U.S. Environmental Protection Agency

U.S. Maritime Administration

National Guidance: Best Management Practices for Preparing Vessels Intended to Create Artificial Reefs

May 2006

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This document was jointly developed by the U.S. Environmental Protection Agency's (EPA) Oceans and Coastal Protection Division within the Office of Water and the Department of Transportation's Maritime Administration. To assist in early stages of document development, an interagency workgroup was established by Laura S. Johnson of EPA. The following agencies actively participated on this workgroup:

- Maritime Administration
- National Oceanic and Atmospheric Administration
- United States Army Corps of Engineers
- United States Fish and Wildlife Service
- United States Coast Guard
- United States Department of the Navy
- United States Environmental Protection Agency

Photo courtesy of Laura S. Johnson
Maritime Administration's James River Reserve Fleet, Virginia.

Cover Photos

Top photo: Ex-USS Spiegel Grove en route to artificial reef sink site. Photo courtesy of Andy Newman, Florida Keys News Bureau.

Middle photo: Ex-USS Spiegel Grove resting at its artificial reef site. Photo courtesy of Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, Artificial Reef Program.

Bottom photo: The scuttling of Navy Dive Tender YDT-14 on April 1, 2000, approximately 18 miles SE of Pensacola Pass, Escambia County, Florida. Photo courtesy of Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, Artificial Reef Program.

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Photo courtesy of Florida Fish and Wildlife Conservation Commission

The scuttling of Adolphus Busch on Dec. 5, 1998, approximately 7 miles S of Summerland Key, Monroe County, Florida.

EXECUTIVE SUMMARY

This guidance document was developed to satisfy the mandate of Section 3516 of the National Defense Authorization Act for Fiscal Year 2004, which requires that the Maritime Administration (MARAD) and the U.S. Environmental Protection Agency (EPA) jointly develop guidance recommending environmental best management practices to be used in the preparation of vessels for use as artificial reefs. It also responds to MARAD's request for the EPA to provide national environmentally-based best management practices for the preparation of vessels to be sunk with the intention of creating artificial reefs in permitted artificial reef construction areas.

Options for managing obsolete and decommissioned military and commercial vessels include re-use of the vessel or parts of the vessel, recycling or scrapping, creating artificial reefs, and disposal on land or at sea. This document discusses the preparation of obsolete and decommissioned military and commercial vessels when employing the vessel management option of artificial reefing. Artificial reefs should only be developed where such reefs will enhance native marine resources and benefit the natural marine environment. Strategically sited artificial reefs not only can enhance aquatic habitat, but also provide an additional option for conserving, managing, and/or developing fishery resources.

Although the best management practices presented in this document are intended for use when preparing vessels to serve as artificial reef habitat, the best management practices may have applicability to other in-water uses of vessels, such as the creation of recreational diving opportunities. It is recommended that these best management practices be implemented for such in-water uses of vessels, with the caveat that further vessel preparation beyond that employed for artificial reef habitat may be needed. When preparing a vessel for such in-water uses, consideration should be given to vessel stability and integrity prior to and after final placement.

This guidance identifies materials or categories of materials of concern that may be found aboard vessels and specifically identifies where they may be found. For each material or category of material, this document provides a narrative clean-up performance goal and information on methods for achieving those goals in preparation of the vessel prior to sinking. Materials of concern include, but are not limited to: oil and fuel, asbestos, polychlorinated biphenyls (PCBs), paint, solids/debris/floatables, and other materials of environmental concern. Exhibit 1 provides a summary of the narrative clean-up goals for materials of concern.

In keeping with Section 3516 of the National Defense Authorization Act for Fiscal Year 2004, this guidance document addresses only recommended clean-up practices for vessels that are intended to be placed as artificial reefs. It neither endorses such placement nor does it address the potential availability or environmental effects associated with alternatives to placement of vessels as artificial reefs.

Exhibit 1. Summary of Narrative Clean-up Goals for Materials of Concern

Material of Concern	Narrative Clean-up Goal
Oil And Fuel	Remove liquid fuels and oils and semi-solids (greases) so that: no visible sheen is remaining on the tank surfaces (this includes all interior fittings, piping, structural members); no film or visible accumulation is remaining on any vessel structure or component (e.g., on machinery or from spills on decking or carpet). The end result of such clean-up should be that no sheen be visible upon sinking a vessel.
Asbestos	Remove any loose asbestos and asbestos that may become loose during vessel sinking; remove or seal accessible friable asbestos.
Polychlorinated Biphenyls (PCBs)	Remove all manufactured products containing greater than or equal to (≥) 50 parts per million (ppm) of solid PCBs; remove all liquid PCBs regardless of concentration; remove all materials contaminated by PCB spills where the concentration of the original PCB source is ≥ 50 ppm.
Paint	Remove harmful exterior hull anti-fouling systems that are determined to be active; remove exfoliating (peeling) and exfoliated paint.
Solids/Debris/ Floatables	Remove loose debris, including materials or equipment that are not permanently attached to the vessel that could be transported into the water column during a sinking event.
Other Materials of Environmental Concern	Remove other materials that may negatively impact the biological, physical, or chemical characteristics of the marine environment.

The narrative clean-up performance goals for the materials of concern highlighted in this guidance should be achieved while preparing a vessel intended for artificial reefing. There are statutory requirements and associated regulations, as well as permit processes applicable to the process of preparing a vessel for reefing that are not highlighted in this document. These include, but are not limited to, issues such as vessel inspections by appropriate authorities and storage and disposal of waste generated during clean-up/preparation. Further, this document does not provide information on how to sink a vessel or the required actions or regulatory procedures/processes associated with the actual act of sinking a vessel.

INTRODUCTION

Several options exist for managing obsolete and decommissioned military and commercial vessels. These options include re-use of the vessel or parts of the vessel, recycling or scrapping, creating artificial reefs, and disposal on land or at sea. This document discusses the vessel management option of artificial reefing. This guidance document was developed to satisfy the mandate of Section 3516 of the National Defense Authorization Act for Fiscal Year 2004, which requires that the Maritime Administration (MARAD) and the U.S. Environmental Protection Agency (EPA) jointly develop guidance recommending environmental best management practices (BMPs) to be used in the preparation of vessels for use as artificial reefs. It also responds to MARAD's request for the EPA to provide national environmentally-based best management practices for the preparation of vessels to be sunk with the intention of creating artificial reefs in permitted artificial reef construction areas.

An interagency workgroup, chaired by EPA, was established to develop the BMPs. The workgroup included representatives from the EPA, U.S. Coast Guard, U.S. Navy, MARAD, U.S. Army Corps of Engineers, National Oceanic and Atmospheric Administration, and the U.S. Fish and Wildlife Service.

Although these best management practices are intended for use when preparing vessels to serve as artificial reef habitat, such best management practices may have applicability to other in-water uses of vessels, such as the creation of recreational diving opportunities. The best management practices presented in this document should be implemented for all permitted in-water uses of vessels; further diver safety preparations may be needed based on the intended in-water use, such as recreational diving.

Objectives of the Guidance Document

The BMPs, jointly developed by EPA and MARAD, are to serve as national guidance for federal agencies for the preparation of vessels for use as artificial reefs. Section 3516 of the National Defense Authorization Act for Fiscal Year 2004 provides that the BMPs are to (1) ensure that vessels prepared for use as artificial reefs "will be environmentally sound in their use as artificial reefs"; (2) "promote consistent use of such practices nationwide"; (3) "provide a basis for estimating the costs associated with the preparation of vessels for use as artificial reefs"; and (4) include measures that will "enhance the utility of the Artificial Reefing Program of the Maritime Administration as an option for the disposal of obsolete vessels." Appendix A provides further detail on Section 3516 and MARAD's authority to transfer obsolete vessels for artificial reefing. Below is a description of how this document addresses the four requirements of the statute.

- The use of this guidance will help ensure that vessels prepared for use as artificial reefs "will be environmentally sound in their use as artificial reefs." For each material of concern identified, this document provides a narrative clean-up performance goal and information on methods for addressing those goals in preparation of the vessel prior to sinking. The preparation of vessels in this manner will help ensure that their use as artificial reefs is environmentally sound. The purpose of creating an artificial reef is to benefit the environment by enhancing aquatic habitat and marine resources, as well as

providing an additional option for conserving, managing, and/or developing fisheries resources. This document describes appropriate vessel preparation that could achieve such benefits as an artificial reef and avoid negatively impacting the environment with pollutants. The narrative clean-up performance goals provided in this document, if implemented and complemented with strategic site selection (siting), will maximize the opportunity for these vessels to benefit the environment as artificial reefs.

- The use of this guidance document will "promote consistent use of such practices nationwide" and in turn will also provide measures that will "enhance the utility of the Artificial Reefing Program of the Maritime Administration as an option for the disposal of obsolete vessels." The best management practices described in this document serve as national guidance for the preparation of vessels for use as artificial reefs. As the use of vessels as artificial reefs is becoming a more common management option for obsolete vessels, the development of this guidance document is timely. Currently, no guidance of this kind is available. The use of this guidance document can enhance the utility of MARAD's Artificial Reefing Program, by establishing a national approach to cleaning and preparing candidate obsolete vessels, while also promoting consistent use of such practices for vessel-to-reef projects.

- The use of this document will "provide a basis for estimating the costs associated with the preparation of vessels for use as artificial reefs." Although the best management practices were developed independent of costs associated with clean-up, the narrative clean-up performance goals in this document can be used as a basis for estimating the cost for appropriate vessel preparation. In order to determine the estimated cost to prepare a specific vessel for use as an artificial reef, the narrative clean-up performance goals, along with the vessel preparation BMPs, can be used to scope the volume of work to be accomplished based on a detailed ship-check and implementation of a representative PCB sampling protocol. There is wide variability of ships and associated kinds and amounts of material found on a particular ship, as well as wide variability of remediation and disposal costs in different geographic locations within the U.S. Therefore, it is not possible to provide in this document representative cost estimates associated with the preparation of a ship for reefing. A reasoned estimate of the actual cost of preparation will require a ship-by-ship analysis.

  In order to provide some insight into the costs that have been incurred for vessel-to-reef projects, some pertinent vessel-specific information is provided here. Two recent examples of vessels that have been prepared with the intent of serving as artificial reefs are the ex-USS Spiegel Grove and the ex-USS Oriskany. The total cost of reefing the ex-USS Spiegel Grove, which was a MARAD vessel, was $1.3 million.[1] This total cost includes costs for both vessel clean-up/preparation, as well as costs other than vessel clean-up/preparation. Details of the project cost estimates are presented in Exhibit 2. Vessel specifications for the ex-USS Spiegel Grove are presented in Exhibit 3. The ex-USS Spiegel Grove was cleaned/prepared prior to the availability of the BMPs presented in this document. Further information regarding the ex-USS Spiegel Grove can be found

[1] Communication between Captain Spencer Slate, ex-USS Spiegel Grove vessel-to-reef project co-manager, and Laura S. Johnson, EPA.

at http://www.fla-keys.com/spiegelgrove/.

Exhibit 2. Ex-USS Spiegel Grove Total Project Costs

PCB sampling protocol and removal	$75,000
Reorienting the vessel	$550,000
Towing and berthing	$125,000
Other clean-up and scuttling preparation and execution	$550,000
Ship clean-up time	7 months
Project duration	8 years

Exhibit 3. Ex-USS Spiegel Grove Vessel Specifications

Type of vessel	Landing Ship Dock (LSD)
Overall length	510 feet
Extreme beam	84 feet
Keel date	Sept. 7, 1954
Launch date	Nov. 10, 1955
Decommission date	Oct. 2, 1989
Location of reefed vessel	6 miles off the Florida Keys in the Florida Keys National Marine Sanctuary

Photo courtesy of Andy Newman

Ex-USS Spiegel Grove, once a MARAD vessel, under way to Florida Keys for final sinking preparations.

The total cost of reefing the ex-USS Oriskany, which is a Navy vessel, was $15.63 million. This total cost includes costs for both vessel clean-up/preparation, as well as costs other than vessel clean-up/preparation. Details of the project cost estimates are presented in Exhibit 4. As noted later in this document, the Navy is required to clean/prepare vessels intended for use as artificial reefs in accordance with this BMP guidance. The Draft BMP guidance was available for the ex-USS Oriskany vessel clean-up/preparation. Vessel specifications for the ex-USS Oriskany are presented in Exhibit 5. Further information regarding the ex-USS Oriskany can be found at http://peos.crane.navy.mil/reefing/oriskany.htm.

Exhibit 4. Ex-USS Oriskany Total Project Costs

Ship remediation (BMP-related)	$8.28M
Flight deck remediation (BMP-related)	$3.61M
PCB model and risk assessment development (BMP-related)	$3.74M
Towing and berthing	$3.07M
Scuttling preparation and execution	$4.90M
Ship clean-up time	12 months
Project duration	3 years (FY03 through FY06)

Exhibit 5. Ex-USS Oriskany Vessel Specifications

Type of vessel	Essex Class aircraft carrier (CV-34)
Overall length	911 ft
Extreme beam	107 ft
Keel date	May 1, 1944
Launch date	Oct. 13, 1945
Decommission date	Sept. 30, 1976
Location designated for reefing this vessel	23 miles south off Pensacola, Florida

Photo courtesy of U.S. Navy

Ex-USS Oriskany arriving at NAS Pensacola, Florida. March 23, 2006.

If the narrative clean-up goals provided in this document cannot be economically achieved, for example because of very significant amounts of materials of concern on the vessel, then the vessel would not be a good candidate for reefing. The methods, approach, and level of effort for clean-up, as well as worker safety concerns, are directly dependent on the vessel's condition and the amount of materials of environmental concern that are found aboard. Vessels where clean-up could pose potential worker safety risks or could incur high costs may not be good candidate vessels for reefing. [2]

Some portions of a candidate vessel may be economically salvageable. Any such salvage operations should occur in a manner that will minimize debris and contamination with oils or other products that have to be cleaned up at a later date. This activity should allow for improved access for subsequent clean-up efforts, and the salvage proceeds may help offset some costs for vessel preparation.

Operations associated with salvage, clean-up, and diver access have the potential to adversely impact vessel stability. Failure to consider the impact of these activities on vessel stability before and during scuttling operations could result in premature and uncontrolled capsizing and/or sinking of the vessel. Therefore, vessel stability considerations should be an integral part of the salvage, clean-up, modification (for diver access), transport, and sinking plans of a vessel-to-reef project.

[2] The BMP guidance does not address worker safety issues. Readers with an interest in such safety issues and concerns should consult other relevant documents, such as those prepared by OSHA, State or local safety agencies, and other relevant EPA documents. For example, EPA's *A Guide for Ship Scrappers – Tips for Regulatory Compliance* presents important information related to environmental and worker safety and health issues for ship scrapping/ship breaking operations when handling specific hazardous materials. This document can be accessed via the World Wide Web at http://www.epa.gov/oecaerth/resources/publications/civil/federal/shipscrapguide.pdf.

Photo courtesy of U.S. Navy
Metal recovery and salvage operations onboard the ex-USS Oriskany while being cleaned.

In the process of preparing a vessel for reefing, there are requirements and regulations, including permit processes, appropriate disposal of waste generated during vessel clean-up/preparation, and vessel inspections by appropriate authorities to consider that are not discussed in great detail in this document, with the exception of TSCA requirements applicable to PCBs. Appendix B does provide, however, an overview of principal federal environmental statutes potentially affecting preparation or placement of a vessel for use as an artificial reef. Further, other than siting considerations that would affect how a vessel is prepared for use as an artificial reef, this document does not detail the legal requirements applicable to transfer, siting, or sinking of vessels as artificial reefs in vessel-to-reef projects, except for the overview offered in Appendix B. The information in Appendix B is intended only for the convenience of the reader in order to provide a useful starting point for identifying the principal environmental statutes of interest. On a case-by-case basis, additional federal statutes also may apply, though the federal statutes identified in Appendix B would be most relevant for the preparation of a vessel for use as an artificial reef. The final preparation plan for any particular artificial reef project will necessarily be vessel-specific, and will depend on the characteristics of the vessel and final permitted artificial reef construction site, as well as regulatory considerations. In addition, State and local laws also may apply to vessel preparation, but the document does not attempt to identify such laws in Appendix B.

