FRASER RIVER ACTION PLAN

Best Management Practices (BMPs) for Ship and Boat Building and Repair Industry in British Columbia

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Background Document

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Best Management Practices (BMPs) for the Ship and Boat Building and Repair Industry in British Columbia

Background Document

to

Environment Canada

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by

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PROJECT TEAM

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RELATED DOCUMENTS

The following documents are related to the best management practices for the ship and boat building and repair industry in British Columbia:

- ***Best Management Practices (BMPs) for Ship and Boat Building and Repair Industry in British Columbia***
- ***Best Management Practices (BMPs) for Marinas and Small Boatyards in British Columbia***
- ***Best Management Practices (BMPs) for Ship and Boat Building and Repair Industry in British Columbia ------- Background Document***
- ***Best Management Practices (BMPs) for Boat Building and Repair (pamphlet).***

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1.0 INTRODUCTION

1.1 Objective and Scope of Background Document

This technical report (the ***Background Document***) is the companion to the ***Best Management Practices (BMPs) for the Ship and Boat Building and Repair Industry in British Columbia*** (the ***BMPs)***. This ***Background Document*** summarizes the state of knowledge surrounding the impact of different contaminants on the receiving environment (Section 2.0), the relevant legislation governing the handling, control and disposal of contaminants generated during shipbuilding and repair activities (Section 3.0), and environmental practices in other Canadian and American jurisdictions (Section 4.0). The ***BMPs*** report sets out industrial techniques and good housekeeping principles for reducing the volume of contaminants from shipyards and boatyards in British Columbia.

This ***Background Document*** report and the associated ***BMPs*** reports are developed by updating and expanding on the ***Draft Recommended Environmental Management Practices For The Ship And Boat Building And Repair Industry (REMP)*** prepared by Environment Canada in 1989 and a study of existing practices at shipbuilding facilities in B.C. (Peter Hatfield, 1993). As well, this current study has afforded the opportunity to take a closer look at practices which have evolved in Washington and other western coastal states. The intent in looking at other jurisdictions has been to learn as much as possible from their experiences and to extract useful guidelines and practices which have already proven workable in boatyards and shipyards in the Pacific Northwest.

The legislation and environmental practices reviewed in this report, as well as the ***BMPs*** report, are intended to apply to all sizes of ship or boat building and repair facilities working on commercial or recreational vessels (including marinas with lifts, marine ways and/or tidal grids), and to government facilities involved in maintaining their own vessels (e.g., Fisheries and Oceans Canada, Department of National Defence, Royal Canadian Mountain Police, B.C. Ferries). These reports are applicable to any facility in British Columbia, whether in a freshwater or saltwater environment. Subsequent to the initial development of the above listed documents, the steering committee of the current study identified that a **simplified** version of the ***BMPs*** should also be developed for the smaller boatyards and marinas because these smaller facilities do not provide all of the servicing activities normally available at the larger operations. Based on the committee's intent, two additional documents have been developed for the smaller facilities and they are:

- ***Best Management Practices (BMPs) for Marinas and Small Boatyards in British Columbia***
- ***Best Management Practices (BMPs) for Boat Building and Repair (pamphlet)***

The shipbuilding and repair industry in B.C. has been in a state of recession for some time and faces stiff competition from other Pacific Rim yards. It was recognized at the outset of this study that these economic realities will be a constraining factor controlling the rate and extent to which new practices can be put into place. In spite of these problems, there is an opportunity to affect significant improvements in local aquatic and air pollution by applying relatively simple, and in most cases common sense modifications to the existing routine operating activities.

1.2 Related Studies and Documents

A number of other initiatives are in progress that are directly or indirectly linked to the BMPs program for the ship and boat building and repair industry.

- BMPs Compliance Checklist, Environment Canada

  A compliance checklist has being developed to help Environment Canada inspectors survey implementation of the Best Management Practices at ship and boat building and repair facilities.

- Small Boatyard and Marina Guidelines.

- Abrasive Grit Testing Protocol, Environment Canada

  Various existing testing methodologies were reviewed and a series of protocol has been recommended for the testing of abrasive blasting materials. The protocol could be used to determine the concentrations of contaminants (e.g. metals and PAHs) in abrasive blasting materials (both virgin and spent) which can affect the selection of acceptable disposal options. The protocol report also provides some technical information on some of the potential environmental impacts from the abrasive blasting materials. A list of commercial testing laboratories capable of carrying out the tests has been compiled and attached.

- Marina Development Guidelines, Fisheries and Oceans Canada and B.C. Ministry of Environment, Lands and Parks

  The marina guidelines are intended to assist developers in understanding the scope of their responsibilities when undertaking a marina development. Information is provided on the measures required to obtain the necessary approvals (under the Fisheries Act, B.C. Water Act, B.C. Waste Management Act and other relevant legislation) for marina construction. Strategies for selecting, developing and operating a marina site are outlined. Applicable best management practices have been incorporated into the guidelines for design and operation of marina upland facilities.

- Tributyltin (TBT) Documents

  In 1995, Environment Canada updated the brochure entitled ***Don't Foul Things Up! - Guidelines for Users of Antifouling Paints on Pleasurecraft or Smaller Vessels (less than 25m in length***). A draft chemicals in the environment fact sheet entitled ***Organotin Compounds in the Aquatic Environment - Hazards and Control*** and a draft TBT profile report have been prepared by Environment Canada. These two draft documents are currently being reviewed and finalized. Environment Canada is also preparing an overview report on TBT which will include a discussion on all the environmental data collected in British Columbia in the past 10 years.

1.3 Profile of the B.C. Shipbuilding and Repair Industry

Approximately 60 companies are active in the commercial ship and boat building and repair industry in British Columbia. Many of these are very small operations, and in some cases, set up for only a single project. Others devote themselves primarily to the pleasure boat market. The Westcoast Mariner (1994) published a directory of lifts, ways and drydocks for commercial vessels: the listing shows that there are about 11 B.C. companies active in ship building and repair, and 41 companies in boat building and repair (based on a definition of "shipyards" having a single lift capable of at least 200 tons). This directory is not an exhaustive list of all facilities and probably many more small firms and sole proprietorships are involved in commercial repair work. An additional source of information on the larger facilities is provided by Hatfield (1993).

Most of the facilities are located in the marine environment with the exception of those along the Fraser River (downstream of Mission). Some of the smaller facilities, located away from the water, build small vessels which can easily be transported by road to a launching site.

There are also at least six government owned and operated ship repair facilities in B.C. Examples include the Deas Dock Refit Complex (BC Ferry Corporation); Esquimalt Graving Dock; Ship Repair Unit Pacific (Canadian Navy's Esquimalt Base); Canadian Coast Guard Victoria Base; and Fisheries and Oceans facilities in Patricia Bay and Prince Rupert. BMPs will apply equally to these government facilities as well as to commercial yards.

Table 1-1 shows the general profile of shipyards and boatyards in B.C. which target commercial vessels (including government facilities) and the types of haul-out services offered (such as ways, lifts and drydocks). This table does not show the absolute number of lifts, ways and drydocks at each yard, but rather whether or not they have a type of service (many facilities have multiple types of lifting gear). The table does not include the many small craft harbours managed by Transport Canada and Fisheries and Oceans Canada.

Table 1-1 Facilities Available for Commercial Vessels at Shipyards and Boatyards in B.C.

Type of Facility	Shipyards (N=11)	Boatyards (N=41)	Gov't. Facilities (N=9)
Graving Dock	0	0	1
Drydock	5	2	1
Travel Lift	1	16	2

Railway	8	18	0
Crane	1	3	1
Lifts	1	8	0
Syncrolift	1	2	0
Dockside Repairs	most	N/A	8+

Source: The Westcoast Mariner, 1994*.

where:
- shipyards are facilities with a haulout capacity of greater than 200 tonnes
- boatyards are facilities dealing primarily with commercial vessels with a haulout capacity of less than 200 tonnes
- N = number of yards

* Not intended to be an exhaustive list.

General Description of the Shipyard Industry in British Columbia
(extracted from Shipbuilding Action Group, 1990)

In evaluating the present status of the B.C. shipbuilding industry, it is important to clearly differentiate between "shipbuilding" and "ship repair". The ratio of new construction to repair work in a shipyard is an estimate based on the assessment of the yard's normal business. This ratio can change significantly at any particular time, as it is dependent on the available work.

Shipyard business can be broken down into four different project types:

- shipbuilding
- ship conversions
- ship refits
- ship repairs

Shipbuilding involves the construction of a new vessel, including the hull and all of the associated structure, machinery, systems and outfit.

Ship conversions are defined as modifications to an existing vessel which may include changes in either the dimension or purpose of the ship. An example of this would be the B.C. Ferry Corporation fleet conversions, which have involved lengthening and heightening existing vessels to increase capacity. Such conversions can involve more work than many new constructions.

Ship refits are more straightforward than shipbuilding or conversions, but can still involve considerable work and management planning, including re-engineering and extensive electrical, electronic and accommodation upgrading.

Ship repairs involve dry-docking, painting, and the replacement of corroded or worn-out parts and materials such as piping and steel plating. Ship repair is a very important component of the B.C. industry, as a large number of yards and private contractors specialize in this aspect of the business. Because all vessels need to be dry-docked and painted at regular intervals, ship repair has tended to be less cyclical than shipbuilding.

Numerous changes have occurred in the industry during the past decade. In 1990, the principal private sector shipyards employed about 1500 people (compared to over 4,000 in the past); this number has continued to decline (witness the recent closure of Yarrows in Victoria).

There is very little actual shipbuilding work left today in British Columbia. Of the current work force, about 1000 people are engaged directly in ship repairs, leaving less than 500 involved directly with new construction.

Some personnel who have lost their employment with the closure of shipyards have chosen to set up their own businesses, building or repairing small towboats and fish boats. Most of these operators have no permanent operations and carry out their business on an "as-required" basis, with no fixed address.

1.4 Profile of the B.C. Pleasure Boat Maintenance and Repair Industry

Previously prepared profile of boatyards, marinas and other facilities catering to maintenance and repair of pleasure boats in B.C. is not available, but some idea of the economic value of the pleasure boating industry to the Province can be derived by a report prepared by Price Waterhouse; a brief synopsis of that report and other sources was summarized by McKenzie (1994) and is used to provide some relevant statistics. It is estimated that 100,000 outboard power boats and sailboats exist in British Columbia. Marinas on the B.C. coast contain a total of 30,000 private berths (165 facilities with an average of 179 berths per marina) and generate $100 million in revenues (paying out over $20 million in salaries to 1,250 employees (ARA, 1991)). In addition to marinas, over two hundred small craft harbours are present in B.C., most of which offer some services for repair (e.g., crane for hauling boats, tide grid) and numerous boatyards catering primarily to recreational boaters .

Although many of the smaller yards focus on the recreational market, they can also service commercial clients. Many marinas having travelifts or elevators, in addition to their pleasure boat services, also perform work on fishing vessels and the growing fleet of private charter vessels (not strictly classed by Transport Canada as commercial vessels but considered "equivalent to commercial" in terms of BMPs). Pleasure boat repair work is characterized by a large proportion of owner-supplied labour which will make the consistent implementation of BMPs a special challenge. Numerous outside contractors are often called in to work on boats in marina work yards (e.g., gelcoat specialists, riggers, engine mechanics, and small companies specializing in general maintenance including the application of antifouling coatings).

2.0 CONTAMINANTS AND EFFECTS

Common industrial activities and operations at ship and boat building and repair facilities include the following:

- sanding
- abrasive blasting
- welding
- refinishing
- painting
- vessel, equipment, and part cleaning

- mechanical repairs
- fueling and fluid change
- dockside repair services
- storage of materials and wastes such as oil, fuel, batteries, hydraulic components and oil filters

All of these activities can impact the receiving environments by directly discharging process wastewater or contaminated surface runoff to the receiving water-bodies, or through entrainment or dispersion of air-borne particulate into the local air-shed.

Table 2-1 summarizes the various pollutants associated with the ship and boat building and repair industry.

Some environmental sampling has been conducted by various regulatory agencies in coastal areas, especially in those regions where ship and boat building and repair activities have been or are currently being performed. Results from these environmental samples indicate the presence of elevated concentrations of metals (such as copper, lead, organotins) and other contaminants (polyaromatic hydrocarbons, polychlorinated biphenyls, and furan/dioxin) in the aquatic sediments in the vicinity of these activities. With the exception of organotins, which are antifouling agents used in the marine industry, it is difficult to delineate the actual extent of sediment contamination in the local environment which can be directly attributed to the ship and boat building and repair industrial sector; there are many other waterfront industrial and/or municipal activities which might have released and contributed some of the contaminants found in the receiving environments. However, some of the potential environmental impacts to B.C. waters from this industry can be extrapolated from general information collected by the U.S. Environmental Protection Agency (EPA) in other coastal regions.

