United States General Accounting Office

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Report to the Acting Secretary of the Navy

July 1992

NUCLEAR SUBMARINES

Navy Efforts to Reduce Inactivation Costs

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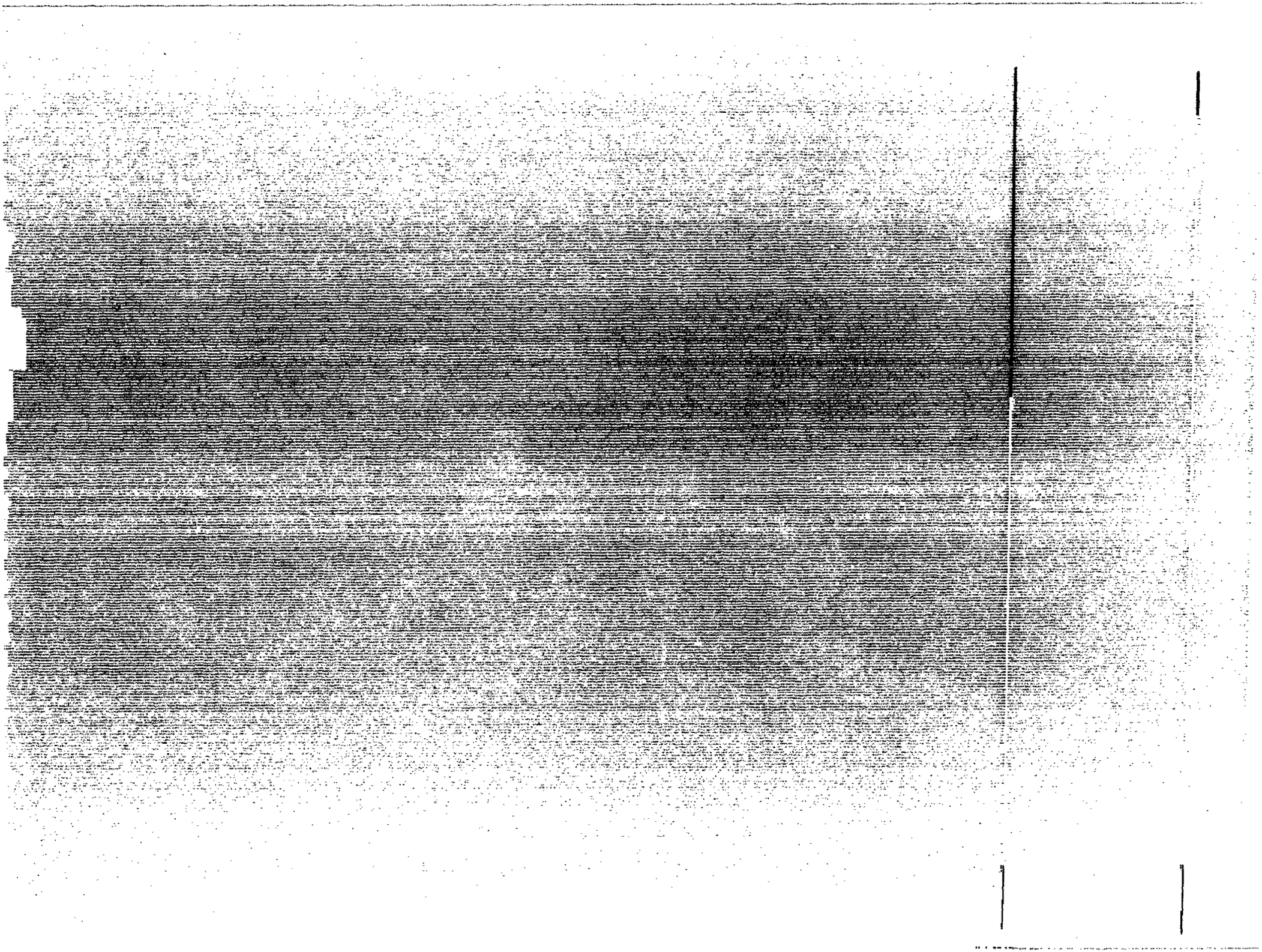

GAO

United States
General Accounting Office
Washington, D.C. 20548

147102

National Security and
International Affairs Division

B-244171

July 21, 1992

The Honorable Sean C. O'Keefe
The Acting Secretary of the Navy

Dear Mr. Secretary:

The Navy has embarked on a program to inactivate about 100 nuclear-powered submarines and dispose of about 85 of those inactivated submarines by the year 2000 at a total estimated cost of about $2.7 billion. We reviewed the program to determine its current status and assess whether the Navy is effectively managing costs. During our review, we identified two areas in which inactivation costs could be managed more effectively. First, the Navy needed to further standardize the way shipyards define and report costs so that shipyard performance can be compared and further efficiencies implemented. Second, by inactivating submarines at Puget Sound rather than other shipyards, we estimated the Navy could avoid an estimated $4.5 million to $11.5 million per submarine. The Navy is addressing these areas and is currently reassessing its workload policies and practices for the nuclear-capable shipyards including submarine inactivations; therefore, we are not making any recommendations to you at this time.

We are sending copies of this report to the Chairmen, Senate Committee on Governmental Affairs, House Committee on Government Operations, Senate and House Committee on Armed Services, and Senate and House Committee on Appropriations; the Secretary of Defense; and the Director, Office of Management and Budget.

Please contact me at (202) 275-6504 if you or your staff have questions concerning the report. Other major contributors to this report are listed in appendix II.

Sincerely yours,

Martin M Ferber
Director, Navy Issues

Executive Summary

Purpose

The Navy has embarked on a program to inactivate about 100 nuclear-powered submarines and fully dispose of about 85 inactivated submarines by the year 2000 at a total estimated cost of about $2.7 billion. GAO reviewed the program to determine its current status and assess whether the Navy is effectively managing costs.

Background

The first nuclear-powered submarine was commissioned in 1954. Through June 1991, the Navy has commissioned 165 nuclear-powered submarines. Many have reached the end of their useful life. Inactivating these submarines involves defueling their nuclear reactors, shutting down ship systems, and removing reusable equipment. Following inactivation, the section of the submarine containing the defueled nuclear reactor is removed and prepared for disposal at a federally controlled disposal site—the Hanford Nuclear Reservation in Washington state. Before March 1991, the Navy rejoined the submarines and placed them in waterborne storage. Beginning in fiscal year 1992, the Navy has instead dismantled the submarines so they can be recycled.

Naval Sea Systems Command (NAVSEA) is responsible for nuclear-powered submarine inactivation and disposal activities. NAVSEA determines which shipyard will conduct the inactivation, negotiates the price, provides the funding, and monitors shipyards performance. There are six nuclear-capable naval shipyards that perform nuclear-related maintenance work. Five of these conduct nuclear-powered submarine inactivations, but because of its proximity to the Hanford Nuclear Reservation only one—Puget Sound Naval Shipyard—removes defueled reactor compartments and recycles submarines. Any submarine not inactivated at Puget Sound is towed there for reactor compartment removal and waterborne storage or recycling.

Results in Brief

As of the end of fiscal year 1991, NAVSEA had initiated the inactivation of 42 submarines. Twenty of those 42 have undergone reactor compartment removal and disposal; 2 have been fully dismantled. NAVSEA is working to resolve environmental regulatory problems encountered during the disposal of defueled reactor compartments and has implemented an approach for disposal of submarine hulls—submarine recycling.

GAO identified two areas in which inactivation costs could be managed more effectively. First, NAVSEA needs to further standardize the way shipyards define and report costs so that shipyard performance can be

compared and further efficiencies implemented. Second, by inactivating submarines at Puget Sound rather than other shipyards, GAO estimates NAVSEA could avoid an estimated $4.5 million to $11.5 million per submarine. This cost avoidance results from lower costs and greater efficiencies at Puget Sound, as well as the avoided cost of preparing submarines inactivated at other shipyards for towing to Puget Sound for reactor compartment removal and disposal.

NAVSEA is addressing both areas. It is developing uniform work categories and estimating standards to make data more comparable among shipyards. It has also increased the number of inactivations planned for Puget Sound and due to some recent policy changes may have the opportunity to further reduce inactivation costs.

Principal Findings

Status of the Program

Of the 42 inactivations started since 1969, 31 were started since 1986, including 9 in fiscal year 1991. As the program evolved, NAVSEA and the shipyards identified and adopted more efficient procedures. For example, NAVSEA and the shipyards have suggested ways to simplify the reactor defueling process and reduce the number of workdays required.

NAVSEA faced several problems related to disposal of defueled reactor compartments and submarine hulls. For example, shipyard workers unexpectedly found a significant amount of a regulated hazardous material, PCB (polychlorinated biphenyl), in a submarine being inactivated. Because NAVSEA considers the cost of removing PCBs to "trace amount" for sea disposal as not cost competitive with hull recycling, this option is no longer under consideration. As an alternative, NAVSEA began a project to dismantle hulls, and sell marketable scrap. NAVSEA believes this approach will be an effective way to dispose of submarine hulls and to deal with a growing inactive submarine hull storage problem. NAVSEA has also developed a strategy, now under review by regulatory agencies, to better meet environmental regulatory requirements for disposal of reactor compartments.

NAVSEA Efforts to Improve Shipyard Inactivation Performance

As shipyards gained more experience in conducting inactivations, their performance improved, but the number of workdays they required to complete similar inactivation activities still differ considerably. NAVSEA and the shipyards have difficulty analyzing the reasons for these differences because of the dissimilarities in how shipyards categorize and report their work. For example, one shipyard categorized its nuclear work for an inactivation into 48 categories, whereas another shipyard had 81 categories. NAVSEA is developing uniform work categories and estimating standards to reduce these differences. If successful, NAVSEA and the shipyards will have improved capability to identify not only problem areas but efficient practices that other shipyards can use to reduce costs.

Navy Efforts to Reduce Inactivation Costs

Through fiscal year 1991, NAVSEA assigned over half—23 of 42—of all inactivations to shipyards other than Puget Sound. GAO's analysis showed that inactivations cost considerably less at Puget Sound than at other shipyards. For inactivations started in fiscal year 1990, Puget Sound inactivations cost an estimated $2.3 million to $7.8 million less per submarine than other shipyards. In addition, submarines inactivated at other shipyards must be towed to Puget Sound for reactor compartment removal and disposal at an estimated additional cost of $2.2 million to $3.7 million per submarine.

NAVSEA's objective in assigning inactivations to shipyards is to make the most efficient use of naval shipyard facilities, equipment, and manpower consistent with a standing policy to maintain the capability of overhauling nuclear-powered submarines at six naval shipyards, rather than to just minimize inactivation costs. Because inactivations provide shipyards with work similar to refuelings, they are used to fill in gaps in the nuclear workload, which helps the nuclear shipyards maintain their nuclear skills and capabilities.