This guidance identifies materials or categories of materials of concern that may be present aboard vessels, indicates where these materials may be found, and describes their potential adverse impacts if released into the marine environment (Appendix C provides related information). The materials of concern include, but are not limited to: fuels and oil, asbestos, polychlorinated biphenyls (PCBs), paints, debris (e.g., vessel debris, floatables, introduced material), and other materials of environmental concern (e.g., mercury, refrigerants). With the

exception of materials containing PCBs, this document does not comprehensively discuss applicable legal requirements, although those requirements that are directly applicable to vessel preparation must also be met prior to vessel sinking and placement. Because the best management practices described in this document are directed at the environmental concerns associated with using vessels as artificial reefs, other sources of information should also be used with regard to preparation of the vessel from a diver safety perspective or for any other potential in-water uses.

A detailed description and characterization of the potential sources of contamination from a vessel intended for use as an artificial reef should be conducted and a plan developed. The purpose of this plan is to assure that materials potentially contributing to pollution of the marine environment are addressed. Appendix D of this document presents information regarding the development of workplans; Appendix E provides information regarding general principles for clean-up operations.

When preparing a vessel that is intended to serve as an artificial reef, documenting the clean-up procedures used and the contaminants that will remain onboard the vessel is a key element of the BMPs. More specifically, a description of how the BMP narrative clean-up performance goals were achieved, and a visual inspection, are needed to determine whether and how the vessel has been cleaned to the level recommended in this guidance document so the vessel can be managed appropriately. A recommended checklist for documenting vessel clean-up using this guidance can be found in Appendix F. A vessel inspection by qualified personnel should be conducted to confirm satisfactory clean-up/preparation. It also should be noted that applicable regulatory regimes may require such an inspection.

Achieving and verifying satisfaction of the BMP clean-up goals could help support permit applications under the Clean Water Act Section 404 (33 U.S.C. 1344) or Rivers and Harbors Act Section 10 (33 U.S.C. 403), if a permit application is submitted to the U.S. Army Corps of Engineers. Further, robust BMP documentation might prove useful for demonstrating consistency with Coastal Zone Management Act programs (16 U.S.C. 1452, et seq.), as well as for any other State or local certifications necessary to carry out a vessel-to-reef project. Also, EPA officials may find BMP documentation useful as part of their review under EPA certification authority pursuant to the Liberty Ship Act. (Note: this Act only applies to DOT/MARAD-owned obsolete vessels intended for use as an artificial reef for the conservation of marine life.)

This guidance does not substitute for any statute or regulation, nor is it a regulation itself. The document recommends environmental best management practices for use in the preparation of vessels for use as artificial reefs. Associated with the recommended environmental best management practices are narrative environmental clean-up performance goals, as well as recommendations and suggestions in furtherance of those goals. By its terms, the guidance itself does not impose binding requirements on any federal agency, States, other regulatory or resource management authorities, or any other entity. Among other things, the document includes mechanisms to enhance the utility of the Artificial Reefing Program of the Maritime Administration as an option for the disposal of obsolete vessels. It should be noted that under 10 U.S.C. 7306b(c), the Secretary of the Navy must ensure that the preparation of a vessel (that is stricken from the Naval Vessel Register) for use as an artificial reef is conducted in accordance

with the environmental best management practices in this guidance. This latter statutory requirement, not today's guidance document itself, governs the Navy's application and use of this document.

Organization of this Guidance Document

This document describes guidelines for the preparation of vessels in a manner that will help ensure that the marine environment will benefit from their use as artificial reefs. Strategic siting is an essential component of a successful artificial reef project. Before the discussion of vessel preparation is presented, a cursory description of reef site selection recommendations is provided.

For each material or category of material of concern identified, this document provides a narrative clean-up performance goal and information on methods for addressing those goals in preparation of the vessel prior to sinking. Additional information for each material includes a description of its shipboard use and where it may be found on a vessel, as well as its expected impacts if released into the marine environment.

Although the best management practices presented in this document are intended for use when preparing a vessel to serve as artificial reef habitat, it is recommended that these best management practices be implemented for other in-water uses of vessels such as recreational diving. This potential obsolete vessel management option is briefly described in this document.

SITING OF ARTIFICIAL REEFS

Artificial reefs can enhance marine resources and in turn benefit the marine environment; however, creating a successful reef entails more than randomly placing miscellaneous materials in ocean, estuarine, or other aquatic environments. Planning (including siting), long-term monitoring, and evaluation are necessary components of each project to help ensure that the anticipated benefits of artificial reefs are attained. Improperly planned, constructed, or managed reefs may be ineffective, may cause conflict among competing user groups of the reef site, may increase the potential to over harvest targeted species, or may damage natural habitats. In such cases, the anticipated benefits of an artificial reef project may be negated.

Because the purpose of creating an artificial reef is to benefit the environment by enhancing aquatic habitat and marine resources, as well as providing an additional option for conserving, managing, and/or developing fisheries resources, artificial reefs should not cause harm to existing living marine resources and habitats. Properly prepared and strategically sited artificial reefs can enhance fish habitat, provide more access to quality fishing grounds, and provide managers with another option for conserving, managing and/or developing fishery resources.

Placement of a vessel to create an artificial reef should:

- enhance and conserve targeted fishery resources to the maximum extent practicable;
- minimize conflicts among competing uses of water and water resources;
- minimize the potential for environmental risks related to site location;
- be consistent with international law and national fishing law and not create an obstruction to navigation;
- be based on scientific information; and
- conform to any federal, State, or local requirements or policies for artificial reefs.

Additional considerations that may be relevant to the placement of a vessel for the creation of an artificial reef include:

- facilitating access and use by recreational and/or commercial fishermen; and
- facilitating access and use by recreational divers.

Artificial reef project planners should identify the habitat type and/or species targeted for enhancement and determine which biological, physical, and chemical site conditions will be most conducive to meeting the reef objectives. Once these siting conditions, including community settlement and recruitment dynamics, are determined, they should be used in identifying potential construction sites. Existing communities (e.g., infaunal, epifaunal, benthic, demersal, mid-water, surface-oriented) in the area where the artificial reef is to be placed should

be considered prior to placement -- this should include monitoring to establish baselines for the fishing resources.

Caution should be exercised when developing artificial reefs in nearshore areas due to the increased potential for resource competition as well as competition for niche space. Improperly sited reefs might enhance a recreational fish resource at the expense of other species or habitat; it may also alter the ecological balance of the area. For example, sandy estuarine habitat often provides critical nursery grounds for the juveniles of many species of bottom fish. During this life stage, the primary predator protection for these juvenile fish is the absence of large fish -- which are favored by recreational anglers. Oftentimes, sandy estuarine locations tend to be popular choices for siting artificial reefs to attract large fish for recreational fishing, thereby altering existing predatory/prey interactions and creating resource competition. Strategic project planning can minimize these conflicts.

Artificial reefs should not be constructed such that they are placed on or threaten the integrity of natural habitats such as:

- existing coral reefs;
- significant beds of aquatic grasses or macroalgae;
- oyster reefs;
- scallop, mussel, or clam beds;
- existing live bottom (i.e., marine areas supporting growth of sponges, sea fans, corals, and other sessile invertebrates generally associated with rock outcrops); or
- habitats of Endangered Species Act listed species and species of State and local concern.

The goals and priorities of an artificial reef project should direct overall site selection. Within the identified target area, existing natural and artificial reefs and known bottom obstructions should be identified. Exclusion areas for potential artificial reef projects should include, but are not limited to:

- shipping lanes;
- restricted military areas;
- areas of poor water quality (e.g., low dissolved oxygen, dredged material disposal sites);
- traditional trawling grounds;
- unstable bottoms;
- areas with extreme currents, or high wave energy;

- existing right-of-ways (e.g., oil and gas pipelines and telecommunication cables);
- sites for purposes that are incompatible with artificial reef development; and
- areas designated as habitat areas of particular concern or special aquatic sites.

The bottom composition and configuration at an artificial reef site affects reef stability and longevity and should be carefully evaluated in the site selection process. In most cases, soft sediments such as clays, silts, and loosely packed sands should be avoided. Over time, artificial reef materials may sink into these sediments or become partially covered.

Project planners should evaluate vessel-to-reef projects and potential sites with regard to chemical and biological conditions as well as long-term durability and stability, as these will affect future habitat value.

Coastal physical processes can greatly influence a potential artificial reef site. Artificial reef planners should be aware that bottom sediments shift and may change significantly during storms, hurricanes, and geologic events. Materials that present large amounts of surface area may scour deeply into almost any bottom type, depending upon storm events, currents, or wave action.

The principal hydrographic factors to be considered in selecting sites for artificial reef placement include water depth, potential wave height, currents, and tides. Water depth is a significant siting criterion. Artificial reefs should be placed in water at sufficient depths to avoid creating a hazard to navigation – minimum clearance above the reef should accommodate the draft of the largest vessels expected to operate in the vicinity with an adequate safety margin. Water depth at the site may critically affect artificial reef material stability and long-term structural integrity. In large, open bodies of water, average wave energy as a function of water depth is the major concern.

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Photo courtesy of Laura S. Johnson

Worker sweeping debris during flight deck removal onboard the ex-USS Oriskany.

OIL AND FUEL

Narrative Clean-up Goal: Remove liquid fuels and oils and semi-solids (greases) so that: no visible sheen is remaining on the tank surfaces (this includes all interior fittings, piping, structural members); no film or visible accumulation is remaining on any vessel structure or component (e.g., on machinery or from spills on decking or carpet). The end result of such clean-up should be that no sheen be visible upon sinking a vessel.

What are oil and fuel?

For purposes of this guidance, the term oil includes crude oil; petroleum and petroleum-refined products (e.g., diesel fuel, gasoline, kerosene, and bunkers); and non-petroleum oils such as synthetic oils (e.g., silicone fluids), wood-derivative oils (e.g., resin/rosin oils), animal fats and oil, and edible and inedible seed oils from plants, which might be more relevant for cargo vessels.

Some common refined petroleum products and their characteristics are as follows:

- ***No. 2 Fuel Oil*** is a lightweight substance that flows easily, spreads rapidly, and disperses readily. It is neither volatile nor likely to form emulsions.

- ***No. 4 Fuel Oil*** is a medium weight substance that flows easily and is readily dispersed if treated promptly. It has a low volatility and moderate flash point.

- ***No. 5 Fuel Oil (Bunker B)*** is a medium to heavyweight substance with a low volatility and moderate flash point. Dispersion is very difficult and potentially impossible.

- ***No. 6 Fuel Oil (Bunker C)*** is a thick substance that is difficult to pump and requires preheating for use. No. 6 fuel oil may be heavier than water. It is not likely to dissolve, and is likely to form tar balls, lumps, or emulsions. No. 6 fuel oil is very difficult or impossible to disperse. It has a low volatility and moderate flash point and is especially persistent in the environment.

What are the potential environmental impacts of oil and fuel?

The impacts of fuel and/or oil introduced into the marine environment are influenced by a variety of factors, including the physical properties of the oil, whether the oil is petroleum-based or non-petroleum-based, and the hydrodynamic properties of the receiving waters. Each type of oil has distinct physical properties that affect the way it disperses and breaks down, the hazard it may pose to ecosystems, and the likelihood that it will pose a threat to manmade resources. For example, the rate at which surface dispersion occurs will help to determine the effect of an oil spill on the environment. Most oils spread horizontally into a smooth and continuous layer, called a "slick," on the water surface.

Petroleum-based and non-petroleum-based oils can have both immediate and long-term adverse

effects on the environment. These oils can be dangerous, or even deadly to wildlife. Light refined petroleum products, such as gasoline and kerosene, spread on water surfaces. The risk of fire and toxic exposure is high, but the products evaporate quickly and leave little residue. Alternatively, heavier petroleum-based refined oil products may pose lesser fire and toxic hazards and do not spread on water as readily. However, heavier oils are more persistent in the environment, and may present a greater clean-up challenge.

Many non-petroleum oils have physical properties similar to those of petroleum-based oils. For example, they both have limited solubility in water, they both create slicks on the water surface, and they both form emulsions and sludge. However, non-petroleum oils tend to be persistent, remaining in the environment for long periods of time.

Oil spills can harm the environment in several ways, including the physical damage that directly impacts wildlife and their habitats and the toxicity of the oil and its constituents, which can poison exposed organisms. Spilled oil in the environment immediately begins to disperse and degrade, with concomitant changes in physical and chemical properties. As these processes occur, the oil threatens natural resources, including birds and mammals as well as a wide range of marine organisms linked in a complex food web. Some organisms can be seriously injured (non-lethal effects) or killed (lethal effects) very soon after contact with the oil in a spill (acute effects); however, non-lethal toxic effects are often more subtle and often longer lasting (chronic effects).

Where are oils and fuels found in a ship?

Diesel fuel and fuel oil may be contained in various tanks throughout a ship. For example, lubricating oil is found in engine sumps, drums of unused lubricating oil in ship storerooms or engineering spaces, and sludge in fuel and cargo tanks. Hydraulic systems and components also contain oils.

The vessel's piping and tank arrangements generally will contain some oil, fuel, sludge, and associated residues. Fuel oil may be found in both integrated and freestanding tanks throughout the ship. Lubricating oils may be found in a variety of tanks depending on their individual use. System oils are generally located in engine room sump tanks, while cylinder oils and lubrication oils will be stored in tanks dedicated for a specific purpose. Other types of fuels and oils may be contained in cargo tanks.

"Used oil" -- any oil that has been refined from crude oil or any synthetic oil that has been used and, as a result of such use, is contaminated by physical or chemical impurities -- also may be found on ships. Used oil includes spent lubricating fluids that have been removed from engine crankcases, transmissions, and gearboxes; industrial oils such as compressor, turbine, and bearing oil; metal working oil; and refrigeration oil.

Spills of fuels and oils may be found near cargo holds, ship store rooms, engineering spaces, and any other equipment that may house fuel and oil.

Photo courtesy of Laura S. Johnson

Flushed hydraulic system onboard the ex-USS Oriskany.

How should the vessel be prepared; what are the appropriate BMPs for oil and fuel?

The aim of clean-up is to remove liquid fuels, oils, and grease. Although it is impossible to remove all fuels, oils, and grease, a very thorough clean-up is achievable. In general, all liquid fuels and oils and semi-solids (greases) should be drained, flushed, and cleaned from fuel/lube and fluid system equipment (including piping, interior fittings, and structural members) so that no visible sheen remains on the tanks or other associated fluid system structures. The opening and cleaning of pipes varies according to the type of product that was in the lines. No visual evidence of weeping (oozing or releasing drops of liquid) should exist at openings. An alternative and very effective option for hydrocarbon clean-up is removal of the equipment and piping. Suggested cleaning methods for liquid fuels and oils, and semi-solids are found in Appendix G.

During vessel preparation, an economical way of managing used oil is recycling. It should be noted that additional used oil might be generated during the final preparation of the vessel prior to sinking (e.g., oil for generators). Such used oil and grease should be removed from the vessel before sinking. While the goal is to remove all oil and grease, it may be acceptable to leave old oil and grease in place if it is determined visually to be dried/solidified and therefore is not likely to cause a sheen.

Fuel and Oil Tanks

All fuels and lubricants should be drained from the tanks and the tanks flushed. Merely sealing tanks, whether as the sole means of fuel and oil tank preparation or in combination with partial

tank draining, is insufficient. Over time, the integrity of the sealed tanks will eventually be compromised as marine growth density increases and the ship's underlying structural components decay. The placement of the Liberty ship, Joseph L. Meek, sunk off Escambia County, Florida, in 1976, demonstrated that corrosion of the ship's metal will eventually release residual fuel sealed in tanks into the environment. Although sealing the tanks without removing the contents is not sufficient for managing fuel and oil on a vessel intended to serve as an artificial reef, fuel/lube and fluid system equipment and piping intended to stay on the vessel should be sealed as necessary for the purpose of towing stability once the fuel/oil has been removed. Because these systems need to be opened during vessel preparation for draining and flushing the systems clean, sealing these systems may be necessary to help maintain vessel stability during transit to the designated artificial reef site.