Table 2-1 Summary of the Pollutants Associated with the Shipbuilding and Repair Industry

Activity	Pollutant Source	Pollutant
Pressure Washing	• washwater	• paint solid • detergents • heavy metals • suspended solids
Surface Preparation, Paint Removal, Sanding	• sanding • mechanical grinding • abrasive blasting; paint stripping	• spent abrasive • paint solids • heavy metals • solvents • dust
Painting	• paint and paint thinner spills • spray painting; paint stripping • sanding • paint clean-up	• paint solids • spent solvents • heavy metals • dust
Engine Maintenance and Repair	• parts cleaning • waste disposal of greasy rags, used fluids, and batteries • use of cleaners and degreasers • fluid spills • fluid replacement	• spent solvents • oil • heavy metals • ethylene glycol • acid/alkaline wastes • detergents
Material Handling and Transfer	• fueling: spills, leaks • hosing area	• fuel oil • heavy metals
Storage	• liquid storage in above ground storage: spills and overfills • external corrosion • failure of piping system	• fuel oils • heavy metals • materials being stored
Disposal	• waste material storage and disposal: paint solids • solvents • trash • spent abrasives • petroleum products	• suspended solids • heavy metals • spent solvents • oil
Shipboard Process (improper discharge to storm sewer or into receiving water)	• process and cooling water • sanitary waste • bilge and ballast water	• wastes that have biochemical oxygen demand • bacteria • suspended solids • oil • fuel

Source: U.S .Federal Register, 1993

The eight parameters listed below are widely recognized as having significant impacts to the receiving environment near shipyards. The first seven parameters are based on the results from an effluent guideline study (U.S. EPA, 1977) and the 1992 industrial stormwater data base (U.S. Federal Register, 1993).

- copper
- lead
- total suspended solids (TSS)
- oil and grease

- zinc
- chromium
- acidity and alkalinity (pH)
- organotin

In addition to these pollutants, other parameters are identified by the EPA that have less significance because: (1) they are unlikely to be created from ship and boat building and repair activities in North America; (2) they have already been banned through legislation for use in these activities; or (3) the contaminants are only found in trace amounts or at levels below immediate concern.

The following section provides a summary of the generic potential environmental impacts from the above list of contaminants. The summary, excluding organotins, has been compiled from the ***Development Document for Proposed Effluent Limitations Guidelines and Standards for the Shipbuilding and Repair Point Source Category*** (U.S. EPA, 1979). The primary focus of these extracts is to provide a short summary of some of the potential impacts of the listed pollutants to the aquatic environment. Detailed and specific toxicity of the listed pollutants can be found in many other references.

Copper - In the ship and boat building and repair industry, copper is primarily used in conjunction with other minerals in antifouling paints and other biocides. Processed copper slag is also used in abrasive blasting grit.

The toxicity of copper to aquatic organisms varies significantly, not only with species, but also with the physical and chemical characteristics of the water, including temperature, hardness, turbidity, and carbon dioxide content. For example, in the marine environment concentrations of copper are detrimental to some oysters above 0.1 ppm. Oysters cultured in sea water containing 0.13 to 0.5 ppm of copper deposited the metal in their bodies and became unfit as a food substance.

Lead - In the ship and boat building and repair industry, lead is primarily used with other minerals as paint pigment, insecticide and fungicide.

Fish and other aquatic life have had adverse effects from lead and lead compounds in their environment. Experiments have shown that small concentrations of heavy metals, especially of lead, can cause a film of coagulated mucous to form first over the gills and then over the entire body probably causing suffocation of the fish. The toxicity of lead is increased with a reduction of the dissolved oxygen concentration in water.

Zinc - In the ship and boat building and repair industry, zinc compounds are used in paint pigments, dyes, and insecticides. Many of these compounds are highly soluble in water, but some zinc salts, such as zinc carbonate, zinc oxide and zinc sulfide, are insoluble in water. Because of this special characteristic, it is expected that some zinc will precipitate and be removed readily in many natural waters. Significant levels of zinc (>1500 ppm) can also be found in some abrasive blasting grits.

Zinc is thought to exert its toxic action by forming insoluble compounds with the mucous that covers the gills, by damaging the gill epithelium, and possibly acting as an internal poison. The sensitivity of fish to zinc varies with species, age, and condition, as well as the physical and chemical characteristics of the water. Some acclimatization to the presence of zinc is possible. It has also been observed that the effect of zinc poisoning may not become apparent immediately, so that fish removed from zinc-contaminated to zinc-free water may die as much as 48 hours after the removal.

A complex relationship exists between zinc concentrations, dissolved oxygen, pH, temperature, and calcium and magnesium concentrations. Prediction of harmful effects has been less than reliable and controlled studies have not been extensively documented.

Observed values for the distribution of zinc in ocean water vary widely. The major concern with zinc compounds in marine waters is not one of acute lethal effects, but rather one of long term sub-lethal effects of the metallic compounds and complexes. From the point of view of acute lethal effects, invertebrate marine animals seem to be the most sensitive organism tested.

Chromium - Besides being utilized in paint manufacture as paint pigments, chromium is also used in the electroplating industry as an ornamental and corrosion resistant plating for steel and as a pickling acid in steel manufacturing.

The toxicity of chromium salts to fish and other aquatic life varies widely with species, water temperature, pH, valence of the chromium, and synergistic or antagonistic effects, especially that of hard water. Studies have shown that trivalent chromium is more toxic to fish of some types than hexavalent chromium. Other studies have shown opposite effects. Chromium is bioaccumulated by aquatic organisms. Fish food organisms and other lower forms of aquatic life are extremely sensitive to chromium. Chromium also inhibits the growth of algae. Therefore, both hexavalent and trivalent chromium must be considered harmful to particular fish or organisms.

Total Suspended Solids (TSS) - Suspended solids include both organic and inorganic materials. Inorganic compounds include sand, silt, and clay. The organic fraction includes such materials as grease, oil, tar, and animal and vegetable waste products. These solids may settle out rapidly and the bottom deposits are often a mixture of both organic and inorganic solids. Solids may also be suspended in water for a long period of time and then settle to the bottom. While in suspension, the solids increase the turbidity of the water, reduce light penetration, and impair the photosynthetic activity of aquatic plants.

Solids in suspension are aesthetically displeasing. When they settle and form bottom deposits, the sediments may result in the destruction of fish habitat. Disregarding any toxic effect attributable to substances leached out by water, suspended solids may kill fish and shellfish by causing abrasive injuries and by clogging gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids are harmful to aquatic life because they screen out light, and they promote and maintain the development of noxious conditions through oxygen depletion. This results in the killing of fish and fish food organisms. Suspended solids also reduce the recreational value of the water.

Oil and Grease - Because of their widespread use, oil and grease often occur in wastewater streams. These oily wastes may be classified as light hydrocarbons, heavy hydrocarbons, or lubricants and cutting fluids. These compounds settle or float in water, and may exist as solids or liquids depending upon factors such as methods of use, production process and the temperature of the wastewater.

Fish and waterfowl are adversely affected by oils in their habitat. Oil emulsions may adhere to fish gills causing suffocation. Deposition of oil in bottom sediments can serve to inhibit normal benthic growth. Oil and grease also exhibit an oxygen demand in the aquatic environment.

Levels of oil and grease which are toxic to aquatic organisms vary greatly, depending on the type of oil and species' susceptibility. Exposure to oil and grease can also increase the toxicity of other substances being discharged into the receiving bodies of water. The light hydrocarbons, such as solvents, are known to be toxic to aquatic organisms.

The presence of oil slicks prevent the full aesthetic enjoyment of water. Oil and grease in quantities of 100 L/sq. km (10 gallons/sq. mile) show up as a sheen on the surface of a body of water.

Acidity and Alkalinity (pH) - Although not a property of a specific pollutant, pH is related to the acidity or alkalinity of a wastewater stream. Some of the chemicals used during shipbuilding and repair activities, such as the electrolyte for the lead batteries and tri-sodium phosphate for cleaning decks or walls, can cause some pH change in the vicinity of the releases. An extreme pH or rapid pH changes can exert stress conditions or kill aquatic life outright. Even moderate changes from "acceptable" criteria limits of pH are deleterious to some species. In the marine environment, extreme pH changes are not expected because of the buffering and dilution capacity of the sea (buffering and dilution varies depending on circulation and salinity).

Organotins - Tributyltin (TBT) and related organic tin compounds were widely used as a marine biocide in antifouling paints from the mid-1960s until the past decade. Their use is now restricted in Canada, the U.S., and internationally, although generally organotin-based paints can still be legally applied on vessels greater than 25 m in length. As required by the federal Pest Control Products Act (see Section 3.3), antifouling paints containing organotins must be registered as pesticides with Agriculture Canada. Removal and application of TBT-based paints on slipways, TBT-based paint chips in fugitive spent abrasive grit, and runoff from work yards results in contamination of the marine environment.

Oysters and other bivalves are particularly sensitive to TBTs. TBT concentrations as low as 10-200 parts per trillion can cause shell thickening and malformation in oysters and reduced bivalve growth and imposex in mud snails. Acute effects have been documented for fish, copepods, oyster larvae and mysids at concentrations of 0.4-4 parts per million (Huggett et al., 1992). National guidelines for tributyltin levels have been set at 0.08 µg/L in fresh water and 0.001 µg/L in marine water (CCME, 1992b).

Sediment samples from Vancouver Harbour have been found to contain tributyltin in dry weight up to 25,900 µg/kg (approx. 26 ppm) (Moore et al., 1992). These levels and those of Esquimalt Harbour were at least an order of magnitude higher than the levels of San Diego Bay, which is considered to be one of the most contaminated sites in the world.

Additional information on organotins can be found in the draft fact sheet entitled ***Organotin Compounds in the Aquatic Environment - Hazards and Controls***, which is available from Environment Canada.

3.0 SUMMARY OF RELEVANT LEGISLATION

This section reviews the relevant Federal and Provincial legislation and municipal bylaws applicable to ship and boat building and repair activities. It focuses on those activities that are unique to the industry and on legislation or bylaws that have an environmental objective.

Regulatory requirements surrounding contaminated sites are not discussed apart from mentioning the potential implications of recent B.C. legislation. Several sections of the Industrial Health & Safety Regulations, and Workers' Compensation Act are covered, as they relate to abrasive blasting.

Each Act is briefly introduced and related where possible to activities associated with shipbuilding and repair. The purpose of this chapter is to provide a brief legislative primer (not to be considered as any form of legal interpretation). Contact numbers for the different government departments and agencies administering the legislation and bylaws are provided in Appendix A. It should be noted that provinces and municipalities have no jurisdiction over federal lands (such as those administered by the Port of Vancouver), but generally the federal government encourages their facilities to follow the most stringent regulations (be they federal, provincial or municipal).

3.1 Canadian Environmental Protection Act (CEPA) - Environment Canada

Two CEPA regulations can apply to the ship and boat building and repair industry: the Ocean Dumping Regulations and the National Pollutant Release Inventory.

Ocean Dumping Regulations

The Ocean Dumping Regulations sets out a process by which applications can be made and permits granted for the ocean disposal of dredging spoils, excavation material and non-hazardous inert materials or uncontaminated materials of natural origin. Permits set out conditions that control disposal operations and mitigate environmental effects. Unless a permit has been granted, CEPA prohibits dumping of materials into the sea from any vessel or anthropogenic structure if the dumping is outside of the normal operations of a vessel. Part VI of CEPA and the Ocean Dumping Regulations provide the conditions for the application and granting of permits. Materials which are prohibited under Schedule III of CEPA from disposal by ocean dumping include organohalogen compounds, cadmium and cadmium compounds, mercury and mercury compound, persistent plastics and other persistent synthetic materials, and crude oil and petroleum products.

In order to receive a permit the applicant must demonstrate the acceptability of the material to Environment Canada and the Regional Ocean Dumping Advisory Committee (RODAC). This may require taking samples of the sediments to be dredged and having them analyzed if no previous sampling and chemical analyses have been done within the previous four years. The minimum requirements for sampling programs and testing of materials for prohibited and restricted substances are summarized in the 1993 *Interim Contaminant Testing Guidelines for Ocean Disposal*. Depending on the nature of the material and history of the site, Environment Canada may require further sampling beyond the minimum requirements. Table 3-1 lists the limits of various contaminants which will trigger the requirement for bioassay testing (this table is a general guideline only and RODAC may impose more stringent limits). Materials which approach or exceed the ocean disposal limits may still be approved, if bioassays and other tests can demonstrate that the material is "rapidly rendered harmless" when placed in the sea. On the other hand, materials which are within the limits of Table 3-1 can be rejected if other factors (listed in CEPA, Schedule III) are not met.

The Ocean Dumping Regulations have considerable impact on yards which must dredge to maintain an effective working draft and are considering ocean dumping of the dredging spoils. Currently, Environment Canada requires a minimum of 120 days to process an ocean dumping application. Environment Canada should be contacted directly by any facility which is considering an application under the Ocean Dumping Regulations.

Table 3-1 Ocean Dumping Guideline Limits (dry weight)
(from Table 3, *Interim Contaminant Testing Guidelines for Ocean Disposal*)

Parameter	Concentration Limits
Cadmium	0.6 µg/g
Mercury	0.75 µg/g
Arsenic	1000 µg/g
Copper	1000 µg/g
Zinc	1000 µg/g
Beryllium	1000 µg/g
Chromium	1000 µg/g
Nickel	1000 µg/g
Vanadium	1000 µg/g
Lead	500 µg/g
PCPs	1.0 µg/g
PCBs	0.1 µg/g
Total PAH [1]	2.5 µg/g
Dioxin/Furan	'quantifiable' 2,3,7,8 TCDD

Note: The values contained in Table 3-1 are in review and it is expected that revised criteria will be established in the near future.

[1] Limits are currently being drafted for specific PAH compounds.

The National Pollutant Release Inventory

The National Pollutant Release Inventory requires facilities to report releases of "listed" substances manufactured, processed or used annually. 178 substances are listed by Environment Canada, and they include heavy metals, aromatic hydrocarbons, alcohols, and ketones. Facilities exempt from the reporting requirements include those engaged in the maintenance and repair of ships (new construction is not exempt), facilities with less than 10 full-time employees, and facilities which use less than 10 tonnes of a listed substance or use the substance in concentrations of less than 1% by weight (these criteria will likely exempt all but the very largest shipyards). Facilities were required to file their first report for 1993 in June, 1994. Reporting requirements and listed substances are likely to be amended in the future.

