

# Environmental, Health, and Safety Guidelines for Ports, Harbors, and Terminals

## Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)<sup>1</sup>. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at:

[www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines](http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines)

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative

<sup>1</sup> Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

## Applicability

The EHS Guidelines for Ports, Harbors, and Terminals are applicable to commercial ports, harbors, and terminals for cargo and passengers transfer. Shipping (including repair and maintenance of ships), fuel terminals, or railways are addressed in separate industry sector EHS Guidelines, specifically the EHS Guidelines for Shipping, Crude Oil and Petroleum Product Storage, Railways, respectively. Annex A provides a summary of industry sector activities. This document is organized according to the following sections:

- Section 1.0 — Industry-Specific Impacts and Management
- Section 2.0 — Performance Indicators and Monitoring
- Section 3.0 — References
- Annex A — General Description of Industry Activities

## 1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues primarily associated with port and terminal construction and operations, along with recommendations for their management. Recommendations for the management of EHS issues common to most large industrial and infrastructure projects, including siting and cumulative impact considerations, are provided in the **General EHS Guidelines**.

### 1.1 Environmental

Environmental issues in port and terminal construction and operation primarily include the following:

- Dredged materials management
- Air emissions
- General waste reception
- Wastewater
- Solid waste management
- Hazardous materials and oil management
- Noise
- Biodiversity

#### Dredged Materials Management

Construction and maintenance dredging, and dredge spoil disposal, may impact habitats and pose a significant hazard to human health and the environment, particularly if the sediments are contaminated by historical deposition and accumulation of hazardous materials, whether due to on-site or off-site activities.<sup>2</sup>

The following recommendations should be adopted to avoid,

---

<sup>2</sup> Hazardous materials that may typically accumulate in sediments include heavy metals and persistent organic pollutants from urban surface or agricultural runoff.

minimize, or control impacts from dredged materials, as part of a Marine Dredging Management Plan.<sup>3</sup>

#### *Dredge Planning Activities*

- Dredging should only be conducted if necessary, and based on an assessment of the need for new infrastructure components or port navigation access to create or maintain safe navigations channels, or, for environmental reasons, to remove contaminated materials to reduce risks to human health and the environment;
- Prior to initiation of dredging activities, materials should be evaluated for their physical, chemical, biological, and engineering properties to inform the evaluation of dredge materials reuse or disposal options.<sup>4</sup>

#### *Dredging*

- Excavation and dredging methods should be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material, especially if the dredge material includes contaminated areas. There are several dredging methods which are commonly used depending on the depth of the sediments and environmental concerns such as the need to minimize sediment suspension and increase dredging accuracy.<sup>5</sup>
- Areas sensitive for marine life such as feeding, breeding, calving, and spawning areas should be identified. Where sensitive species are present, dredging (and blasting)

---

<sup>3</sup> The environmental risk further depends on the concentration and type of hazardous materials, the dredging method, the intended disposal option, and the potential exposure to humans and living organisms during the dredge materials management cycle. Therefore, dredging activities should be conducted based on a careful assessment of potential impacts and in consultation with experts.

<sup>4</sup> Additional information on dredge materials evaluation methods is provided in the Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Guidelines for the Management of Dredge Materials (1998) and Guidelines for the Beneficial Use of Dredge Material (1996).

<sup>5</sup> Examples of dredging methods include grab, backhoe, trailing section hopper, and water injection / suction dredgers.

- should be conducted in a manner so as to avoid fish migration or spawning seasons, routes, and grounds;
- Use techniques (e.g. silt curtains), to minimize adverse impacts on aquatic life from the re-suspension of sediments;
- Inspection and monitoring of dredging activities should be conducted to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.