There are several accepted and widely used methods to clean fuel and oil tanks. The appropriate method will be determined by the type of fuel or oil in the tank, the amount of residue in the tank, and the extent of any hard or persistent deposits or residues. In general, lower quality fuels and heavy oils will require more cleaning effort. Similarly, tanks for dirty or water-contaminated oils will require more cleaning effort.

When cleaning tanks, the following factors should be considered: worker access and safety issues, machinery and resources available, and the methods or facilities available to deal with the cleaning residues. It may be necessary to experiment with several cleaning methods to see which best suits the particular circumstance.

Some methods for cleaning tanks are detailed in Appendix G. Regardless of the selected tank cleaning method, the effluent and water must be collected, treated, and disposed of in compliance with applicable regulations. Large volumes will require the services of a pumper truck or barge, while smaller quantities should be collected and stored in drums. Caution should be used during all transfer operations to avoid spills. If transferring large quantities of oil or oil contaminated liquid, a containment boom around the vessel should be used to minimize the extent or spreading of an accidental release.

Structural and Non-structural Tanks

All structural and non-structural tanks are assumed to be contaminated by fuel or oil until proven otherwise. Structural tanks include, but are not limited to: fuel storage/settling/service/day tanks, cargo tanks, oil tanks, structural hydraulic tanks, fresh water tanks, ballast tanks, stabilizer tanks, black and gray water tanks, voids, and cofferdams. At a minimum, liquid fuels and oils in such tanks should be removed.

Tank interiors including deckheads should be cleaned of all fuel and oil. No visible fuel and oil should remain on the tank surfaces (this includes all interior fittings, piping, structural members), or on the water surface when flooded after sinking. No emulsified oil, as determined by visual inspection, should remain. Oil absorbent pads and excess loose oil absorbent material should be removed before sinking.

Gauges and Gauge Lines

Pressure gauges and gauge lines are assumed contaminated with the product that they were intended to measure. Fluid filled gauges should be removed. Pressure gauges and gauge lines

should also be removed to prevent oil seepage from these lines. Lines that remain in place should be flushed, and the lines cleaned.

Special care should be exercised with mercury thermometers and pressure (typically vacuum) measuring devices. These should be removed intact from the vessel. A temperature gauge that does not contain any hazardous material can remain in its position. Other measuring instruments should be removed from the vessel or opened for cleaning, examination, and possible removal.

Combustion Engines

Combustion engines include any reciprocating engine in which fuel is consumed (diesel, gasoline, gases), stirling cycle engines, and gas turbines. The entire fuel/oil system should be drained and flushed. Any items (e.g., oil filters and strainer elements) that can not be flushed should be removed.

Combustion engines and associated manifolds should be thoroughly drained, flushed, and cleaned. Machinery need not be removed if it is completely drained and the sumps flushed and cleaned. Sometimes, engines are removed for reuse or to assure that all oil is removed before reefing. In some cases, it might be less expensive to remove and dispose of the engines than to clean the oil from them. Some methods for cleaning combustion engines are detailed in Appendix E.

Non-combustion Engines, Shafting, Gearing and Stern Seals

Main gear boxes and associated clutches should be drained of all lubricating oils. Internal gear sprayers, lubricating lines, and other components should be removed, or drained. External pedestal and thrust bearings should be drained.

Stern tubes and seals, if of the oil bath type, should be drained of oil. Note that draining the stern tubes and seals may require extraordinary measures to preserve the watertight integrity of the vessel during the clean-up and salvage operation.

Vessels that are equipped with thrusters, Z-drives, or other unconventional propulsion systems will be addressed on a case-by-case basis. The objective is that no oil or fuel remains in the propulsion system.

Steering Gear

Hydraulic pumps and associated piping and fittings should either be removed or drained and flushed clean. Hydraulic telemotor systems should be treated similarly. Grease lines and reservoirs for rudder heads should be removed from the ship, or opened and cleaned. Vessels with combined propulsion and steering systems should be addressed as described in the previous subsection (“Non-combustion Engines, Shafting, Gearing, and Stern Seals”).

Auxiliary Machinery

Auxiliary machinery that has oil as its working fluid should be completely drained and flushed clean. Auxiliary machinery refers to machinery and components that are not an integral part of the main propulsion system of the vessel. The term can include but is not limited to: pumps, motors, compressors, galley equipment, capstans, elevators, and cargo handling machinery.

Many pieces of auxiliary machinery have a lubricating oil system or are in direct contact with oil.

All lubricating oil system components should be stripped from auxiliary machinery, drained and cleaned. Lubricating oil sumps should be drained and cleaned.

Hydraulics
All hydraulic systems should be assumed to have employed a petroleum- or synthetic-based fluid that needs to be cleaned. Hydraulic lines should be removed from the vessel, or opened and blown through with air until clear. Hydraulic fittings (valves and valve blocks of all types, cylinders, pumps, accumulators, filters, coolers) should be removed from the ship or drained clean. Hydraulic sumps should be opened and drained clean.

Grease
All grease reservoirs should be removed from the ship, or opened and cleaned. Grease lines should be removed or blown through until clear and all visible grease accumulations should be removed so that no visible sheen remains. Machinery that employs grease-packed gearboxes (common on deck machinery), as well as grease packed couplings, stuffing boxes, chain sprockets, and worm drives should be opened and cleaned of grease. Grease on chains and sprockets should be removed. Greased cables should be cleaned or removed from the vessel.

Sealed rolling element bearings that contain grease can be left in-situ. Grease in other fittings such as stuffing boxes and glands can be left in situ if the seals are intact and the quantities are small (for example, less than 100 milliliters evenly distributed throughout the component). Any grease on the outside of the sealed bearings should be removed.

Bilge Areas
The bilge area includes all areas that would be subject to contact with oily water, or may be a catch area for spills from cargo holds or storerooms, and interior surfaces which may have been subject to contamination through sprays, spills, or disposal. Bilge areas also include the plating and all surfaces of attached stiffeners and fittings. Bilge areas should be free of visible oils, greases, and sludge. Oil or grease films evident to the touch should be removed. All debris should be removed, particularly any debris contaminated with fuel, oil, or grease. Any cleaning fluids used to clean the bilge should be removed from the vessel. Accumulations of loose oil absorbent material should be limited to those amounts that cannot reasonably be picked up with brooms and vacuums.

Photo courtesy of Laura S. Johnson

Oil absorbent pad in engine room bilge of the ex-USS Oriskany.

Cleaning bilges is frequently complicated by poor access caused by piping, gratings, and equipment. In many cases, it is cheaper and easier to remove the dirty or contaminated items that limit access than to clean the items as well as the bilge. Once clean, bilges are very vulnerable to recontamination. Note the following recontamination issues:

- Piping, valves, and fittings in systems containing fuels, oils, or grease will continue to drip for some time after initial draining. Over a short period of time, these drips can necessitate a major rework cleaning effort. Therefore, drips should be captured whenever possible; drip pans should be emptied frequently.

- Containers used for clean-up are vulnerable to tipping and spilling, especially in conditions -- such as poor lighting -- that are often found in vessels undergoing sinking preparation. Remove containers used for clean-up when they are full.

- Water should not be allowed to enter bilges unless it is part of a planned clean-up effort. Water that otherwise enters the bilge should be handled as oily wastewater.

In general, the approach and methods recommended for cleaning bilges are the same as for cleaning tanks.

Decks and Floor Coverings

Oil and grease films on decks and floor coverings should be cleaned. Floor coverings include ceramic tile, linoleum and linoleum tile, carpet, and any other floor coverings. In compartments subject to fuel and oil spills during the vessel's life (e.g., workshops, compartments with fuel or oil tank overflows or tank covers), the deck covering and underlayment should be examined for oil saturation. Floor coverings or underlayment that has been saturated with fuels, oils, or grease should be removed from the vessel.

Bulkheads and Deckheads

Bulkheads and deckheads should be cleaned of oil and grease films. Where it is evident that a spill or accumulation resulting from leaks has occurred, coverings should be removed to reveal the full extent of the spill or accumulation.

ASBESTOS

Narrative Clean-up Goal: Remove any loose asbestos and asbestos that may become loose during vessel sinking; remove or seal accessible friable asbestos.

What is asbestos?

Asbestos refers to a group of minerals that occur naturally as masses of long silky fibers. There are three main types of asbestos fibers:

- Chrysotile fibers (white asbestos) are fine, silky flexible white fibers. They are pliable and cylindrical, and arranged in bundles. This was the most commonly used asbestos in the United States.

- Amosite fibers (brown asbestos) are straight, brittle fibers that are light grey to pale brown. This was the most commonly used asbestos in thermal system insulation.

- Crocidolite fibers (blue asbestos) are straight blue fibers that are like tiny needles.

There are three other types of asbestos fibers: anthophyllite, tremolite, and actinolite. Unlike most minerals, which turn into dust particles when crushed, asbestos breaks up into fine fibers that may be too small to be seen by the human eye.

Individual asbestos fibers are often mixed with a material that binds them together, forming what is commonly called asbestos-containing material (ACM). There are two kinds of ACM: friable and non-friable.

- **Friable ACM** is any material containing more than 1% asbestos that, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure.

- **Non-friable ACM** is any material containing more than 1% asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. Non-friable ACM is divided into two categories.

    1. **Category I** non-friable ACM includes asbestos-containing resilient floor coverings, packings, and gaskets.

    2. **Category II** non-friable ACM includes all other non-friable ACM that is not included in Category I.

Asbestos is resistant to abrasion and corrosion, inert to acid and alkaline solutions, and stable at high temperatures. It is strong yet flexible, non-combustible, conducts electricity poorly, and is an effective thermal insulator.

What are the potential environmental impacts of asbestos?

Asbestos is a naturally occurring mineral. The environmental impacts caused by asbestos are dependent upon 1) whether asbestos is reduced to fibers or is in a non-friable form; and 2) whether the asbestos is air-borne or water-borne.

Even though adverse impacts from asbestos are largely from inhalation -- which is not expected to be an issue in the marine environment -- vessel preparation should eliminate the possibility of pieces of asbestos breaking free from the vessel during the sinking operation or asbestos materials losing surface integrity after the vessel has been placed as an artificial reef. Loose asbestos pieces can lead to rafting and may be capable of washing ashore. These asbestos pieces could dry up, break apart, and be reintroduced into the atmosphere. Exposure to airborne asbestos can negatively impact human health via inhalation.

Once a vessel has settled on the ocean floor, asbestos remaining on the vessel (e.g., intact and undisturbed asbestos insulation) will be covered with bacteria over time. This in turn will cause the asbestos fibers to sink and remain contained within the reef matrix, minimizing any potential direct impacts to the marine environment. (See Appendix C)

Where is asbestos found on a ship?

Asbestos on ships may be found in many materials, including, but not limited to:

- Bulkhead and pipe thermal insulation
- Bulkhead fire shields/fireproofing
- Uptake space insulation
- Exhaust duct insulation
- Electrical cable materials
- Brake linings
- Floor tiles and deck underlay
- Overhead and panel sheeting (cement and cellulose based)
- Steam, water, and vent flange gaskets
- Adhesives and adhesive-like glues (e.g., mastics) and fillers
- Sound damping
- Molded plastic products (e.g., switch handles, clutch facings)
- Sealing Putty
- Packing in shafts and valves
- Packing in electrical bulkhead penetrations
- Asbestos arc chutes in circuit breakers
- Pipe hanger inserts
- Weld shop protectors and burn covers, blankets, and any fire-fighting clothing or equipment
- Any other type of thermal insulating material

NOTE: Asbestos-containing material may be found underneath materials that do not contain

asbestos. Thermal system insulation and surfacing material found in vessels and vessel sections constructed after 1980 may be presumed to be free of asbestos-containing material.

Photo courtesy of Laura Casey

Asbestos pipe wrapping on the ex-USS Oriskany.

How should the vessel be prepared; what are the appropriate BMPs for asbestos?

Asbestos can be found throughout ships, from the top of the bridge to the bilge. Identifying the locations and types of asbestos onboard early in the clean-up process is essential for vessel preparation and may involve qualified asbestos inspectors. Once the type and location of asbestos and asbestos-containing materials are identified, a determination should be made whether to remove, encapsulate, or leave the asbestos undisturbed.

The method of demolition is particularly important to the effective management of asbestos on board ships. If the sinking method for the vessel includes the use of explosives, asbestos-containing material that may become disturbed during detonation should be removed from the vessel.

In addition, any asbestos that is moved or disturbed (including during clean-up operations) or can potentially get dislodged as the vessel sinks should be removed from the vessel. Friable asbestos should be sealed as a precautionary measure to prevent releases of asbestos in high concentrations during the sinking event. Intact and undisturbed asbestos insulation need not be removed.

Engine Room and Engine Compartments

Removal or encapsulation of exposed, disturbed and deteriorated asbestos should be considered since it is likely that the asbestos will break free and create debris during sinking. If the asbestos is to be encapsulated, the encapsulation should be strong enough that its integrity will not be impacted by the preparation for sinking as well as the sinking itself.

The primary source of friable asbestos is pipe wrappings around the main boilers and steam fittings. On most vessels the asbestos coating, which is 1 to 3 inches thick, is covered with canvas and is usually painted. If work needs to be done around the piping and the covering, causing the asbestos to be disturbed, the disturbed material should be removed. If the covering is deteriorated and it is likely that the asbestos will break free during sinking, then removal or encapsulation with an epoxy or other non-water soluble and non-toxic sealer should be considered. Certain boilers and piping are covered with a very friable asbestos paste. If such friable asbestos is not covered with canvas and/or paint, the friable asbestos should be sealed or encapsulated with an epoxy or other non-water soluble and non-toxic sealer.

Throughout the engine room there are numerous asbestos gaskets connecting piping and ductwork. If left intact, these gaskets usually will not release asbestos fibers. However, if the ductwork or piping needs to be cut or removed and vessel debris is created as a result, gaskets should be removed or encapsulated if possible.

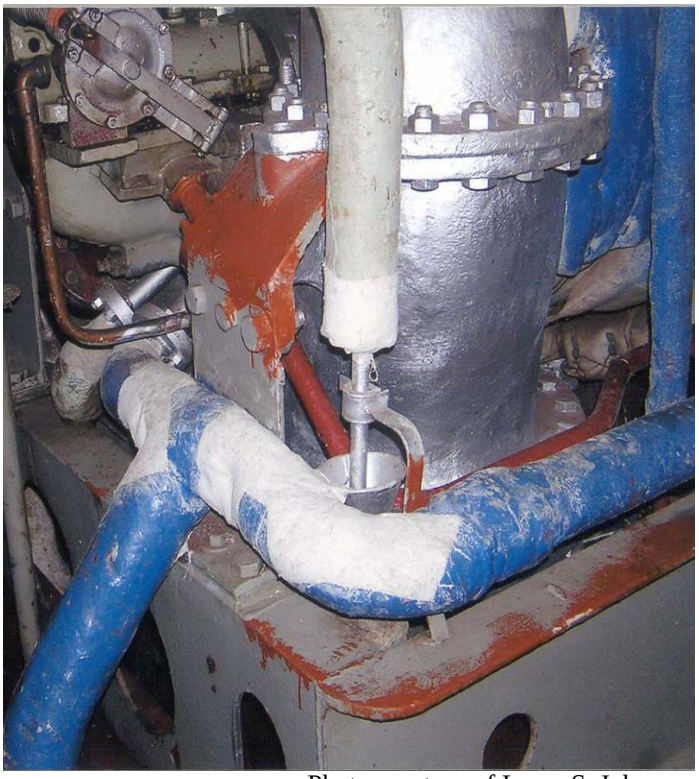

Photo courtesy of Laura S. Johnson
Patched asbestos pipe wrapping on the ex-USS Oriskany.

In some engine rooms asbestos/cellulose sheets are found behind power and electrical panels or in the overhead where electrical service passes. Undisturbed, this material is not friable. However, once the sheets are exposed to the marine environment, the sheets lose their integrity and can break up and raft. Where possible, these sheets should be removed. Note that asbestos cement sheets may also be used as panels on the vessel. However, these sheets are not water-soluble and therefore should not break apart when exposed to the marine environment. These sheets can stay in place unless cut, drilled or disturbed. Friable asbestos may also be found between bulkheads; this asbestos may remain in place because the asbestos is contained within the bulkheads. If, however, the bulkheads are drilled, cut, or disturbed, the friable asbestos that is now exposed should be encapsulated or removed.