Shipyards with more than 10 employees must report the release of "listed" substance if they use more than 10 tonnes of a substance annually for new construction. For example, substances found in paint must be reported if they exceed 1% concentration and their use totals more than 10 tonnes annually. These substances include xylene, n-butanol, isopropanol, methyl isobutyl ketone, antimony, lead, copper, and zinc.

3.2 Fisheries Act - Fisheries and Oceans Canada

The relevant sections of the Fisheries Act are Sections 20-22, 26, 27 and 29 (Habitat: Obstructions to Fish-ways and Canals), Sections 28 and 32 (Habitat: Destruction of Fish), Section 30 (Habitat: Fish Guards and Screens), and Sections 34-37 (Fish Habitat Protection and Pollution Prevention). In general terms, these sections prohibit harmful alteration, disruption, or destruction of fish habitat and throwing overboard or depositing of a substance deleterious to fish. The definition of "deposit" of any substance which is deleterious to fish or habitat is broad-based and covers any discharging, spraying, releasing, spilling, leaking, seeping, pouring, emitting, emptying, throwing, dumping or placing.

Concerns about the introduction of spent abrasive blasting material included fouling of fish gills with suspended abrasives, leaching of heavy metals from the abrasives, and potential smothering of fish habitat. The Act has no accompanying regulations specific to the ship and boat repair industry. Spent abrasive blasting material could be considered as a deleterious substance under the Act.

Pressure washing to remove marine growth, also removes paint to a certain degree, depending on the pressure of the jet and the condition of the old paint. Studies in Washington State have shown that washwater from low pressure washing (10,000 kPa-35,000 kPa or 1,500 psi-5,000 psi) contains significant amounts of paint and heavy metals (Municipality of Metropolitan Seattle - METRO, 1992). It is a contravention of the Canadian Fisheries Act to discharge deleterious washwater to fish-bearing water or to waterways which lead to the fish-bearing water. If the washwater has been treated to remove paint sludge and other contaminants to an acceptable level, it may be possible to discharge the treated water directly to the receiving waters.

3.3 Pest Control Products Act - Agriculture Canada

The Act requires that antifouling paints containing biocides (i.e. copper, tributyltin, zinc) be registered with Agriculture Canada as per Section 4.0 of the Pest Control Products Act (Agriculture Canada, 1994). Paints that use physical barriers to prevent growth, such as Teflon or silicon, are exempted.

The labeling requirements for both tin and copper-based antifouling coatings have been upgraded in the past five years to contribute to the safe and proper use of these paints. Registrations pursuant to the PCP Act require labels to reflect the current knowledge regarding the individual ingredients contained in the formulation.

Manufacturers wishing to obtain registration for copper-based antifouling coatings will be required to provide relevant studies on the environmental chemistry, fate and environmental toxicology of the copper-based products, and data on the release/leaching CU^{+2} rate, which should not exceed 40 µg/cm^2/day.

The registration guidelines for organotin (tin-based) coatings were established in 1989 and they state that the maximum daily release rate must not exceed 4 µg/cm^2/day and that organotin products are prohibited from use on vessels that are less than 25 metres, unless the vessels are aluminum. Furthermore, TBTF formulations (TBT with fluoride) can be used **only** on aluminum vessels and are completely prohibited from use in freshwater.

Combination tin/copper/organotin products must meet both release and leaching rates for copper (40 µg/cm^2/day) and organotin (4 µg/cm^2/day).

All antifouling coatings that meet the maximum daily release rate criteria will be accepted for registration provided they contain a registered technical active ingredient, that the test data indicates that the coating meets the release rate requirements, and the products are labeled according to the standard model label.

3.4 Canada Shipping Act - Transport Canada, Canadian Coast Guard

The Canada Shipping Act prohibits the discharge of water containing oil in any concentration from vessels; drydocks are considered vessels by definition under this Act (confirmed by Canadian Coast Guard, Vancouver). Any oil spills or oily water discharges from vessels must be reported immediately to the Coast Guard. "Not to exceed" oil in water concentrations (10 ppm) are regulated under BC Environment's Pollution Control Objectives for Discharges to Marine Water. Recently, four new regulations have been amended to the Canada Shipping Act. The new regulations include criteria to be met by response organizations seeking certification, as well as requirements that oil handling facilities operators have Oil Pollution Emergency Plans. Amendments have also been made to the pollution discharge reporting regulations and to the oil pollution prevention regulations. Another new regulation prescribes how the standards to be incorporated by reference into the regulations are to be made public. The discharge of sewage into any waters in the Schedule under SOR/91-661 is prohibited. These Schedule waters in B.C. include Shuswap Lake, Mara Lake, and Okanagan Lake.

3.5 Workers' Compensation Act - Worker's Compensation Board (WCB)

The Industrial Health & Safety Regulations of the Worker's Compensation Act protect employees from exposure to harmful substances and potential accidents by specifying protective equipment and safety procedures. The WCB has issued (May 1994) a draft regulatory proposal for abrasive blasting procedures (focusing on worker exposure to dust).

The WCB Regulations have also set requirements for ventilation, use of personal protective equipment, availability of personal cleansing, labeling of materials, operator training for airless spray applications and equipment for airless spray.

Re-use of abrasives is prohibited if the dust has 1% or more free silica or contains paint pigments with heavy metals. A May 1994 draft regulatory proposal calls for enclosures with exhaust ventilation and dust collection where practical to control airborne emissions. A similar "where practical" provision is attached to the replacement of any silica based materials with less toxic products.

Controls for stopping the flow of abrasives must be immediately accessible to operator. The proposal also calls for all workers to wear air hoods, and assistants and others to wear personal protective equipment.

Under the proposed draft regulation, dry sweeping of abrasive blasting materials would be prohibited and spent grit containing any harmful impurities (including metals and other substances contained in paints or coatings) will need to be removed from the work area at the end of each work shift.

3.6 B.C. Waste Management Act - B.C. Ministry of Environment, Lands and Parks

The Waste Management Act prohibits the introduction of waste from the conduct of industry, trade or business into the environment except in accord with a permit, approval, order, waste management plan or regulation under the Act.

This Act includes the Special Waste Regulation and the Spill Reporting Regulation. **The Special Waste Regulation** primarily uses the dangerous goods classifications from the Transport of Dangerous Goods Regulations to define special wastes. A substance may also qualify if it exceeds the leachable toxic criteria (see Table 3-2).

Once a waste is classified as a special waste, it requires disposal at an approved facility. Special treatments apply to waste oils and waste paint. The Act also requires generators of special waste to register if the 30 days production or storage of waste exceeds set volumes (e.g., waste oils - 1000 L).

If the leachate from **spent abrasives** qualifies as a leachable toxic waste (see Table 3-2 for substances typically found in abrasives) and if more than one tonne of material is generated in 30 days, a special waste generator registration is required. Additionally, a permit or approval under the Act is required where more than 10 tonnes of leachable toxic waste materials are stored.

As there is currently no regulation covering the discharge to the environment of **washwater from pressure washing**, such discharges technically require a permit or approval under the Act whether or not the washwater is treated. The Province of British Columbia is currently considering the development of regulations on a broad basis for a wide variety of operations and may address this in the near future.

Bilge or ballast containing more than 3% oil by weight is considered a special waste and must be disposed of at an approved facility (i.e., oily water separation facility). A generator permit is required for oily water quantities of 5000 L or more processed or stored in 30 days.

Most **solvents and waste paints** are considered a special waste as their flashpoints qualify them as a Dangerous Good under the Transport of Dangerous Goods Regulations (solvents having flashpoints - 61° C are qualified as dangerous goods).

Spent abrasive blasting materials containing antifouling paint chips and **paint scrapings** are considered a special waste if the pesticides (i.e., antifouling agents) in the material exceed 100 ppm.

Table 3-2 Leachable Quality Standards for Selected Contaminants, Special Waste Regulation

Parameter	Concentration (mg/L)
Arsenic	5.00
Barium	100.00
Cadmium	0.50
Chromium	5.00
Copper	100.00
Fluorides	150.00
Lead	5.00
Mercury	0.10
Selenium	1.00
Silver	5.00
Toluene	2.40
Xylenes	30.00
Zinc	500.00

Note: Only the contaminants most relevant to shipbuilding are listed here. See Table 3 of the ***Special Waste Legislation Guide*** for a complete list.

Waste paint can be treated at an approved facility if it meets recycling specifications (i.e. mercury <75 mg/L, lead and total organic chlorides <1% by weight, and total poly-chlorinated biphenyls <2 mg/L). (Note: most marine coatings meet these limits, but as they are epoxies they cannot be recycled once mixed.) If the waste paint cannot be recycled it must be disposed of in the same manner as any other special waste.

Chemical degreasers usually qualify as special wastes (e.g., Ardrox 204 is classified as a dangerous good, Class 6.1 - poisonous substances) and must be disposed of by an approved facility. Generator registration is required if the shipyard use or storage of degreasers exceeds the Special Waste Regulation (e.g. for a Class 6.1 substance, use or storage of 100 L or more in 30 days).

Most **epoxies** are considered a special waste and must be disposed of as such.

The Spill Reporting Regulation under the Waste Management Act requires facilities to report spills (primarily of materials that would classify as special wastes) if the spill volumes exceed those listed in the Schedule of the Regulation (e.g. waste oils - 100 L). Under the Waste Management Act, the B.C. Ministry of Environment can also require facilities who control a polluting substance to prepare a contingency plan and make other precautions to contain spills.

The B.C. Spill Reporting Regulation requires that anyone in possession, charge or control of a spilled or leaked substance must report the spill to the Provincial Emergency Program (PEP) by telephone (see Appendix A for details). Spilled material and minimum volumes which trigger the reporting mechanism are as follows: flammable liquids of Class 3 (e.g. paints, solvents) - 100 L, poisons of Class 6.1 (e.g. degreasers) - 5 kg, waste oils - 100 L, and antifouling paints >5 kg (if they are flammable liquids of Class 3 and also registered as pesticides). Facilities are encouraged to prepare individual emergency response contingency plans (refer to guidelines prepared by the B.C. Ministry of Environment Lands and Parks, March 1992).

3.7 Pesticide Act - B.C. Ministry of Environment, Lands and Parks

The Pesticide Act controls the retailing and application of pesticides in B.C. Antifouling paints that use biocides fall under this Act but are not currently regulated by the Act in any way (in comparison most other pesticides can only be sold by licensed outlets). B.C. Ministry of Environment is evaluating the potential benefits of licensing personnel who apply antifouling paints (the Workers Compensation Board requires the training of operators applying paints and coatings).

3.8 Contaminated Sites Legislation (Provincial)

The Contaminated Sites Legislation (Bill 26) was scheduled to become law in 1994, but the public consultation period has been extended into 1995. No new date has been set for enactment of the legislation. Bill 26 will have far reaching consequences for any ship or boatyard which may have used its own land for long term disposal and/or storage of spent grit, separated water from waste oil, hull washwater, etc. Not only will a facility be directly responsible for all remediation costs within its own property limits and the neighbouring properties if there is any evidence of adjacent ground water contamination, but the banks may demand evidence of no future environmental liability in securing any line of credit or operating loan against the property (Bill 26 may not apply to shipyards located on federal lands).

3.9 Municipal and Regional District Bylaws

<u>Air Quality Control - Greater Vancouver Regional District</u>

The Greater Vancouver Regional District (GVRD) regulates the discharge of air contaminants through its administration of Air Quality Management Bylaw No. 725. Persons discharging air contaminants are required to obtain permits or authorizations issued under the Bylaw by the Air Quality Director. Persons discharging less than five kilograms per day of particulate matter, nitrogen oxides, sulphur oxides, hydrocarbons and other organic compounds, and less than 100 kilograms per day of carbon monoxide are not required to obtain permits unless it is considered necessary for the protection of the environment. The conditions under which the Air Quality Director may accept an application and grant a permit are contained in Waste Management Regulation 432/82.

Permits issued to shipyard operations typically regulate the discharge of air contaminants from abrasive blasting and spray painting activities. Restrictions may be placed on the rate of discharge, the duration and frequency of operation, the concentration of contaminants in the discharge, as well as the visible opacity of the emission. In general, these permits require the use of good operating practices and that air contaminants be contained on-site so that air pollution is not caused. Annual reports detailing the types and amounts of raw materials used, fuel burned, and organic solvents or solvent containing materials used are also required. Furthermore, the Air Quality Director can require ambient air sampling and monitoring where it is considered necessary.

The GVRD has begun implementing an Air Quality Management Plan which will work towards a GVRD Board of Directors goal of reducing by 50% the total quantity of air contaminants discharged within the Regional District by the year 2000. The Plan identifies emission reduction

strategies and targets specific emission sources (e.g. industrial and commercial boilers are among the first sources to be targeted). Strategies identified in the Plan may be implemented at a later date in permits issued under the Bylaw.

Municipal Sewer Bylaws

Facilities must meet the requirements of their local sewer authority before discharging sanitary and grey water from vessels, hull washwater, or other wastewaters to sanitary sewer systems. This requires contact with one or more levels of government. For example, facilities discharging into the Greater Vancouver Sewerage and Drainage District must comply with the District's Sewer Use Bylaw No. 164 and any bylaws and requirements of the specific municipality that they are located within. Bylaw 164 requires that facilities obtain authorization from the Sewage Control Manager for the discharge of certain wastewater types. These authorizations normally identify the wastewater sources, set the allowable quantity and quality of the discharge (e.g., metals, suspended solids, oils), and specify a monitoring and reporting program. Facilities should check with their local municipality to determine the specific requirements in their area.