### *Disposal of Dredged Material*

- Dredged material should be analyzed in order to select appropriate disposal options (e.g. land reclamation, open water discharge, or contained disposal). Beneficial reuse of uncontaminated, dredged material should be considered (e.g. for wetland creation or enhancements, habitat restoration, or creation of public access / recreational facilities);
- Use of submerged discharges should be considered for hydraulic disposal of dredged material;
- Use of lateral containment in open water disposal should be considered. Use of borrow pits or dikes reduces the spread of sediments and effects on benthic organisms;
- Use of cap containment sediments with clean materials should be considered. Level bottom capping or a combination of borrow pits / dikes with capping reduces the underwater spread of contaminated material;
- Confined disposal facilities should be used, either near-shore or upland, when open water disposal is not feasible or desirable. If dredge spoil is contaminated, confined disposal facilities should include liners or other hydraulic containment design options to prevent leaching of contaminants into adjacent surface or groundwater bodies. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) may be required prior to discharge. Site-specific discharge quality standards should be established depending on the type and toxicity of the effluents and the discharge location;

- Since much sediment contamination originates from land use practices in the surrounding watershed, port managers should work with national and local authorities, as well as facility owners and operators in the watershed, to reduce sources of key contaminants. This may involve informing the authorities as to the difficulties in disposal of dredged material; actively participating in watershed protection programs sponsored by local or state agencies or in surface water discharge permitting efforts, if any, for sources in the port's watershed; and actively participating in zoning procedures.<sup>6,7</sup>

### **Air Emissions**

The most significant sources of air pollutants from port operations include combustion emissions from ships' propulsion and auxiliary engines and boilers, mainly consisting of sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), greenhouse gases (e.g. carbon dioxide [CO<sub>2</sub>] and carbon monoxide [CO]), fine particulate matter [PM], and volatile organic compounds [VOC]), followed by combustion source emissions from vehicles and land-based engines and boilers contributing similar pollutants.

Volatile organic compounds (VOC) may also be emitted from fuel storage and transfer. Storage and handling of dry bulk cargo, as well as from onshore construction activities and vehicle traffic on unpaved roads, may also contribute to particulate matter emissions.

Recommended air emissions management strategies include:

<sup>6</sup> Based on recommendations of the American Association of Port Authorities.

<sup>7</sup> See also the International Maritime Organization (IMO), London Convention on Prevention of Marine Pollution by Dumping of Wastes and Other Matter (and its 1996 Protocol) and the guidelines developed for disposal of dredged materials at sea.

### Combustion Sources

- Developing air quality management procedures applicable to ship operators, such as:<sup>8</sup>
  - Maintaining emissions of NO<sub>x</sub> and SO<sub>x</sub> within the limits established by international regulations<sup>9</sup>
  - Using low-sulfur fuels in port, if feasible, or as required by international regulations<sup>10</sup>
  - Navigation of port access areas at partial power, achieving full power only after leaving the port area
  - Avoiding or limiting the practice of blowing soot from tubes or flues on steam boilers while in port or during unfavorable atmospheric conditions
  - If the port provides onshore power for vessels to reduce shipboard power use during loading / unloading activities, requiring vessels to shut down power plants (go “cold iron”) if docked above a specified time threshold
- Depending on the need to address local air quality concerns, operators should develop air quality management procedures for application to land-based activities which may include:
  - Keeping transfer equipment (e.g. cranes, forklifts, and trucks) in good working condition
  - Upgrading the land vehicle fleet with less-polluting trucks and vehicles, and using alternative fuels and fuel mixtures
  - Encouraging reduction in engine idling during on- and off-loading activities

<sup>8</sup> While the port authority may not always have direct control over the operation of vessels and tenant operations in the port, it can establish regulations for use of the port facilities and stipulate conditions in tenant rental and lease agreements. The port operator can also establish financial incentives, such as tariffs, to influence the behavior of vessels and tenants at the port.

<sup>9</sup> NO<sub>x</sub> and SO<sub>x</sub> emissions from ships are regulated under Annex VI, Chapter III, Regulation 13 and 14 of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

<sup>10</sup> Sulfur content of fuel oil used by ships is regulated under Annex VI, Chapter III, and Regulation 14 of MARPOL 73/78.

- Encouraging storage planning to avoid or minimize re-storage and reshuffling of cargo

- Where practicable, designing new facilities to minimize travel distance from ships off-loading and on-loading facilities to storage areas.