Ship Interior and Living Spaces

Asbestos was also used in some hatch gaskets mixed with rubber throughout ships, especially in watertight spaces. Under normal circumstances this will only present a problem if grinders or torches are used. In such cases, the gaskets should be removed prior to disturbance.

Asbestos/asphalt floor tile was common from the 1940's to the mid-1970's. This form of asbestos is manufactured with the asbestos encapsulated. If preparation of the vessel requires the tile to be disturbed via grinding, cutting, or burning, those pieces of tile should be removed.

Asbestos sheets both with cement and cellulose may be found especially in the combat information center, the radio room and other spaces where electrical equipment may be found. Cellulose/asbestos panels should be removed but cement panels are safe. As an example, while inspecting an old Navy tug planned for reefing off the coast of Virginia, it was determined that the entire interior of the wheel house was paneled with cellulose/asbestos panels and had to be removed.

Exterior Spaces

There are a few areas on the exterior of ships where asbestos was used. Asbestos may have been mixed with paint and applied as a coating near some vents and hatches. Also, some hatches may have gaskets that contain asbestos. In either case, the material does not need to be removed unless these exterior areas require grinding or cutting.

POLYCHLORINATED BIPHENYLS (PCBs)

Narrative Clean-up Goal: Remove all manufactured products containing greater than or equal to (≥) 50 parts per million (ppm) of solid PCBs; remove all liquid PCBs regardless of concentration; remove all materials contaminated by PCB spills where the concentration of the original PCB source is ≥ 50 ppm.

What are PCBs?

PCBs belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. PCBs, which were domestically manufactured from 1929 until their manufacture was banned in 1979, have a range of toxicity and vary in consistency from thin, light-colored liquids to yellow or black waxy solids. Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and many other industrial applications.

What are the potential environmental impacts of PCBs?

PCBs have been demonstrated to cause a variety of adverse health effects. PCBs have been shown to cause cancer in animals and have also been shown to cause a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system, and other health effects. Studies in humans provide supportive evidence for potential carcinogenic and non-carcinogenic effects of PCBs. The different health effects of PCBs may be interrelated, as alterations in one system may have significant implications for the other systems of the body. EPA's peer reviewed cancer reassessment concluded that PCBs are probable human carcinogens. In addition, PCBs are persistent and bioaccumulative. PCBs bioaccumulate in fatty or lipid-rich tissues. PCBs have a limited solubility in aqueous solutions and PCBs can leach into a marine or aqueous environment (sediment and water column) where they can be taken up by organisms in the food web. PCBs bioaccumulate in fish and other animals; PCBs also bind to sediments. As a result, people who ingest fish may be exposed to PCBs that have been released into the environment and bioaccumulated in the fish they are ingesting.

There is a risk of human exposure during vessel preparation and after sinking the vessel. During vessel preparation, typical routes of human exposure include inhalation, accidental ingestion, or dermal contact. After sinking, exposure routes may be limited to accidental ingestion of or contact with contaminated water and sediments, or ingestion of contaminated fish, shellfish, or crustaceans. (See Appendix C)

Where are PCBs found on a ship?

Although no longer commercially produced in the United States, PCBs are most likely to be present in vessels deployed before the 1979 PCB ban. For such vessels, PCBs may be found in both the solid (waxy) and liquid (oily) forms in equipment and materials onboard ships. The equipment that may contain PCBs in concentrations of ≥ 50 ppm and the manufactured products containing ≥ 50 ppm of solid PCBs, include:

Materials and items that could contain solid PCBs

- Cable insulation
- Rubber and felt gaskets
- Thermal insulation material including fiberglass, felt, foam, and cork
- Voltage regulators, switches, reclosers, bushings, and electromagnets
- Electronic equipment, switchboards, and consoles
- Adhesives and tapes
- Oil-based paint
- Caulking
- Rubber isolation mounts
- Foundation mounts
- Pipe hangers
- Plastics

Materials and items that could contain liquid PCBs

- Oil used in electrical equipment and motors, anchor windlasses, hydraulic systems, and leaks and spills from such items

Materials and items that could contain either liquid or solid PCBs

- Transformers, capacitors, and electronic equipment with capacitors and transformers inside
- Fluorescent light ballasts
- Surface contamination of machinery and other solid surfaces

Items containing PCBs may be found throughout a ship and are not always easily identifiable or readily accessible. PCBs may be found in a variety of shipboard materials, but the location and concentration can vary from item to item and within classes of items. PCB-containing materials also are likely to vary from ship to ship, and even ships in the same class can contain differing types and amounts of PCB-containing materials. While these materials may be found throughout a ship, several areas on ships may have an increased likelihood of containing PCB-bearing materials: areas or rooms subject to high heat or fire situations such as boiler rooms, engine rooms, electrical/radio rooms, weapons storage areas, or areas with hydraulic equipment. Be aware that these pieces of equipment or systems are vulnerable to leaks and spills, which could leave spill residues behind and contaminate porous materials (e.g., carpet, wood, rubber/plastic mats, paint).

Photo courtesy of Laura S. Johnson
Ex-USS Oriskany electronic equipment stripped of capacitors and transformers.

How should the vessel be prepared; what are the appropriate BMPs for PCBs?

PCBs are regulated for disposal under 40 CFR Part 761, and will be discussed in this context. The PCB regulations require manufactured products containing ≥ 50 ppm of solid PCBs (PCB bulk product waste) and materials contaminated by spills of liquids containing PCBs (PCB remediation waste) to be properly disposed. Although the ship itself is being "reused" or "recycled" as an artificial reef, the PCBs must be properly disposed. Disposal requirements for each type of PCB waste are referenced below (also see Appendix B).

Where there is reason to suspect that equipment or manufactured products containing solid PCBs may contain PCBs ≥ 50 ppm, either remove the equipment or component from the vessel, or provide proof that the equipment or component is free of PCBs, unless a PCB bulk product waste disposal approval has been obtained under 40 CFR 761.62(c) (see below).

Under TSCA regulations, a spill of liquids containing PCBs ≥ 50 ppm is considered an illegal disposal of PCBs. Material(s) contaminated by such a spill must be cleaned or removed and disposed of, unless a risk-based disposal approval has been obtained under 40 CFR 761.61(c). Spill residues and materials contaminated by these spills are regulated differently than bulk product waste (see below).

The design and implementation of a representative sampling and analytical plan can help determine the presence or absence of PCBs in materials containing solid PCBs at ≥ 50 ppm or materials containing PCBs as the result of spills. If the data from the sampling and analytical

plan indicates the absence of PCBs, the ship and its components are not subject to the PCB provisions of TSCA.

Liquid Materials Manufactured with PCBs
Remove all liquid-filled electrical equipment suspected of containing PCBs or PCB-contaminated dielectric fluid, regardless of PCB concentration. Materials such as lubricating oils and greases used for winches and cargo-handling machinery, hydraulic fluids, heat transfer fluids, and waste oils should be removed from the vessel in accordance with the guidance in the "Oil and Fuel" section of this document.

Photo courtesy of Laura Casey

Engine room electrical cabling on the ex-USS Oriskany.

Manufactured Products Containing Solid PCBs
Remove all manufactured products containing ≥ 50 ppm of solid PCBs, which includes, but is not limited to, felt gasket and faying material, cables, paints, rubber gaskets, as well as battle lanterns and fluorescent light ballasts.

Thermally removing PCB-containing materials is generally not authorized without prior written approval. Because PCB sampling and analytical procedures can be expensive and time consuming, there may be situations when the cost of sampling and analysis far exceeds the cost for removal and disposal. In some cases, vessel-to-reef projects have shown that removal of all electrical cables and wires suspected of containing PCBs was the most economical course of action.

While the complete removal of all manufactured products containing ≥ 50 ppm of solid PCBs is recommended, EPA recognizes that in some vessels it may not be feasible to identify and remove every such item. If such materials cannot be feasibly identified and/or removed, an application to EPA for a risk-based approval to dispose of the PCB bulk product waste in a marine environment for purposes of creating an artificial reef is required pursuant to 40 CFR 761.62(c). (EPA's decision includes consideration of a risk assessment submitted by the applicant, and a public participation process. Please consult the responsible EPA office for more information.)[3]

Materials Containing PCBs as a Result of Spills

Remove all materials containing ≥ 50 ppm of PCBs due to PCB spills. In addition, depending on the concentration of the spilled PCBs and the date when the spill occurred, it may be necessary to remove materials currently containing less than 50 ppm of PCBs due to spills.[4] If it is not known when a spill occurred, you should generally assume that it occurred after July 1, 1979.

During vessel clean-up/preparation, attention should be directed to locations on the ship that are known to house equipment and systems that typically contain PCB liquids. Because such equipment or systems are vulnerable to leaks and spills during the lifetime of the vessel, the areas surrounding the equipment or systems are likely contaminated by liquids containing PCBs.

If there is no information regarding whether a spill occurred and/or the PCB concentration of any spilled liquid, design and implement a representative sampling plan to verify that there are no PCBs present in the areas surrounding the liquid-filled equipment or systems. If the sampling results indicate presence of PCBs as a result of a spill of liquids containing PCBs, remove the spill residue and the materials contaminated by the spill (e.g., remove paint from a contaminated surface such as a metal deck, strip the contaminated area down to bare metal in accordance with 40 CFR 761.79(b)(i)(B)). If spill residues or materials contaminated by PCB spills cannot be feasibly removed, an application to EPA for a risk-based approval to dispose of the PCBs in a marine environment for purposes of creating an artificial reef is required pursuant to 40 CFR 761.61(c). (EPA's decision includes consideration of a risk assessment submitted by the applicant, and a public participation process. Please consult the responsible EPA office for more information (see footnote # 3).)

[3] Any vessel owner and/or sponsor should carefully consider the amount of time, resources and financial commitments necessary to address the identification, removal, and disposal of non-liquid PCB-containing materials and materials contaminated by spills of liquids containing PCBs before finally deciding if a vessel is suitable for reefing, and well in advance of commencing clean-up. EPA strongly recommends vessel owners and/or sponsors to begin discussions as soon as possible with the PCB coordinator for the EPA Region in which the vessel is proposed to be sunk. A list of EPA's current PCB coordinators may be found at www.epa.gov/pcb/coordin.html.

[4] For PCB spills that occurred between April 18, 1978, and July 1, 1979, and where the original source was ≥ 500 ppm PCBs, remove all materials containing any concentration of PCBs. For PCB spills that occurred after July 1, 1979, and where the original source was ≥ 50 ppm PCBs, remove all materials containing any concentration of PCBs. Remove all materials currently containing ≥ 50 ppm PCBs as a result of spills (of any concentration) that occurred prior to April 18, 1978. Consult the PCB regulations at 40 CFR 761.3, 761.50(b)(3) and 761.61.

PAINT

Narrative Clean-up Goal: Remove harmful exterior hull anti-fouling systems that are determined to be active; remove exfoliating (peeling) and exfoliated paint.

What types of paint and anti-fouling systems are used on ships, and where are they found?

Paint and preservative coatings can be found on both interior and exterior surfaces of a ship. Particularly on older ships, paint may be flammable or may contain toxic compounds, such as polychlorinated biphenyls (PCBs), heavy metals (e.g., lead, barium, cadmium, chromium, and zinc), and biocides. Lead compounds, such as red lead tetraoxide (Pb_3O_4) and lead chromate, have been used extensively in marine paint. Other paints containing biocides, such as organotin (including compounds such as tributyl tin), have been used on the hulls of ships to prevent the buildup of marine organisms (e.g., bacteria, protozoa, barnacles, and algae).

Paints

Paint above the water line (topside paint) is not designed to leach because these paints are designed to protect topside surfaces from physical degradation and do not typically contain antifoulant biocides like that of anti-fouling coatings. However, these paints may contain added biocides.

Anti-fouling System

For most types of candidate vessels for reefing, the paint-related contaminants of concern are limited to exterior hull coatings below the water line. These hull coatings consist primarily of anti-fouling (AF) agents (biocides) such as copper, organotin compounds, and zinc.

Photo courtesy of Laura S. Johnson

Exfoliating ceiling paint on the ex-USS Oriskany before being cleaned.

What are the potential environmental impacts of paints?

Scientific investigations by governments and international organizations have shown that certain anti-fouling systems (AFS) used on vessels pose a substantial risk of both acute and chronic toxicity and other adverse impacts to ecologically and economically important non-target marine organisms. Because this document addresses vessels that would be sunk for the creation of artificial reef habitat, the presence of biocides and other anti-fouling systems that inhibit marine growth are antithetical to this purpose. Furthermore, because anti-fouling systems can be reactivated via physical disturbance and/or biological degradation (e.g., scouring during a storm event or burrowing caused by marine organisms) over time, anti-fouling systems that retain potency may become harmful or be reactivated following the sinking. (See Appendix C)

How should the vessel be prepared; what are the appropriate BMPs for paints?

Anti-fouling Underwater Hull Coatings

If there is minimal active biocide remaining on the vessel, no preparation to the underwater hull area is necessary. It can be assumed that biocide activity is minimal if the anti-fouling coating on a candidate vessel is more than twelve years old **and** essentially all the underwater hull area is covered with marine growth.

When assessing the efficacy of the anti-fouling system, existing documentation relating to the anti-fouling properties of the hull coating could provide supporting information when determining if such coatings should be removed. Sources of such supporting information include, but are not limited to, any documentation related to the following: the type and age of the existing AFS, the most recent repainting or dry-dock cycle, and the most recent underwater hull cleaning. When necessary, such information may be supplemented by a physical, underwater hull examination by trained divers or remote operating vehicles. Repair and maintenance records for the vessel should provide the dates when the vessel was last removed from the water for hull maintenance.

If anti-fouling coatings on candidate vessels are at least twelve years old and essentially all the underwater hull area is covered with marine growth, the AF coatings can be left in place without further evaluation, as they are no longer likely to be harmful. If satisfactory evidence relating to underwater hull coating types and coating application dates is not available, and if the AF coating seems to be inhibiting fouling growth according to established AF paint efficacy, further evaluations should be carried out to ascertain the current anti-fouling properties of the coating. If it is determined that the AFS is active, the system should be removed to prevent the release of the AFS's harmful biocides.

Interior and Exterior, Above the Waterline Paints

In some cases, interior and exterior paints onboard vessels may contribute to debris/floatable materials or contain other contaminants of concern. Interior paint and paint above the waterline should be evaluated according to the guidance presented under the "PCB" and "Solids/Debris/Floatables" sections when appropriate. If paint is found to contain PCBs, then the protocols found in the "PCB" section of this document should be followed.

Removal of intact paints generally is not necessary. Topside paint may contain other constituents, such as trace metals or biocides. Unlike underwater hull paint containing high concentrations of biocides designed to leach rapidly, topside paints are designed for long life. They also may contain significantly lower levels of these substances than hull coatings. However, exfoliating paint (paint that is blistering, peeling, and pitting) and exfoliated paint (paint chips and flakes) should be removed.

SOLIDS/DEBRIS/FLOATABLES

Narrative Clean-up Goal: Remove loose debris, including materials or equipment not permanently attached to the vessel, which could be transported into the water column during a sinking event.

What are solids/debris/floatables?

Solids, debris, and floatables are loose materials that could break free from the vessel during transportation and placement as an artificial reef, thereby adversely affecting the ecological or aesthetic value of the marine environment or posing a risk to humans or animals. These materials can consist of vessel debris and clean-up debris. Vessel debris refers to material that was once part of the vessel or was generated during vessel clean-up operations and has been removed or disconnected from its original location on the vessel. Clean-up related debris is material that was not a part of the vessel, but rather was brought on the vessel during preparation operations.

Photo courtesy of Laura S. Johnson
Solids, debris, floatables, and exfoliating paint on a vessel of the MARAD James River Reserve Fleet.

What are the potential environmental impacts of solids, debris, and floatables?

Marine debris consists of solid materials of human origin discarded at sea. Floatable material/debris is any unsecured foreign matter that floats, remains suspended in the water column, or washes up on shore. Floatable materials can travel long distances in the ocean and be deposited far from their source. The degradability of floatable materials and marine debris influences the persistence of these items in the marine environment. Most marine debris does not biodegrade readily. The longer that introduced materials remain in the marine environment, the greater the threat they pose to the environment.