Municipal Landfill Bylaws

Municipalities often have bylaws controlling the materials which can be disposed of in landfills within their jurisdiction. For spent abrasive blasting grit, the CCME contaminated soil criteria (CCME, 1991) or the Provincial criteria for contaminated sites (B.C. Ministry of Environment, 1989) is often used to set the limits for allowable heavy metals and other contaminants. For example, the city of Richmond Bylaw 5712 limits materials which may be landfilled within the City to Level B or better of the Provincial criteria. Facilities should check with their local municipality to determine the applicable criteria in their area.

Municipal Noise Bylaws

Shipyards are required to abide by municipal bylaws setting limits on allowable noise level (in decibels) at the property boundaries according to time of day. It is beyond the scope of this study to detail individual requirements of each community affected by a ship/boatyard repair facility in B.C.

Fire Safety Codes

Shipyards and boatyards in the Seattle Metro area are closely regulated by the local Fire Marshall in terms of acceptable standards for flammable materials handling and storage. A similar type of permit system is expected to be put in place by the Vancouver Fire Department in 1995. Standards will be governed by Part 4 of the Vancouver Fire Bylaw which is essentially the same as Part 4 of the National Building Code (Part 4 - Fire Code). It should be noted that the Vancouver Fire Department has no jurisdiction on federal lands administered by the Vancouver Port Corporation (the Fire Department conducts routine inspections along the waterfront and submits its findings to the Port authorities).

3.10 Regional and Provincial Project Review Processes

In addition to the legislation, regulations and bylaws governing particular activities and substances, there are a number of environmental programs and review processes which the ship and boat building and repair industry may need to consult a number of environmental programs and review processes when carrying out any foreshore project (e.g., dock construction, shoreline protection). Examples of these programs are the Burrard Inlet Environmental Action Program (BIEAP), which encompasses the area from Port Moody to a line connecting Point Atkinson and Point Grey; the Fraser River Estuary Management Program (FREMP), encompassing the North and South Arms and the River as far east as Kanaka Creek; and the B.C. Major Project Review Process, which applies to harbour and port operations industries (SIC 4552). Similar regional review processes are in the process of being established in other coastal areas (e.g., Victoria harbour and Cowichan Bay).

4.0 OVERVIEW OF CURRENT ENVIRONMENTAL MANAGEMENT PRACTICES

4.1 Practices in British Columbia

4.1.1 Current Practices

Current environmental management practices in B.C. have been derived from two sources of information:

- the 1993 questionnaire survey and site visits reported in Peter S. Hatfield Ltd. (1993); and
- visits to five B.C. shipyards conducted in January 1994.

In 1993, a fourteen page questionnaire was circulated to all shipyards and boatyards in B.C. involved in repair or new construction of commercial vessels (marinas were not included) to determine their current environmental management practices. Approximately 42% of the yards responded to the survey for a total of 20 responses. Results of the survey are presented in Peter S. Hatfield Ltd. (1993).

A summary of B.C.'s current practices was compiled from the questionnaire responses and additional information collected during the site visits in January 1994. This information is shown Table 4-1 under the heading "B.C. Current Practices" (the other information presented in this table is discussed in the following sections). Following the distinction made in Hatfield's report, environmental practices documented in this report have been specified for either boatyards or shipyards, where a shipyard is defined as having 30 or more full time employees and a lifting capacity (through drydock, lift, or marine railway) of at least 200 tonnes.

Typically, shipyards have more formal procedures in place for conducting activities and managing waste because of the large quantities of materials used on-site and their dedicated administrative staff. In boatyards, the small quantities of waste generated from each job often result in different types of wastes being mixed together and sometimes disposed of with general waste, rather than stored in segregated containers and picked up by a recycling agency. In spite of the small batch volumes, the cumulative volume of toxic substances handled by a medium sized boatyard working on approximately 800 to 1,000 vessels per year is significant.

The questionnaire identified the major activities in the yards as being abrasive blasting, painting, and metal and reinforced plastic fabrication. High pressure hull-washing is commonly used with pressures ranging from 1,500 psi to 5,000 psi (10,000 kPa -35,000 kPa); hydroblasting (ultra-high pressure water jet stripping with pressures up to 35,000 psi or 240,000 kPa) is not currently practiced by B.C. yards. Only a few facilities repair engines. The questionnaire responses also indicated that few shipyards in B.C. process sanitary waste or grey water (in these cases the fluid is pumped directly to the municipal sewer).

Several activities surveyed in the questionnaire have been dropped from the discussion of environmental practices in this project as the work is primarily carried out by specialized subcontractors or not conducted at all. For example, asbestos removal and disposal is normally carried out by subcontractors. With the exception of Canadian Forces Base Esquimalt, B.C. shipyards do not service refrigeration or air conditioning units, or PCB electrical devices. No B.C. yards service halon fire suppression equipment.

Overall, the industry is taking steps to control the environmental impacts of abrasive blasting and painting by using different grits and switching to airless or high-volume, low pressure (HVLP) spray guns. Most facilities follow the Special Waste Regulation for the disposal of waste paints, solvents, degreasers, oils and other waste chemicals.

4.1.2 Practices Contained in the 1989 Draft Discussion Document

In 1989, Environment Canada released a draft *Best Environmental Management Practices for the Shipbuilding and Repair Industry* (Environment Canada, 1989). The draft document focused on abrasive blasting and painting and was limited to commercial vessel repairs at conventional shipyards. Table 4-1 includes a summary of key points from this document (under the column title "B.C. Best Management Practices").

A stakeholders' meeting was held in 1989 to discuss the report. The main comments from the meeting are summarized below (from Wituschek, memo, 1989).

- Industry supported the concept of assigning abrasive blasting grits into toxic and non-toxic categories, and felt that the grit suppliers should supply toxicity data with their products (bioassays, total metal content, and leachate extraction results).

- The shipyards supported the concept of best management practices and preferred guidelines over regulations.

- Industry suggested some minor changes to the practices including a less restrictive wording for the practices of abrasive blasting over water and dropping of a maximum limit of 20% on dust cloud opacity.

- Industry felt that paint suppliers should be required to supply shipyards with the elemental composition of paints, so that operators could determine the toxicity of spent abrasives (paint chips usually account for 1% of spent abrasive materials). *This information would be very difficult to apply in practice as the complete coating history of each vessel would have to be available prior to blasting in order to predict the eventual composition of the spent grit.*

- Traditional shipyards were concerned that the best management practices would not be applied to abrasive blasting and coating operations carried out alongside wharves, small commercial contractors who conduct operations at various locations, and vessel cleaning and painting operations at marinas.

- Industry felt that the recommended practices should be applied to the Canadian industry as a whole, rather than limited to British Columbia.

4.1.3 British Columbia Bridge Painting Practices

Fisheries and Oceans Canada has developed guidelines for the protection of fish and fish habitat during bridge maintenance operations in B.C. (Fisheries and Oceans Canada, 1991). They include abatement techniques that minimize losses of paints and abrasives into fish habitat. These guidelines were intended primarily for freshwater situations and may not be completely relevant to marine applications.

4.2 Practices in the United States

Federal and state agencies in the United States have been developing and enforcing Best Management Practices for their ship and boat building and repair industry for over a decade.

This study examines EPA regulations, including the *Guides to Pollution Prevention: The Marine Maintenance and Repair Industry* (U.S. EPA, 1991), and BMPs developed for this industry in the Pacific states of Washington, Oregon, California and Alaska. As Washington State has been the most progressive with reference to developing and enforcing BMPs, their codes of practice are included in Table 4-1 for a point of comparison with current and previously recommended Canadian practices.

4.2.1 United States Environmental Protection Agency

EPA oversees environmental regulations at a national level and is responsible for ensuring that federal environmental regulations are complied with in each state. Some states can administer the federal regulations under the oversight of the EPA, but in such cases, the state's programs must meet or exceed EPA's standards.

Any industry discharging wastewater must comply with Sections 101, 301 (b), 304, 308, 401, 402, and 405 of the U.S. Clean Water Act and have a National Pollutant Discharge Elimination System (NPDES) permit. EPA evaluates discharges with respect to these sections of the Act and relevant NPDES regulations to determine which conditions should be included in each NPDES permit.

EPA first determines which technology-based limitations are required, as well as best management practices or other requirements. The Agency then evaluates the effluent quality expected to result from these controls to see if it will result in a violation of applicable water quality standards in the receiving waters. If violations could occur, EPA must include water quality-based limitations in the permit. The permit limitations, therefore, reflect whichever limits, technology-based or water quality-based, that are the most stringent.

EPA must also include monitoring requirements in the permit to determine compliance with effluent limitations. Effluent and ambient monitoring may be required to gather data for future limitations, to evaluate the effectiveness of BMPs to control pollutants in the discharge(s), or to monitor effluent impacts on receiving water quality.

The basis for permit conditions is described in the following sections.

EPA Statutory Basis for Technology-Based Limitations

The Clean Water Act requires particular categories of industrial dischargers to meet effluent limitations established by EPA. The Act initially focuses on the control of "traditional pollutants" (conventional pollutants and some metals) through the use of Best Practical Treatments Economically Achievable (BPT). Industrial dischargers were required by section 301(b)(1)(A) of the Act to meet this level of control by July 1, 1977. Section 301(b)(3) of the Act allowed a deadline of March 31, 1989, under certain circumstances, but that deadline has also passed. All permits issued after March 31, 1989, must include any conditions necessary to ensure that the BPT level control is achieved.

In many cases, limitations are based on effluent guidelines developed by EPA for specific industries. Where EPA has not yet developed guidelines for a particular industry or a particular pollutant, permit conditions must be established using Best Professional Judgment (BPJ) procedures (40 CFR 122.43, 122.44, and 125.3).

Section 301(b)(2) of the Act requires further technology-based controls of effluents. After March 31, 1989, all NPDES permits are required by section 301(b)(2) and (3) of the Act to contain effluent limitations for all categories and classes of point sources which:

1. control the use of Best Available Technology Economically Achievable (BAT), and

2. represent Best Conventional Pollutant Control Technology (BCT).

BCT effluent limitations apply to conventional pollutants (pH, BOD, oil and grease, suspended solids, and fecal coliform). Non-conventional pollutants include all pollutants not included in the toxic and conventional pollutant categories. In no case may a BCT or BAT be less stringent than a BPT.

Like BPT requirements, BAT and BCT permit conditions must be established using BPJ procedures in the absence of effluent limitations guidelines for a particular industry or pollutant.

As required by section 304(b)(2)(B) of the Act, when developing BPJ/BAT permit conditions, the Agency must consider the age of equipment, the application of various types of control techniques, process changes, costs of achieving such effluent reduction, non-water quality environment impacts (including energy requirements), and other factors the director of the Agency deems appropriate.

EPA Best Management Practices

Best Management Practices (BMPs), in addition to numerical effluent limitations, are required to control or abate the discharge of pollutants in accordance with 40 CFR 122.44 (k). The NPDES permit requires the development and implementation of a Best Management Practices Plan which prevents or minimizes the generation of pollutants, their release, and potential release from a facility into the waters of the United States through normal operations and ancillary activities, including material storage areas, plant site runoff, stormwater, implant transfer, process and material handling areas, loading or unloading operations, spillage or leaks, sludge and waste disposal, or drainage from raw material storage. The BMP Plan should incorporate elements of pollution prevention as set forth in the Pollution Prevention Act of 1990 (42 U.S.C. 13101).

EPA developed a ***NPDES Best Management Guidance Document*** in 1979 for the ship and boat building and repair industry sector which outlines BMPs established by the Agency for NPDES permitting (EPA, 1979). These guidelines set the minimum standards for all facilities in the United States. Individual states may set higher standards than these, but not lower.

The 1990 Clean Air Act requires EPA to issue control techniques guidelines for Volatile Organic Carbons and particulate emissions from coatings and solvents used in ship building and repair facilities. Draft rules have been developed by EPA and they are currently in the rule promogation process. Additional information on the draft rules are available from EPA.

4.2.2 Washington State Practices

Washington State Department of Ecology has been actively developing a rigorous set of BMPs for the ship and boat building and repair industry in Washington State. Their commitment to improving their aquatic environment is a good example to regulatory agencies in British Columbia.

Table 4-1 summarizes the Washington BMPs for both shipyards and boatyards and compares them to British Columbia's current practices and the code of practice developed in 1989 by Environment Canada. Section 4.5 highlights some key differences in approaches to minimizing environmental damage from different activities in B.C. and Washington.

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Table 4-1 Review of Practices in B.C. and Washington

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
SURFACE PREPARATION				
Sandblasting	Shipyards • mostly in drydocks, some afloat. • grit collected from drydocks and disposed in landfills. Boatyards • used by 1/3 or less yards. • most work carried out in yard, generally not enclosed. • some blasting afloat. • grit not collected.	• new and spent abrasives should be stored to prevent entry into receiving waters. • sandblasting should not be carried out over water unless fallout is prevented. • rundown of grit into dry dock drains should be prevented by removing grit routinely and redesigning drains. • spent abrasives should be disposed of in accordance with local regulations. • dust cloud opacity not to exceed 20% (or 1 on the Ringleman scale). • remove spent grit and debris from drydocks prior to flooding.	• confine blast dust to the drydock and yard area to the max. extent feasible. • shrouding systems (ie., plastic barrier or tarpaulins) with bottom weights are acceptable. • alternate acceptable blasting control technology may include slurry blasting, sodium bicarbonate blasting agent, vacuum return sandblasting heads or shot blasting technologies. • no blasting on vessels docked pier-side. • collected sand blasting debris stored under cover in a designated area for spent grit. • spent grit, dust, and other debris limited to piles less than one foot in height between regular cleanup intervals. • flooding and sinking of drydocks with standing piles of spent debris on drydock floor is prohibited. Photos and supporting documentation for each launching. • those portions of a drydock reasonably accessible shall be scraped or broomed clean to remove spent abrasive. • no visible sheens allowed from any floating detritus resulting from blasting.	• blasting contained (tarpaulins as minimum) and followed by cleanup to prevent materials from entering marine env., drains, ditches, etc. • use ground tarps to catch all scrapings, debris, dust and paint drips. • use tape and visquine to cover the gap between the boat and the dock when working over water. • use a sander that has a dust containment bag and avoid sanding in windy conditions. • plug scuppers to prevent accidental run-off of dust and debris. • limit grid work to replacing zincs and thru-hulls and doing minor keel and prop repairs. • when working on water, reverse the boat in the slip to work on the other side. • sweep and vacuum all residual dust. • dispose all residues in proper trash containers.

