides the public with information on the disposition of nonreactor compartment portions of ships. Sections 2.1 and 2.3.2 of the Environmental Impact Statement explain that non-reactor compartment portions of the ships could be dispositioned by recycling.

2.5 Summary of Issue

Permits will be given out by the Department of Ecology on wastes, which if they were anywhere else in the state except Hanford, would not be permitted.

Those Identifying Issue	Identification Number
Pat Herbert	1

Response

The Washington Administrative Code, WAC-173-303 does require that certain types of wastes be disposed of only at Hanford. However, the technical standards for issuance of permits at Hanford are as stringent as for elsewhere in the State.

SECTION 3

This Section contains issues related to the Summary
and Chapter 3 of the Environmental Impact Statement

3.1 Summary of Issue

The Environmental Impact Statement refers to the production of 1,625 cubic meters of mixed waste. The Environmental Impact Statement does not appear to address disposal of these materials. It is evident that Hanford's Low-Level Burial Ground is not appropriate for disposal of these materials. Accordingly, the Environmental Impact Statement must address a site for disposal of these materials and the environmental impacts attendant thereto.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6, 6a

Response

Most of the 1,625 cubic meters of mixed waste is potassium chromate waste as discussed in sections 2.1, 4.3.3.2.1.6 and 4.5.2. As discussed in section 2.1.1.1, the potassium chromate mixed waste can be readily treated to render it nondangerous, after which it can be disposed of as nondangerous radioactive waste. The Final Environmental Impact Statement has been revised to state that mixed wastes will be managed in accordance with the approved Site Treatment Plan pursuant to the Federal Facilities Compliance Act of 1992.

SECTION 4

This Section contains issues related to the Summary
and Chapter 4 of the Environmental Impact Statement

4.1 Summary of Issue

Private shipyards in the Puget Sound area or along the Columbia River could perform the reactor compartment disposal work envisioned in the preferred alternative. The Draft Environmental Impact Statement should be revised to establish the criteria which a privately owned shipyard would have to meet in order to become certified for performance of reactor compartment disposal work.

Those Identifying Issue	Identification Number
Dakota Creek Industries Inc. - Richard N. Nelson	12

Response

Specific analysis of private shipyard performance of the preferred alternative was not identified by any commenters during the scoping process as a topic to be evaluated in the Environmental Impact Statement.

Any shipyard performing work on Naval nuclear propulsion plants is required to be authorized to perform such work by the Naval Nuclear Propulsion Program, pursuant to the Atomic Energy Act of 1954 as amended. Currently, there are four Naval Shipyards authorized to perform such work and two private shipyards, Newport News Shipbuilding of Newport News, Virginia and the Electric Boat Division in Groton Connecticut. Authorization to perform such work is a long and complex process involving extensive qualification in the areas of nuclear quality control, radiological control, welding, lifting and handling, and the specific features of the nuclear propulsion plants which are serviced in the shipyard. The last time any shipyard undertook the steps to achieve such authorization was in 1967. With the end of the Cold War, the Navy was faced with excess capacity in nuclear capable shipyards. Two nuclear capable Naval Shipyards have been closed in the 1990's through the Base Realignment and Closure Act process, and the workload at the two private shipyards has been reduced significantly. The Navy currently is not pursuing additional nuclear capable shipyard capacity.

If a private shipyard in the Puget Sound area were authorized and available to perform such work, the standards and radiological controls applied to the work would be the same as those employed at Puget Sound Naval Shipyard. The environmental impacts associated with the work, which are quite small as described in the Draft Environmental Impact Statement, would remain essentially unchanged. Therefore, the environmental impacts of this minor proposed variation of the preferred alternative were covered in the Draft Environmental Impact Statement.

4.2 Summary of Issue

A shipyard located on the Columbia River would have a significant advantage over Puget Sound Naval Shipyard. The shipping distance would be closer with less chance of accident. Shipments could be made all winter since winter storms in the ocean would not preclude shipments. The Columbia River channel is maintained at 40 feet deep to Portland and 14 feet deep upriver, so the entire shipment could be made without risk of package rupture in the event of a sinking.