### Volatile Organic Compounds

VOC emissions from fuel storage and transfer activities should be minimized by means of equipment selection, such as the use of floating top storage tanks or vapor recovery systems for fuel storage, loading / offloading, and fueling activities (depending on the type of material to be stored), and adoption of management practices such as limiting or eliminating loading / unloading during poor air quality episodes or implementing tank and piping leak detection and repair programs. Additional prevention and control recommendations for VOC emissions applicable to fuel storage and handling are provided in the **General EHS Guidelines** and the **EHS Guidelines for Crude Oil and Petroleum Product Terminals**.<sup>11</sup>

### Dust

- Dry bulk materials storage and handling facilities should be designed to minimize or control dust emissions, including:
  - Storing pulverized coal and pet-coke in silos
  - Installing dust suppression mechanisms (e.g. water spray or covered storage areas)
  - Using telescoping chutes to eliminate the need for slingers
  - Using vacuum collectors at dust-generating activities
  - Using slurry transport, pneumatic or continuous screw conveyors, and covering other types of conveyors
  - Minimizing free fall of materials

<sup>11</sup> Additional VOC emissions management strategies are also presented in the European Union (EU) Best Available Technique Reference Document (BREF) for Emissions from Storage (2005). See also the EU VOC Directive 1999/13/EC.

- Minimizing dry cargo pile heights and containing piles with perimeter walls
- Removing materials from the bottom of piles to minimize dust re-suspension
- Ensuring hatches are covered when material handling is not being conducted
- Covering transport vehicles
- Regularly sweeping docks and handling areas, truck / rail storage areas, and paved roadway surfaces
- Additional dust prevention and control recommendations applicable to construction and operational phase activities are provided in the **General EHS Guidelines**.<sup>12</sup>

## Wastewater

Water effluents associated with port activities may include stormwater and sewage from port operations, as well as sewage, ballast water (e.g. from oil tankers), bilge water, and vessel-cleaning wastewater from ships. Ship sewage and wastewater contains high levels of BOD and Coliform bacteria, with trace concentrations of constituents such as pharmaceuticals, and typically low pH levels. Wash water may contain residues such as oil. Pollutants in bilge water contain elevated levels of BOD, COD, dissolved solids, oil, and other chemicals that accumulate as the result of routine operations.

### *Port Sewage and Stormwater*

Stormwater and sewage from port facilities should be managed according to the recommendations provided in the **General EHS Guidelines**. Additional recommendations specific to stormwater and wastewater from port facilities include:

- Avoiding installation of storm drainage catch basins that discharge directly into surface waters, using containment

<sup>12</sup> Additional dust management strategies are also presented in the EU Best Available Technique Reference Document (BREF) for Emissions from Storage (2005).

basins in areas with a high risk of accidental releases of oil or hazardous materials (e.g. fueling or fuel transfer locations), and oil / grit or oil / water separators in all runoff collection areas. Oil / water separators and trapping catch basins should be maintained regularly to keep them operational. Recovered contaminated solids or liquids disposed of as hazardous materials (see the **General EHS Guidelines**);

- Installing filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) to prevent sediment and particulates from reaching the surface water.

### *Ship Wastewater*

- Port operators should provide collection, storage, and transfer and / or treatment services, and facilities of sufficient capacity and type for all wastewater generated by vessels at the port in accordance with MARPOL and national regulations:<sup>13</sup>
  - Oily waste and wastewater should be collected in barges, vehicles, or central collection systems and storage tanks.<sup>14</sup> The capacity of oily waste collection should be established based on applicable MARPOL provisions<sup>15</sup>
  - Wastewater with noxious chemicals from bulk tank cleaning should be collected through appropriate on-site or off-site treatment prior to discharge. Incompatible substances should not be mixed in the

<sup>13</sup> Consistent with the International Maritime Organization (IMO) Comprehensive Manual on Port Reception Facilities.

<sup>14</sup> Possible oily waste streams which a port receiving facility may need to accept include dirty ballast water, tank washing slops, oily mixtures containing chemicals, scale and sludge from tanker cleaning, oily bilge water, and sludge from fuel oil purifiers (IMO MEPC.3/Circ.4/Add.1, 20 December 2004).