Table 4-1 Continued...

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
SURFACE PREPARATION CONTINUED...				
High Pressure Washing & Hydroblasting	• wash water not collected. • water either returned to marine env. or collected in storm drains.	• no recommended practices	• pressure wash wastewater (including hydroblast) must be discharged to a local sewerage agency after meeting the limits established by the local authority.	• wash water should be collected and treated. • after treatment, wash water can be discharged if it meets effluent criteria or, with approval from sewage authority, discharged to sewer.
Sanding & Scraping	• material collected and disposed of with other trash.	• no specific recommendations	• no BMP	• no BMP
Steam Cleaning	• majority of shipyards collect condensate. • Navy collects condensate and sends with other liquid waste to oily waste treatment plan.	• no specific recommendations	• no BMP	• no BMP
PAINTING				
Mixing	• often mixed in yards, drydocks and on wharves.	• no specific recommendations	• mix paints and solvents in locations and under conditions so that no spill enters the water. • drip pans or other protective devices are required for all paint mixing and solvent transfer operations.	• mix only the amount of paint needed for the job. • always mix paints on a tarp or other form of containment. • whenever possible, mix paint on land, not on dock.
Application	• roller, air spray and airless spray (boatyards still prefer air spray). • 10% or less of paint applied afloat. • some yards take measures to capture overspray and provide sheeting to contain drips. • shipyards use very little water-based paints, antifouling paint is typically copper-based.	• only transport required amounts of paint to work area. • painting over water prohibited unless atmospheric transport or fallout of paint onto receiving waters can be prevented. • reduce VOC emissions by changing the pigment carrier or use a non-organic carrier. • suspend painting operations when prevailing winds carry overspray onto nearly properties.	• no spray painting while vessels are docked pier-side. • overspray confined to the drydock and yard area to max. extent feasible during spray painting. • shrouding systems (ie., plastic barrier or tarpaulins with bottom weights) are acceptable. • when painting from floats or on drydocks, paint with cans of 5 gallons or less.	• to max. extent feasible, structures or drapes shall be used when painting to capture overspray. • no spill shall enter the marine environment. • TBT paints prohibited on non-aluminum hulls <25 m in length. • TBT paints can only be applied by licensed person. • use tape and visquine to cover the gap between boat and dock when working over water.

Table 4-1 Continued...

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
PAINTING CONTINUED...				
Application Continued...	• some boatyards use water-based paints for topsides and teflon paints for anti-fouling.	• TBT paints prohibited on non-aluminum hulls < 25 m in length.	• paint container should be kept in drip pans with drop cloths or tarpaulins underneath the pans.	• use drip pans and containment trays. • keep containers sealed tight when not in immediate use.
Cleanup	• sludge and solvent separated & reused in some cases.	• no specific recommendations	• no specific recommendations	• on-site use of stills to recycle solvent is encouraged.
ENGINE REPAIRS				
Chemical Degreasing	• yards use dip tanks and parts washers. • degreaser in dip tanks is reused.	• no specific recommendations	• re-use through solvent still or settling tank (thinners).	• re-use through solvent still or settling tank (thinners).
Batteries	• stored outside. • collected by scrapper or recycler.	• no specific recommendations	• dispose of at approved facility.	• dispose of at approved facility.
FABRICATION SHOPS				
Reinforced Plastics (resin)	<u>Shipyards</u> • yards have separate building for epoxies and resins with restricted access. • generally no specified place for mixing. <u>Boatyards</u> • no special storage area and access to materials not restricted. • waste epoxies, resins, and cloth disposed of in garbage.	• no specific recommendations.	• no specific BMPs. Covered under general practices for secure storage of hazardous liquids.	• no specific BMPs. Covered under general practices for secure storage of hazardous liquids.
VESSEL CLEANING				
Bilge & Ballast Water	• some yards collect and treat as for waste oils. • boatyards do not collect or handle bilge and ballast water.	• no specific recommendations	• bilge and ballast water discharges not to exceed an oil/grease concentration of 10 mg/L and not to cause any visible sheen in receiving waters.	• bilge water discharges shall not cause a visible oil sheen. • bilge water shall not be discharged if solvents, detergents, emulsifiers, etc., have been added.

Table 4-1 Continued...

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
VESSEL CLEANING CONTINUED...				
Bilge & Ballast Water Continued...			• bilge, ballast and boiler water cannot contain solvents, detergents or other known or suspected additives unless a water quality variance is granted by the Dept. of Ecology. • oily bilge waters from machinery or pump room spaces must be handled by a waste oil hauler or tank cleaning service.	• sorbent pads to be used in bilges when moving vessel. • oily bilge waters disposed of at approved facility.
Sanitary & Grey Water	• pumped directly to sewer.	• no specific recommendations	• sanitary waste and grey water shall be discharged to the sanitary sewer or hauled away for suitable disposal.	• discharge to marine environment prohibited. • with approval of sewage authority, discharge to sewer.
STORAGE AND DISPOSAL				
Chemical Storage (paints, solvents, oils, acids, degreasers, strippers)	• paints stored in separate room or building.	• bulk liquid storage tanks for oils, solvents, chemicals, and waste bilge and tank cleaning water mounted in a diked area or curbed concrete pad to contain 110% of the full capacity of the largest tanks. • paints, solvents, and degreasers stored in curbed concrete pads or floors to contain spills.	• oil and fuel storage tanks to have secondary containment. • amount of paint stored on drydock floor kept to a minimum not exceeding the usage of one shift. • all liquid products shall be stored on durable impervious surfaces and within bermed containment capable of containing 110% of the volume of the largest container in the storage area. • incompatible materials segregated and stored in separate containment areas. • all metal finishing chemicals solution, caustic wash and rinse water tanks stored in diked areas with drains to intercept	• liquid products stored outside require durable impervious surfaces and diked areas. • dikes to contain 10% of total tank volume or 110% of largest tank. • roofs and tarpaulins to keep rainwater out of containment area.

Table 4-1 Continued...

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
STORAGE AND DISPOSAL CONTINUED...				
Chemical Storage Continued...			overflows and spills. • all metal finishing chemicals solution, caustic wash and rinse water tanks stored in diked areas with drains to intercept overflows and spills.	
Waste Chemicals	• leftover paint stored for reuse. • waste paint separated from other waste and picked up by disposal company or recycler (waste paint is burned in some yards). • chemical strippers sometimes reused. • waste stripper is generally segregated and picked up by recycler, although sometimes it is left to evaporate, or is disposed of with general waste. • waste degreaser is segregated from other wastes. Disposal ranges from no disposal to recycler. • most yards drain oil filters and segregate waste oils from other waste in a lidded container or above ground tank. • shipyards segregate hydraulic fluid and store in above ground tank or lidded container. • majority of boatyards do not segregate waste hydraulic fluid. • waste oil and hydraulic fluid generally collected by recycler. • waste antifreeze collected by disposal contractor.	• waste liquid storage tanks (oils, solvents, degreasers) mounted in a diked area or curbed concrete pad to contain the full capacity of the tanks.	• waste liquids stored under cover or roofed structure, and the products clearly designated and segregated from new product storage. • all liquid waste stored on durable impervious surfaces and within bermed containment capable of containing 110% of the volume of the largest single container in the storage area. • oil contaminated sand shall be removed from the drydock as soon as possible and prior to submersion of the drydock. • incompatible materials segregated and stored in separate containment areas.	• waste liquids stored outside require durable impervious surfaces and diked area. • dikes to contain 10% of total tank volume or 110% of largest tank. • roofs and tarpaulins shall keep rainwater out of containment area. • dispose of wastes at approved facility.

Table 4-1 Continued...

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
ENVIRONMENTAL MANAGEMENT PRACTICES				
General	• most yards have a maintenance plan that assigns tasks to specific personnel. • few boatyards have a maintenance plan.	• no specific recommendations.	• drydock flood water can be discharged to public waters if it meets these limits: • oil and grease - 10 mg/L • turbidity - 5 NTU above background • pH - range of 6.0 to 8.0 • stormwater from drydock must be discharged to local sewerage agency when vessel is in drydock. • stormwater discharges from yard to public waters must meet effluent criteria. Discharge criteria are site specific and established by the Dept. of Ecology. • floatable and low density waste (ie., wood, plastic, insulation packaging materials) removed from drydock prior to flooding/sinking. • sediment traps in stormwater drainage systems in yard and drydock inspected monthly and cleaned as necessary. • after vessel is removed from drydock, remaining areas of floor (previously inaccessible) cleaned prior to next vessel being put into drydock. • cleaning should continue as long as practical during repositioning of bilge and keel blocks.	• copies of BMP to be posted in yards. • yard to be cleaned on a regular basis to prevent materials from being washed into marine env., storm drains, ditches, etc. • use of hose water to be minimized and water collected and treated. • sediment traps to be inspected monthly and cleaned as necessary. • leaking valves, pipes etc. repaired/replaced immediately. • slip-side maintenance projects shall be limited to less than 25 percent of the above-the-water surface area. • use only phosphate-free and biodegradable soaps or other environmentally friendly products for washing.

Table 4-1 Continued...

Activity	B.C. Current Practices	B.C. Best Management Practices (Env. Can., 1989)	Washington Best Management Practices	
	Shipyards/Boatyards	Shipyards	Shipyards	Boatyards
ENVIRONMENTAL MANAGEMENT PRACTICES CONTINUED...				
General continued...			• shipboard cooling and non-contact cooling water directed to minimize contact with spent abrasive material, paint and other debris. • soil chute connections to vessels and to receiving lines tightly connected and leak free as practicable.	
Pollution Prevention & Spills	• only a few yards have published practices. • most yards have employee training. • most shipyards have spill contingency plans covering marine and land spills, but few boatyards do.	• prepare a spill contingency and clean-up plan	• drip pans or other protective devices are required for all oil, paint and solvent transfer operations to catch incidental spills and drips from hose nozzles, hose racks, drums or barrels. • emulsifier and dispersants cannot be used without prior approval.. • other protective devices should include covered and controlled areas away from storm drains, surface waters, shorelines and piers.	• prepare approved Spill Control Plan. • begin cleanup and notify gov't agencies immediately. •containment booms stored for easy access. • use drip pans for all petroleum, paint and solvent transfer operations. • chemical spills (metal finishing, caustic wash, rinse water) to be recycled back into the tank or disposed of. • keep absorbent pads and thinner on hand in case of an emergency.

4.2.3 Oregon State Practices

Oregon State has developed its own set of best management practices for the ship and boat building and repair industry based on EPA's guidelines. These BMPs are summarized below:

Shipyards

- Ballast water must be treated prior to discharging into public waters. The treated water shall meet the following limits:

oil and grease	10 mg/L
total suspended solids	30 mg/L (monthly avg.) & 50 mg/L (daily max.)
pH	range from 6.0 to 9.0

- Cooling water, condenser water and boiler blowdown water must be treated prior to discharging into public waters. The treated water shall meet the following limits:

oil and grease	10 mg/L
temperature	shall not exceed 105°F
pH	range from 6.0 to 9.0

- All drydock drains shall be sealed or thoroughly cleaned prior to each vessel rotation. Vessel rotation means to submerge the drydock, to remove vessel, place the next vessel on the drydock, and refloat the drydock.

- All abrasive blasting sand within 30 feet of the drydock ends and sallyports shall be removed prior to each vessel rotation. Other grit is allowed to remain on the drydock floor during submergence (by comparison, Washington State requires complete removal of all grit before each launch).

- Abrasive blasting sand shall not be allowed to remain on any drydock for more than four vessel rotations. Prior to the fifth vessel rotation, all abrasive blasting sand shall be removed and the drydock shall be thoroughly cleaned as determined by the port dock master.

- All floating materials around the drydock areas must be skimmed after each vessel departure. If floating materials is being generated, the areas shall be skimmed immediately after cessation of each activity, but not less than daily during continuous, multi-ship operations.

- Sanitary waste shall be disposed of to a local sewerage authority.

- Floating containment booms shall be placed around all ships while transferring fuel in the ship yard. Permanent oil containment booms shall be installed on the inside of the most outboard pier pilings and around all drydock areas.

Boatyards

- Biodegradable detergent can be used in washwater. Detergents or cleaners that contain phosphate are prohibited.

- Washwater must have a pH between 6 and 9, and the oil and grease concentration must be less than 10 mg/L.

- All steam cleaning, hot water or chemical cleaning of oily or greasy equipment must be done over an impermeable slab so that any grit, oil or grease can be removed before disposing of the washwater.

4.2.4 California State Practices

Effluent discharge and stormwater runoff in California are regulated by the California State Water Quality Control Board. Effluent limitations and toxic effluent standards are pursuant to those set by EPA and regulated by the United States Clean Water Act, Water Pollution Control Act and California Water Code.