Some potential impacts of solids/debris/floatables to the marine environment include:

- Marine life is endangered by entanglement, ingestion, or both; injury, infection, and death may often occur when marine animals encounter debris of this nature. For example, floating debris may act as an attractant for marine animals that would try to use it as shelter or a food source, thereby potentially causing injury or death and altering behavior and/or distribution of indigenous species;

- Alteration of the ecosystem and its processes may occur throughout the water column as a result of debris introduced into the marine environment. Debris settling on the bottom may change benthic floral and faunal habitat structure, potentially causing a direct deleterious impact on members of the benthic community (i.e., injury or mortality) or indirect impact to other species linked in the benthic food web;

- Recurring clean-up for coastal communities impacted by the debris -- which could be costly; and

- Increasing the risk of spills and other environmental impacts resulting from potential danger to navigation (e.g., hull damage, damage to propellers, and damage to cooling and propulsion systems).

Where are solids/debris/floatables found on ships?

Solids, debris, and floatables can be found anywhere within the vessel as well as on the decks.

How should the vessel be prepared; what are the appropriate BMPs for solids/debris/floatables?

Vessel Debris

All material or equipment that is not an integral part of a permanently attached appurtenance and that could become separated from the vessel during sinking should be removed from the ship prior to sinking. Ship's surfaces (e.g., decks, bulkheads, overheads, and surfaces of appurtenances) should be thoroughly cleaned to remove all dirt, loose scale, trash, exfoliating paint, paint chips, hazardous materials, and other foreign matter (including netting material). Deck drains should be proven clear of debris. Consideration should also be given to the removal of items that could become a floatable over time (e.g., floatable fiberglass insulation, floatable foam).

When assessing vessel debris removal, consideration should be given to the following:

- no vessel debris contaminated with hydrocarbons or hazardous material should remain in the vessel;

- vessel debris that is heavy and/or bulky fitted equipment, and was disconnected or otherwise detached from the structure of the vessel for cleaning or inspection can

remain in its original compartment subject to issues of diver safety. Otherwise, vessel debris should be contained in a sealed compartment or structural tank that is below the waterline of the ship and underneath the largest section of the superstructure;

- vessel debris should not be placed in a compartment or structural tank that will be sealed until both the compartment and the debris have been inspected; and

- vessel debris remaining on the vessel should always be negatively buoyant.

Any vessel debris determined to be acceptable to remain on the vessel for sinking should be cleaned as understood in the context of this guidance.

Clean-up Related Debris
Clean-up debris that was introduced to the vessel solely for cleaning purposes and final preparation of the vessel should always be removed. This would include items such as tools, generators, warning tape, and temporary wooden covers.

Introduced Debris
Foreign material should not be placed on the vessel solely for disposal. However, material needed for the reefing operation (e.g., clean concrete or rock for ballast) or of a commemorative nature (e.g., plaques and markers) is not considered debris for the purposes this document.

OTHER MATERIALS OF ENVIRONMENTAL CONCERN

Narrative Clean-up Goal: Remove other materials that may negatively impact the biological, physical, or chemical characteristics of the marine environment.

What are other materials of environmental concern?

Refer to the list provided below.

What are the potential environmental impacts of other materials of environmental concern?

When placed in the marine environment, materials of environmental concern can have adverse effects on fish, wildlife, shellfish, recreation, or municipal water supplies. Adverse effects on the environment include any of the impacts mentioned in the preceding sections of the document. The magnitude of the impact of these materials on the marine environment will be related to the nature of the material, the level of toxicity, and the ecological resources that could come in contact with "other material of environmental concern."

Where are other materials of environmental concern found on ships?

Other materials of environmental concern can be found anywhere within the vessel as well as on the decks.

How should the vessel be prepared; what are the appropriate BMPs for other materials of environmental concern?

Shipboard equipment or materials with constituents that can leach into the water column (e.g., petroleum products, batteries, and/or mercury-containing switches) should be removed from the vessel prior to sinking. Fluorescent light tubes and ballasts should be removed. Waste water resulting from clean-up processes, including but not limited to, decontamination, contaminated rain water, and water from rinsing of tanks and lines, should be properly collected and disposed.

Antifreeze and Coolants
Antifreeze and coolant mediums, other than untreated sea water, should be drained and removed from the vessel, and the equipment should be flushed.

Batteries
All batteries should be removed from the vessel. This includes batteries that are part of fitted equipment.

Fire Extinguishing Systems
Fire extinguishing systems should be fully decommissioned. Except for fire-fighting systems that employ untreated seawater or fresh water, all fire-fighting compounds should be removed from the ship. Storage containers, if left in situ, should be cleaned, flushed, and re-closed for transit. Any lines that have been charged with any fire-fighting product other than untreated seawater or fresh water should be treated in the same manner as fuel lines and oil piping.

Refrigerants and Halons
All refrigerants and halons should be removed from the vessel.

Mercury
Ship system components using mercury (e.g., some gyroscopes, vacuum measurement gauges, some laboratory equipment, some light switches, some older radar displays) should be removed from the vessel. All portable thermometers and other measuring equipment employing mercury should be removed intact from the vessel. Any other extant mercury or items containing mercury should be removed from the vessel. Even minute quantities of mercury may be of concern and should be removed. Note that there is a health hazard associated with airborne mercury.

Photo courtesy of Laura Casey
Mercury removed from smoke detector onboard the ex-USS Oriskany.

Lead
Lead ballast bars, shielding and fittings should be removed from the vessel if the reef site is located in fresh or brackish water.

Black and Gray Water
Remove black water (sewerage) and gray water (waste water from sinks, showers, galleys, dishwashers) from the vessel; flush the lines.

Radioactive Materials
Ex-warships, research vessels, and a few other types of vessels may have used equipment containing low-level radioactive material. Residual radioactivity and any source of non-naturally occurring radioactive materials such as luminescent devices should be removed (except where it may safely be left on the ship in accordance with the references below). The Navy is more familiar with addressing this material generally aboard vessels, and as such, the Navy has guidance and established procedures regarding the removal and disposal of radioactive materials. For this reason, it is recommended that the procedures for removal and disposal of radioactive materials follow that provided in DLA INST 4145.8, "Material Management for Radioactive Items in the DoD" and implementing instructions. Another reference that may be useful is the American National Standard Institute's standard N13.12-1999, "Surface and Volumetric Radioactivity Standards for Clearance." This document contains tables of surface contamination criteria developed to allow users of radioactive material to demonstrate that the material or equipment can be safely released with no further regulatory control.

Invasive Species
Assess the presence of invasive species that could be transported to and survive at the artificial reef location on the hull of the ship or from other locations on or in the vessel such as ballast and bilge tanks. If a viable invasive species is found that may be expected to survive at the artificial reef site, that species should be removed or eliminated; the vessel should be clean of all such living organisms.

Considerations for Other In-water Uses of Obsolete Vessels

Photo courtesy of Florida Fish and Wildlife Conservation Commission
Diver exploring the ex-USS Spiegel Grove artificial reef.

DIVING OPPORTUNITIES

The narrative goals set out under the section "Guidance for Preparing Vessels to Create Artificial Reef Habitat" also should be achieved while preparing a vessel for diver opportunities. For example, if preparation for diver use calls for the removal of wall paneling that will in turn expose any materials of concern that were identified in the aforementioned section, the respective narrative goals should be addressed (e.g., if asbestos is exposed once the panel is removed, the objectives of the asbestos narrative goal should be met).

Additional vessel preparation to support the in-water use of recreational diving may include:

- Removal of sharp and protruding objects along the divers' access path which could snag on divers' equipment or otherwise pose a danger to the divers.
- Removal of doors and access hatches and widening of openings to allow safe access for divers.
- Widening of corridors by removal of some wall paneling and provision of large openings in the exterior of the ship to allow light to penetrate and help ensure safe diver access.
- Sealing entrances into restrictive compartments such as the boiler rooms and engine rooms to help ensure diver safety.

When preparing the vessel for diver opportunities, careful consideration also should be given to vessel stability (for transport and sinking operations) as well as vessel integrity (for the life of the vessel once placed at the reef site).

Appendix A

Federal Statutes Related to the Transfer of Obsolete MARAD and Navy Vessels for Use as Artificial Reefs

National Defense Authorization Act for Fiscal Year 2004

The National Defense Authorization Act for Fiscal Year 2004 (PL 108-136) included two provisions relating to the use of vessels as artificial reefs. One such provision, § 3516 (PL 108-136, Div. C, Title XXXV, § 3516, Nov. 24, 2003, 117 Stat. 1795), amended the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (PL 107-314, Div. C, Title XXXV, § 3504(b), Dec. 2, 2002, 116 Stat. 2754; 16 U.S.C. 1220 note) to read in pertinent part as follows:

Title XXXV – Maritime Administration
Subtitle A – Maritime Administration Reauthorization
Section 3516. AUTHORITY TO CONVEY OBSOLETE VESSELS TO UNITED STATES, TERRITORIES, AND FOREIGN COUNTRIES FOR REEFING

(b) **Environmental Best Management Practices for Preparing Vessels for Use as Artificial Reefs**.—

(1) Not later than March 31, 2004, the Secretary of Transportation, acting through the Maritime Administration, and the Administrator of the Environmental Protection Agency shall jointly develop guidance recommending environmental best management practices to be used in the preparation of vessels for use as artificial reefs.

(2) The guidance recommending environmental best management practices under paragraph (1) shall be developed in consultation with the heads of other federal agencies, and State agencies, having an interest in the use of vessels as artificial reefs.

(3) The environmental best management practices under paragraph (1) shall --

(A) include recommended practices for the preparation of vessels for use as artificial reefs to ensure that vessels so prepared will be environmentally sound in their use as artificial reefs;

(B) promote consistent use of such practices nationwide;

(C) provide a basis for estimating the costs associated with the preparation of vessels for use as artificial reefs; and

(D) include mechanisms to enhance the utility of the Artificial Reefing Program of the Maritime Administration as an option for the disposal of obsolete vessels.

(4) The environmental best management practices developed under paragraph (1) shall serve as national guidance for federal agencies for the preparation of vessels for use as artificial reefs.

(5) Not later than March 31, 2004, the Secretary of Transportation, acting through the Maritime Administration, and the Administrator of the Environmental Protection Agency shall jointly establish an application process for governments of States, commonwealths, and United States territories and possessions, and foreign governments, for the preparation of vessels for use as artificial reefs, including documentation and certification requirements for that application process.

(6) The Secretary of Transportation shall submit to Congress a report on the environmental best management practices developed under paragraph (1) through the existing ship disposal reporting requirements in section 3502 of Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (as enacted into law by Public Law 106-398; 1654A-492) [Pub.L. 106-398, Div. C, Title XXXV, § 3502, Oct. 30, 2000, 114 Stat. 1654A-492, which is not classified to the Code]. The report shall describe such practices, and may include such other matters as the Secretary considers appropriate.

The second such provision, § 1013 (PL 108-136, Div. A, Title X, § 1013, Nov. 24, 2003, 117 Stat. 1590), amended Title 10 of the United States Code by adding § 7306b. New § 7306b(a) authorizes the Secretary of the Navy to transfer vessels stricken from the Naval Vessel Register for use as an artificial reef. New § 7306b(c) requires the Secretary of the Navy to ensure that the preparation of a vessel transferred pursuant to 10 U.S.C. § 7306b(a) for use as an artificial reef is conducted in accordance with the environmental best management practices developed pursuant to 16 U.S.C. § 1220 note and applicable environmental laws. The complete text of Section 1013 of the National Defense Authorization Act for Fiscal Year 2004 is as follows:

Title X – General Provisions
Subtitle B – Naval Vessels and Shipyards
Section 1013. TRANSFER OF VESELS STRICKEN FROM THE NAVAL VESSEL REGISTER FOR USE AS ARTIFICIAL REEFS.

(a) AUTHORITY TO MAKE TRANSFER- Chapter 633 of title 10, United States Code, is amended by inserting after section 7306a the following new section:

`Sec. 7306b. Vessels stricken from Naval Vessel Register: transfer by gift or otherwise for use as artificial reefs

`(a) AUTHORITY TO MAKE TRANSFER- The Secretary of the Navy may transfer, by gift or otherwise, any vessel stricken from the Naval Vessel Register to any State, Commonwealth, or possession of the United States, or any municipal corporation or political subdivision thereof, for use as provided in subsection (b).

`(b) VESSEL TO BE USED AS ARTIFICIAL REEF- An agreement for the transfer of a vessel under subsection (a) shall require that--

`(1) the recipient use, site, construct, monitor, and manage the vessel only as an artificial reef in accordance with the requirements of the National

Fishing Enhancement Act of 1984 (33 U.S.C. 2101 et seq.), except that the recipient may use the artificial reef to enhance diving opportunities if that use does not have an adverse effect on fishery resources (as that term is defined in section 2(14) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1802(14)); and

`(2) the recipient obtain, and bear all responsibility for complying with, applicable federal, State, interstate, and local permits for using, siting, constructing, monitoring, and managing the vessel as an artificial reef.

`(c) PREPARATION OF VESSEL FOR USE AS ARTIFICIAL REEF- The Secretary shall ensure that the preparation of a vessel transferred under subsection (a) for use as an artificial reef is conducted in accordance with--

`(1) the environmental best management practices developed pursuant to section 3504(b) of the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107-314; 16 U.S.C. 1220 note); and

`(2) any applicable environmental laws.

`(d) COST SHARING- The Secretary may share with the recipient of a vessel transferred under subsection (a) any costs associated with transferring the vessel under that subsection, including costs of the preparation of the vessel under subsection (c).

`(e) NO LIMITATION ON NUMBER OF VESSELS TRANSFERABLE TO PARTICULAR RECIPIENT- A State, Commonwealth, or possession of the United States, or any municipal corporation or political subdivision thereof, may be the recipient of more than one vessel transferred under subsection (a).

`(f) ADDITIONAL TERMS AND CONDITIONS- The Secretary may require such additional terms and conditions in connection with a transfer authorized by subsection (a) as the Secretary considers appropriate.

`(g) CONSTRUCTION- Nothing in this section shall be construed to establish a preference for the use as artificial reefs of vessels stricken from the Naval Vessel Register in lieu of other authorized uses of such vessels, including the domestic scrapping of such vessels, or other disposals of such vessels, under this chapter or other applicable authority.'.

(b) CLERICAL AMENDMENT- The table of sections at the beginning of such chapter is amended by inserting after the item relating to section 7306a the following new item:

`7306b. Vessels stricken from Naval Vessel Register: transfer by gift or otherwise for use as artificial reefs.'.

Transfer of Obsolete Vessels by the Department of Transportation
Public Law 92-402 (16 U.S.C. 1220, et. seq.) authorizes the U.S. Maritime Administration (MARAD), under the Department of Transportation, to transfer obsolete ships to any state for use as an artificial reef. In addition, MARAD's authority was amended by Public Law 107-314 section 3504, as amended by Public Law 108-136, to allow MARAD to provide financial assistance to states for environmental preparation, towing, and/or sinking and also allows MARAD to transfer obsolete vessels to U.S. territories and foreign countries for use as artificial reefs.

Title XXVI – Conservation
Chapter 25B – Reefs for Marine Life Conservation

§ 1220. State applications for obsolete ships for use as offshore reefs

(a) Conservation of marine life

Any State may apply to the Secretary of Transportation (hereafter referred to in this chapter as the "Secretary") for obsolete ships which, but for the operation of this chapter, would be designated by the Secretary for scrapping if the State intends to sink such ships for use as an offshore artificial reef for the conservation of marine life.

(b) Manner and form of applications; minimum requirements

A State shall apply for obsolete ships under this chapter in such manner and form as the Secretary shall prescribe, but such application shall include at least (1) the location at which the State proposes to sink the ships, (2) a certificate from the Administrator, Environmental Protection Agency, that the proposed use of the particular vessel or vessels requested by the State will be compatible with water quality standards and other appropriate environmental protection requirements, and (3) statements and estimates with respect to the conservation goals which are sought to be achieved by use of the ships.