<sup>15</sup> See Annex I, Chapter II, Regulation 12 of MARPOL 73/78.

collection system. Treatment methods should be established based on the effluent characteristics<sup>16</sup>

- Sewage from ships should be collected and treated on-site or off-site according to the recommendations provided in the **General EHS Guidelines**
- Smaller vessels used for harbor services should be equipped with recycling or chemical toilets, or holding tanks, that can be discharged to shore facilities.

## Waste Management

The type and amount of solid and liquid wastes associated with port operations may vary significantly depending on the nature of port operations and the types of ships serviced. Wastes originating at the port may include inert solid waste from cargo packaging and from administrative offices, as well as hazardous or potentially hazardous waste associated with vehicle maintenance operations (e.g. used lubricating oils and engine degreasing solvents). Wastes originating from ships may include oily sludge (addressed above under "Wastewater"), inert materials such as food packaging, and food waste.

Guidance applicable to port generated wastes, whether hazardous or non-hazardous, is discussed in the **General EHS Guidelines**. Specific pollution prevention, minimization, and control recommendations for ship-generated wastes received by port facilities is outlined below.

### *General Waste Reception*

Port facilities should provide adequate means of receiving and managing effluents and wastes to meet its own needs and those of visiting ships and for which the port is designed to service.<sup>17</sup>

<sup>16</sup> According to Annex II, Regulation 7 of MARPOL 73/78, cargo hoses and piping systems receiving noxious liquid substances cannot be drained back into the ships.

<sup>17</sup> Since ships are responsible for the costs associated with the management of their waste streams, these services should be provided within the context of a balanced fee structure that allows for the recovery of these costs while not fostering illegal disposal at sea (EU Directive 2000/59/EC).

The provision of waste reception facilities should be developed in coordination with the local governments according to their commitments to the MARPOL Convention<sup>18</sup> as port states. Port waste reception facilities should provide adequate capacity to receive port and ship generated wastes including appropriately sized and located receptacles, and the capacity to deal with seasonal fluctuations.<sup>19</sup>

### *Ship Wastes*

- Information should be available for ship captains to identify solid waste reception facilities and acceptable handling procedures at ports;
- Discharge of solid waste from vessels should be prohibited while in port in accordance with MARPOL and national regulations. More stringent restrictions should be considered, if necessary, to protect the port environment;
- A collection and disposal system should be developed for ship-generated garbage for ships alongside and at anchor, consistent with the International Maritime Organization (IMO) Comprehensive Manual on Port Reception Facilities. Closable skips should be provided at the berths and towed or self-propelled barges fitted with skips should be used to collect garbage from ships at anchor;
- Food waste from ships delivered to the port should be managed according to applicable local regulations intended to protect human and animal health.<sup>20</sup> Local requirements may include rendering, incineration, or landfilling of food waste and mixed waste containing food waste.

<sup>18</sup> International Convention for the Prevention of Pollution from Ships of 1973, modified by its Protocol in 1978 (MARPOL 73/78).

<sup>19</sup> IMO Comprehensive Manual on Port Reception Facilities (1999)

<sup>20</sup> Countries have specific regulatory requirements for the disposal of food catering waste originating from international ship arrivals. The objective of most of these regulations is to prevent the spread of communicable diseases across borders.

## Hazardous Materials and Oil Management

Hazardous materials at ports include large volumes of hazardous cargo, as well as oil and fuels and hazardous substances used in port activities including vessel, vehicle, and grounds maintenance. Spills may occur due to accidents (e.g. collisions, groundings, fires), equipment failure (e.g. pipelines, hoses, flanges), or improper operating procedures during cargo transfer or fueling, and involve crude oils, refined products or residual fuels, liquid substances, and substances in packaged form. Additionally, equipment maintenance may involve the use of potentially hazardous materials including solvents and lubricants. General hazardous materials management is addressed in the **General EHS Guidelines**. Additional recommended prevention, minimization, and control techniques specific to ports include the following.