Those Identifying Issue	Identification Number
Dakota Creek Industries Inc. - Richard N. Nelson	12

Response

While the shipping distance from a Columbia River shipyard would be shorter, this does not confer a significant advantage. Risks associated with shipping would be correspondingly smaller for a Columbia River shipyard, but these risks are already extremely small as discussed in Section 4.3.2 of the Draft Environmental Impact Statement. For example, the radiological risk to the public from all 100 shipments was calculated to be 0.000061 latent cancer fatalities for normal conditions and 0.0000929 for accidents. Section 4.3.2.3 discussed how even in the case of the sinking of two nuclear powered submarines in the deep ocean, environmental monitoring of the wreckage sites confirmed negligible impact. The winter shipping restriction has not limited the reactor compartment disposal output of the Puget Sound Naval Shipyard since reactor compartment packages completed in the winter can be stored easily for shipment during the following year.

4.3 Summary of Issue

The City of Portsmouth has serious objections to disposal of dredge spoils at Craney Island. Craney Island is reaching capacity, and the City strongly opposes any proposed expansion.

Those Identifying Issue	Identification Number
City of Portsmouth Virginia - Gloria O. Webb, Mayor	14

Response

Section 4.4. of the Draft Environmental Impact Statement stated that current permits for dredging at Norfolk Naval Shipyard specify Craney Island as the disposal site. The Environmental Impact Statement has been revised to explain that Craney Island receives about 3,500,000 cubic yards of dredge spoils per year from the Hampton Roads area. Based on this annual volume of dredge spoils, it is estimated that the site will not exceed its current capacity until the year 2030. It is also estimated that 165,000 cubic yards of dredge spoils would be produced over a 15 year period in support of the no action alternative. This would constitute less than 1/3 of 1% of the 52,500,000 cubic yards (3,500,000 cubic yards per year multiplied by 15 years) of dredge spoils that are expected to come from the Hampton Roads area during the same time period.

With regard to the indefinite storage option, the major point of this discussion in Section 4.4 is that the amount of dredging related to storage is small compared to overall dredging activity at Norfolk Naval Shipyard, and this small amount of dredge spoil could be disposed of in the same manner as the other shipyard dredge spoil.

4.4 Summary of Issue

Storage of ships would bring no economic benefit to the City of Portsmouth.

Those Identifying Issue	Identification Number
City of Portsmouth Virginia - Gloria O. Webb, Mayor	14

Response

This comment is consistent with Section 4.4.1 of the Draft Environmental Impact Statement, which stated that the storage alternative would result in no socioeconomic impact at Norfolk Naval Shipyard.

4.5 Summary of Issue

The Draft Environmental Impact Statement states that Norfolk Naval Shipyard "does not lie in the principal storm tracks' for hurricanes." In fact, Portsmouth has been in the middle of the expected landfall area several times in recent years.

Those Identifying Issue	Identification Number
City of Portsmouth Virginia - Gloria O. Webb, Mayor	14

Response

The quoted statement appeared in Section 4.4.2 of the Draft Environmental Impact Statement, which discusses the consequences of extreme weather for the waterborne storage alternative. A more complete description of the hurricane risk appeared in Section 3.2.2. The latter section noted that hurricanes can and do strike in the Portsmouth area, but they often veer away to sea. It also noted that the Shipyard's location protects it from buildup of large waves, and that the key threat posed by hurricanes at Norfolk Naval Shipyard is high water due to storm surge. The final Environmental Impact Statement has been revised to include more of this discussion in Section 4.4.2 and to exclude the statement concerning principal storm tracks.

4.6 Summary of Issue

The Final Environmental Impact Statement should provide data on an alternative where the preferred alternative of reactor compartment disposal is deferred for 15 years. It may be that this alternative would significantly reduce worker exposures, exposures in transit, and therefore the costs associated with disposal.

Those Identifying Issue	Identification Number
Washington Department of Ecology - Rebecca J. Inman	11

Response

From Table C-3, Appendix C, the total estimated exposure for the preferred alternative is 1,508 Rem. The majority of that exposure is a result of water removal which is accomplished during the inactivation phase. Water removal would also be done in preparation of the defueled, decommissioned submarines or cruisers for waterborne storage. Delaying reactor compartment disposal operations would reduce exposure by about 25% compared to immediate disposal operations.