In July 1991, NAVSEA took a step towards reducing inactivation costs by modifying its inactivation schedule to place more inactivations at Puget Sound than previously planned. This revised schedule, which added eight inactivations to Puget Sound's schedule through fiscal year 1997, was primarily due to expanded inactivation capacity at Puget Sound. GAO estimates that inactivating these submarines at Puget Sound rather than at other shipyards could allow NAVSEA to avoid at least $40 million in inactivation costs.

The Navy is also examining other possible changes that could result in additional opportunities to reduce inactivation costs. In December 1991, the Chief of Naval Operations rescinded the long-standing policy requiring six nuclear-capable shipyards, and in February 1992 the Secretary of the Navy established procedures to study the reduction and consolidation of the fleet support infrastructure, including naval shipyards. NAVSEA officials said that in conjunction with this effort, they are reassessing their workload policies and practices for the nuclear shipyards including how inactivation work is assigned.

Recommendations

GAO is not making any recommendations in this report.

Agency Comments

The Department of Defense provided written comments on a draft of this report. The draft report contained a recommendation that the Navy further assess its workload policies and practices for the nuclear-capable shipyards with the goal of minimizing the overall costs of nuclear-related maintenance, overhaul, and inactivation work. Defense agreed with the intent of the recommendation and identified several efforts it had underway, some of which were begun after GAO completed its audit work, to assess these policies. GAO believes these efforts should help ensure that costs are minimized.

Defense also commented that GAO's estimates of costs to be avoided were substantially overstated. Our estimate was based on actual costs incurred for inactivations conducted between fiscal years 1988-1990, while Defense's estimate was based on projected workdays and workday rates. We believe our estimate was reasonable.

Defense's comments are discussed in chapter 3 and reprinted in appendix I with GAO's evaluation.

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Abbreviations

DOD	Department of Defense
DOE	Department of Energy
NAVSEA	Naval Sea Systems Command
PCB	polychlorinated biphenyl

Introduction

The Navy commissioned the first nuclear-powered submarine, the Nautilus, in 1954. Through June 1991, it has commissioned a substantial number of nuclear-powered vessels—6 aircraft carriers, 9 cruisers, 114 attack submarines, and 51 ballistic missile submarines. The Congress has authorized the construction of 3 additional aircraft carriers, 19 attack submarines, and 7 ballistic missile submarines.

As nuclear-powered submarines commissioned in the 1950s and 1960s reach the end of their life cycle (usually 20 to 30 years) or become obsolete or too expensive to operate, they are removed from the active fleet. An official from the office of the Chief of Naval Operations explained that submarines are also removed to correspond with the Navy's desired fleet size based on its assessment of threats to the nation's security, on strategic arms treaty requirements, and on budget limitations. Unlike many conventionally powered Navy surface vessels, a nuclear-powered submarine's classified design precludes selling it after inactivation, and once inactivated it is not reactivated.

Key Events in Disposing of a Nuclear-Powered Submarine

Disposing of a nuclear-powered submarine involves three primary events: 1) inactivating and defueling the submarine, 2) removing and disposing of the defueled reactor compartment, and 3) recycling of the submarine hull. These three events are detailed in table 1.1 below.

Table 1.1: Key Events In Disposing of a Nuclear-Powered Submarine

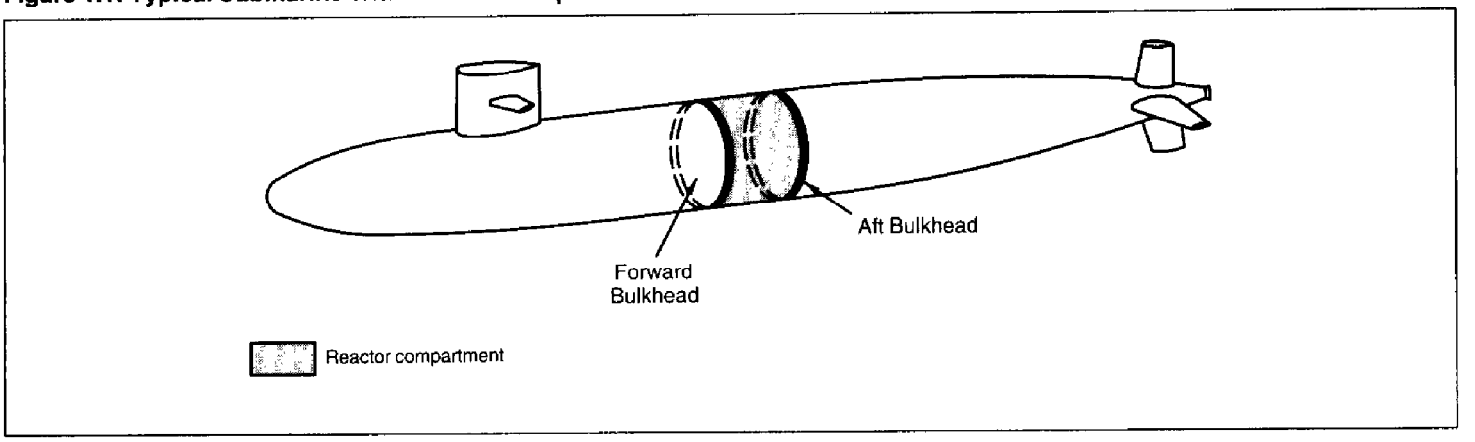
Event	Description
Inactivation	Reactor defueling includes training shipyard personnel, preparing the ship and reactor for fuel removal, removing the fuel from the reactor, and preparing the fuel for shipment to the Department of Energy's expended core facility in Idaho. Ship system shut-down involves the shutting down, laying up, draining, disconnecting, or servicing all ship systems including propulsion, armament, communications, water, steering and diving and ventilation. Equipment removal involves the removal of equipment identified for reuse in the active fleet. Missile compartment dismantlement for ballistic missile submarines involves removing the section of the submarine containing the missile compartment, dismantling the missile compartment, and rejoining the hull if hull recycling is not taking place concurrently. Preparations for waterborne storage are made if the inactivated submarine is not concurrently undergoing hull recycling. Preparations include establishing a watertight hull integrity that will support a minimum of 15 years of wet stowage. Tow modifications are made on submarines not inactivated at Puget Sound in order to tow them there for reactor compartment removal and disposal. Modifications include installing special towing equipment and modifying some ship systems for use during the tow.

(continued)

Event	Description
Defueled Reactor Compartment Removal and Disposal	Removal of a defueled reactor compartment includes: disconnecting all piping and electrical systems connected to the reactor compartment, making hull cuts at each end of the reactor compartment to remove it from the rest of the submarine, welding shipyard-manufactured bulkheads and support fixtures to each end of the reactor compartment "package," and loading the "package" onto a barge for shipment to the disposal site. The remaining hull sections were previously joined and prepared for waterborne storage, but now are recycled. Disposal of a defueled reactor comparment includes preparing the defueled reactor compartment "package" and the barge for shipping and towing the barge, with the "package" welded to its deck, through the Straits of Juan de Fuca, down the coast of Washington, and up the Columbia River to the Department of Energy's Hanford Nuclear Reservation. The "package" is then off-loaded from the barge onto a trailer and towed about 25 miles across the reservation to its burial site.
Submarine Recycling	Submarine recycling involves dismantling submarines that have undergone inactivation and reactor compartment removal. Equipment is removed and put into inventory and scrap metals and other materials not reutilized by the government are sold after demilitarization is complete.

Inactivations are conducted at five nuclear-capable naval shipyards, but the removal and preparation for disposal of the defueled submarine reactor compartments and the recycling of the remaining submarine hull are conducted only at Puget Sound Naval Shipyard. Figure 1.1 shows a typical submarine and the placement of the reactor compartment within the submarine hull.

Figure 1.1: Typical Submarine With Reactor Compartment Identified



Source. "Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants," Department of the Navy, May 1984.

Inactivated submarines undergoing defueled reactor compartment removal at Puget Sound come from three sources: submarines undergoing inactivation at Puget Sound, submarines inactivated at other shipyards and towed to Puget Sound, and previously inactivated submarines in waterborne storage at Puget Sound. Upon completion of reactor compartment removal, the defueled reactor compartment is shipped to its disposal site at the Hanford Nuclear Reservation in Washington state. The remaining hull sections are then rejoined and placed in waterborne storage at Puget Sound.

Beginning in fiscal year 1992, all submarine hulls undergoing inactivations and reactor compartment removal at Puget Sound will be recycled and sold for scrap. Also beginning in fiscal year 1992, submarines previously inactivated that are undergoing reactor compartment removal at Puget Sound will be recycled and sold for scrap. The average cost to complete an inactivation and reactor compartment removal and disposal for the 11 nuclear-powered submarines inactivated at naval shipyards between fiscal years 1988 and 1990 was $23.6 million; the average number of workdays was 55,272.[1]

[1]The average numbers presented are based on the actual cost and workdays required for the 11 nuclear-powered submarine inactivations conducted at naval shipyards between fiscal years 1988 and 1990. The five inactivations conducted at Puget Sound included the reactor compartment removal and disposal. The six inactivations not conducted at Puget Sound include the average cost and workdays for each shipyard to conduct the inactivation and the average cost and workdays required by Puget Sound to complete a reactor compartment removal and disposal.

Responsible Agencies and Offices

Naval Sea Systems Command (NAVSEA) provides material support to the Navy and the Marine Corps for ships, submarines, other sea platforms, shipboard combat systems and components, and other surface and undersea warfare and weapons systems. Three NAVSEA directorates administer the submarine inactivation program—the Naval Nuclear Propulsion Program (which is also part of the Department of Energy), the Strategic Submarine Program, and the Industrial and Facility Management Directorate.

The Naval Nuclear Propulsion Program is responsible for the development, manufacture, operation, maintenance, and disposal of naval nuclear reactors. The program consists of naval officers and civilians jointly assigned to the Department of the Navy and the Department of Energy. The Director, Naval Nuclear Propulsion Program, reports directly to the Chief of Naval Operations and also serves as the Deputy Assistant Secretary for Naval Reactors, Department of Energy.

The Strategic Submarine Program is responsible for technical and logistics support for the operation of all nuclear ballistic missile submarines and for managing the inactivation of all nuclear-powered submarines. The Strategic Submarine Program manages the inactivation program by defining work requirements, monitoring shipyard performance, and controlling program funds. It also coordinates inactivation activities with the Naval Nuclear Propulsion Program, which is responsible for the technical requirements associated with inactivating the reactor plant and disposing of the defueled reactor compartment. The Industrial and Facility Management Directorate is responsible for waterborne storage of inactivated submarines. This includes maintenance, monitoring, and security.