### *Spill Prevention*

- Oil and chemical-handling facilities should be located with consideration of natural drainage systems and environmentally-sensitive areas (e.g. mangroves, corals, aquaculture projects, and beaches, providing physical separation / distance whenever possible);
- Ports should include secondary containment for above ground liquid storage tanks and tanker truck loading and unloading areas;
- Hazardous materials storage and handling facilities should be constructed away from active traffic and protect storage areas from vehicle accidents. Covered and ventilated temporary storage areas should be provided for leaking hazardous cargo and designed to facilitate collection of leaks and spills (e.g. slope surface to allow capture of spills, use valved catch basins that allow spills and releases to enter a dead-end sump from which spilled materials can be pumped);

- Fuel dispensing equipment should be equipped with “breakaway” hose connections that provide emergency shutdown of flow should the fueling connection be broken by movement. Fueling equipment should be inspected daily to ensure all components are in satisfactory condition.

### *Spill Control Planning*

- Port operators should prepare a spill prevention, control, and countermeasure plan consistent with the IMO Manual on Oil Pollution Section II - Contingency Planning, which:
  - Identifies areas within the port that are sensitive to spills and releases of hazardous materials and locations of any water intakes (e.g. cooling water for shore-based industries)
  - Outlines responsibility for managing spills, releases, and other pollution incidents, including reporting and alerting mechanisms to ensure any spillage is reported promptly to the Port Authorities and personnel are informed to take appropriate action
  - Includes provision of specialized oil spill response equipment (e.g. containment booms, recovery devices, and oil recovery or dispersant application vessels)
  - Includes training of response personnel in deployment of equipment, and testing of the contingency plan through regular reporting and alerting exercises and less frequent deployment of the specialized spill response equipment
  - Includes training of response personnel in animal welfare techniques related to spills

### *Dangerous Goods Handling*

Ports should implement systems for the proper screening, acceptance, and transport of dangerous cargo based on local

and international standards and regulations,<sup>21</sup> including the following elements:

- Establishment of segregated and access-controlled storage areas with the means to collect or contain accidental releases;
- Requesting Dangerous Goods Manifests for hazardous materials whether in transit, loading or unloading to and from ships, including proper shipping (technical) name, hazard class, United Nations number, and packing group;<sup>22</sup>
- Training staff in relevant aspects of dangerous goods management including screening and acceptance of dangerous goods at the port;
- Emergency response procedures specific to dangerous goods.

## Noise

Noise sources in ports include cargo handling, vehicular traffic, and loading / unloading containers and ships. Atmospheric conditions that may affect noise levels include humidity, wind direction, and wind speed. Vegetation, such as trees, and walls may reduce noise levels. Maximum allowable log equivalent ambient noise levels that should not be exceeded and general recommendations for prevention and control of noise are described in the **General EHS Guidelines**.

## Biodiversity

Construction and maintenance dredging, disposal of dredge spoil, construction of piers, wharves, breakwaters, and other water-side structures, and erosion may lead to short and long-

term impacts on aquatic and shoreline habitats. Direct impacts may include the physical removal or covering of sea floor, shore, or land-side habitat, in addition to changes to water flow patterns and related sedimentation rates and patterns, while indirect impacts may result from changes to water quality from sediment suspension or discharges of stormwater and wastewater.<sup>23</sup>

Additionally, the discharge of ballast water and sediment from ships during port operations may result in the introduction of invasive aquatic species. Recommended measures to prevent and control these impacts include the following:

- Potential impacts to shoreline vegetation, wetlands, coral reefs, fisheries, bird life, and other sensitive aquatic and near-shore habitat habitats during port construction and operation should be fully assessed with special consideration for areas of high biodiversity value or those required for the survival of critically endangered or endangered flora and fauna. The depth of the port should be considered at the design phase in terms of habitat destruction and the amount and nature of dredging required. Additionally, specific prevention and mitigation measures should be adopted for blasting activities which can cause considerable impacts to marine organisms and their habitats during construction;<sup>24</sup>
- Port facilities that conduct cleaning or repair of ballast tanks should be equipped with adequate reception facilities able to prevent the introduction of invasive species. Treatment technologies may include those applied to other effluents accepted in port reception facilities or more specific

<sup>21</sup> Examples of additional requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (<http://www.basel.int/>) and Rotterdam Convention on the Prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (<http://www.pic.int/>)

<sup>22</sup> According to the IMO International Convention for the Safety of Life at Sea (SOLAS) Chapter VII: Carriage of Dangerous Goods (1974) and International Maritime Dangerous Goods (IMDG) Code (2004).