From Table C-2, Appendix C, the cost to keep the ships covered by this EIS in protected waterborne storage for 15 years is about $143 million. This cost would subtract from any savings realized from the reduced exposure due to a 15 year delay in disposal operations. An important factor in reducing Shipyard operational expenses is through the efficient use of Shipyard resources, facilities and labor forces. This can best be accomplished (or achieved) by allowing as much flexibility in work scheduling as possible. The 15 year waterborne storage would (or could) be counter productive to the most efficient uses of Shipyard assets which would result in additional expenses to the disposal operations.

4.7 Summary of Issue

The numerous inactivated ships moored on the waterfront of Puget Sound Naval Shipyard are a concern. How is the integrity of these older vessels being maintained? How are they going to continue to be maintained there?

Those Identifying Issue	Identification Number
Henrik Langhjelm	3

Response

Section 2.2 on page 2-29 provides a description of the basic measures necessary to keep decommissioned defueled nuclear powered vessels in waterborne storage. This section discusses the conclusion given in the 1984 Final Environmental Impact Statement that protective waterborne storage could safely be done. The defueled submarines currently in waterborne storage at Puget Sound Naval are safely stored as described in both EIS documents.

4.8 Summary of Issue

The recycling part of the work is hurting workers. Emissions from arc welding processes over lead canning and ballast tanks and using torches to cut through copper anti-fouling paint are concerns. A toxic Release Information Summary Report, by the State Department of Ecology, does not contain one single entry for the entire county, but airborne and waterborne emissions are being created.

Those Identifying Issue	Identification Number
Henrik Langhjelm	3

Response

The Navy currently maintains and will continue to maintain comprehensive environmental and occupational, safety and health programs. Under those programs Puget Sound Naval Shipyard has conducted industrial hygiene sampling for work on cutting through hull sections coated with paint that contains a high percentage of copper. Air samples taken in the worker's breathing zone show levels of copper to be well below the permissible limit established by the Occupational Safety and Health Administration. Workers at any distance from the actual burning operation would receive an even lower exposure. In addition, welders wear respiratory protection during the cutting operation, which effectively reduces their exposure.

4.9 Summary of Issue

Material safety data sheets are not readily available for boats being worked on. Some Material Safety Data Sheets address how exposure to the material may increase the risk of birth defects. This information is of particular concern to pregnant workers.

Those Identifying Issue	Identification Number
Henrik Langhjelm	3

Response

This issue concerns the integrity of day-to-day operation of Puget Sound Naval Shipyard's occupational safety and health program. The program is comprehensive and covers thousands of workers involved in most every conceivable industrial task. It is to be expected that periodically a worker with legitimate concerns about exposure to hazardous substances will question an aspect of the program, therefore processes exist within the program for resolving issues such as the one raised by the commenter. Should any pregnant employee have any questions about her working environment, whether Material Safety Data Sheet related or not, she is trained and encouraged to raise those questions with her chain of command, or directly with the Shipyard's Environmental, Safety and Health Office.

Material Safety Data Sheets are not required for articles, which are manufactured items and may be fabricated from one or more different materials. Material Safety Data sheets fall under the hazard communication regulation set forth in 29 CFR 1910.1200. The purpose of the regulation is to ensure that hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. Under the regulation, articles are exempted from the requirements of the hazardous communication program and do not require Material Safety Data Sheets. For example, because a submarine or ship hull arrives in the shipyard in its final form, it is considered an article per 29 CFR 1910.1200. Hull surface coatings are considered intrinsic to the hull design and therefore also fall under the definition of an article and do not require a Material Safety Data Sheet.

Employees need to be protected from hazards associated with the work that they do, such as flame-cutting of painted metal articles, even though Material Safety Data Sheets are not required for the articles being cut. The keys to protecting them in such situations are training, material sampling, work area monitoring and personnel protective equipment. These are thoroughly addressed by the Shipyard's occupational safety and health program.