A summary of the codes of practice for California shipyards is provided below (as determined by a NPDES permit for shipyard in San Francisco Bay):

- The discharge of waste stormwater which contains constituents in excess of the following limits is prohibited:

    - cadmium 10 µg/L (daily maximum)
    - chromium 11 µg/L (daily maximum)
    - copper 20 µg/L (daily maximum)
    - lead 5.6 µg/L (daily maximum)
    - zinc 58 µg/L (daily maximum)
    - oil/grease 20 µg/L (daily maximum)

- Storm wastewater shall not have a pH of less than 6.5 nor greater than 8.5.

- Prior to the submergence of any portion of either of the floating drydocks, the discharger shall remove spent abrasives, paint residues, and other debris from those portions of the drydock floor which are reasonably accessible, to a degree achievable by scraping and broom cleaning.

- After a vessel has been removed from a drydock, the remaining areas of the floor which were previously inaccessible shall be cleaned by scraping and broom cleaning as soon as practical and prior to the introduction of another vessel. This provision does not apply in cases where a vessel must be introduced into the drydock on an emergency basis, such as to prevent sinking or leakage of oil or other materials.

4.2.5 Alaskan State Practices

The Alaska Department of Environmental Conservation (ADEC) administers environmental regulations in Alaska. ADEC administers some federal programs such as the Clean Air Act and

parts of the Resource Conservation and Recovery as well as non-federal state programs. ADEC also provides technical assistance for environmental compliance.

The State of Alaska, however, has not been delegated by EPA to implement NPDES permits as established by the Clean Water Act. Therefore, EPA Region 10, located in Seattle, Washington, has the authority to issue these permits in the State of Alaska.

The Alaska Health Project, a private, non-profit organization, has published Shipyard Tips as part as their Waste Reduction Assistance Program (Alaska Health Project, 1992). However, the management practices outlined in this document are not enforceable under the Clean Water Act.

4.3 Practices in Other Canadian Jurisdictions

4.3.1 Ontario

No codes of practice or guidelines have been developed for the Great Lakes region (ref. Environment Canada and the Ontario Government). Present practices in these regions are regulated by federal and provincial legislation.

4.3.2 Quebec

The Quebec's Environmental Quality Act, Division VII, Section 20, restricts fugitive dust emissions from sandblasting operations and applies to shipyards as well as other industries. Section 20 reads:

> "Dust emissions resulting from dry sandblasting operations must be controlled by using an enclosure or screen in order to confine the dust inside the spaces thus enclosed or closed, except in the case of a metal bridge. This section applies, *mutatis mutandis*, to wet-type sandblasting operations when there are dust emissions that can be seen in the atmosphere more than 2 meters from the emission source."

4.3.3 Atlantic Canada

Environment Canada in the Atlantic Region has developed a draft document for the surface preparation and coating of marine structures (Environment Canada, 1994). The guidelines are intended to apply to surface preparation and painting of ships as well as bridges, wharves and other structures in or near the marine environment. The report is directed specifically to activities where dust, waste coating, paints, debris and other substances from these operations may result in contravention of the Ocean Dumping Regulations under the Canadian Environmental Protection Act (CEPA). The guidelines are presently not in use. They are pending evaluation by Environment Canada for decisions on further development and implementation.

Both the Nova Scotia and New Brunswick Departments of Environment have developed and implemented their own guidelines for the application and removal of structural steel protective coatings. The New Brunswick guidelines (New Brunswick Department of the Environments, 1992) have been finalized, while the Nova Scotia guidelines (Nova Scotia Department of the Environment, 1993) are still in draft form. Neither document refers directly to the ship and boat building and repair industry.

Applicable guidelines from these documents are as follows:

Environment Canada (Atlantic Region)

- Metallic slags should be avoided during abrasive blasting. Grits with low metal content are preferable.
- A full enclosure with negative pressure is required for open abrasive blast cleaning. A full enclosure is defined as air impermeable walls with framing and full sealed joints and entryways.
- A partial enclosure (vertically hung tarps or permeable sheeting) is required for hand/power cleaning.
- A full enclosure with a collection system for wastewater is required for water jetting (with or without abrasive).
- A full enclosure with negative pressure is required for spray painting; a partial enclosure for manual painting.
- All spent material must be collected daily and securely stored in rigid leak-proof containers with tight lids.
- Wastewater from water blasting should be collected and treated if necessary to meet sewer disposal guidelines prior to disposal.

New Brunswick

- A full enclosure is required for the blasting area.
- If there is a serious concern for health, property or fisheries damage, a full enclosure with a negative pressure system should be utilized.
- Spent blasting medium must be handled and disposed of according to its classification defined by leachate test criteria in the Canadian General Standards Board provisional standard No. 164-GP-IMP. Non-hazardous waste must be transported to an approved waste disposal site. Hazardous solid waste must be transported and disposed of in compliance with provincial and federal regulations.

Nova Scotia

- Enclosure requirements depend on site classification and type of paint (lead or lead-free). The nearer a site is to a water body, residence, public area, or sensitive facility, the more stringent the enclosure regulations. A matrix is provided in the guidelines to help determine enclosure requirements.
- All debris is to be collected daily and placed in covered containers in a storage area. Debris is not to be removed from the storage area until it is tested.

- Spent blasting medium must be stored and disposed of according to its classification as defined in the leachate test criteria in the CGSB provisional standard no. 164-GP-IMP. Non-hazardous waste shall be transported to an approved waste disposal site. Hazardous waste shall be stored under cover in a secure fenced area. Approval from the Nova Scotia Department of the Environment is required for treatment and/or disposal of the spent blasting medium. Hazardous solid waste must be transported and disposed of in compliance with provincial and federal regulations.

4.4 International Practices

Government agencies and shipyards in the United Kingdom, Germany and Norway were contacted for information regarding their practices. No responses were obtained from agencies in Norway; it is not certain as to whether or not they have established guidelines or codes of practice.

The United Kingdom relies on environmental legislation to determine ship and boat building and repair environmental practices. Permits for shipyards are approved on a case-by-case basis and standardized guidelines do not formally exist.

Germany is in the process of finalizing a code of practice concerning the environmental aspects of grit blasting and painting of vessels. This report is unavailable yet. All practices in Germany at the present time rely on general environmental legislation.

4.5 Overall Comparison of Practices: B.C. vs. Washington State

In general, existing practices at many B.C. yards meet most of the recommendations made in 1989 with regard to abrasive blasting and painting activities; an exception is the normally accepted procedures for storing spent grit, where little or no attempt is made to prevent runoff of metals and other contaminants. Compared with Washington State, most facilities in B.C. do not carry out the recommended practices now accepted as standard procedure in the Puget Sound region. The following somewhat subjective comparison was prepared based on impressions gained during site visits to a range of shipyards and boat yards in Vancouver, Victoria and Seattle over a two week period in January 1994.

British Columbia

- lack of a paved or concrete apron/yard sometimes makes general cleanliness and control of debris, spills, and spent grit extremely difficult
- storage of waste oils and chemicals without bermed containment or rain cover was observed
- few yards have storm drains (most runoff from yards discharges directly to the receiving waters)
- the used of so called "envirotanks" is easily compromised by having no regular pumpouts (this encourages leaving mixed containers of waste oil out in the open with no security, containment, or protection from rainwater contamination); this could be a problem at some marinas with "do it yourself" yards
- there is no treatment of hull washwater in British Columbia
- spent blasting grit is often allowed to accumulate outside in piles exposed to rainwater, thereby leaching metals and paint into the soil or receiving waters
- smaller yards or facilities may have no environmental code of practice or spill contingency plan
- unopened paints and chemicals were observed to be stored immediately adjacent to the shore or directly on wharves and piers with no containment or fire protection (the Vancouver Fire Department has plans to launch an extensive inspection and permit system with regard to flammable liquids)
- paint mixing often takes place directly on the yard or dock with no containment or cover
- marinas appear to lack any posted environmental guidelines for owners working on their own vessels
- not all facilities have solvent stills

- shrouding of outdoor blasting activities is not common. Components may be blasted under partial cover but with no means of air filtration or dust control
- there is a lack of consistent policy on the ultimate disposal of the so called "clean water" after separation of bilge water
- drydock cleaning may be practiced on a "hit or miss" basis as time and work schedules allow

Washington State

- concerns over heavy metal contamination of washwater appear to conflict with the treatment of dry paint residue scraped off hulls. In the first instance, the sludge collected from the wastewater is treated as hazardous waste while in the second example the collected paint (by vacuum or sweeping) is simply disposed in the municipal dumpster
- overlapping jurisdictions, multiple agencies, frequent reporting, inspections, sampling, permit applications, etc., can impose a heavy financial burden (both in time and dollars) on all yards, particularly smaller owner operated boatyards.
- all blasting and most painting operations are extensively shrouded
- no blasting or spray painting is carried out on vessels alongside the dock
- drydocks are cleaned thoroughly before each launch
- spent grit is maintained under cover in walled, cement or paved area
- spent grit is commonly disposed of in cement kilns as an alternative to the landfilling practice most prevalent in B.C.
- waste oils, chemicals, and petroleum products are kept in secure, bermed, covered lockups, preventing cross-contamination and spills
- marinas are presently exempt from new regulations even though they may have an extensive repair yard (this loophole is a major concern of the boatyards and shipyards which rely solely on repair work)
- solvent stills are commonly used and found to be cost effective

The shipyard and boatyard industry in Washington State appears to have a higher level of environmental awareness than that in British Columbia, particularly with regard to abrasive blasting practices. There seems to be a fundamental difference in attitudes and practices which goes beyond the argument that "they have to comply because it is legislated".

REFERENCES

Relevant Legislation

B.C. Special Waste Legislation Guide, BC Environment, May 1992.

B.C. Waste Management Act, Consolidated Nov. 10, 1992.

B.C. Waste Management Act, Special Waste Regulation [effective April 1, 1988].

B.C. Waste Management Act, Spill Reporting Regulation [effective August 10, 1990].

B.C. Waste Management Act, Waste Management Regulation [Consolidated Jan. 8, 1993].

B.C. Waste Management Amendment Act, 1993 (Bill 26 - 1993).

B.C. Ministry of Environment, Lands and Parks. 1994. Waste Management Act, Petroleum Storage and Distribution Facilities Storm Water Regulation, (B.C. Reg. 168/94).

B.C. Water Act [consolidated November 15, 1990].

Canadian Environmental Protection Act. Chapter 16 (4th Supp.) (assented to 28th June, 1988).

Canadian Environmental Protection Act, Amendment. 38 Elizabeth II, Chapter 9 (assented to 29th June, 1989).

Canadian Fisheries Act, Amendment List, June 18, 1992.

Ocean Dumping Regulations, 1988. Extract Canada Gazette, Part II, November 8, 1989.

Ocean Dumping Regulations, 1988, Amendment. Extract Canada Gazette, Part II, September 8, 1993.

Ocean Dumping Regulations, 1988, Amendment. Extract Canada Gazette, Part II, September 21, 1994.

Reports

Agriculture Canada. 1993. Antifouling Coatings Memorandum.

Alaska Health Project. Waste Reduction Guide: Shipyards.

Barclays Law Publishers. 1990. Shipbuilding, Ship Repairing, and Ship Breaking Safety Orders, California Code of Regulations. Title 8., Division 1., Chapter 4, Subchapter 18., Vol. 11.

B.C. Ministry of Environment, Lands and Parks. 1993. News Release, May 19. , Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1993. Contaminated Site Characterization and Confirmation Testing Guidelines. Environmental Protection Division, Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1992. Special Waste Legislation Guide. Environmental Protection Program, Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1992. Guidelines for Industry Emergency Response Contingency Plans. Environmental Emergency Services Branch, Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1989. Criteria for Managing Contaminated Sites in British Columbia. Waste Management Program, Victoria, B.C.

Burrard Inlet Environmental Action Program. 1992. Inventory of Codes of Practices/Regulations. Vancouver.

Burrard Inlet Environmental Action Program. Environmental Review of Projects in Burrard Inlet. Vancouver.

California State Water Resources Control Board. 1992. Amended General Industrial Activities Storm Water Permit. Sacramento, CA.

Carmichael, N.G., and F.G. Galloway. 1990. The Toxicity, Ecotoxicity and Environmental Impact of Copper (Cuprous Thiocyanate) in Antifouling Paints. Prepared by Inveresk Research International for International Paint. Scotland.

CCME (Canadian Council of Ministers of the Environment). March 1992a. Canadian Water Quality Guidelines. Ottawa, Ont.

CCME (Canadian Council of Ministers of the Environment). March 1992b. Canadian Water Quality Guidelines Updates, Appendix X. Ottawa, Ont.

CCME (Canadian Council of Ministers of the Environment). September 1991. Interim Canadian Environmental Quality Criteria for Contaminated Sites. Report No. CCME EPC-CS34, Ottawa, Ont.

Coastal Marina Operations Task Force. 1992. B.C. Coastal Marina Facility and Operating Standards.

CH2M HILL, Inc. Best Management Practices for Boat Building and Repair Yards. Prepared for Puget Sound Shipbuilders Association.

DF Dickins Associates Ltd. March 1994. Recommended Environmental Best Management Practices for Ship and Boat Building and Repair Facilities in British Columbia, Vols. 1 and 2. for Environment Canada, North Vancouver, B.C.

ENTECH Environmental Consultants Ltd. 1992. Inventory and Evaluation of Environmental Monitoring Programs in Burrard Inlet: 1985 to 1991, Volume I, Overview Report. Prepared for Burrard Inlet Environmental Action Program, Vancouver, B.C.

Environment Canada. 1993. Interim Contaminant Testing Guidelines for Ocean Disposal, Pacific and Yukon Region, North Vancouver, B.C.