There are six nuclear-capable naval shipyards each with different capabilities ranging from working on conventionally powered surface ships to refueling nuclear-powered surface ships and submarines. Five of them conduct nuclear-powered submarine inactivations (see table 1.2). The sixth one, Norfolk Naval Shipyard, does not. The Navy has also used private shipyards for inactivations—Electric Boat conducted one in fiscal year 1969, and Newport News Shipbuilding conducted two each in fiscal years 1986 and 1989.

Table 1.2: Naval Nuclear-Capable Shipyards That Conduct Nuclear-Powered Submarine Inactivations

Shipyard	Location
Puget Sound Naval Shipyard	Bremerton, Washington
Mare Island Naval Shipyard	Vallejo, California
Portsmouth Naval Shipyard	Kittery, Maine
Charleston Naval Shipyard	Charleston, South Carolina
Pearl Harbor Naval Shipyard	Pearl Harbor, Hawaii

Inactivation shipyards are responsible for conducting inactivation activities including planning the work and estimating workday requirements. Naval shipyards are industrial fund activities operated under NAVSEA. Industrial fund activities, established by the Department of Defense (DOD) with the approval of the Congress in 1949, cover the cost of shipyard work until the shipyard receives payment from the customer. The customers use annual appropriations to reimburse these activities for work performed. The financial goal of these activities is to break even—to cover costs without experiencing a gain or loss.

The Office of the Chief of Naval Operations is also involved in determining which submarines will be inactivated and in which year those inactivations will take place. The Office of the Chief of Naval Operations also approves NAVSEA's nuclear-powered submarine inactivation schedule.

Objectives, Scope, and Methodology

Our objective was to determine the status of the Navy's nuclear-powered submarine inactivation program and to determine whether the Navy is effectively managing program costs. To accomplish our objective, we performed audit work at two NAVSEA offices that are primarily responsible for the nuclear-powered submarine inactivation program, four of the five naval shipyards that conduct submarine inactivations, and the defueled reactor compartment disposal site at Richland, Washington. The organizations visited were:

- Department of Energy, Office of Naval Reactors, Arlington, Virginia;
- Department of the Navy, Naval Nuclear Propulsion Program, Naval Sea Systems Command, Arlington, Virginia;
- Naval Sea Systems Command, Arlington, Virginia, including their Strategic Submarine Program and the Industrial and Facility Management Directorate;
- Puget Sound Naval Shipyard, Bremerton, Washington;
- Mare Island Naval Shipyard, Vallejo, California;
- Portsmouth Naval Shipyard, Kittery, Maine;

- Charleston Naval Shipyard, Charleston, South Carolina; and
- Department of Energy, Richland Field Office, Hanford Nuclear Reservation, Richland, Washington.

We selected those four shipyards because they did 11 of the 13 nuclear-powered submarine inactivations conducted between fiscal years 1988 and 1990. The fifth submarine inactivation shipyard—Pearl Harbor Naval Shipyard—did not start an inactivation during this time. Pearl Harbor conducted inactivations prior to fiscal year 1988 and resumed conducting inactivations in fiscal year 1991. The two remaining inactivations were conducted at a private shipyard in 1989. However, we limited our review to inactivations at public shipyards.

To determine the status of the program, we obtained background information from Naval Reactors and NAVSEA officials on the 42 inactivations conducted through fiscal year 1991 and more detailed information on shipyard costs and workday requirements for 16 inactivations completed between fiscal years 1986 and 1990. We used this information to develop a historical data base to determine, among other things, the number of inactivations completed at each shipyard each fiscal year and the cost and workdays required by each shipyard to complete inactivations. In addition, we obtained information on the evolution of the inactivation program from officials at Naval Reactors, NAVSEA, and Puget Sound.

To determine whether the Navy was effectively managing program costs, we focused on two issues: (1) the reasons for and the costs associated with inactivating a submarine at a shipyard other than Puget Sound and towing it to Puget Sound for reactor compartment removal and disposal and (2) the reasons for differences among shipyards in the cost and workdays required to complete similar inactivation tasks.

To determine the costs associated with NAVSEA's practice of assigning inactivations to multiple shipyards, we obtained historical data from NAVSEA and shipyard officials that we used to estimate the costs associated with each additional task required when an inactivation was not conducted at Puget Sound. We used our historical data base to establish NAVSEA's inactivation assignment practices through fiscal year 1991 and obtained NAVSEA's planned inactivation schedule (as of July 1991) through fiscal year 1999. We used this information to estimate the cost NAVSEA has incurred by assigning inactivations to shipyards other than Puget Sound and the potential inactivation cost savings of NAVSEA's future inactivation

schedule. Cost savings presented in this report are based on actual inactivation costs for inactivations started between fiscal years 1988-90. We did not consider the potential nuclear ship maintenance and refueling cost savings the Navy may achieve by assigning other nuclear work to Puget Sound and inactivations to shipyards other than Puget Sound.

To analyze variances in cost and workdays among shipyards conducting inactivations tasks, we obtained detailed cost and performance information from NAVSEA and each shipyard we visited for the 11 inactivations conducted at naval shipyards between fiscal years 1988 and 1990. Where reported costs and workdays differed significantly among shipyards, we used shipyard inactivation work requirements and discussions with shipyard officials to determine the reasons.

To achieve the assignment's objectives, we relied in part on data contained in the Standard Naval Shipyard Management Information System. We did not independently assess the reliability of the data because recent audits by the Naval Audit Service indicated that, although the management information system has some accuracy problems, overall the data was useable. The data was the best available and was used by the Navy in evaluating shipyard activities.

We provided DOD with a draft of this report. Their principal comments are discussed in chapter 3 and have been reprinted in their entirety in appendix I.

Our review was conducted in accordance with generally accepted government auditing standards between September 1990 and October 1991.

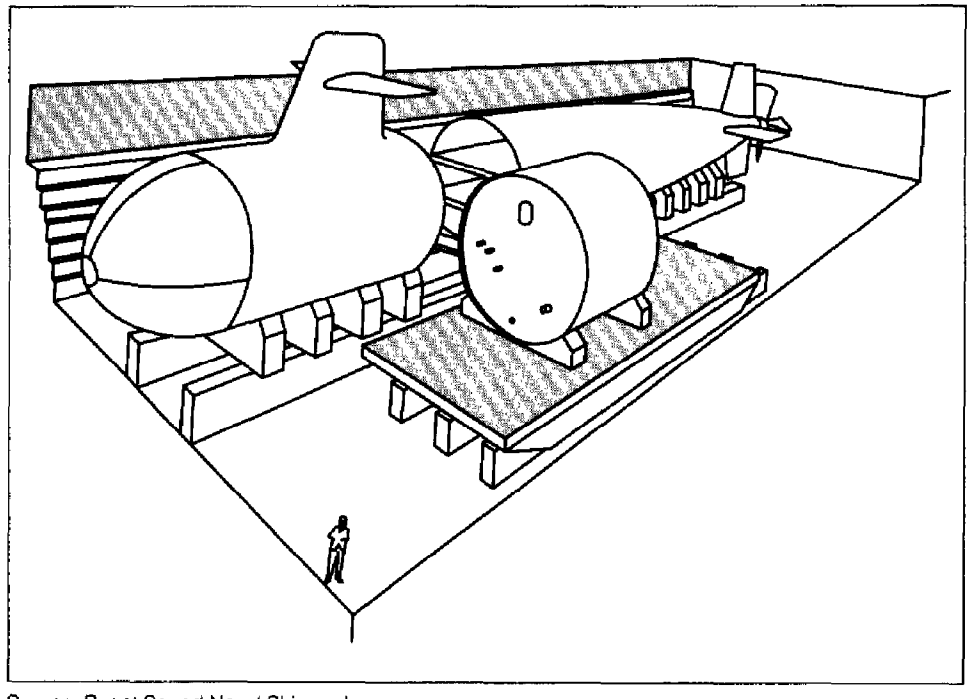
Status and Evolution of the Nuclear-Powered Submarine Inactivation and Disposal Program

As of the end of fiscal year 1991, the Navy had initiated the inactivation of 42 of the 100 nuclear-powered submarines it plans to inactivate by the year 2000. Most are either in the process of being disposed of or are in waterborne storage awaiting disposal. Two submarines have been disposed of fully. The Navy plans to fully dispose of about 85 inactivated submarines by the year 2000. Based on actual inactivation costs incurred between fiscal years 1988-90, the total estimated cost for this program through fiscal year 2000 is about $2.7 billion. As the Navy's program has evolved, NAVSEA has also been faced with two significant issues—full compliance with environmental regulations for reactor compartment disposal and limited waterborne storage space for inactivated submarines.

Status of Inactivated Submarines

The first nuclear-powered submarine inactivation was begun in fiscal year 1969. Between 1969 and 1980, only four inactivations were started (see table 2.1) and between fiscal years 1981 and 1985, seven inactivations were started. Beginning in fiscal year 1986, the number of inactivations increased with three to five each year through fiscal year 1990, and nine in fiscal year 1991. This increase followed the establishment of the disposal site at the Hanford Nuclear Reservation in December 1985 for defueled reactor compartments. At this time, Puget Sound began removing defueled reactor compartments either in conjunction with or following an inactivation and preparing them for shipment to Hanford. Figure 2.1 shows an inactivated submarine in dry dock at Puget Sound with its defueled reactor compartment removed and placed on a barge in preparation for shipment to Hanford.

Figure 2.1: Inactivated Submarine in Dry Dock With Defueled Reactor Compartment Removed



Source: Puget Sound Naval Shipyard.

The first defueled reactor compartment removal and disposal was completed in fiscal year 1986, and through fiscal year 1991, 20 reactor compartments have been removed and shipped to Hanford (see table 2.1). According to NAVSEA and Puget Sound officials, reactor compartment disposals are expected to continue at a rate of at least six a year through fiscal year 1999 subject to the availability of funds and changes in the inactivation schedule. In fiscal year 1991, Puget Sound recycled its first two nuclear-powered submarine hulls. As directed by the Chief of Naval Operations in May 1991, beginning in fiscal year 1992, all submarines undergoing inactivation and reactor compartment removal, and previously inactivated submarines undergoing reactor compartment removal at Puget Sound, will be recycled. In addition each year at least two inactivated submarines in waterborne storage that have previously had their reactor compartments removed will be recycled.