4.10 Summary of Issue

Some of the profits from recycling of nonradioactive sections of ships should be invested in process improvements for the shipyard workers and environment.

Those Identifying Issue	Identification Number
Henrik Langhjelm	3

Response

Although the Shipyard sells the nonradioactive materials from the ship recycling program, this program operates at a net loss for the Navy. The funds received from the sale of recycled materials are not sufficient to pay the costs of the Shipyard recycling effort. The Federal Government supports this program in order to ensure that the ships are recycled safely and responsibly. As discussed in the responses to Issues 4.8 and 4.9, this work is being conducted safely.

4.11 Summary of Issue

The Environmental Impact Statement should clarify statements about how much radioactivity is removed by defueling and how much remains in the defueled reactor compartment.

Those Identifying Issue	Identification Number
Henrik Langhjelm	3

Response

All (100%) of the fuel would be removed prior to disposal of the reactor compartment as explained in Section 1.1. Section 1.2 of the statement explains that 99.9 percent of the radioactive material that remains is an integral part of the solid metal structural alloys forming the plant components and that the other 0.1 percent remaining is radioactive corrosion and wear products deposited on piping system internals.

4.12 Summary of Issue

The fact that the Shipyard denies public access in the Restricted Area along the Shipyard waterfront suggests that the Navy is unwilling to allow objective scrutiny of the environmental impacts of decommissioning and transportation operations in Puget Sound.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6, 6a

Response

Since Puget Sound Naval Shipyard is a defense installation, public access to the Shipyard and the waters along the Shipyard waterfront is restricted. Nevertheless, the Navy consistently has invited independent environmental sampling by State and Federal officials, such as in the case of the 1994 and 1995 joint sampling with the Washington Department of Health and the

U.S. Environmental Protection Agency. The results of such monitoring have been published. In addition, the U.S. Environmental Protection Agency's "Radiological Surveys of Naval Facilities on Puget Sound" (EPA 520/5-88-016) reports the results of independent sampling performed in 1987. Representatives of Washington and Oregon routinely survey reactor compartment packages prior to shipment.

4.13 Summary of Issue

The reactor compartments contain lead and PCB-laden materials. Although deemed a low-level burial ground, the area slated for disposal is, in effect, a system of large trenches with minimal protections against leaching and contaminants. It is imperative that the EIS address the potential environmental impacts of these materials in the absence of institutional controls. These materials must be subject to regulation under the Washington State Dangerous Waste Regulations to minimize the effect of disposal of these materials.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6, 6a

Response

It is inaccurate to describe the reactor compartment disposal site as a trench with minimal protections against leaching contaminants. As discussed in section 4.3.3.2.1.1 of the Draft Environmental Impact Statement, the Hanford Low-Level Burial Grounds will have a protective cover installed to minimize water intrusion. As discussed in section 4.3.3.2.1.1 and Appendix B, the corrosion resistance provided by the thick steel reactor compartment package will prevent any leaching of contaminants for many hundreds of years, far longer than the regulatory requirements (30 years) for hazardous waste disposal trench liners and covers.

Nevertheless, the evaluation of migration of both radioactive and nonradioactive contaminants in the sections 4.3.3.2 and 4.3.3.3 takes no credit for the protective cover. Furthermore, the long term analysis in Appendix B assumes the absence of institutional controls.

As stated in section 1.2, reactor compartment disposal would be regulated by the Washington Department of Ecology under the Washington State dangerous waste regulations because of the lead shielding and by the U.S. Environmental Protection Agency for the small quantity of polychlorinated biphenyls (PCBs).

4.14 Summary of Issue

The Navy has recently instructed the Department of Energy to bar public and press viewing of burial grounds containing naval reactor compartments during U.S. Department of Energy tours of the Hanford Nuclear Reservation. By this action, the Navy is implicitly stating that it is unwilling to open its disposal practices to public scrutiny. This is objectionable. The public should not be barred from seeing these practices.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6, 6a

Response

Beginning with the first defueled reactor compartment disposal at Hanford in 1986, security of the low level waste burial grounds area established and enforced by the DOE did not allow public access to the trench. After DOE began to relax security requirements at the low level waste burial grounds and allow escorted public tours, the Navy requested that the Department of Energy limit access to the reactor compartment trench area to persons with regulatory responsibilities, such as personnel from the Washington State Department of Ecology or the U.S. Environmental Protection Agency. This provided consistency with Navy security practices that remained in effect at facilities involved in submarine activities. This practice did not prevent the public from receiving technical information regarding reactor compartment disposal.