Environment Canada. 1993. Reporting to the 1993 National Pollutant Release Inventory, Part 1.

Environment Canada. February 1995. Guidelines for Surface Preparation and Coating of Marine Structures, Draft. Marine Disposal Section, Pollution Reduction Division, Environmental Protection Branch, Atlantic Region, Dartmouth, N.S.

Environment Canada. 1989. Best Environmental Management Practices for the Shipbuilding and Repair Industry in British Columbia. Draft Discussion Document. Environmental Protection, Conservation and Protection, Pacific and Yukon Region, North Vancouver, B.C.

Environment Canada. March 1995. Draft Fact Sheet, Chemicals in the Environment, Organotin Compounds in the Aquatic Environment - Hazards and Controls, Environmental Protection Service, Environment Canada, North Vancouver, B.C.

Fisheries and Oceans Canada. February 1995. Marina Development Guidelines, Draft. Pacific Region, Vancouver, B.C.

Fisheries and Oceans Canada. 1991. Guidelines for the Protection of Fish and Fish Habitat During Bridge Maintenance Operations in British Columbia. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1692.

Fraser River Estuary Management Program. Project Review in the Fraser River Estuary. Vancouver, B.C.

Gazette Officielle du Québec. January 14, 1981, Vol. 113, No. 2, pp. 59-60

Greater Vancouver Regional District. 1992. McKenzie Barge & Marine Ways Ltd. Air Quality Permit. Burnaby, B.C.

Greater Vancouver Regional District. 1992. Vancouver Shipyards Co. Ltd. Air Quality Permit. Burnaby, B.C.

Huggett, R.J., M.A. Unger, P.F. Seligman, and A.O. Valkirs. 1992. The Marine Biocide Tributyltin. in Environmental Science and Technology, Vol. 26, No. 2, 1992, pp. 232-237.

International Chamber of Shipping. 1993. Shipping and the Environment, a Code of Practice. London.

International Marina Institute. 1994. Practices & Products for Clean Marinas. North Kingstown, Rhode Island.

Metro Seattle. 1993. An example of a Metro Discharge Authorization for an [unknown] Shipyard in Seattle, Washington, 1993-1998.

Metro Seattle. 1992. Business and Metro: A Clean Water Partnership. Industrial Waste Program.

Metro Seattle. 1992. Maritime Industrial Waste Project: Reduction of Toxicant Pollution from the Maritime Industry in Puget Sound. Water Pollution Control Department, Industrial Waste Section, Seattle, WA.

Metro Seattle. Best Management Practices for Small Boatyards. Seattle, WA.

Moore, D.R.J., D.G. Noble, S.L. Walker, D.M. Trotter, M.P. Wong and R.C. Pierce. 1992. Canadian Water Quality Guidelines for Organotins. Environment Canada, Conservation and Protection, Scientific Series No. 191, Ottawa, Ont.

National Research Council. 1990. National Building Code of Canada. Issued by the Associate Committee of the National Building Code, National Research Council, Ottawa, Ont.

New Brunswick Department of the Environment. 1992. Guideline for the Application and Removal of Protective Coatings.

Nova Scotia Department of the Environment. 1993. Interim Environmental Protection Guidelines for the Application and Removal of Structural Steel Protective Coatings.

Peter S. Hatfield Ltd. 1993. Update: Environmental Management Practices, B.C. Shipbuilding Industry. Draft. Prepared for Environment Canada, Conservation and Protection, Pacific and Yukon Region, North Vancouver, B.C.

Puget Sound Alliance. 1993. Pollution Prevention Opportunities: Reducing Hazardous Waste and Chemical Use in the Marine Industry. Seattle, WA.

Shipbuilding Action Group. 1990. A Strategy for Change: British Columbia Shipbuilding and Repair Industry. Prepared for the B.C. Minister of Regional and Economic Development.

The Canadian Shipbuilding and Ship Repairing Association. 1976. A National Strategy for the Shipbuilding, Ship Repairing and Marine Component Industries. Ottawa, Ont.

The Canadian Shipbuilding and Ship Repairing Association. 1983. Annual Statistical Report. Ottawa, Ont.

The Canadian Shipbuilding and Ship Repairing Association and Employment and Immigration Canada. 1983. Opportunities in Shipbuilding. Ottawa, Ont.

The Seatrade Organization. 1991. Seatrade Ship Repair Study 1991. Colchester, United Kingdom.

The Westcoast Mariner. 1994. 1994 Directory of Lifts, Ways and Drydocks.

U.S. Environmental Protection Agency. 1991. Guides to Pollution Prevention: The Marine Maintenance and Repair Industry. Risk Reduction Engineering Laboratory and Center for Environmental Research Information, Office of Research and Development, Cincinnati, OH.

U.S. Environmental Protection Agency. 1979. Development Document for Proposed Effluent Limitations Guidelines and Standards for the Shipbuilding and Repair Point Source Category. Draft. Effluent Guidelines Division, Washington, DC.

U.S. Environmental Protection Agency. 1979. Document for Proposed Effluent Limitations Guideline and Standards for the Shipbuilding and Repair Industry (Draft). EPA/440/1-79/076b.

U.S. Environmental Protection Agency. 1994. Document for Surface Coating Operations at Shipbuilding and Ship Repair Facilities. EPA/450/D-94/011a.

U.S. Federal Register. Nov. 19, 1993. The Fact Sheet for the Multi-Sector Stormwater General Permit. Vol. 58, No. 222, page 61146.

Vancouver Port Corporation. 1991. Bunker Safety Checklist - Guidelines. 2nd Edition, Report # HM101/91.

Virginia Water Control Board. 1989. Best Management Practices Manual for the Shipbuilding and Repair Industry. Draft.

Warman, R.W. 1992. Capital Regional District Liquid Waste Management Plan - Stage 2. Referendum Technical Information Document. Victoria, B.C.

Washington Department of Ecology. 1993. Best Pollution Prevention Practices for Abrasive Blast Media Waste from Shipyard and Repair Activities. Draft. Olympia, WA.

Washington Department of Ecology. 1993. Boat Building and Repair Facilities National Pollutant Discharge Elimination System Waste Discharge Permit. Olympia, WA.

Washington Department of Ecology. Fact Sheet for National Pollutant Discharge Elimination System (NPDES) General Permit to Discharge Pollutants from Boatyards to State Waters. Olympia, WA.

Workers' Compensation Board of British Columbia. May 1994. Final Report of the Occupational Hygiene Subcommittee. issued by the Secretariat for Regulation Review, Board of Governors, Richmond, B.C.

Workers' Compensation Board of British Columbia. 1980. Industrial Health & Safety Regulations. Richmond, B.C.

Appendix A

Contact List:
Applicable Government Agencies

CONTACT LIST

Legislation	Agency	Telephone No.
Fisheries Act	Habitat Management Division Fisheries and Oceans Canada, Vancouver	666-6566
GVRD Air Quality Management Bylaw 725	Greater Vancouver Regional District, Burnaby	436-6700
Greater Vancouver Sewerage & Drainage District Sewer Use Bylaw 164	Greater Vancouver Sewerage & Drainage District Burnaby	432-6450
Pest Control Products Act	Agriculture Canada, New Westminister	666-2153
Pesticide Act	B.C. Ministry of Environment, Lands and Parks Victoria	387-9411
Ocean Dumping Regulations	Environment Canada, North Vancouver	666-0724
Special Waste Regulation	B.C. Ministry of Environment, Lands and Parks Victoria	387-9992
Worker's Compensation Act	Worker's Compensation Board Richmond	276-3121 or 1-800-661-2112
Environmental Review (new projects)	Burrard Inlet Environmental Action Program Vancouver	775-5195
	Fraser River Estuary Management Program New Westminister	525-1047

Emergency Numbers		
Spill Reporting Regulation	Provincial Emergencies Program	**1-800-663-3456** (1-800-645-7911)
	Environment Canada	666-6100
	Canadian Coast Guard	666-6011

Appendix B

Definitions of Shipbuilding and Repair Terminology

(derived from Environment Canada, 1989)

INTRODUCTION

The ship building and repair industry constructs, converts, alters and repairs all types of ships and barges. These activities include a broad range of operations such as erecting structural steel frameworks, fastening steel plates, installing mechanical, electrical and hydraulic equipment, as well as repairing malfunctioning equipment and systems. These activities are carried out in drydocks where new ships can be launched or where ships can be positioned safely for repairs.

Drydocking for ships can be achieved in a graving dock, floating dock, syncrolift-transfer or marine way.

Operations conducted during repair of ships may include cargo or fuel tank cleaning, abrasive removal of paint, mechanical repair and maintenance of ships' parts, alterations to ships' structure, and painting.

A short description of each of the above-described facilities and activities is provided below. Photographs showing typical facilities and services are provided at the end of this section.

TYPES OF FACILITIES

Graving Dock: A graving dock is four-sided structure with a bottom and a gate at one end to allow water to enter when a ship is entering or leaving the dock. The bottom of the dock is located below the adjacent water surface level with sufficient depth to permit ship movement into the dock. Keel blocks are positioned on the bottom of the dock to match the keel contour of the ship. After closing the gate, water is pumped out of the dock.

During ship repairs, the graving dock is kept dry with sump or stripping pumps in low areas of the dock in order to remove any water leakage from the gate. After ship repairs are completed, the graving dock is flooded with water and the ship is floated out of the dock.

The Federal Department of Public Works graving dock at Esquimalt, B.C. is 361 metres in length, 41 metres in width and some 15 metres deep. (The largest ship in drydock was the Queen Elizabeth - 314 metres long).

This graving dock can be separated into three berths where repairs can be completed on three vessels. The graving dock is equipped with complete utility facilities and berths are rented to ship repair contractors. These contractors are responsible for maintaining good housekeeping practices and adequate environmental control.

Floating Drydock: A drydock is built similarly to a graving dock; however, the structure floats on water with the bottom of a drydocked-vessel being above the water's surface. The floating drydock consists of a platform and ballast tanks. The ballast tanks are flooded to submerge the dock. A ship is moved over the dock and positioned over keel and bilge blocks on the dock platform. De-watering the ballast tanks lifts the drydock structure and the ship above the surface of the water.

Syncrolift: The syncrolift system is quite similar to the floating drydock operation, except the ship is moved on rails from the syncrolift platform to a work area on land. There is usually a rail transfer bay where vessels can be shifted laterally to engage parallel tracks.

The platform, with its keel and bilge blocks set on a rail car, is submerged, a ship is moved into position over the platform and the platform is raised to ground elevation.

Travelift: As a common means of lifting smaller vessels, the travelift is a self-propelled mobile lift which straddles a boat in a purpose-built slipway and lifts the vessel with two adjustable sling straps. Once out of the water the travelift moves to a work area where the vessel is placed on blocks.

Marine Way: Marine ways (or marine railways) are used to move small ships from the water to a work area on shore. The ship is mounted on a submerged platform and lifted out of the water along an inclined rail ramp. Work is carried out above the high tide line directly on the platform.

Elevator Lifts: Numerous smaller facilities employ elevator lifts where the vessel is located over the submerged lift and then elevated vertically out of the water for repair and maintenance. The lift platform serves as the working surface and base for the activities which are carried out over water.

Tidal Grids: Tidal grids have been traditionally used as a simple and economical means of working on a vessel hull between high water periods in the tidal cycle. The open grids which support the vessel keel do not prevent any scraped material or paint drippings from directly entering the marine environment.

ACTIVITIES

Tank Cleaning: Before repair work can be done on fuel tanks and bilges, they have to be pumped out and cleaned. Oil from fuel tanks and bilges is transferred to shore storage facilities or directly to a private contractor's tank truck for immediate removal.

The dirt and sludges from the fuel tanks or bilges are treated with detergents, solvents or hot water (steam). This process forms an oily emulsion which must be disposed of separately.

Waste water or solvents are pumped to storage tanks or trucks for further disposal. Stills are becoming increasingly common as the cost effective means of reprocessing spent solvents on-site.

Paint Removal: To achieve good bonding of the paint to the surface of the ship, several surface preparation methods (described below) are used to remove the loose, flaking or old paint. These methods include dry-abrasive blasting, hydroblasting, and chemical removal. The most commonly-used and effective method is dry-abrasive blasting.

Dry-Abrasive Blasting: This method consists of propelling dry abrasive material with air under high pressure against the surface of the ship. Dry abrasive (or grit) blasting removes loose, flaking or non-adhering paint and profiles the hull to receive a new coating. These old paint flakes and chips, as well as rust scale, become

mixed with the dry abrasive material. Blasting may involve only a light sweep of the hull or the full removal of all paint to bare metal or wood.

The most common abrasive materials contain a mix of aluminum, zinc, iron and magnesium oxides in different proportions. Most grits are slag by-products from smelting, coal fired electric generating, blast furnaces and mining operations; dust suppressants are added. Steel shot is sometimes used for blasting of components within a closed loop shelter. Glass beads may be used on softer metals like brass and bronze. Small amounts of silica sand are still used in Canada (banned in Washington State).

Hydroblasting (Wet Abrasive Blasting): Extreme high pressure (up to 35,000 psi or 240,000 kPa) hydroblasting systems are available to take the hull back to its original bare profiled state. This technology is relatively new and is not fully accepted by the marine industry (including insurance companies and paint manufacturers).

This method is similar to the abrasive blasting with water replacing air as the propellant. Pressures are much higher than the 5,000 psi (35,000 kPa) upper limit usually associated with high pressure hull washing. Residues from these operations are contaminated water, loose paint particles, spent grit, water and rust inhibitors. Wet abrasive blasting significantly controls dust generation. An inhibitor can be added to the water or slurry to prevent rusting of surfaces before painting. Common rust inhibitors are diammonium phosphate and sodium nitrite.