Table 2.1: Status of Nuclear-Powered Submarine Inactivation Program

Fiscal year	Number of inactivations started	Number of reactor compartments shipped to Hanford[a]	Number of submarine recyclings completed[b]
1969-1980	4	N/A	N/A
1981-1985	7	N/A	N/A
1986	5	1	N/A
1987	4	1	N/A
1988	3	2	N/A
1989	5	2	N/A
1990	5	5	N/A
1991	9	9	2
Total	**42**	**20**	**2**

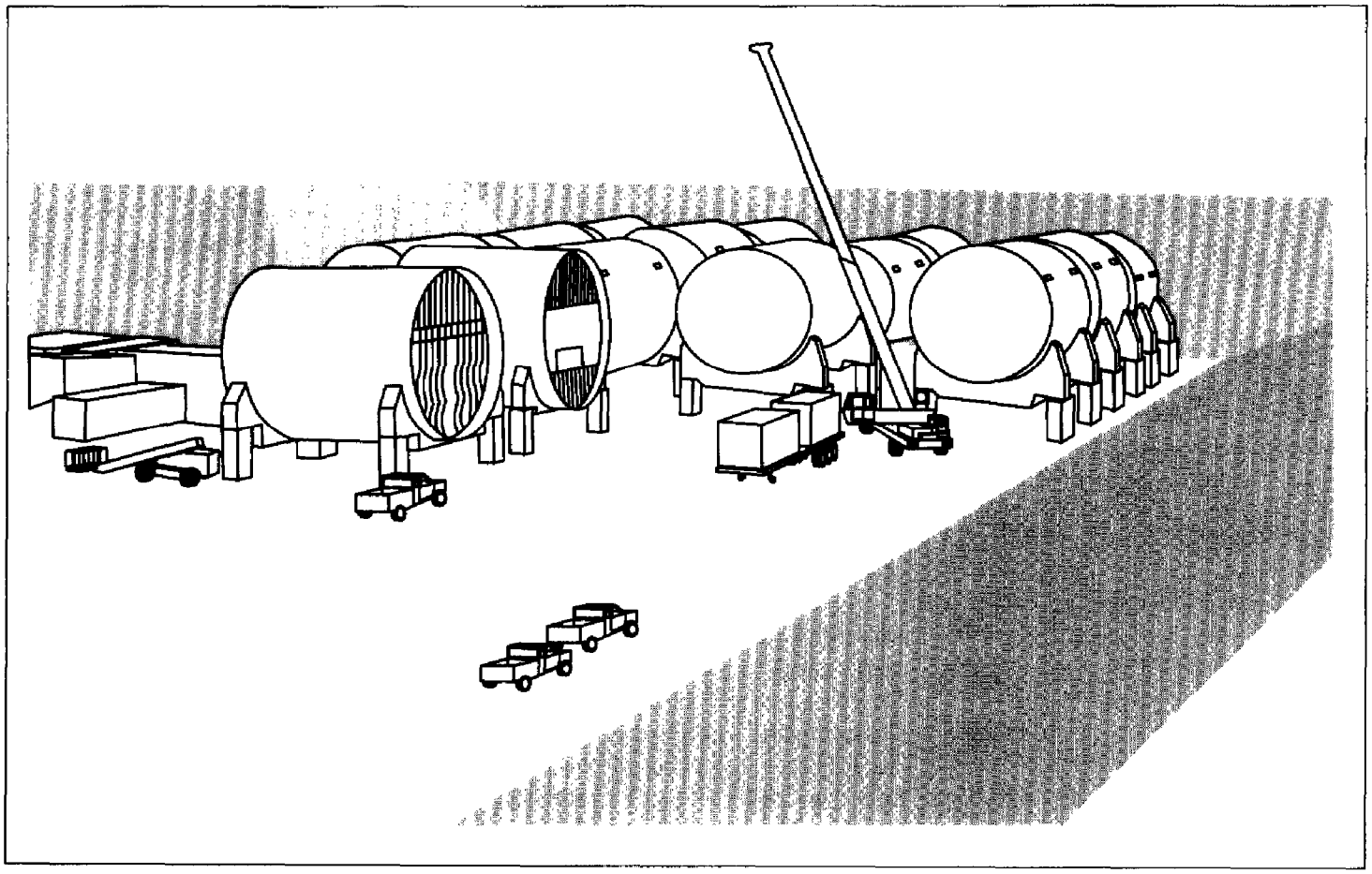
[a]The first reactor compartment was shipped to Hanford in fiscal year 1986.

[b]The first submarine recyclings were completed at Puget Sound in fiscal year 1991.

Difficulties in Complying With Environmental Regulations Associated With Defueled Reactor Compartment Disposal

After beginning to dispose of defueled reactor compartments at the disposal site at Hanford (shown in 1990 in figure 2.2), NAVSEA encountered three environmental regulation compliance issues with the reactor compartments: the unexpected discovery of significant amounts of PCBs (polychlorinated biphenyl)—a toxic chemical regulated by the Environmental Protection Agency under the Toxic Substances Control Act—the presence of residual water, and the regulation of lead by Washington state.

Figure 2.2: Defueled Reactor Compartment Disposal Site at the Hanford Nuclear Reservation, 1990



Source: Department of Energy, Richland Operations.

In April 1989, while inactivating the USS JOHN ADAMS (SSBN 620), Puget Sound workers unexpectedly discovered significant amounts of the regulated hazardous material PCB in wool-felt material inside of the hull. Subsequent investigation determined that this PCB-laden material was also present in the six reactor compartment packages already at Hanford. Because Environmental Protection Agency regulations allow land disposal of PCBs only in a permitted chemical waste landfill, NAVSEA spent about $14.9 million to remove PCB-laden material from the reactor compartment packages at Hanford. In addition, shipyard procedures were modified to remove this material during reactor compartment removal. Up to 5 pounds of PCBs remain in each reactor compartment shipped to Hanford widely distributed in industrial materials such as insulation and electrical cabling.

Since this material is very difficult and, according to NAVSEA officials, costly to remove, the Department of Energy, at NAVSEA's behest, has applied for interim approval to operate the disposal site as a chemical waste landfill until the Environmental Protection Agency grants final approval.

While removing the PCBs from the defueled reactor compartment packages at Hanford in 1989, water was found in the package bilge areas adjacent to the reactor compartment. NAVSEA and Washington state officials stated that both Washington state and federal regulations prohibit free-standing liquid in hazardous waste disposed of in a permitted disposal site. NAVSEA responded to this discovery by removing accessible water from the reactor compartment packages at Hanford and by modifying shipyard procedures to drain as much water as practical from the reactor compartment packages before they are shipped to Hanford. Puget Sound also worked with regulators to establish 230 gallons as the acceptable amount of water that can be left in the reactor compartment packages. According to NAVSEA officials, virtually all of the water is contained within the defueled reactor vessel and piping systems that have been drained to the maximum extent practical and then sealed.

An additional dangerous material in the reactor compartment package is lead, which in some instances is considered a hazardous waste under Environmental Protection Agency regulations implementing the Resource Conservation and Recovery Act. Although the Environmental Protection Agency does not consider the lead contained in the reactor compartment to be a hazardous waste because it serves as a radiation shielding device, Washington state has the authority under the act to regulate lead regardless of its use. In October 1989, the state notified the Navy that it intended to regulate the lead shielding contained in the reactor compartment as a dangerous waste. As a result, to allow disposal of lead shielding in the reactor compartments burial site, the Department of Energy included the site in its application to the state to operate Hanford as a low-level dangerous waste burial site.

The Department of Energy also submitted a request to exempt the reactor compartment disposal site from the state's requirement to line the disposal site and install a system, required to be operational for 100 years, to collect any run-off liquid to prevent its transport outside of the site. This request is based on an evaluation of the integrity of the reactor compartment package that indicates it would not be breached by corrosion for at least several hundred years.

Although defueled reactor compartments continue to be shipped to Hanford, as of January 1992 the following issues are still not resolved:

- state approval of the Department of Energy's application to operate Hanford as a low-level dangerous waste burial site,
- state approval of the Department of Energy's request for exemption from the liner and liquid collection system requirement for the reactor compartment disposal site, and
- Environmental Protection Agency approval of the interim and the final permit to allow disposal of PCBs remaining in the reactor compartment packages in the reactor compartment disposal site.

Submarine Recycling Helps Resolve Storage Problems

Following the completion of inactivations and reactor compartment removals started at Puget Sound prior to March 1991, the remaining submarine hulls sections were rejoined and placed in waterborne storage at Puget Sound. Until the April 1989 discovery of PCBs in submarine hulls at Puget Sound, NAVSEA had planned to ultimately dispose of submarine hulls at sea. Because NAVSEA considers the cost of removing PCBs to "trace amounts" for sea disposal as not cost competitive with hull recycling, this option is no longer under consideration.

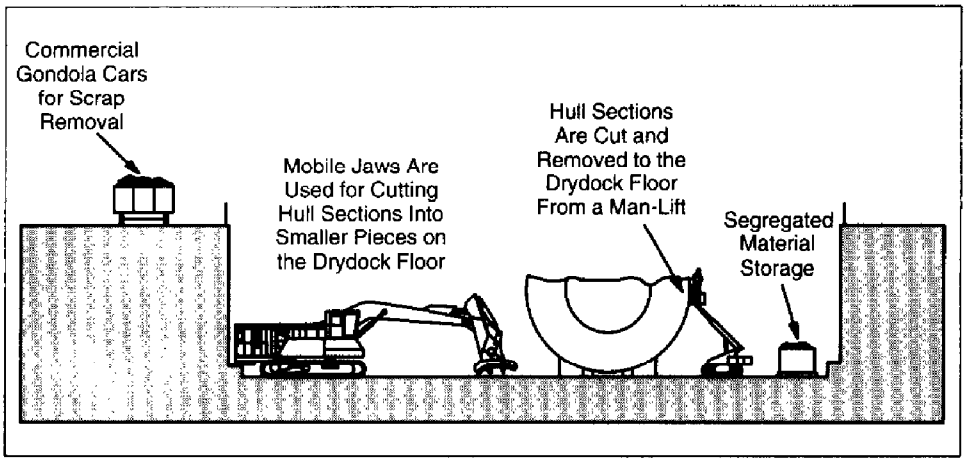
The amount of waterborne storage space available for inactivated submarines is limited. Puget Sound currently has space for 15 hulls, but a not-yet-complete fiscal year 1992 military construction project will increase storage capacity to 35 hulls at an estimated cost of $3.3 million.

To reduce the number of submarine hulls in waterborne storage, in May 1990 Puget Sound submitted a proposal to NAVSEA to dispose of submarine hulls by dismantling and recycling them (see figure 2.3). Recycling a submarine hull involves identifying, removing, and disposing of all hazardous wastes; identifying and removing equipment for reuse in the active fleet; demilitarizing equipment; removing all salvageable material; and selling scrap metals and other materials that are not reutilized by the government.