The comment that the Navy is unwilling to subject its disposal practices to public scrutiny is incorrect. Examples of the extensive technical information which has been made available to the public regarding this project include: the 1984 Environmental Impact statement on the disposal of reactor plants from pre-LOS ANGELES class submarines; permitting documents for the disposal trench; and various studies. This information was placed in public libraries in Bremerton, Richland, Seattle, and Portland. In addition, the U.S. Navy publication, "US Naval Nuclear Powered Submarine Inactivation, Disposal, and Recycling" provides more detailed information about the reactor compartment disposal program. Further, this Environmental Impact Statement fully describes the reactor compartment disposal process, including a site map (Figure 2.8), a photograph of the reactor compartment disposal trench (Figure 2.11), conceptual diagrams of expanded trench capacity (Figures 2.10 and 2.12), and an extensive technical evaluation of the potential environmental impact (Chapter 4).

In summary, the information readily available to the public, fully describes the reactor compartment burial process.

4.15 Summary of Issue

The Navy should minimize its use of Hanford lands for disposal of Naval reactor plants. The public does not consider Hanford a sacrifice zone and objects to the continual use of large areas of Hanford for Navy and Department of Energy waste disposal. Moreover, the cost of Hanford lands should be included in any analysis of the fiscal cost.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6, 6a

Response

The Final Environmental Impact Statement has been revised to include discussion of a trench arrangement where the reactor compartments are placed closer together than the current arrangement. Such an arrangement appears to be feasible, and would eliminate the need to expand the trench or dig an adjacent trench.

The Federal Government has owned the land at the Hanford Site for over 50 years. Therefore, it is difficult to put an accurate monetary price on the value of the land. The highest prices for privately owned land in the Richland area are approximately $75,000 per acre for prime riverfront property that has been developed for residential use. Even with this high land value, the land cost would be less than 0.05 percent of the total project cost for the preferred alternative.

4.16 Summary of Issue

The production of mixed waste should be minimized and materials recycled where possible. The Environmental Impact Statement should consider inclusion of recyclable materials within the proposed United States Department of Energy Program policy, known as Recycle 2000.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6, 6a

Response

The Draft Environmental Impact Statement discusses recycling of radioactive materials. Section 2.1.1.1 discusses reuse of radioactive potassium chromate solutions. Such solutions are recycled in the construction of new submarines. This reduces the generation of mixed wastes. Section 2.3.2 explains that much of the radioactive metal that would be generated with the subdivision alternative would be recycled using already existing private industry foundry technology. This section also notes that the Navy already recycles radioactive metals by this method. The Department of Energy Recycle 2000 initiative envisions recycling of radioactive metals into radioactive waste containers. If implemented by DOE, this program would provide another metal recycling option for the Navy in addition to the existing private industry foundry prosess.

4.17 Summary of Issue

The calculated times for transport of contaminants from the burial ground are disturbing. The Environmental Impact Statement should consider them more fully. The calculations might be based on United States Department of Energy calculations which have been shown to be erroneous, especially for tritium.

Those Identifying Issue	Identification Number
Heart of America Northwest - Cynthia Sarthou	6

Response

The corrosion and transport evaluation in the Draft Environmental Impact Statement is the result of work of several organizations, including not only the Department of Energy, but the Battelle Pacific Northwest National Laboratory, the Naval Civil Engineering Laboratory, the Naval Facilities Engineering Laboratory, the National Institute of Standards and Technology, and Puget Sound Naval Shipyard. The contribution of each organization is identified in the Draft Environmental Impact Statement.