Problems with this procedure include the limited availability of coatings which can be applied over a "rust bloom" and the potential interference of the inhibitor affecting paint adhesion. Some form of effluent treatment system is needed to process the recovered water.

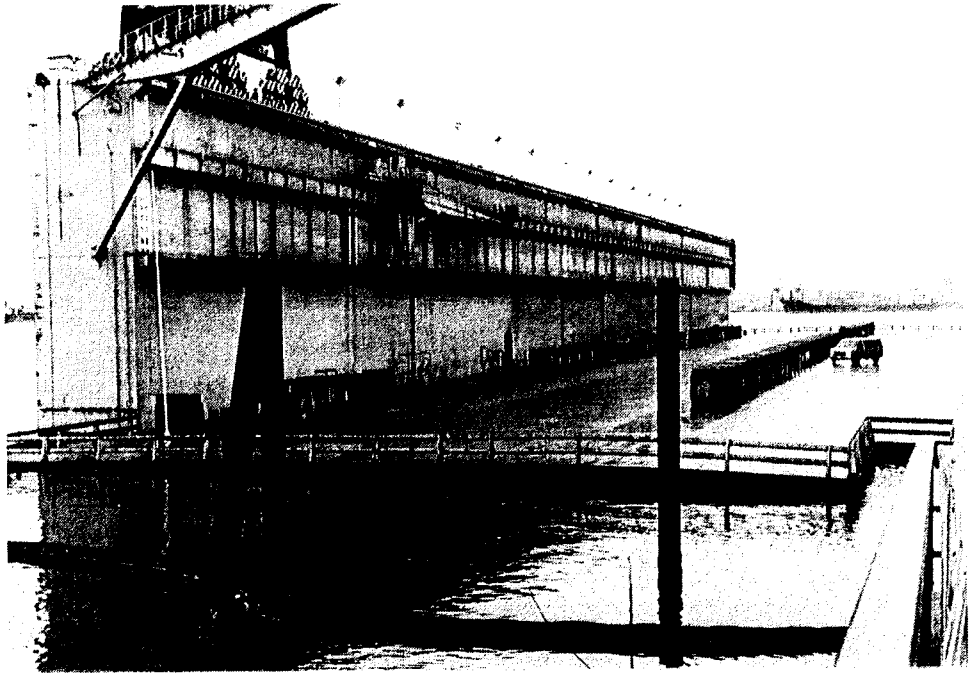
Hydroblasting has traditionally been used as a light sweep to remove only loose paint. The remaining paint, left after hydroblasting the hull, is overpainted.

Painting: After abrasive blasting the hull of an older or a new ship, anti-corrosion and antifouling paints are applied to protect the hull from corrosion and from the buildup of marine organisms. Application of paint is done by one of two methods

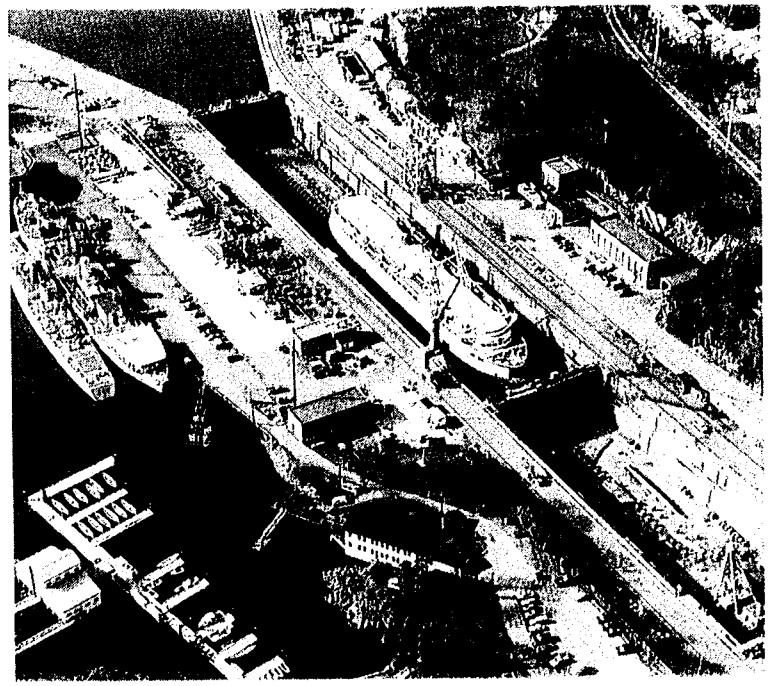
of spraying. One method uses a stream of compressed air to apply the paint to the ship, while the other method uses hydrostatic pressure to apply the paint.

It has been estimated that paint losses due to drips, spills and overspray range from 1 to 2% with airless spraying. Paint losses are higher with air spraying. Many yards are moving to high volume low pressure (HVLP) guns to reduce overspray.

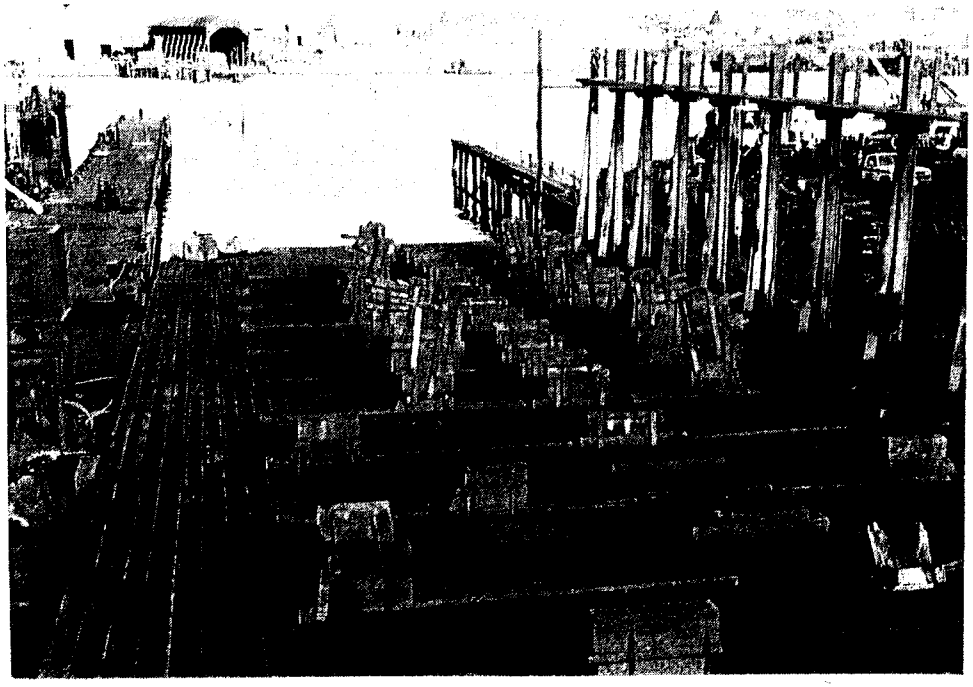
Paints may also be applied manually by brush or roller. Since drydock availability is limited and expensive, much of the painting activity on the ship's superstructure, interiors, and internal fuel and water tanks is carried out alongside a berth.



Drydock



Graving dock



Marine railway with wood deck

Travelift

Appendix C

Abrasive Blasting Practices at Todd Shipyards, Seattle, WA

Presentation by Al Rainsberger, Nov 30, 1994

ABRASIVE GRIT BLASTING

REGULATIONS

COMPANY PROCEDURES

TRAINING

CONTAINMENT

DISPOSAL OF SPENT GRIT

ALTERNATIVE METHODS

• *PUGET SOUND AIR POLLUTION CONTROL AGENCY*

SECTION 9.15 (d) - It shall be unlawful for any person to cause or allow the emission of fugitive dust in sufficient quantities and of such characteristics and duration as is, or is likely to be, injurious to human health, plant or animal life, or property, or which unreasonably interferes with enjoyment of life and property.

• *WASHINGTON DEPARTMENT OF ECOLOGY*

MONITORING AND REPORTING - Monitoring shall include photographs to document the extent of each drydock cleaning.

Photographic records shall be maintained on site to document the use of measures taken to control dust and paint overspray.

All records shall be retained for a minimum of three years.

SEDIMENT MONITORING REQUIREMENTS - A Sediment Monitoring Plan shall be submitted within twelve months of the permit issuance date and executed within thirty months of the permit issuance date.

YARD CLEANING - The yard shall be cleaned on a regular basis to minimize the possibility that runoff will carry sandblasting material or other debris into the receiving water.

DUST AND OVERSPRAY CONTROL - Dust and overspray from abrasive blasting and painting in yard facilities shall be controlled with structures or drapes to the extent feasible to minimize the spreading of wind blown materials. Frequent cleanup of these areas shall be practiced to prevent abrasive waste from being washed into storm sewers or adjacent waterway.

CLEANUP OF BLASTING DEBRIS AND SPENT PAINT - Cleanup of spent paint, paint chips, protective coating materials and abrasive shall be undertaken as part of the repair or production activities to prevent their entry into state waters. Those portions of the drydock floor which are reasonably accessible shall be scrapped or broomed clean using shovels to remove spent abrasive material prior to flooding.

Mechanical cleanup may be accomplished by mechanical sweepers, frontend loaders, vacuum cleaners or other innovative equipment. Manual methods include the use of shovels and brooms. Innovations and procedures which improve the effectiveness of cleanup operations shall be adopted where they are feasible, appropriate and can be demonstrated as preventing the discharge of solids to the water.

After a vessel has been removed from the drydock and the dock has been raised for repositioning of the keel and bilge blocks, the remaining areas of the dock which were previously inaccessible shall be cleaned by scrapping or broom cleaning prior to the introduction of another vessel into the drydock.

PROCEDURE

Replaces	Issuing Department: GENERAL MANAGER By:	Number 29.1.65
Dated	Subject: EXTERIOR ABRASIVE GRIT BLASTING OPERATIONS	Page: 1 of 2 Date:10/9/91

1. PURPOSE

To accomplish work practices in exterior abrasive grit blasting operations that comply with the Clean Water Act and the Clean Air Act.

2. SCOPE

This procedure applies to all exterior abrasive grit blasting operations.

3. DETAILS

3.1 All abrasive grit materials utilized in any exterior blast operation shall have the approval of the Manager of Environmental/Occupational Safety and Health prior to the start of any work process.

3.2 The Best Available Control Technology, including total containment, shall be utilized for all exterior grit blasting operations.

3.3 All exterior abrasive blasting shall be restricted to the confines of the drydocks.

3.4 When abrasive grit blasting any coating containing Tributyltin, all employees in the vicinity where possible exposure exists shall wear half mask respirators with high efficiency cartridges and tyvek clothing.

3.5 Good personal hygiene shall be required at all times.

3.6 Upon completion of any exterior abrasive grit blasting operation, the drydock shall be cleaned to the degree deemed necessary by the Dockmaster prior to submerging the drydock.

3.7 The dockmaster shall photograph the drydock floor prior to submerging the drydock and submit the photographs to the Safety Department.

3.8 The Safety Department shall accumulate all photographs in a photo log required by the National Pollutant Discharge Elimination System parameters.

3.9 Disposal of any abrasive blasting grit shall be done in accordance with all applicable agency regulations and handled through the Facilities Department.

3.10 Hydroblasting, slurry blasting, or power tooling should be considered as an alternative to abrasive grit blasting whenever practical or feasible.

Attachments:

TODD SHIPYARDS CORPORATION Seattle Division	Distribution: "D"	Approved:

CONTAINMENT MATERIALS

- TARPS
- PLYWOOD
- VISQUEEN
- CANVAS
- SHEET METAL
- RUBBER
- STENCIL
- METAL SHIM STOCK

4. TRAINING

4.1 All employees shall be trained in exterior grit blasting by their immediate supervisor.

4.2 Training shall include the following:
- A) Personal hygiene.
- B) Personal protective equipment.
- C) Proper air pressure utilized.
- D) The purpose of the containment and the elimination of fugitive dust.
- E) Work practices that reduce fugitive dust emissions (i.e. blast downward vs. blasting upward).
- F) Caution needed to assure the containments integrity and effectiveness.

5. GENERAL

5.1 All employees must do their best to accomplish a workplace that is both occupationally and environmentally safe.

ALTERNATIVE METHODS OF BLASTING

- POWER TOOL PREPARATION
- SLURRY BLAST
- HIGH PRESSURE WATER BLAST
- VACUUM BLAST
- DRY ICE BLAST
- PAINT STRIPPERS

DISPOSAL OF SPENT GRIT

- MUST PASS A TOXICITY CHARACTERISTIC LEACHING PROCEDURE. (ARSENIC, BARIUM, CADMIUM, CHROMIUM, LEAD, MERCURY, SELENIUM AND SILVER

- DOUBLE DECK SCREEN TO REMOVE ANY LARGE OBJECTS.

- SCREENED MATERIAL IS TRANSFERRED TO AN IRON SILO WHERE IT IS MECHANICALLY ADDED TO SILICA, LIMESTONE AND ALUMINA. IT IS THEN GROUND WITH WATER INTO A SLURRY.

- THE SLURRY IS ADDED TO THE COOL END (150 DEGREES FAHRENHEIT) TO TRAVEL 500 FEET (2 1/2 HOURS) TO THE HOT END (2,700 DEGREES FAHRENHEIT) OF THE KILN WHERE IT IS INCORPORATED AS A RAW PRODUCT INGREDIENT INTO A CLINQUER.

- THE CLINQUER IS THEN GROUND WITH GYPSUM TO COMPLETE THE PROCESS OF PRODUCING PORTLAND CEMENT.