In July 1990, NAVSEA informed Puget Sound that it could begin a submarine recycling demonstration project to test its feasibility. NAVSEA officials stated that they would consider the project a success if Puget Sound could dispose of the increased amount of hazardous materials created by the process, appropriately complete demilitarization, and physically complete the demonstration project within projected cost and schedule estimates. In

May 1991, after successful progress on this project, the Chief of Naval Operations approved a submarine recycling program that beginning in fiscal year 1992 includes hull recycling for all Puget Sound inactivations and reactor compartment removals, and the recycling of at least two hulls each year from those already in waterborne storage which have had their reactor compartments removed. Puget Sound officials estimated that it will cost from $3.5 million to $4.5 million to recycle each rejoined hull. This cost includes a return of about $1.5 million per hull from the sale of scrap metal and other materials.

Figure 2.3: Schematic of Submarine Hull Dismantlement in a Dry Dock



Source: Puget Sound Naval Shipyard.

In a May 1991 report to the House and Senate Appropriations Committees on Naval Ship Dismantling and Disposal, the Navy stated that implementing the submarine recycling program will (1) make storage facility expansions unnecessary beyond fiscal year 1992, (2) reduce the liability of having inactivated submarines containing hazardous materials in storage, (3) allow for complete declassification and demilitarization of sensitive military technology, and (4) reduce inactivation hull storage and maintenance costs.

Navy Efforts to Reduce Submarine Inactivation Costs

Puget Sound has been the least expensive location for inactivating nuclear-powered submarines. For inactivations started in fiscal year 1990, we estimate that the cost was from $2.3 million to $7.8 million less at Puget Sound than at other shipyards. In addition, Puget Sound is the only shipyard that removes and disposes of reactor compartments from inactivated nuclear-powered submarines. Consequently, all submarines inactivated at other shipyards must be towed to Puget Sound for reactor compartment removal and disposal, which, based on actual fiscal year 1988-90 costs, we estimate adds an additional $2.2 million to $3.7 million to the cost.

NAVSEA's focus in assigning nuclear-powered submarine inactivations to shipyards has not been to just minimize inactivation costs, but to make the most efficient overall use of naval shipyard facilities, equipment, and manpower. The Navy's assignment of inactivations to shipyards is also consistent with its policy of maintaining six naval shipyards capable of overhauling nuclear-powered submarines.

NAVSEA has recently taken a step to reduce future costs by revising its inactivation plan so that Puget Sound conducts more inactivations over the next several years. We estimate, based on actual fiscal year 1988-90 inactivation costs, that NAVSEA will avoid between $40 million and $82 million in inactivation costs through fiscal year 1997. This revised plan was not the result of a change in Navy policy, but the actions of NAVSEA officials to reduce inactivation costs by taking advantage of expanded inactivation capacity at Puget Sound and by delaying missile compartment dismantlement until the submarine is recycled at Puget Sound.

In December 1991, the Navy rescinded its six nuclear-capable shipyards policy and due to the requirements of the Defense Base Closure and Realignment Act of 1990 is evaluating a possible reduction of its fleet support infrastructure, including naval shipyards. This evaluation will include a reassessment by NAVSEA of its nuclear shipyard workload polices and practices including the assignment of inactivations to shipyards. Recognizing that inactivations are not the only nuclear work assigned to the nuclear shipyards, this reassessment should provide NAVSEA an opportunity to reduce its inactivation costs.

Inactivations Are Less Costly at Puget Sound

Based on the actual cost each shipyard incurred to complete inactivations started in fiscal year 1990, we estimated that inactivations conducted at Puget Sound cost from $2.3 million to $7.8 million less than at the other shipyards, as shown in table 3.1. While nuclear submarine inactivations are not identical due to ship class and design differences, the tasks required to complete an inactivation are similar enough to raise questions about the extent of these differences.

Table 3.1: Estimated Workdays and Cost Required by Each Shipyard to Complete a Nuclear-Powered Submarine Inactivation Started in Fiscal Year 1990

Shipyard	Workdays per inactivation	Cost per inactivation (millions)	Difference from Puget Sound cost (millions)
Puget Sound	30,083	$12.8	---
Mare Island	28,707	15.3	$2.5
Portsmouth	49,521	20.6	7.8
Puget Sound	44,977	19.1	---
Charleston	51,105	21.4	2.3

Note. Excludes workdays and costs we estimated are associated with reactor compartment disposal for Puget Sound inactivations and those associated with tow modifications for inactivations conducted at all other shipyards to make workday and cost data comparable across shipyards. This estimate is based of actual cost data for fiscal year 1990 inactivation starts.

There may be several reasons for the differences in the number of workdays and cost required by each shipyard to complete an inactivation. However, we did not determine what these reasons were for the differences. This is discussed more fully in chapter 4, where we also discuss the limitations involved in determining the reasons for these differences.

Puget Sound Inactivations Avoid Towing and Other Costs

Additional costs are avoided when inactivations are conducted at Puget Sound. Due to its proximity to the submarine reactor compartment disposal site at the Department of Energy's Hanford Nuclear Reservation in eastern Washington, NAVSEA conducts all reactor compartment removals and disposals of nuclear-powered submarines at Puget Sound. As a result, all submarines not inactivated at Puget Sound must be towed there for reactor compartment removal and disposal, which increases total inactivation cost.

Based on actual costs incurred for inactivations conducted between fiscal years 1988-90, we estimate that the additional cost and workdays for each submarine not inactivated at Puget Sound ranged from $2.2 million to $3.7 million and from 5,500 to 8,600 workdays, depending on the type of

submarine inactivated and the inactivation shipyard. Additional cost and workdays are incurred because submarines not inactivated at Puget Sound require tow modifications to the hull and selected ship systems, towing to Puget Sound, and additional work to complete reactor compartment removal and disposal. Additionally, those ballistic missile submarine inactivations, which include missile compartment dismantlement, require the hull be rejoined prior to being towed to Puget Sound. Based on the actual costs and workdays incurred by the shipyards for inactivations started in fiscal years 1988-90, we estimated that the costs and workdays incurred for these additional tasks include:

- $1.2 million and 2,900 workdays for tow modifications,
- $1.0 million and 2,600 workdays for additional reactor compartment removal and disposal work,
- $1.2 million and 3,100 workdays to rejoin a hull following a missile compartment dismantlement.

In addition based on fiscal year 1991 costs, between $40,000 and $270,000 is required for the fuel consumed by the tow and escort vessels towing an inactivated submarine to Puget Sound.[1]

None of these additional tasks and their related costs and workdays apply to inactivations that take place at Puget Sound.

NAVSEA Inactivation Scheduling Practices

NAVSEA officials stated that the most important considerations in assigning inactivations to shipyards have been to make the most efficient overall use of naval shipyard facilities, equipment, and manpower, and to level out the nuclear workload to maintain needed refueling and other nuclear capabilities, not to just minimize inactivation costs. According to NAVSEA officials, this is consistent with a December 1983 Chief of Naval Operations Instruction that requires the maintenance of six naval shipyards capable of overhauling nuclear-powered submarines.

In January 1991, NAVSEA officials said that given the planned nuclear workload, they needed to maintain six nuclear-capable shipyards at least through the late 1990s. Therefore, because inactivations provide shipyards

[1]We did not request the Navy to provide information on the total cost to tow an inactivated submarine to Puget Sound including the operating cost of the tow and escort vessels because of the time it would have taken to prepare this information. The Navy did provide information on the cost and amount of fuel consumed by tow and escort vessels.

with nuclear work similar to refuelings, they are used to fill in gaps in the nuclear workload, which helps the shipyards maintain their nuclear skills and capabilities. NAVSEA officials explained that not filling in these gaps could increase the cost of other nuclear ship refueling and maintenance work. Through fiscal year 1991, over one-half—23 of 42—of all inactivations were assigned to shipyards other than Puget Sound.

Developments That Allow Inactivation Cost Reductions

NAVSEA's current inactivation plan, as provided to us in July 1991, reduces inactivation costs by placing more inactivations at Puget Sound. According to NAVSEA officials, the July 1991 plan is not a result of a change in Navy policy and is consistent with the 1983 Chief of Naval Operations Instruction described above. NAVSEA also plans to avoid some inactivation costs by deferring missile compartment dismantlement of ballistic missile submarines until the submarine undergoes recycling at Puget Sound. Four developments allowed NAVSEA to make these scheduling changes: 1) expanded capacity at Puget Sound to conduct inactivations through completion of a project authorized in fiscal year 1990 to make an additional dry dock capable of nuclear refueling, 2) a higher rate of inactivations, 3) a reduction in the amount of commissioned ship work assigned to Puget Sound, and 4) Chief of Naval Operations approval to delay missile compartment dismantlement provided it is completed within the time constraints of applicable strategic arms treaties.

Under this July 1991 plan, between fiscal year 1992 and 1997, eight additional inactivations will take place at Puget Sound compared to NAVSEA's November 1990 schedule. Six are new inactivations added since November 1990, and two have been shifted to Puget Sound from other shipyards. NAVSEA officials stated that they believe assigning these eight additional inactivations to Puget Sound optimizes its expanded capacity to conduct inactivations. By assigning these eight inactivations to Puget Sound rather than to the other shipyards, based on actual fiscal year 1988-90 inactivation costs, we estimate NAVSEA will avoid between $40 million and $82 million in inactivation costs as follows:

- $20 million to $62 million due to Puget Sound's lower costs,
- $17.6 million for avoided tow modifications and additional reactor compartment removal and disposal work, and
- $2.4 million for delaying missile compartment dismantlements for the two ballistic missile submarines scheduled for inactivation outside of Puget Sound during this time period.

The Navy also avoids the expense of towing these submarines from their inactivation shipyard to Puget Sound for reactor compartment removal and disposal.

The Navy Is Assessing Nuclear Workload Strategy

Since the completion of our audit work, the Navy has canceled the 1983 Chief of Naval Operations Instruction that required the maintenance of six naval shipyards capable of overhauling nuclear-powered submarines. In addition, due to the requirements of the Defense Base Closure and Realignment Act of 1990, and as directed by the Department of Defense, in February 1992, the Secretary of the Navy established procedures to study the reduction and consolidation of its fleet support infrastructure, including the naval shipyards. In conjunction with this effort, NAVSEA officials said they are assessing workload policies and practices for the nuclear shipyards including how inactivation work is assigned.