(c) Copies to federal officers for official comments and views

Before taking any action with respect to an application submitted under this chapter, the Secretary shall provide copies of the application to the Secretary of the Interior, the Secretary of Defense, and any other appropriate federal officer, and shall consider comments and views of such officers with respect to the application.

§ 1220a. Transfer of title; terms and conditions

If, after consideration of such comments and views as are received pursuant to section 1220(c) of this title, the Secretary finds that the use of obsolete ships proposed by a State will not violate any federal law, contribute to degradation of the marine environment, create undue interference with commercial fishing or navigation, and is not frivolous, he may transfer without consideration to the State all right, title, and

interest of the United States in and to any obsolete ships which are available for transfer under this chapter if--
(1) the State gives to the Secretary such assurances as he deems necessary that such ships will be utilized and maintained only for the purposes stated in the application and, when sunk, will be charted and marked as a hazard to navigation;
(2) the State agrees to secure any licenses or permits which may be required under the provisions of any other applicable federal law;
(3) the State agrees to such other terms and conditions as the Secretary shall require in order to protect the marine environment and other interests of the United States; and
(4) the transfer would be at no cost to the Government (except for any financial assistance provided under section 1220(c)(1) of this title) with the State taking delivery of such obsolete ships and titles in an "as-is-- where-is" condition at such place and time designated as may be determined by the Secretary of Transportation.

§ 1220b. Obsolete ships available; number; equitable administration

A State may apply for more than one obsolete ship under this chapter. The Secretary shall, however, taking into account the number of obsolete ships which may be or become available for transfer under this chapter, administer this chapter in an equitable manner with respect to the various States.

§ 1220c. Denial of applications; finality of decision

A decision by the Secretary denying any application for a obsolete ship under this chapter is final.

§ 1220c-1. Financial assistance to State to prepare transferred ship

(a) Assistance authorized

The Secretary, subject to the availability of appropriations, may provide, to any State to which an obsolete ship is transferred under this chapter, financial assistance to prepare the ship for use as an artificial reef, including for--
(1) environmental remediation;
(2) towing; and
(3) sinking.

(b) Amount of assistance

The Secretary shall determine the amount of assistance under this section with respect to an obsolete ship based on—
(1) the total amount available for providing assistance under this section;
(2) the benefit achieved by providing assistance for that ship; and
(3) the cost effectiveness of disposing of the ship by transfer under this chapter and provision of assistance under this section, compared to other disposal options for that ship.

(c) Terms and conditions

The Secretary--
(1) shall require a State seeking assistance under this section to provide cost data and other information determined by the Secretary to be necessary to justify and document the assistance; and
(2) may require a State receiving such assistance to comply with terms and conditions necessary to protect the environment and the interests of the United States.

§ 1220d. "Obsolete ship" defined

For purposes of sections 1220, 1220a, 1220b, and 1220c of this title, the term "obsolete ship" means any vessel owned by the Department of Transportation that has been determined to be of insufficient value for commercial or national defense purposes to warrant its maintenance and preservation in the national defense reserve fleet and has been designated as an artificial reef candidate.

Appendix B

Federal Environmental Laws Relevant for Consideration in the Preparation of a Vessel for Use as an Artificial Reef

This Appendix identifies selected federal statutes relevant for consideration in preparation of a vessel for use as an artificial reef. For these statutes, the Appendix explains their potential relevance and briefly summarizes the relevant provisions. The first set of statutes briefly summarized are environmental laws administered by EPA which may be relevant to the removal of material from vessels or the disposal of such removed material. In addition, although this document focuses on environmental best management practices for vessel preparation, for the reader's convenience the Appendix also briefly summarizes federal statutes establishing permit requirements for the actual placement of the vessel as an artificial reef. Finally, the Appendix briefly describes a number of other significant federal environmental statutes that may affect issuance of such permits or the actual conduct of placement activities.

The information in this Appendix is intended only for the convenience of the reader in order to provide a useful starting point for identifying the principal environmental statutes of interest. The Appendix is not intended to be an exhaustive list of every conceivably relevant statute, nor do the brief summaries in this list alter or replace any requirements, regulations, or applicable guidance under those statutes that are summarized. Readers also should be aware that in 2000, EPA published tips for regulatory compliance for ship scrapping, and that document contains additional guidance that may be useful in preparation of a vessel for use as an artificial reef. See www.epa.gov/oecaerth/resources/publications/civil/federal/shipscrapguide.pdf.

State and local laws also may apply to vessel preparation or placement for use as an artificial reef, and interested readers should consult with appropriate State and local authorities to identify such further requirements.

EPA-Administered Federal Environmental Laws Relevant to Vessel Preparation

- The Clean Air Act (CAA), 42 U.S.C. §§ 7401, et seq., generally addresses the emission of air pollutants. Among other things, it directs EPA to establish minimum national standards for air quality, and assigns primary responsibility to the states to assure compliance with the standards through State Implementation Plans (SIPs). State-specific SIPs may impose requirements that are more prescriptive, more stringent, or more specific than the minimum national standards. Among national standards relevant for vessel preparation, EPA has established a National Emissions Standards for Hazardous Air Pollutants (NESHAP) for asbestos at 40 CFR Part 61 Subpart M. The asbestos NESHAP is intended to minimize the release of asbestos fibers during demolition and renovation activities, which would include asbestos removal when preparing a vessel for use as an artificial reef. EPA has delegated authority to inspect and enforce the asbestos NESHAP to most states, which, as noted, may have requirements that are more stringent than federal requirements. Other NESHAPs also may be relevant to removal of other materials on vessels, and may be found at 40 CFR Parts 61 and 63. In addition, Title VI of the Act directs EPA to establish requirements for the control of substances that contribute to stratospheric ozone depletion, which include substances such as halons used

in fire suppression systems and certain refrigerants, that the best management practices in this guidance recommend be removed from a vessel in preparation for its use as an artificial reef. The recovered ozone-depleting refrigerants and halons should be delivered to an EPA-approved refrigerant and/or halon reclaimer for proper handling. Regulations addressing recycling and reuse of such removed refrigerants and halons, including chlorofluorocarbons and hydrofluorocarbons (sometimes referred to under the trade name Freon), appear at 40 CFR Part 82.

- The Clean Water Act (CWA), 33 U.S.C. §§ 1251, et seq., generally regulates the addition of pollutants from a point source to waters of the United States. The definition of point source includes a "vessel or other floating craft." CWA requirements are implemented, among other things, through permits under either section 402 (the National Pollutant Discharge Elimination System (NPDES) permitting program) or section 404 (the permitting program for dredged and fill material). Pollutants generated in the preparation of a vessel for use as an artificial reef that are discharged to waters of the U.S., including via contaminated storm water, require NPDES permit authorization. The NPDES permitting program is primarily administered by states, with EPA oversight. In addition to the CWA's NPDES permitting program, section 311 establishes a program for the prevention and abatement of, and remedial response to, oil and hazardous substance spills. See 40 CFR Parts 110, 112, 116, and 117. Section 311 imposes requirements for reporting the release of oil and hazardous substances, which might be relevant to the preparation of a vessel for use as an artificial reef should preparation result in such a release. Section 311 is jointly administered by EPA and the U.S. Coast Guard, depending on the location of the source. (For discussion of CWA section 404 permitting and the placement of vessels as artificial reefs, refer to the section of this Appendix describing federal laws that establish permitting requirements for placement of artificial reefs).

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601, et seq., better known as the "Superfund Act," addresses cleanup of hazardous substances. CERCLA and its implementation documents empower EPA and other agencies to identify and prioritize sites for cleanup, and to order or carry out environmental remediation. Subject to limited defenses, CERCLA imposes strict liability for environmental cleanup on persons connected to facilities from which there are releases into the environment. CERCLA also mandates reporting to the National Response Center of hazardous substance releases. In conjunction with CWA section 311, CERCLA provides for federal preparation of the National Contingency Plan for responding to a hazardous substances release. As noted regarding CWA section 311, CERCLA is relevant to the preparation of a vessel for use as an artificial reef in its release reporting requirements, particularly for oil and hazardous substances. CERCLA is administered by federal agencies, not states.

- The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. §§ 136, et seq., generally regulates the registration, labeling, distribution, sale, and use of pesticides. EPA regulates anti-foulant paints, including those containing organotins, copper, and other pesticidal compounds under FIFRA. EPA has relied on FIFRA and the Organotin Anti-fouling Paint Control Act of 1988 (33 U.S.C. §§ 2401, et seq.) for authority to impose requirements, such as certification and training for applicators and label

requirements dealing with tributyl tin (TBT) application and disposal. TBT anti-fouling paint label requirements include provisions directing that all paint chips, spent abrasives, and any other waste products from paint removal be disposed of in a sanitary landfill. 53 Fed. Reg. 39022, 39038, col. 3 (October 4, 1988). In addition, use of any pesticide in the preparation of a vessel for use as an artificial reef must comply with label requirements. For the most part, FIFRA is administered by EPA, though some states have primary enforcement responsibility for FIFRA use violations.

- The Marine Protection, Research and Sanctuaries Act (MPRSA), 33 U.S.C. §§ 1401, et seq., prohibits, unless authorized by an MPRSA permit, (1) transportation of material from the United States for the purpose of ocean dumping; (2) transportation of material from anywhere for the purpose of ocean dumping by federal agencies or U.S. flagged vessels; and (3) dumping of material transported from outside the United States into the territorial sea of the United States. If any materials removed from vessels being prepared for use as an artificial reef were subsequently proposed for ocean dumping, a permit under the MPRSA would be necessary. Denial of such a permit request, however, would be highly likely because land-based alternatives (the consideration of which are required for MPRSA permit issuance) typically would be available. In addition, it would seem improbable that such a proposal could satisfy the other applicable environmental criteria of the MPRSA and implementing regulations. The MPRSA is administered by EPA and the U.S. Army Corps of Engineers, not states.[5]

- The Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901, controls the management of hazardous wastes "from cradle to grave." If, in the preparation of a vessel for use as an artificial reef, a waste is generated that is specifically listed as hazardous or exhibits any hazardous characteristics, e.g. toxicity, and the waste is not excluded or exempt from the RCRA Subtitle C regulations, then this waste would be considered hazardous waste and subject to all applicable RCRA regulations. See 40 CFR Parts 260 and 261. Depending upon the volume of hazardous wastes that are generated and the length of time the hazardous wastes are accumulated, RCRA regulations provide conditional exemptions from some of the regulatory requirements. In most states, EPA has authorized the State to administer some or all of RCRA requirements under state law in lieu of federal law and, depending on the state, state law may include requirements that are more stringent or prescriptive than federal law. Hazardous waste and used oil must be managed according to RCRA regulations.

- The Toxic Substance Control Act (TSCA), 15 U.S.C. §§ 2601, et seq., bans the manufacture, processing, use, and distribution in commerce of polychlorinated biphenyls (PCBs) and directs EPA to set regulations for the disposal of PCBs. TSCA requirements generally determine the degree of necessary PCB removal from vessels being prepared for use as an artificial reef. Although TSCA imposes requirements for toxic substances other than PCBs, TSCA's PCB requirements are uniquely relevant to preparation of a

[5] The MPRSA definition of "dumping" excludes the construction of fixed structures or artificial islands, as well as deposits of materials for the purpose of developing or maintaining fisheries resources, when otherwise regulated by federal or state law (or occurring pursuant to authorized federal or state programs). Because the placement of a vessel to create an artificial reef in waters subject to jurisdiction of the United States is regulated under other federal laws, the actual placement of vessels for use as an artificial reef is not subject to regulation under the MPRSA.

vessel for use as an artificial reef because of the likely presence of PCBs on many obsolete vessels. More specific guidance on the applicability of TSCA's PCB requirements to vessels being prepared for use as an artificial reef is provided in the section of the environmental best management practices addressing PCBs, and readers should refer to that section for further information.

Federal Environmental Laws Establishing Permit Requirements for Placement of Vessels as Artificial Reefs

- Section 404 of the CWA, 33 U.S.C. § 1344, establishes a permitting program for the discharge of dredged or fill material to waters of the Unites States. Placement of a vessel in waters of the United States as an artificial reef would constitute a discharge of fill material, and therefore would require a CWA section 404 permit. 33 CFR 323.2(e) & (f). For CWA purposes, "waters of the United States" include most inland waters as well as the waters of the territorial sea, which, under the CWA, is measured from the baseline (i.e., the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters) in a seaward direction a distance of three miles. Section 404 permitting is primarily administered by the U.S. Army Corps of Engineers (Corps), using environmental guidelines set out in EPA regulations appearing at 40 CFR Part 230. Among other things, except as provided by 40 CFR 230.5(b) and 230.7(b)(1) (relating to activities covered by an applicable general permit), these guidelines require consideration of practicable alternatives to the proposed discharge, and in the case of proposed discharges to special aquatic sites, presume that all practicable alternatives not involving a discharge into a special aquatic site have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise. 40 CFR 230.5(c); 230.10(a). Special aquatic sites are identified at 40 CFR Part 230 Subpart E and include, among other things, marine sanctuaries and coral reefs. In addition to evaluation for compliance with these guidelines, section 404 permits are also subject to the Corps' public interest review under 33 CFR 320.4. Corps regulations relevant to the CWA section 404 permitting program appear at 33 CFR Parts 320, 323, 325, 328, and 331. Though EPA has authorized two States to administer the section 404 permitting program for certain waters in those States, these State programs probably would not to be relevant to the placement of a vessel for use as an artificial reef because states may not assume section 404 permitting authority for discharges of fill material to waters supporting commercial navigation, waters subject to the ebb and flow of the tide, or waters of the territorial seas, where a former vessel/artificial reef would likely be sited.

- Section 10 of the Rivers and Harbors Act of 1899 (RHA), 33 U.S.C. §§ 403, requires a permit from the Corps for, among other things, the construction of any structure (including artificial reefs) in or over any "navigable water of the United States" as that term is defined at 33 CFR Part 329.[6] Structures or work outside the limits of "navigable waters of the United States" also require a section 10 permit if the structure or work

[6] In cases where the waters in which the vessel is being placed for use as an artificial reef are subject to both RHA section 10 and CWA section 404 permitting (e.g., the 3 mile territorial sea), Corps practice is to issue a single consolidated permit satisfying the requirements of both these statutes.

affects the course, location, or condition of the waterbody in such a manner as to impact on navigational capacity. Under section 4(e) of the Outer Continental Shelf Lands Act, 43 U.S.C. § 1333(e), RHA section 10 permit requirements also apply to the creation of structures on the Outer Continental Shelf of the United States, including artificial reefs. 33 CFR 322.3(b). Issuance of permits under RHA section 10 involves a public interest review by the Corps in accordance with 33 CFR 320.4. To help safeguard navigational and other marine uses, Corps permits for artificial reefs have required that permittees notify the National Oceanic & Atmospheric Administration (NOAA) prior to, and upon completion of, the reefing activity, including a drawing certifying the location and configuration of the completed activity. 33 CFR Part 325, Appendix A, special condition B.5. Corps regulations relevant to the RHA section 10 permitting program appear at 33 CFR Parts 320, 322, 325, 329, and 331.

Other Significant Federal Environmental Statutes That May Affect Issuance of Permits or Licenses for Artificial Reefs or the Conduct of Placement Activities.

- The Liberty Ship Act, 16 U.S.C. §§ 1220, et seq., authorizes states to apply to the Secretary of the Department of Transportation (DOT) for the use of DOT-owned obsolete vessels, including obsolete vessels of the Maritime Administration, as an artificial reef for the conservation of marine life. The Liberty Ship Act requires that the state application to DOT include a certification from EPA that the proposed use of the vessel will be compatible with "applicable water quality standards and other appropriate environmental protection requirements." 16 U.S.C. § 1220 (b). The ability to meet such standards and requirements will be affected by what materials are onboard the vessel.

- The National Fishing Enhancement Act of 1984 (NFEA), 33 U.S.C. §§ 2101, et seq., applies to all artificial reefs in waters of the United States or on the Outer Continental Shelf for the purpose of enhancing fishery resources. Section 204 of NFEA obligates NOAA to issue a national artificial reef plan that addresses issues such as siting and design criteria. Additionally, NFEA section 205 establishes further requirements to be applied by the Corps in the exercise of its previously described permitting authority for placement of artificial reefs under RHA section 10 or CWA section 404. Such requirements are reflected in the previously identified Corps permitting regulations for artificial reefs (e.g., 33 CFR 320.3(o), 322.5(b), and 325.1(d)(8)).