The migration analysis for elements such as lead and nickel differs greatly from the tritium migration example cited by the commenter. Tritium is in the chemical form of water, and it migrates readily wherever water migrates in the environment. Migration of metallic oxides is greatly retarded by soil and arid conditions. This results in the extremely long migration times discussed in the Draft Environmental Impact Statement.

4.18 Summary of Issue

The reactor compartment disposal at Hanford contributes to the perception of Hanford as the nuclear waste site capitol of the world. This makes it difficult to recruit new businesses and diversify the local economy. The Navy should help the Tri-Cities mitigate this perception and help demonstrate to industrial recruitment clients, potential tourists, and agricultural customers that there are no demonstrable human health and safety effects as a result of the reactor compartment disposal.

Those Identifying Issue	Identification Number
Tri-City Industrial Development Council - Dave Dillman	7, 7a

As discussed in sections 4.3 and 4.8.1 of the Draft Environmental Impact Statement, the socioeconomic and environmental impacts on the region from shipment of reactor compartments to the Hanford Site would be insignificant and therefore would not warrant mitigation. As part of the Environmental Impact Statement process, the Navy is going to considerable expense and effort to produce a credible and understandable analysis of the very small environmental impacts associated with reactor compartment disposal at Hanford. The Navy has made this analysis available to the public by widely distributing the Environmental Impact Statement to private citizens and groups, advertising its availability in newspapers, holding four public meetings throughout the state, and notifying elected public officials.

SECTION C

This Section contains issues related to the Summary
and Appendix C of the Environmental Impact Statement

C.1 Summary of Issue

In order to make a comparison more understandable, Table C-1 should be revised to show the actual cost data for a pre-LOS ANGELES Class submarine and to show the number of mandays of shipyard effort needed to accomplish the various phases of work.

Those Identifying Issue	Identification Number
Dakota Creek Industries Inc. - Richard N. Nelson.	12

Response

Appendix C summarizes the monetary costs as well as the radiological exposure costs of the alternatives in a format suitable for comparison. Dollars, as opposed to man-days, were used throughout Appendix C because dollars are considered most meaningful to most people for comparing monetary costs. The complexities of the Naval Shipyard financial and accounting systems would have to be explained in detail in order to make manday information meaningful to the public. The cost to dispose of a LOS ANGELES Class reactor compartment was considered to be the same as the actual cost of the most common pre-LOS ANGELES Class reactor compartments due to similarity in size and plant configuration. The footnote to Table C-1 has been revised to clarify this point.

C.2 Summary of Issue

The cost analysis of alternatives does not indicate that future values have been discounted to present value, although there is reference to 1994 FY dollars. Since completion of this program will be spread out over 15 to 20 years, time values are an important consideration. The President's Office of Management and Budget (OMB) currently recommends an 8.1% nominal rate for 30 year projects (Circular A-94). Even though the cost estimates are "orders of magnitude" (C-2), it would be helpful to have some further explanation of the treatment of cost over time.

Those Identifying Issue	Identification Number
United States Environmental Protection Agency - Richard B. Parkin.	16

Response

The purpose of including cost information in the Environmental Impact Statement is to provide the opportunity to compare various options on the same cost-type basis. Although not clearly stated in the Draft Environmental Impact Statement, all costs were expressed in constant (FY 1994) dollars. The Environmental Impact Statement has been revised to state clearly that all costs are provided in constant dollars.

The constant dollar costs were calculated by determining the cost of accomplishment in 1994. In the past, the cost of working with radioactive waste has increased much faster than the OMB established nominal rates. Due to the uncertainty of these primary cost drivers, the Navy did not forecast future values and then discount the costs to constant dollars, but took a more direct approach by applying FY 1994 estimates for all anticipated work. This method provides the constant dollar cost estimates required in capital budgeting and is considered by the Navy to be a more accurate and valid cost comparison procedure in this instance.

However, for comparison purposes, the Navy has modified the Environmental Impact Statement to include footnotes that provide total program costs discounted to present value using the Office of Management and Budget 30-year real discount rate of 4.9% per year. The "real" discount rate of 4.9% was used rather than the "nominal" rate of 8.1% since the future costs were already expressed in FY 1994 dollars rather than in future nominal dollars.