Conclusions

Inactivation costs differ significantly among the shipyards. NAVSEA's new emphasis on reducing inactivation costs by placing more inactivations at Puget Sound, the least-cost shipyard, we estimate could result in a cost avoidance of at least $40 million through fiscal year 1997. This schedule change did not result from a change in Navy policy, but is due to NAVSEA officials taking advantage of several developments that allowed them to place more inactivations at Puget Sound.

We believe the Navy's plan to increase submarine inactivations at Puget Sound, the recent rescission of its policy requiring the maintenance of six nuclear-capable shipyards, and its ongoing assessment of policies and practices for nuclear shipyards, including how inactivation work is assigned, will likely minimize the overall cost of nuclear-related maintenance, overhaul, and inactivation work.

Agency Comments and Our Evaluation

In a draft report provided to the Department of Defense, we had recommended that the Secretary of the Navy direct NAVSEA to further assess workload policies and practices for the nuclear-capable shipyards with the goal of minimizing the overall costs of nuclear-related maintenance, overhaul, and inactivation work. DOD agreed with the intent of our recommendation and pointed out several actions it had begun after we had completed our audit work that made the recommendation unnecessary. These actions are underway and we believe they will achieve

the intent of this recommendation; therefore, a recommendation is unnecessary at this time.

In its comments on the report, DOD agreed that assigning submarine inactivations to Puget Sound rather than other shipyards avoided costs, but disagreed with our projections. DOD estimated avoided costs to be between $1.5 million to $37 million. Our estimate was based on actual costs incurred for inactivations conducted between fiscal years 1988-1990, while DOD's estimate was based on projected workdays and workday rates. We believe our estimate was reasonable.

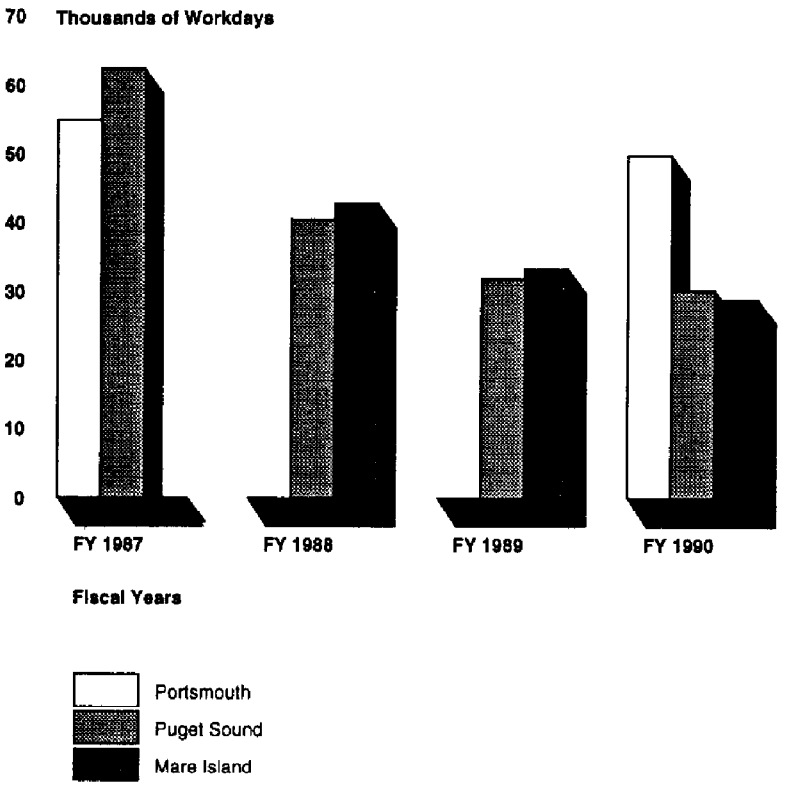
NAVSEA Efforts to Improve Inactivation Shipyard Performance

Shipyards have found ways to reduce the number of workdays required to complete inactivations as they have gained experience. However, shipyards vary considerably in the degree to which they have improved their performance. NAVSEA and the shipyards have limited ability to compare shipyard performance because each defines and reports work differently. To address this problem, NAVSEA has begun to revise existing uniform work categories and develop new uniform work categories and estimating standards. If this effort is successful, NAVSEA and the shipyards will be better able to analyze shipyard performance, identify problem areas for corrective action, and help reduce costs.

Shipyards Vary in Improving Their Performance

The shipyards that conduct the majority of submarine inactivations have generally been better able to reduce the number of workdays required to complete an inactivation. Figure 4.1 illustrates this trend for comparable inactivation activities for attack submarine inactivations. During fiscal years 1987-90, Puget Sound and Mare Island began four and three attack submarine inactivations, respectively, while Portsmouth began two. All three shipyards improved their performance. Puget Sound and Mare Island reduced their inactivation workdays by 52 and 33 percent respectively, while Portsmouth reduced its by 10 percent.

Figure 4.1: Trends in Shipyard Inactivation Workdays, Attack Submarines, Fiscal Years 1987-90 Inactivation Starts



Note: Excludes workdays associated with reactor compartment disposal for Puget Sound inactivations, and workdays associated with tow modifications for inactivations conducted at all other shipyards to make the workdays comparable across the shipyards.

The trend is not as clear for ballistic missile submarine inactivations. During fiscal years 1987-90, Charleston and Puget Sound each began two. While Charleston was able to reduce its inactivation workdays by 9 percent, Puget Sound's increased by 16 percent. According to NAVSEA and Puget Sound officials, this workday increase was primarily the result of higher than expected radiation levels.

This general pattern of workday reductions results from shipyards learning to work more efficiently. For example, Puget Sound and Mare Island have conducted two inactivations in one dry dock at the same time. Shipyard officials explained that this practice is more efficient because services, workers, and other resources can be shared. In addition, based on an initiative begun by NAVSEA in November 1989, nuclear shipyards have submitted suggestions to simplify nuclear work. For example, both Puget

Sound and Mare Island have suggested ways to simplify the reactor defueling process and reduce the number of workdays required to complete the defueling. These changes, which NAVSEA has approved, were possible because less stringent requirements for defueling a reactor are acceptable when the reactor will not be refueled. The changes include adopting less stringent cleanliness standards and verification procedures and using the ship's systems to support defueling rather than developing new temporary systems.

Difficulties in Comparing Performance Between Shipyards

Although shipyard performance is improving, the wide variance in cost between shipyards indicates that additional improvements are possible. NAVSEA and the shipyards have difficulty identifying why significant variances in workdays exist between shipyards because each shipyard categorizes and reports the work differently. This results in cost data that are not comparable and that complicate efforts to improve inactivation performance. For example:

- Although NAVSEA provides the shipyards with technical requirements and manuals to guide the nuclear work, each shipyard defines its own nuclear work categories. Charleston defined its nuclear work for the inactivation of the USS HENRY CLAY (SSBN 625) into 48 categories while Portsmouth defined its nuclear work into 81 categories for the inactivation of the USS JACK (SSN 605).
- Some non-nuclear inactivation work, such as tow modifications, is not done for all inactivations. These unique tasks are included in many different work categories, making it difficult for the shipyards to determine how much of a work category variance is due to these unique tasks and how much is due to shipyard performance.
- In some cases, shipyards define work categories the same, but report them differently. For example, Puget Sound reports hull blanking (welding shut of hull penetrations) in two different work categories while Portsmouth reports it in one; and Portsmouth reports work for equipment removal in several work categories while Mare Island reports all equipment removal in one work category. Without established work categories that uniformly define the work, comparisons between shipyards to identify opportunities to improve performance are difficult. Shipyard officials explained to us that because each shipyard defines, categorizes, and reports the work somewhat differently, they have difficulty determining if variances are due to differences in the scope of work, differences in how the work is reported, actual differences in shipyard efficiency, or a combination of these factors.

NAVSEA Oversight of Inactivations

NAVSEA's oversight of shipyard inactivation work is primarily done on a shipyard-by-shipyard basis and includes aggregate level comparisons among the shipyards. NAVSEA officials said they use past inactivation performance and actual shipyard costs for comparable work to determine the reasonableness of the shipyard's proposed workday estimates. If the estimate for any category of work seems too high or too low, NAVSEA asks the shipyard to adjust it or to justify the difference. NAVSEA officials told us that they believe working with the shipyards to establish a reasonable estimate is one of the best ways to control inactivation cost because it is done before the inactivation starts and is the basis for authorization of shipyard expenditures.

Throughout an inactivation, NAVSEA compares shipyard performance to the shipyard's estimate. These comparisons, which cover both nuclear and non-nuclear work, allows NAVSEA to determine if the shipyard is managing the inactivation according to the agreed upon estimate. NAVSEA uses this information to negotiate a fixed price with the shipyard prior to 50 percent completion of the inactivation. NAVSEA also makes comparisons to past performance of shipyards conducting similar inactivation work.

NAVSEA also assesses completed inactivations when performance significantly differed from the shipyard estimate. NAVSEA officials explained that they use the shipyard's final inactivation cost report to look for variances as a means to identify areas where the shipyard could improve its performance or where the shipyard performed better than expected. NAVSEA analyzes these reports, which list workdays and costs expended for each work category, by grouping categories by function or task and comparing it with the performance of other shipyards.

NAVSEA recently attempted to assess the performance of two inactivations completed at different shipyards, but had only limited success in determining why one shipyard performed less efficiently than another. NAVSEA officials explained that they assessed two 1990 inactivations—the USS JACK (SSN 605) at Portsmouth and the USS SHARK (SSN 591) at Mare Island. Portsmouth inactivated the USS JACK (SSN 605) for less than the shipyard's estimate of 55,000 workdays, but still required significantly more workdays than the other shipyards. NAVSEA officials stated that based on their assessment of Portsmouth's performance they concluded that the high number of workdays, which occurred in most work categories, was due to a lack of experience and proficiency. Mare Island inactivated the USS Shark (SSN 591) in about 31,000 work days, which was almost 19,000 less than they estimated. NAVSEA's assessment of Mare Island's

performance on the USS SHARK (SSN 591) identified areas of significant improvement, but could not identify how Mare Island attained its improved performance. NAVSEA subsequently directed all inactivation shipyards to work with Mare Island to determine if its inactivation work techniques and practices might be applicable to their shipyards.