- The Coastal Zone Management Act (CZMA), 16 U.S.C. 1451, et seq., establishes a federal/state partnership to provide for the comprehensive management of coastal resources. Under CZMA section 307(c)(3), applicants for a required federal license or permit to conduct an activity affecting the coastal zone of a state with an approved coastal management program need to provide the federal permitting agency and the relevant state with a certification that the proposed activity complies with the enforceable policies of the state's approved program and will be conducted in a manner that is consistent with the program. Under CZMA section 307(c)(1), a federal agency activity that affects the coastal zone must be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of an approved coastal management program. Relevant implementing regulations established by NOAA (which is responsible for federal administration of the CZMA) appear at 15 CFR Part 930,

Subpart C (consistency for federal agency activities) and Subpart D (consistency for activities requiring a federal license or permit). NOAA's CZMA regulations were recently amended. 71 Fed. Reg. 788 (Jan. 5, 2006). The regulations provide that in the case of federal agency applications for federal licenses or permits, as well certain general permits proposed by a federal agency, review will be conducted under the Subpart C regulations. See 15 CFR 930.31(d) & 930.52. Corps regulations implementing the CZMA for its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(b), 320.4(h), and 325.2(b)(2).

- The National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. §§ 4321, et seq., requires that federal agencies include in their decision-making processes appropriate and careful consideration of the environmental effects of, and alternatives to, their actions. NEPA section 102(2)(C) includes a requirement for preparation of an environmental impact statements (EIS) for "major federal actions significantly affecting the quality of the human environment." For proposed federal actions where the environmental effects are unclear, the agency often prepares an environmental assessment, which is a brief and concise document containing sufficient evidence and analysis for the agency to determine whether to prepare an EIS or to issue a finding of no significant impact. 40 CFR 1501.4(b), 1508.9(a)(1), 1508.13. Council on Environmental Quality regulations implementing NEPA appear at 40 CFR Parts 1500 – 1518. Corps regulations implementing NEPA for its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(d) and Part 325, Appendix B.

- Under Clean Air Act section 309, 42 U.S.C. § 7609, EPA reviews and comments on the environmental impacts of several types of actions of other federal agencies, including all actions subject to the requirement under the National Environmental Policy Act to prepare an Environmental Impact Statement. EPA comments in writing and make those comments available to the public. If EPA determines that the action is unsatisfactory from the standpoint of public health or welfare or environmental quality, EPA refers the matter to the Council on Environmental Quality.

- The Endangered Species Act (ESA), 16 U.S.C. §§ 1531, et seq., addresses the conservation of federally-listed threatened and endangered species and the ecosystems on which those species depend. ESA section 7 requires that federal agencies, in consultation with the National Marine Fisheries Service and/or the U.S. Fish and Wildlife Service[7], ensure that any action authorized, funded, or carried out by the agency (including issuance of federal permits) is not likely to jeopardize the continued existence of listed species or result in the adverse modification of their designated critical habitat. Whenever such an agency action may affect a listed species or critical habitat, the interagency consultation requirement is triggered, and the ESA section 7 procedural requirements at 50 CFR Part 402 apply. In addition, ESA section 9 generally prohibits anyone from taking listed animal species without authorization. "Take" is defined in ESA section 3(19) to include harming and killing. Authorization to take is generally granted through the section 7 consultation process, in exchange for measures to minimize

[7] The National Marine Fisheries Service is now referred to as NOAA Fisheries, and is generally responsible for marine species under the ESA. The U.S. Fish and Wildlife Service is generally responsible for terrestrial and freshwater species.

the take. Detailed information regarding ESA compliance can be found online at http://www.nmfs.noaa.gov/pr/species/esa.htm and http://www.fws.gov/endangered/wildlife.html. EPA's CWA section 404(b)(1) guidelines also address ESA issues in the context of CWA section 404 permitting and appear at 40 CFR 230.30. Corps regulations implementing the ESA for its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(i) and 325.2(b)(5).

- The Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661, et seq., provides that whenever the waters or channel of a waterbody are proposed or authorized to be modified by a public or private agency under federal permit or license, the agency first shall consult with the USFWS and the head of the state agency responsible for wildlife resources. The purpose of this consultation is to promote conservation of wildlife resources by preventing loss of and damage to such resources and to provide for the development and improvement of wildlife resources in connection with the agency action. Although the recommendations of the Secretary of the Interior and state officials are not binding, the federal agency must give them full consideration. In addition, EPA's CWA section 404(b)(1) guidelines address wildlife issues in the context of section 404 permitting and appear at 40 CFR Part 230, Subpart D. Corps regulations implementing the Fish and Wildlife Coordination Act for its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(e) and 320.4(c).

- Title III of the National Marine Sanctuaries Act (NMSA), 16 U.S.C. §§ 1431, et seq., authorizes the Secretary of Commerce to designate and manage national marine sanctuaries. Under NMSA section 304(d), federal agency actions (including private activities authorized by federal permits) that are likely to destroy, cause the loss of, or injure sanctuary resources are subject to consultation with the Secretary of Commerce. If the Secretary finds that a federal action is likely to have this effect, the Secretary must recommend feasible alternatives to protect resources, and if the agency does not follow those alternatives it must provide a written statement explaining why. The marine sanctuary program is administered by NOAA, which has promulgated implementing regulations at 15 CFR Part 922. Part 922 specifically identifies all designated marine sanctuaries and their boundaries, as well as applicable regulations and restrictions governing their use. EPA's CWA section 404(b)(1) guidelines also address marine sanctuaries in the context of section 404 permitting and appear at 40 CFR 230.40. Corps regulations implementing these NMSA provisions for its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(c) and 320.4(i).

- The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), 16 U.S.C. §§ 1801, et seq., is the principal federal law addressing the conservation and management of fisheries resources. Among other things, Magnuson-Stevens Act section 305(b)(1) provides that fisheries management plans developed under the Magnuson-Stevens Act must identify essential fish habitat (EFH). Magnuson-Stevens Act section 3(10) defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Under section 305(b)(2), federal agencies are directed to consult with the Secretary of Commerce with respect to any action to be authorized, funded, or undertaken that may adversely affect any identified EFH. If the Secretary determines the action would adversely affect such EFH, the

Secretary is to recommend measures that could be taken by the agency to conserve the EFH. The agency must respond to such recommendations in writing, including a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on the EFH. Under Magnuson-Stevens Act section 305(b)(4), if the agency's response is inconsistent with the Secretary's recommendations, the agency must explain why. The locations of EFH identified under the Act can be found online at http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/fish_manage_c.htm. NOAA regulations implementing the EFH provisions of the Act appear at 50 CFR Part 600, Subparts J and K.

- The Marine Mammal Protection Act of 1972 (MMPA), 16 U.S.C. §§ 1361,1362, 1371-1384 note, 1386-1389, 1401-1407, 1411-1417, 1421-1421h, is the principal federal legislation addressing marine mammal species protection and conservation. MMPA section 102 prohibits, with certain exceptions, the take of marine mammals in United States waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. Marine mammals subject to the MMPA are defined in MMPA section 3(6) to include both species that are morphologically adapted to the marine environment (e.g., sea otters, manatees, seals, walruses, dolphins, whales) or which primarily inhabit the marine environment (e.g., polar bears). MMPA section 3(13) provides that "take" means to harass, hunt, capture, or kill, or to attempt to do so. Depending on the species of marine mammal involved, MMPA section 3(12) divides MMPA implementation responsibility between the Department of the Interior (USFWS) and the Department of Commerce (NOAA). Under this division of responsibility NOAA manages the majority of marine mammals, including whales, dolphins, porpoises, seals, and sea lions, while the USFWS manages five species: polar bears, walrus, sea otters, manatees, and dugongs. Relevant implementing regulations appear at 50 C.F.R Part 216 (NOAA) and 50 CFR Part 18 (USFWS). Corps regulations implementing the MMPA for its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(k).

- Section 401 of the Clean Water Act (33 U.S.C. 1341) requires that any applicant for a federal license or permit (e.g., an EPA-issued NPDES permits or a Corps-issued section 404 permit) to conduct an activity that may result in a discharge into waters of the United States shall provide the permitting agency a certification from the state in which the discharge originates certifying that the license or permit complies with CWA requirements, including applicable state water quality standards. No federal license or permit subject to CWA section 401 may be issued unless the state either grants or waives certification. As a result, CWA section 401 provides states with the ability to preclude the issuance of federal permits or licenses subject to section 401 by denying certification, as well as the ability to indirectly impose conditions upon such federal permits or licenses by placing limitations or conditions on its section 401 certification. EPA regulations implementing CWA section 401 appear at 40 CFR Part 121. Corps regulations implementing the CWA section 401 its RHA section 10 and CWA section 404 permit programs appear at 33 CFR 320.3(a), 320.4(d), and 325.2(b)(1).

Appendix C

*Information related to materials found on scuttled vessels that may have potentially hazardous effects on the marine environment**

*****The text provided in this appendix is an excerpt from the 2005 "*Policy Statement of the National Marine Sanctuary Program: Artificial Reef Permitting Guidelines.*"

Scuttled Vessels

The scuttling of vessels requires particular attention in this policy because of their size and potential toxicological effects on the environment. As discussed above, sunken ships potentially attract divers away from natural reefs and thus may be beneficial to natural reefs in National Marine Sanctuaries. However, there is a wide array of concerns that must be addressed before intentionally sinking a ship.

The removal of petroleum products, hazardous materials, paint cans, batteries, plastics, oil, and fuel is specified on the U.S. Coast Guard's Ocean Disposal/Artificial Reef Inspection form. Additionally, under the Toxic Substances Control Act (TSCA), the EPA has the authority to gather information on and regulate chemical substances and mixtures imminently hazardous or presenting unreasonable risk of injury to public health or the environment. Despite these controls, some materials of concern may still remain on items used as artificial reef material. Such materials include: asbestos, polychlorinated biphenols (PCBs), iron, lead paint, and antifouling paint. The National Marine Sanctuaries Program (NMSP) should consider the risks associated with materials remaining on vessels to be used as artificial reefs. The NMSP will consult with appropriate agencies (i.e., U.S. EPA, MARAD) to determine the best management practices to use in evaluating materials for pollution potential).

Asbestos is the name given to six naturally occurring minerals that are used as insulators and fire retardants. Several studies have investigated the effects of asbestos on fish (Batterman and Cook 1981, Belanger *et al.* 1990, Belanger *et al* 1986, Woodhead *et al.* 1983). The findings indicate that asbestos concentrations on the order of 10^6 to 10^8 fibers/L may cause epidermal lesions, epithelial hypertrophy, kidney damage, decreased orientation and swimming ability, degradation of the lateral line, reduced growth, and increased mortality in fish. Undisturbed, non-friable (not easily crumbled) asbestos has been found to be relatively harmless (Garcia and Salzwedel 1995, Montoya *et al* 1985).

PCBs may still exist in water-tight gaskets, cable insulation, paint, transformers, capacitors, and other components of decommissioned Navy vessels (Martore *et al.*1996, Eisler and Belisle 1996). These chemicals have been implicated in: reduced primary productivity in phytoplankton; reduced hatchability of contaminated fish and bird eggs; reproductive failure in seals; altered steroid levels and subsequent reproductive impairment in fish and sea stars; reduced fertilization efficiency in sea urchins; and reduced plasma retinal and thyroid hormone levels potentially leading to increased susceptibility to microbial infections, reproductive disorders and other pathological alternation in seals and other marine mammals (Adams and Slaughter-Williams 1988, Brouwer *et al.* 1989, Clark 1992, den Besten *et al*. 1991).

Antifouling paints typically containing tributyltin (TBT) and copper (Cu) are often used to paint vessel hulls to inhibit the growth of organisms below the water line. An IMO convention to

control the use of harmful anti-fouling systems on ships was adopted on October 5, 2001. The convention will prohibit the use of harmful organotins, including TBT, in anti-fouling paints used on ships and establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. TBT has been found to be toxic to non-target, non-fouling organisms at low levels (approximately 7.5-10.5 ng TBT/L). One of its most marked effects has been the induction of shell thickening and growth anomalies in oysters and imposex in the dogwhelk *Nucella lapillus* potentially leading to sterility (Gibbs *et al.* 1998).[8] The discovery of the highly toxic nature of TBT-based paints has led many countries to ban the use of these paints for non-aluminum hulled vessels less than 25 meters in length. Copper, though an effective antifoulant, has not been shown to cause extensive effects on non-target organisms at relatively low levels. When present in high concentrations, however, copper can be toxic to aquatic life (Sorrenson 1991). In a study conducted when a cargo ship collided with part of the Great Barrier Reef and remained grounded for 12 days, sediment containing 8.0 mg kg super(-1) TBT, 72 mg kg super(-1) Cu and 92 mg kg super(-1) Zn was found to significantly inhibit larval settlement and metamorphosis (Negri *et al.* 2002). At this level of contamination, larvae survived but contracted to a spherical shape and swimming and searching behavior ceased. At higher contamination levels, 100% mortality was recorded. These results indicate that the contamination of sediment by anti-fouling paint has the potential to significantly reduce coral recruitment in the immediate vicinity of the site and that this contamination may threaten the recovery of the resident coral community unless the paint is removed.

Iron, an essential element like copper, can be contributed to the environment from steel hulls of sunken vessels. As an essential element, iron levels will tend to be closely regulated by organisms, and thus, it is unlikely that any pollution-derived effects will be observed except in severe and localized cases (Thompson 1990). Corals living in seawater with high iron concentrations have been shown to incorporate the iron into their skeletons (Brown *et al.* 1991). Studies on phytoplankton and macroalgae indicate that in areas where plant nutrients such as nitrate and phosphate are abundant the availability of iron is actually a limiting factor in growth and biomass (Coale *et al.* 1996, Frost 1996, Matsunaga *et al.* 1994, Takeda 1998, Wells *et al.* 1995). Hence the concern of unnatural iron inputs from artificial reefs seems to center not on the occurrence of adverse toxicological effects in marine organisms, but rather on the alteration of the composition of natural assemblages of algae and species which compete with algae.

Lead paint has been used on the interiors of some vessels. Lead has no biological function and, therefore, exhibits accumulation trends in organisms (Thompson 1990). Corals have been shown to incorporate lead into their skeletons (Dodge and Gilbert 1984). Unicellular algae and sea urchins appear to be the most sensitive marine organisms (Berhard 1980). Growth inhibition has been observed in the algae species *Thalassiosira pseudonana* and *Porphyridium marinum* exposed to lead as well as in sea urchins.

References

Adams, J.A. and S. Slaughter-Williams. 1988. The effects of PCBs on fertilization and morphology in *Arbacia punctulata*. Water Air Soil Pullot. 38: 299-310.

Batterman, A.L. and P.M. Cook. 1981. Determination of mineral fiber concentrations in fish tissues. Can. J. Fish. Aquat. Sci. 38: 952-959.

[8] Imposex is defined as the development of specific male sexual organs in females.

Belanger, S.E., K. Schurr, D.A. Allen, and A.F. Gohara. 1986. Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of pathological stress. Environ. Res. 39: 74-85.

Belanger, S.E., D.S. Cherry, and J. Cairns, Jr. 1990. Functional and pathological impairment of Japanese Medaka (*Oryzias latipes*) by long-term asbestos exposure. Aquat. Toxicol. 17: 133-154.

Brouwer, A., P.J.H. Reijnders, and J.H. Koeman. 1989. Polychlorinated biphenol (PCB)-contaminated fish induces vitamin A and thyroid hormone deficiency in the common seal. Aquatic Toxicology. 15: 99-106.

Brown, B.E., A.W. Tudhope, M.D.A. Le Tissier, and T.P. Scoffin. 1991. A novel mechanism for iron incorporation into coral skeletons. Coral Reefs 10: 211-215.

Clark, R.B. 1992. Marine Pollution. Clarendon Press, Oxford, 172.