NAVSEA Is Developing More Uniform Work Categories and Estimating Standards for Inactivations

To help address the variances in shipyard inactivation performance, NAVSEA is involved in two related efforts. The first is developing uniform work categories for the nuclear portion of submarine inactivations. These uniform work categories will define the nuclear work to allow for uniform cost accounting at each shipyard. In January 1991, NAVSEA directed Puget Sound to develop a draft of these categories, which Puget Sound submitted in August 1991 and NAVSEA approved and implemented in October 1991 for all future inactivations. The second effort is developing work category estimating standards for inactivations. According to NAVSEA officials, this ongoing effort includes revising the current non-nuclear work categories to isolate unique work, such as tow modifications and reactor compartment removal preparations, into separate work categories, and developing estimating standards for both the nuclear and non-nuclear work based on the uniform work categories. NAVSEA officials stated that inactivation estimating standards will establish a standard workday estimate for each category of work defined in the uniform nuclear and non-nuclear work packages. In January 1992, NAVSEA approved estimating standards for the nuclear work that will commence with inactivations beginning in February 1992. NAVSEA officials stated that they plan to have revised uniform work categories and estimating standards for the non-nuclear work ready for fiscal year 1993 inactivations.

NAVSEA expects these efforts will help standardize how shipyards define work and report inactivation costs. This will enable NAVSEA and the shipyards to more readily make meaningful performance analyses because work categories will be more comparable between shipyards. A NAVSEA official stated that as shipyard estimates and performance begin to reflect the established standard, shipyard performance variances should be reduced.

Conclusions

Efforts to determine why inactivation performance varies between shipyards are complicated by differences in how each shipyard categorizes and reports its inactivation work requirements. Without comparable work categories, it is difficult to compare performance of the shipyards to identify opportunities for improvement. NAVSEA's current efforts to develop uniform work categories and estimating standards will provide information for improved measurement of shipyard performance and the means to better identify areas for improvements.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

7 APR 1992

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report entitled--"NUCLEAR SUBMARINES: Navy Can Further Reduce Inactivation Costs," dated February 26, 1992 (GAO Code 394421; OSD Case 8743-A).

The GAO included only one recommendation--i.e., that the Secretary of the Navy direct the Naval Sea Systems Command to further assess workload policies and practices for the nuclear capable shipyards with the goal of minimizing the overall costs of nuclear related maintenance, overhaul, and inactivation work. The DoD agrees with the intent of the recommendation, but considers it unnecessary for several reasons:

See comment 1.

- The stated goal is already integral to Navy policy and practices.
- The Naval Sea Systems Command is already assessing ship workload policies and practices with the objective of minimizing overall costs in conjunction with the Defense Base Closure and Realignment Act. That objective cannot be achieved if the Navy assigns inactivations in isolation to minimize their costs--without regard to impact on the costs of other more complex and expensive work.
- The scope of the report does not support the recommendation as it does not adequately address the costs of ship work other than submarine inactivations.

See comment 2.

The GAO also has overstated substantially its calculated Navy savings resulting from assigning submarine inactivations at Puget Sound Naval Shipyard in lieu of other shipyards. Six of the eight submarine inactivations on which the GAO calculated its savings figures were assigned to Puget Sound in the first place as a result of Navy decisions in 1991 to accelerate the pace of inactivations. Furthermore, the Department is concerned that the report title itself--"Navy Can Further Reduce Inactivation Costs"--may mislead the reader to conclude that overall costs to the Government can be reduced by assigning more inactivations to Puget Sound Naval Shipyard.

See comment 3.

See comment 4.

Finally, the GAO draft report includes substantial material on the Navy submarine recycling and reactor compartment removal programs--material from an earlier GAO survey on Navy policies, plans and practices to deactivate and dispose of nuclear powered vessels and reactor cores (GAO survey 394388). A GAO letter of February 21, 1991 closed out that survey with no external reporting. In their exit conference on this survey, GAO representatives expressed that the "overall RC [reactor compartment disposal] program is being managed well" and that the submarine recycling program is a "responsible efficient alternative to long-term storage of submarines."

The detailed DoD comments on the report findings and recommendation are included in the enclosure. Thank you for this opportunity to review and comment on the GAO draft report.

Sincerely,

Victor H. Reis

Enclosure

GAO DRAFT REPORT - DATED FEBRUARY 26, 1992

(GAO CODE 394421, OSD CASE 8743-A)

"NUCLEAR SUBMARINES: NAVY CAN FURTHER REDUCE INACTIVATION COSTS"

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

FINDING A: Nuclear Submarine Inactivation. The GAO reported that the Navy has embarked on a program to inactivate and dispose of about 100 nuclear-powered submarines by the year 2000, at a total estimated cost of about $2.4 billion. The GAO reported that inactivating the submarines involves: (1) defueling their nuclear reactors, (2) shutting down ship systems, and (3) removing reusable equipment. The GAO explained that, following inactivation, the section of the submarine containing the nuclear reactor is removed and prepared for disposal at a Federally-controlled disposal site at the Hanford Nuclear Reservation in Washington State. The GAO noted that the Naval Sea Systems Command is responsible for nuclear-powered submarine inactivation and disposal activities. The GAO found that five naval shipyards conduct nuclear-powered submarine inactivations, but only one (the Puget Sound Naval Shipyard) removes reactor compartments and dismantles submarines. This is because of its proximity to the Hanford Nuclear Reservation. The GAO further found that any submarine not inactivated at Puget Sound is towed there for reactor compartment removal and waterborne storage or dismantlement. The GAO observed that the Navy also has used private shipyards for inactivations--for example, Electric Boat conducted one in FY 1969, and Newport News Shipbuilding conducted two each in FY 1986 and FY 1989. (pp. 1-2, p. 14, pp. 10-13/GAO Draft Report)

Now pp. 2-3, 12, and 8-15.

DoD Response: Partially concur. The $2.4 billion figure pertains to the Navy plan for the period FY 1992 through FY 2000 to inactivate approximately 60 and dispose of approximately 75 nuclear-powered submarines at a total estimated cost of about $2.4 billion. The figure of 100 submarines includes those submarines whose inactivations preceded FY 1992. Also, for clarification, it should be emphasized that the Navy disposes of only defueled nuclear reactors at Hanford, Washington--including the entire defueled reactor compartment. It should also be noted that a limited number of inactivated submarines are stored temporarily in a facility at Norfolk Naval Shipyard.

See comment 5.

FINDING B: Status of the Program. The GAO reported that, of the 42 inactivations started since 1969, 31 were started since 1986--including nine in FY 1991. The GAO observed that, as the Navy program has evolved, the Naval Sea Systems Command also has been faced with two significant issues: (1) compliance with

environmental regulations for reactor compartment disposal and (2) limited waterborne storage space for inactivated submarines. The GAO pointed out that, beginning in FY 1992, all submarine hulls will be dismantled at Puget Sound and sold for scrap, including recycling two of the hulls per year in waterborne storage. The GAO found that the average cost to complete an inactivation and reactor compartment removal and disposal for the 11 nuclear-powered submarines inactivated at naval shipyards between FY 1988 and FY 1990 was $23.6 million, with the average number of workdays at 55,272. The GAO found that, as the program evolved, the Naval Sea Systems Command and the shipyards identified and adopted more efficient procedures. For example, the GAO noted that the shipyards have suggested ways to simplify the reactor defueling process and reduce the number of workdays required.

The GAO also reported that the Naval Sea Systems Command faced three major environmental problems related to disposal of reactors and submarine hulls: (1) the discovery of a hazardous material, polychlorinated biphenyl, (2) the discovery of residual water, and (3) the regulation of lead by Washington State. Although reactor compartments continue to be shipped to Hanford, the GAO found that the following issues are still not resolved as of January 1992:

- State approval of the Department of Energy application to operate Hanford as a low-level dangerous waste burial site;
- State approval of the Department of Energy request for exemption from the liner and liquid collection system requirement for the reactor compartment disposal site; and
- Environmental Protection Agency approval of interim and final permits to allow disposal of polychlorinated biphenyls in the reactor compartment disposal site.

The GAO observed that the cited problems also prohibited the Naval Sea Systems Command from disposing of submarine hulls at sea. The GAO found that, as an alternative, the Naval Sea Systems Command began a project to dismantle hulls and sell marketable scrap. The GAO observed that, according to the Naval Sea Systems Command, selling that scrap will be an effective way (1) to dispose of submarine hulls and (2) to deal with a growing hull storage problem. The GAO concluded that the Naval Sea Systems Command has developed a strategy to meet environmental requirements for disposing of reactor compartments. The GAO noted that strategy is now under review by regulatory agencies. (pp. 2-3, p. 10, pp. 20-29/GAO Draft Report)

Now pp. 2-5, 8, and 16-22.
See comment 6.

DoD Response: Partially concur. Beginning in FY 1992, all submarines undergoing inactivation and/or reactor compartment removal at Puget Sound will be recycled at that location. Submarines inactivated outside Puget Sound will be moved to Puget Sound for recycling and defueled reactor compartment disposal.

See comment 7.

See comment 8.

See comment 9.

See comment 10.

See comment 11.

See comment 12.

The statements regarding "major environmental problems" require clarification. First, "the disposal of reactors" is imprecise. It is actually the disposal of defueled submarine reactor compartments. Second, since polychlorinated biphenyls have been in use since 1940 and first were regulated as "hazardous material" in the 1970s, the issue is the unexpected discovery aboard submarines of significant amounts of a type of regulated hazardous material (polychlorinated biphenyls). Third, the presence of residual water in reactor compartment disposal packages has been recognized all along and does not pose a technical environmental problem, but rather a regulatory problem which is being resolved and has not held up further submarine reactor compartment disposals. Each submarine reactor compartment has small amounts of residual water remaining after systems are drained. Fourth, in general, lead has been regulated since the 1970s; but Federal regulations exempted lead used for radiation shielding from regulation as a "hazardous waste." The matter involves regulation of all forms and sources of lead by Washington State as a chemically hazardous waste.

The GAO also states that one of the unresolved issues is the Environmental Protection Agency approval of interim and final permits to allow disposal of polychlorinated biphenyls in the reactor compartment disposal site. Although submarine reactor compartments do have small amounts of polychlorinated biphenyl bearing materials remaining (constituting about 5 pounds per submarine reactor compartment package in materials such as electrical cabling, rubber mounts, and thermal insulation), the Navy is expending substantial effort to remove other materials containing significant quantities of polychlorinated biphenyls. Thus, it is more accurate to state that approval is being sought to allow disposal of minor--but regulated--amounts of residual polychlorinated biphenyl materials.

The GAO also states the three cited problems prohibited the Naval Sea Systems Command from disposing of submarine hulls at sea. Since the early 1980s, the Navy has had no intention of disposing of any submarine hulls at sea unless their reactor compartments had been removed; therefore, the only cited problem applicable to the disposal of submarine hulls at sea is the presence of significant amounts of polychlorinated biphenyl materials. Neither international treaty nor Federal law specifically prohibits sinking a vessel containing trace amounts of polychlorinated biphenyls, but the Navy most likely would have to remove as much polychlorinated biphenyl material as practical prior to sinking. That prevents the ocean disposal option from being cost competitive with recycling submarines in a drydock. Therefore, the unexpected discovery aboard submarines of significant amounts of polychlorinated biphenyl materials resulted in a Naval Sea Systems Command determination that ocean disposal incurred additional regulatory uncertainties and was no longer the most cost effective option for disposing of submarine hulls upon removal of their reactor compartments.

FINDING C: Performing Inactivations at Puget Sound Reduces Inactivation Costs. The GAO reported that the Naval Sea Systems Command assigns nuclear-powered submarine inactivations to shipyards consistent with a 1983 Chief of Naval Operations policy to maintain six naval shipyards capable of overhauling nuclear-powered submarines, rather than trying to minimize inactivation cost. The GAO estimated, however, that for inactivations started in FY 1990, the Puget Sound Naval Shipyard completed the work at the lowest cost by $2.3 to $7.8 million for each submarine (as shown in report table 3.1). The GAO also found that nuclear-powered submarines inactivated at other shipyards must be towed to Puget Sound for reactor compartment removal and disposal at an additional estimated cost of $2.2 to $3.7 million per submarine. The GAO observed, however, that through FY 1991, the Naval Sea Systems Command had assigned 23 of the 42 inactivations to shipyards other than Puget Sound.

The GAO also reported that, in 1991, the Naval Sea Systems Command took a step towards reducing inactivation costs to the Navy by modifying its inactivation schedule (within the Navy policy to maintain six nuclear capable shipyards) to place a greater number of inactivations at Puget Sound than previously planned. The GAO calculated that the revised schedule could save at least $40 million through FY 1997. (p. 4, pp. 30-39/GAO Draft Report)

Now pp. 4 and 23-28.

DoD Response: Partially Concur. Maintaining six Naval shipyards capable of overhauling nuclear-powered submarines has been only one aspect of the Navy policy for assigning inactivations to Naval shipyards. Specifically, it is Navy policy to assign ship work in a manner that makes the most efficient overall use of Naval shipyard facilities, equipment, and manpower. "The Naval Shipyard Corporate Operations Strategy and Plan (1990-1994)" of May 30, 1990 details the strategy for driving the cost of ship maintenance down and makes improved cost performance the top priority. The objective is not to minimize inactivation costs in isolation, but rather to focus on the overall cost of ship work. Assigning inactivation work in the most efficient manner would necessitate assigning other more costly work in an inefficient manner, thereby making overall ship work less efficient and driving up overall costs. Moreover, as explained to the GAO evaluators in July 1991, the planned assignment of inactivations was based on maintaining the capability to handle the anticipated nuclear refueling, overhaul, and modernization workload planned through the 1990s--a workload which, as of July 1991, would require the capacity of all six nuclear capable shipyards. Never was the assignment of inactivations based solely on the Navy written policy [which recently has been cancelled] to maintain six Naval shipyards capable of nuclear submarine overhaul work.

See comment 13.

The potential cost savings of performing eight inactivations at Puget Sound instead of the other shipyards evaluated by the GAO are overstated by about $5 million per ship. Therefore, a more accurate calculated cost savings is $1.5 to $37 million (rather than the $40 to $82 million projected by the GAO). For

See comment 14.

inactivations started in FY 1990, the GAO estimated that Puget Sound completed the work for $2.3 to $7.8 million less for each submarine, along with an additional savings of $2.2 to $3.7 million, by avoiding the cost to tow to Puget Sound a submarine inactivated elsewhere. The GAO then used the FY 1990 savings estimate to project that the Navy will save $40 to $82 million by its decision to schedule eight additional future submarine inactivations to Puget Sound. The GAO concluded that the Navy could achieve additional savings by placing even more submarine inactivations at Puget Sound. The GAO analysis of FY 1990 performance data does not, however, reflect that the relative labor and overhead rate advantage for Puget Sound has shrunk since FY 1990, and that other shipyards (through experience and proficiency acquired in performing submarine inactivations) have improved their efficiency significantly relative to Puget Sound. Moreover, the GAO estimate of savings from tow avoidance does not reflect the costs incurred when a ship makes the transit to Puget Sound on its own power rather than under tow.

Although the GAO correctly observes that, through FY 1991, the Naval Sea Systems Command had assigned 23 of 42 inactivations to shipyards other than Puget Sound, it is important to note that these 23 inactivations could not have been accommodated by Puget Sound because of the unavoidably heavy workload involving refueling, overhaul, and modernization of commissioned nuclear powered submarines and surface ships at the yard.

See comment 15.

The GAO also reported that, in 1991, the Naval Sea Systems Command took a step towards reducing inactivation costs to the Navy by modifying its inactivation schedule (within the Navy policy to maintain six nuclear-capable shipyards) to place a greater number of inactivations at Puget Sound than previously planned. That statement requires clarification. The process of modifying the inactivation schedule began in FY 1990, when the Naval Sea Systems Command authorized Puget Sound to develop additional dockside defueling capability for the purpose of multiple concurrent submarine inactivations. Also, six of the eight additional inactivations assigned to Puget Sound were a result of a Navy acceleration in the pace of submarine inactivations (i.e., these six inactivations were never scheduled to other than Puget Sound). Moreover, the other two inactivation assignments at Puget Sound resulted from measures reducing the number of commissioned ship availabilities scheduled for Puget Sound, thereby making room for more inactivation work.

See comment 16.

FINDING D: Additional Scheduling Changes May Save More. The GAO reported that the Navy could achieve additional savings by shifting even more inactivations to Puget Sound since about one-third of the inactivations are still scheduled for other shipyards. The GAO noted, however, that according to Command officials, given the planned workload through the late 1990s, the Navy needs to continue to maintain six nuclear-capable shipyards--and, because inactivations provide the shipyards with nuclear work similar to refuelings and overhauls, they use

inactivations to fill gaps in the nuclear workload to help maintain shipyard nuclear skills and capabilities during those times. The GAO further noted, according to the same officials, that not assigning inactivations the current way could increase the cost of the other nuclear work. The GAO did not consider the potential nuclear ship maintenance and refueling savings the Navy may achieve by assigning other nuclear work to Puget Sound and inactivations to shipyards other than Puget Sound. The GAO recognizes that inactivations are only part of the workload at the six nuclear-capable shipyards, and there undoubtedly would be workload trade-offs among the shipyards--if the Navy assigned more inactivations to Puget Sound. (p. 4, p. 18, p. [illegible]. 15-39/GAO Draft Report)

DOD Response: Partially concur. The GAO states that the Navy could achieve additional savings by shifting even more inactivations to Puget Sound. However, the statement does not take into consideration that Puget Sound has neither the facilities nor work force capacity to perform more inactivation work than is currently scheduled without displacing more complex nuclear work to other more expensive shipyards. This would increase the cost of the displaced work as well as the cost to maintain critical trade skills at Puget Sound--thus increasing the overall cost of nuclear ship work.

The GAO also states that there undoubtedly would be workload trade-offs among shipyards--if the Navy assigned more inactivations to Puget Sound. In clarification, there would be both workload and cost trade-offs along with impacts on maintaining critical trade skills among shipyards.

FINDING E: Naval Sea Systems Command Efforts to Improve Shipyard Inactivation Performance. The GAO reported that, as shipyards gained more experience in conducting inactivations, their performance improved. The GAO found that, in 1989, the Naval Sea Systems Command and shipyards had initiated ways to simplify reactor defueling practices and related procedural requirements. The GAO found that Puget Sound, Mare Island, and Portsmouth shipyards were able to reduce their performance on inactivations of attack submarines by 52 percent, 33 percent, and 10 percent, respectively. The GAO listed the trends in report figure 4.1. The GAO observed, however, that the number of workdays the shipyards require to complete similar inactivation activities still differ considerably. The GAO found that the Naval Sea Systems Command and the shipyards have difficulty analyzing the reasons for the differences because of the inconsistencies in how shipyards define and report work categories. The GAO explained that the Naval Sea Systems Command oversight of shipyard inactivation work is primarily done on a shipyard-by-shipyard basis, rather than a comparative basis. For example, the Navy has one shipyard as defining its nuclear work for an inactivation into 48 categories; another shipyard had four categories.

The GAO also reported that the Naval Sea Systems Command is developing uniform work requirements and estimating standards to reduce those differences. The GAO noted that, in January 1992, the Command approved estimating standards for the nuclear work that will commence with inactivations beginning in February 1992. The GAO also noted that, according to Naval Sea Systems Command officials, they plan to have the uniform work requirements and estimating standards for the non-nuclear work requirements ready for FY 1993 inactivations. The GAO concluded that, if that effort is successful, the Naval Sea Systems Command and the shipyards will have improved capability to identify not only problem areas, but efficient practices that other shipyards can use to reduce costs. (p. 4, pp. 41-50/GAO Draft Report)

Now pp. 4 and 29-34.

See comment 18.

DoD Response: Partially concur. In actual practice, the Naval Sea Systems Command compares the current inactivation work at a given yard with its own previous work and with work at other yards. The comparisons with other yards are on a ship-wide basis rather than at the detailed job level because, as the GAO noted, cost comparisons at the detailed job level reflect variations in the way costs are accounted for by each shipyard. The Navy uniform inactivation work categories and estimating standards are expected to minimize that problem.

The GAO also stated that the Navy plans to have uniform work requirements and estimating standards for the non-nuclear work requirements ready for the FY 1993 inactivations. Uniform work categories for non-nuclear work were established in 1979 and have been updated frequently. Estimating standards will be applied to these work categories starting with the FY 1993 inactivations.

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RECOMMENDATION: The GAO recommended that the Secretary of the Navy direct the Naval Sea Systems Command to further assess workload policies and practices for the nuclear capable shipyards--with the goal of minimizing the Navy overall costs of nuclear related maintenance, overhaul, and inactivation work. (p. 5, pp. 39-40/GAO Draft Report)

Now pp. 5 and 23-28.

See comment 19.

DoD Response: Partially concur. It already is the goal of the Navy to minimize the overall costs of shipyard work in accordance with the strategy detailed in the Naval Shipyard Corporate Operations Strategy and Plan (1990-1994) of May 30, 1990. Navy officials have emphasized to the GAO (both orally and in writing) that the Navy objective in assigning ship work to yards is not (and should not be) to minimize submarine inactivation costs per se; rather, the objective is to perform active fleet maintenance, modernization and refueling, plus inactivations, in a manner that makes the most efficient overall use of public shipyard facilities, equipment and manpower.

See comment 20.

The draft report provides cost data only on submarine inactivations, while acknowledging that there are trade-offs