Coale, K.H., S.E. Fitzwater, R.M. Gordon, K.S. Johnson, and R.T. Barber. 1996. Control of community growth and export production by upwelled iron in the equatorial Pacific Ocean. Lett. Nature 379: 621-624.

den Beston, P.J., J.M.L. Elenbaas, J.R. Maas, S.J. Dieleman, H.J. Herwig, and P.A. Voogt. 1991. Effects of cadmium and polychlorinated biphenols on steroid metabolism and cytochrome P-450 monooxygenase system in the sea star *Asterias rubens L.* AquaticToxicology. 20: 95-100.

Frost, B.W. 1996. Phytoplankton bloom on iron rations. Nature 383: 475-476.

Garcia, C.B. and H. Salzwedel. 1995. Successional patterns on fouling plates in the Bay of Santa Marta, Colombian Caribbean. An. Inst. Invest. Mar. Punta de Betin. 24: 95-121.

Gibbs, P.E., P.L. Pascoe, and G.R. Burt. 1988. Sex change in the female dog-whelck, *Nucella lapillus*, induced by tributyltin from antifouling paints. *J. Mar. Biol. Ass.* U.K. 68:715-731.

Martore, R.M., T.D. Mathews, and M. Bell. 1998. Levels of PCBs and heavy metals in biota found on ex-military ships used as artificial reefs. South Carolina Department of Natural Resources, Charleston, South Carolina.

Matsunaga, K., Y. Suzuki, K. Kuma, and I. Kudo. 1994. Diffusion of Fe(II) from an iron propagation cage and its effect on tissue iron and pigments of macroalgae on the cage. J. Appl. Phycol. 6: 397-403.

Montoya, A.J., Q.R. Quesada, Z.E. Madriz, M.E. Castro, and P.O. Urpi. 1985. Comparative analysis of substrates for collection of mangrove oyster spat in Viscaya estuary, Limon, Costa Rica. Rev. Biol. Trop. 33: 1-6.

Negri, A.P., L.D. Smith, N.S. Webster, A.J. Heyward. 2002. Understanding ship-grounding impacts on a coral reef: potential effects of anti-foulant paint contamination on coral recruitment. Mar. Pollut. Bull. Vol. 44: 111-117.

Sorrenson, E.M. 1991. *Metal poisoning in fish.* CRC Press, Inc., Boca Raton, 374 pp.

Takeda, S. 1998. Influence of iron availability on nutrient consumption ratio of diatoms in oceanic waters. Nature 393: 774-777.

Thompson, D.R. 1990. Metal levels in marine vertebrates. In R.W. Furness and P.S. Rainbow (eds.), Heavy Metals in the Marine Environment. CRC Press, Inc., Boca Raton, pp 143-183.

Wells, M.L. N.M. Price, and K.W. Bruland. 1995. Iron chemistry in seawater and its relationship to phytoplankton: a workshop report. Mar. Chem. 48: 157-182.

Woodhead, A.D., R.B. Setlow, and V. Pond. 1983. The effects of chronic exposure to asbestos fibers in the Amazon molly, *Poecelia Formosa*. Environ. International. 9:173-176.

Appendix D

Developing Workplans for Vessel Preparation Prior to Reefing

Determining the type and location of the potential sources of contamination from a vessel intended for use as an artificial reef should be conducted as part of a workplan for vessel clean up and preparation. The purpose of such a workplan is to assure that materials of concern potentially contributing to pollution of the marine environment are addressed prior to reefing. The development of a workplan also can allow for more effective clean-up efforts during vessel preparation by considering activities such as recycling and reuse operations and possibly diver safety preparations. Any such salvage operations should occur in a manner that will minimize debris and contamination with oils or other products that have to be cleaned up at a later date. This activity may allow for improved access for subsequent clean-up efforts.

Information which may be useful in the preparation of a workplan could include:

- Asbestos documentation for the vessel;
- PCB documentation for the vessel;
- Documentation that naval vessels have been previously demilitarized and certified to be radiologically decontaminated;
- Documentation that refrigerants and halons have been removed from shipboard systems;
- Information on hazardous materials onboard the vessel;
- Information on exterior hull paint which could include paint type and date of last application;
- General drawings of machinery, compartments, and tank layouts;
- Description of vessel dimensions including size, weight, and superstructure materials;
- Tank soundings describing the volume and contents of fuel oil tanks prior to preparation for reefing;
- List of items with beneficial reuse potential to be salvaged prior to sinking;
- Assessment of applicable laws and regulations, including permit requirements; and
- Reef site surveys and proposed site preparation.

An assessment of the above mentioned information could then direct the actions needed for preparation of the reef project workplan. Some general workplan preparation actions include:

- Assess vessel drawings and dimensions;
- Identify which items will remain on the vessel;
- Identify items to be salvaged prior to sinking;
- Estimate economic viability of the reef project (including permit costs and timeframes);
- Determine if the vessel is a good candidate (i.e., does the workplan fall within reasonable time and financial commitments);
- Coordinate with all regulatory agencies, local, regional, State and federal, as well as stakeholders, during all project phases;
- Apply for and receive the appropriate permits for the project;

- Remove hazardous materials and clean vessel;
- Inspect vessel to clear all findings (that the workplan for removal of materials as well as the vessel clean-up is met);
- Conduct vessel stability analysis;
- Develop strategy for vessel sinking;
- Notify NOAA to update nautical charts once the ship has settled on the ocean floor; and
- Deploy relevant aids to navigation and mooring/marker buoys at the site.

Appendix E

General Principles for a Vessel Clean-up Operation

In order to prepare a vessel intended to create an artificial reef, a workplan should be developed to direct cleaning operations – as described in Appendix D. Salvage operations should take place first, being careful to minimize debris and contamination with oils or other products that will need cleaning sometime during the vessel preparation. Other vessel clean-up preparations to be considered include:

- Re-use/recycle/dispose of all or some vessel components – besides ferrous scrap materials, there may be high-value components onboard the vessel, such as non-ferrous metals (e.g., copper, aluminum, nickel), and re-useable equipment such as generators, machines, pumps, and cranes;

- Generally, clean-up operations should begin at the highest part of the compartment or tank and proceed downwards to the bilge;

- Deal with the large concentrations of oil and hazardous products early in the operation;

- Keep compartments clean and make concerted efforts to avoid spillage during salvage and clean-up operations; and

- Consider removing, instead of cleaning, heavily contaminated machinery and piping. Removal may be quicker and less expensive. Removal may also allow for less overall effort in clean-up as access to the contaminated machinery and piping is improved and ongoing contamination from drips and seepage is minimized.

Appendix F

Recommended Checklist for Documenting Vessel Clean-up Using this Guidance[9, 10]

I. Specify particular material of concern

II. Describe narrative clean-up goal for that material of concern

III. Conduct surveys and assessments to determine current conditions/amounts of material of concern and document and describe:

- ✓ Survey design and assessment methodologies
- ✓ Who conducted survey/assessment
- ✓ When survey/assessment was conducted
- ✓ Results of survey/assessment

IV. Discuss how the narrative clean-up goal for the given material of concern was achieved (vessel preparation/clean-up initiated specifically for vessel-to-reef project)

- ✓ Who carried out the work?
- ✓ When was the work completed?
- ✓ What cleaning method was used? What preparation was done to address this material of concern? How was the narrative clean-up goal achieved?
- ✓ For some materials, the narrative clean-up goal is the removal of all of that given material (e.g., oil and fuel, solids/debris/floatables, antifreeze and coolants, fire extinguishing systems, batteries, refrigerants and halons, mercury, black and gray water, invasive species). For these materials of concern, has the removal of all the specified material been verified? How much of the material was removed and what was done with it after removal?
- ✓ For some materials of concern, the narrative goal allows for some materials to remain on the vessel if prepared properly (e.g., asbestos, paint, lead ballast bars, radioactive materials, negatively buoyant vessel debris). For these materials of

[9] This template would be used for each material of concern as presented in the BMPs (e.g., oil and fuel; asbestos; PCBs; paint; solids/debris/floatables; and batteries, antifreeze, coolants, mercury, radioactive materials and other materials of environmental concern).

[10] This checklist is not a regulatory requirement, nor is it a requirement to submit this information to any particular governmental or quasi-governmental agency, State or Federal. However, this checklist outlines the type of information that might be useful to show that the goals in this guidance document have been met.

concern, how much of the specified material was removed and how much remains on the vessel (e.g., approximately how many lead ballast bars, approximately how much surface area is still covered with paint, how many rooms/compartments still contain friable or nonfriable asbestos-containing material)?

-Was the material prepared with the intention of leaving it on board?

-Is the material encapsulated (friable asbestos) or covered with growth (active anti-fouling paint)? Enclosed in a room (negatively buoyant vessel debris)?

- ✓ How has the completed work been verified?

V. Identify who prepared this document

- ✓ Name(s) and title(s)
- ✓ Contact information

Appendix G

Suggested Cleaning Methods for Oils, Fuels and Semi-solids (Greases)

Tanks

Methods for cleaning tanks include but are not limited to:

- Mechanical Cleaning: Mechanical cleaning involves mechanical removal of sludge and remaining fluids and wiping down all surfaces with oil absorbent material. Although manpower intensive, this cleaning method limits the spread of contamination and does not require large volumes of fluids that are expensive to dispose.

- Steam or Hot Water Cleaning: This method is quite effective, although it requires special equipment and generates large volumes of oily water. If this method is considered, a plan should be developed so that oily water generated during this cleaning method is dealt with in accordance with all applicable regulations. Surfactants or soaps are not recommended, as they tend to emulsify any oil present and make the oily water exceptionally difficult to treat. This would likely create higher disposal costs. In tanks where deckheads and sides are reasonably free of contamination, pressure washing can cause significant contamination of these otherwise clean surfaces through splashing, misting, and carry-over.

- Solvent Washing: Solvent washing may be an option where there are especially difficult residuals or deposits that need removal. Note that the use of solvents will require special handling and disposal of all liquid product generated as wastes.

In rare cases, especially where low-grade fuels have been stored, it may be necessary to resort to advanced tank cleaning methods such as ultrasonic or special solvents. It may also be advantageous to use a combination of several different methods, depending on the nature and location of the contamination. In general, mechanical cleaning would be the first method to try, followed by steam/hot water washing, then solvent washing in extremely difficult situations. Whatever method is selected, the effluent and water should be collected and treated. Large volumes will require the services of a pumper truck or barge, while smaller quantities should be collected and stored in drums and removed from the vessel. Caution should be used during all transfer operations to avoid spills. If transferring large quantities of oil or oil contaminated liquid, a boom around the vessel should be used to minimize the extent or spreading of a release.

Fuel and Oil Pipe Fittings, Piping with Manifolds, and Filling Points

Filling points: All filling stations or deck fittings that were used for receiving fuels or oils should be opened and cleaned. Access to the filling stations and deck fittings is necessary to ensure that they are completely drained and free of such fuels or oils. This will typically require access from the bottom and the top.

Fuel and Oil Piping Including Manifolds: Fuel and oil piping (including non-segregated ballast systems) should be drained of all fuel and oil. The cleaning and opening of pipes varies according to the type of fuel or oil that was contained in the lines. In general, the more viscous the fuel or oil, the more opening of pipes and cleaning activity will be required. For very viscous products (e.g., No. 6 fuel oil or Bunker C fuel as described in the "Oil and Fuel" section of this document), all piping and fittings should be fully opened for visual inspection.

Vertical piping runs should have all valves completely opened and any blanking flanges or spectacle plates removed for cleaning. Horizontal piping runs should be opened at low spots. Once draining of piping systems is completed, no visual evidence of weeping should exist at openings.

Fuel and Oil Piping Fittings: Fittings consist of valves, site glasses, coolers, siphon breakers, and filters. A visual examination of internals, or a cut through the lowest point of the fitting may be useful. Where fittings are of complex construction or have more than one oil-tight compartment (as in coolers), then access to all sub-compartments or components may be necessary. No visual evidence of weeping should exist at openings.

Unless the piping is clearly identified as being part of a non-hydrocarbon system or there is clear evidence to indicate that the system was not part of a hydrocarbon containing system (e.g., seawater piping to coolers, fresh water piping to domestic spaces), it should be assumed that the piping contained fuel or oil. Fittings should be cleaned, or removed from the vessel.

Bilge Compartments and Piping

All piping that runs through the bilge areas of machinery spaces should be assumed to be contaminated by fuel, oil, or greases until proven otherwise. Piping in bilge spaces should follow the clean-up suggestions as presented in the subsection above entitled "Fuel and Oil Piping Including Manifolds."

Combustion Engines

Structure: Remove access panels, explosion doors, handhold doors, maintenance panels, gear covers, bearing covers/retaining plates, as necessary to remove oil. Visible oil should be removed from all internal components. The surrounding and support structure should be made accessible for inspection, especially the area under the engine. At least one main bearing should be opened to determine if the design allows oil to be trapped, thereby indicating whether all bearings should be opened and cleaned.

Fuel System: All fuel system components should be cleaned or removed from the engine. These include injectors, carburetors, supply,

distribution and return lines, filters, pumps, relief valves, pressure regulating mechanisms, governors, and heat exchangers. Removal of these items will prevent fuel seepage from their connections. If these items are to be sunk with the vessel, they should be opened, cleaned, and prepared for inspection.

Lubricating Oil System: Lubricating oil sumps should be drained and opened for cleaning and visual inspection. This may require that additional access openings be made. All lubricating oil piping, both internal and external to the engine, should either be removed or drained. Lubricating oil system components should either be cleaned or removed from the vessel. Internal oil gallery plugs should be removed. Pedestal and thrust bearings should be drained. Engine driven oil pumps should be pulled or cleaned. Engine oil filling and dirty oil drainage arrangements should be removed or cleaned.

Other Systems: Other components and systems susceptible to contamination with fuels, oils, or greases (e.g., superchargers, turbochargers, air filters) should be examined visually and cleaned if they are present.

REFERENCES

Delaware Department of Natural Resources and Environmental Control's (DNREC) Program Summary and Endorsement of NYC Transit's Plan to Use Subway Cars as Artificial Reef Material. 2001.

Environment Canada. 1998. Cleanup Guidelines for Ocean Disposal of Ocean Vessels. Artificial Reef Society of British Columbia website. [http://www.artificialreef.bc.ca/ARresources/cleanup_guidelines.html]

Environment Canada. 1998. Cleanup Standards for Ocean Disposal of Vessels. Artificial Reef Society of British Columbia website. [http://www.artificialreef.bc.ca/ARresources/cleanup_standards.html]

Lukens, Ronald R. 1997. Guidelines for Marine Artificial Reef Materials. Final report of the Artificial Reef Subcommittee of the Technical coordinating committee Gulf States Marine Fisheries Commission. [http://www.gsmfc.org/pubs/SFRP/Guidelines_for_Marine_Artificial_Reef_Materials_January_1997.pdf]

London Convention. Revised 2003. Waste-Specific Guidelines for Vessels Proposed for Disposal at Sea (Waste Assessment Guidelines for Vessels). [http://www.londonconvention.org/documents/guidelines/4%20-%20Vessels.pdf]

OSPAR Commission. 1999. OSPAR Guidelines on Artificial Reefs in relation to Living Marine Resources. OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic. (Reference Number: 1999-13). ANNEX 6 (Ref. Section 3.24).

San Diego Oceans Foundation, Marine Technology Society, and the Artificial Reef Society of British Columbia. 2000. *Proceedings from* Artificial Reef Conference: Converting Unused Ships and Structures to Enhance Ocean Environments. San Diego, California.

Telephone conversation with Captain Spencer Slate, ex-USS Spiegel Grove vessel-to-reef project co-manager. April 17, 2006.

U.S. Department of Commerce. 1985. National Artificial Reef Plan. NOAA Technical Memorandum NMFS OF-6. National Marine Fisheries Service. Washington, D.C.

U.S. Department of Commerce. 2002. Draft National Artificial Reef Plan (February 2002). NOAA, National Marine Fisheries Service. Silver Spring, Maryland.

U.S. EPA. 2000. A Guide for Ship Scrappers: Tips for Regulatory Compliance. EPA/315-B-00-001. Environmental Protection Agency. Washington, D.C.

U.S. Navy. Material Management for Radioactive Items in the DoD. DLA INST 4145.8.

U.S. Environmental Protection Agency

U.S. Maritime Administration

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