<sup>23</sup> Construction of some water-side structures (e.g. piers and breakwaters) and disposal of new layers of sediment may also create new habitats for aquatic organisms.

<sup>24</sup> Additional information on examples of prevention of impacts due to marine blasting is available at: [http://www.dfo-mpo.gc.ca/oceans-habitat/index\\_e.asp](http://www.dfo-mpo.gc.ca/oceans-habitat/index_e.asp)

methods such as filtration, sterilization (e.g. using ozone or ultraviolet light), or chemical treatment (e.g. biocides).<sup>25</sup>

- Ports should provide ship operators with details on the port, state, or port authority ballast water management requirements, including the availability, location, and capacities of reception facilities, as well as with information on local areas and situations where ballast water uptake should be avoided.<sup>26</sup>

Additional guidance on the avoidance or minimization of impacts to habitats during design and construction activities is presented in the **General EHS Guidelines**.

## 1.2 Occupational Health and Safety

Occupational health and safety issues during the construction and decommissioning of ports are common to those of most large infrastructure and industrial facilities and their prevention and control is discussed in the **General EHS Guidelines**. These issues include, among others, exposure to dust and hazardous materials that may be present in construction materials and demolition waste (e.g. asbestos), hazardous materials in other building components (e.g. PCB and mercury in electrical equipment), and physical hazards associated with the use of heavy equipment, or the use of explosives.

Specific occupational health and safety issues relevant to port operations primarily include the following:

- Physical hazards
- Chemical hazards
- Confined spaces

<sup>25</sup> Additional information on ballast water treatment to avoid release of harmful aquatic organisms is provided by the Global Ballast Water Management Program (<http://globallast.imo.org/>)

<sup>26</sup> Additional information is provided in the International Convention for the Control and Management of Ships Ballast Water & Sediments (2004) and the International Maritime Organization (IMO) Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens (1997).

- Exposure to organic and inorganic dust
- Exposure to noise

### General Approach

Port operation activities should be conducted in accordance with applicable international regulations and standards, including:

- International Labour Organization (ILO) Code of Practice for Safety and Health in Ports (2005);
- General Conference of the International ILO Convention concerning Occupational Safety and Health in Dock Work, C-152, (1979);
- General Conference of the ILO Recommendation concerning Occupational Safety and Health in Dock Work, R-160;
- IMO Code of Practice for Solid Bulk Cargo (BC Code);
- International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code);
- International Code for the Safe Carriage of Grain in Bulk (International Grain Code);
- Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code);
- International Maritime Dangerous Goods Code (IMDG Code).

### Physical Hazards

The main sources of physical hazards at ports are associated with cargo handling and use of associated machinery and vehicles. General recommendations for managing physical hazards are addressed in the **General EHS Guidelines**.

Additional prevention, minimization, and control techniques specific to ports include the following:

- Implementation of applicable recommendations from the above-referenced international codes of practice, including:<sup>27</sup>
  - Separation of people from vehicles and making vehicle passageways one-way, to the extent practical
  - Locating means of access to ensure suspended loads do not pass overhead, to the extent practical
  - Constructing the surface of port areas to be: of adequate strength to support the heaviest expected loads; level, or with only a slight slope; free from holes, cracks, depressions, unnecessary curbs, or other raised objects; continuous; and skid resistant
  - Providing safe access arrangements suitable for the sizes and types of vessels calling at their facilities. These access arrangements should include guard rails and / or properly secured safety nets to prevent workers from falling into the water between the ship's side and the adjacent quay
  - Effectively guarding every weatherdeck and 'tween-deck' hatchway to an adequate height when open
  - Avoiding placing cargo on, or allowing passage of vehicles over, any hatch cover that is not of adequate strength for that purpose
  - As far as is reasonably practicable, preventing workers from working in the part of a hold where a trimming machine or grab is operational
  - Inspecting and approving all slings before use
  - Clearly marking (indicating its own weight) all lifting beams and frames, vacuum lifting, or magnetic lifting device which does not form an integral part of a lifting appliance and every other item of loose gear weighing more than 100 kilograms (kg)
    - Inspecting disposable pallets and similar disposable devices before use and avoiding re-use of such disposable devices
    - Equipping lifting appliances with means of emergency escape from the driver's cabin and a safe means for the removal of an injured or ill driver
- Risk of free fall of materials should be minimized by installing telescoping arm loaders and conveyors;
- Materials handling operations should follow a simple, linear layout to reduce the need for multiple transfer points.

### Chemical Hazards

Port workers may be exposed to chemical hazards especially if their work entails direct contact with fuels or chemicals, or depending on the nature of bulk and packaged products transferred in port activities. Work with fuels may present a risk of exposure to volatile organic compounds (VOC) via inhalation or skin contact during normal use or in the case of spills. Fuels, flammable liquid cargo, and flammable dust may also present a risk of fire and explosions. Recommended measures to prevent, minimize, and control risk of exposure to chemical hazards is provided in the **General EHS Guidelines**.

### Confined Spaces

As in any industry sector, confined space hazards can be potentially fatal. The potential for accidents among port workers may vary among port facilities and activities, including cargo handling, and may include ship cargo holds, silos, sewage tanks, and water tanks. Port operators should implement confined space entry procedures as described in the **General EHS Guidelines**. With specific reference to access into cargo holds, confined space entry programs should include procedures that prevent or minimize the use of combustion equipment, including fueling activities, in the interior of cargo holds and that provide for alternative means of egress.

<sup>27</sup> The listed recommendations are largely based on the International Labour Organization (ILO) Code of Practice for Safety and Health in Ports, 2005

## Dust

Potential exposure to fine particulates is associated with handling of dry cargo (depending on type of cargo handled, e.g. china clay, grain, and coal) and from roads. Occupational health and safety impacts associated with nuisance dust in ports are similar to those for other industries, and their prevention and control are discussed in the **General EHS Guidelines**. Specific recommendations for prevention, minimization, and control of dust generation are identified in this document under "Air Emissions".

## Noise

Noise sources in ports may include cargo handling, including vehicular traffic, and loading / unloading containers and ships. Occupational exposures should be managed as described in the **General EHS Guidelines**.

## 1.3 Community Health and Safety

Community health and safety issues during the construction of ports are common to those of most large infrastructure or industrial facilities, and are discussed in the **General EHS Guidelines**. These impacts include, among others, dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of temporary construction labor.

The following operational phase issues are specific to ports:

- Port marine safety
- Port security
- Visual impacts

### Port Marine Safety

Port operators have certain key responsibilities necessary for the safe operation of ships ranging from passenger safety to the safe

access and maneuvering of chemicals and oil transporting ships inside the harbor and port areas. Port operators should therefore implement a Safety Management System (SMS) able to effectively identify and correct unsafe conditions.

This safety system should include procedures to regulate the safe movement of vessels within the harbor (including pilotage procedures), protect the general public from dangers arising from marine activities at the harbor, and prevent events that may result in injury to workers, the public, or the environment. The Safety Management System should include comprehensive emergency preparedness and response plans that provide a coordinated response based on the port and community resources required to manage the nature and severity of the emergency event.<sup>28</sup>

### Port Security

Port operators should have a clear understanding of their responsibilities, including international legal and technical obligations to provide security to passengers, crews, and personnel in port. In accordance with applicable international legal requirements, port security arrangements (e.g. access control) may be established through the completion of a Port Facility Security Assessment of port operations followed by the appointment of a Port Facility Security Officer and the preparation of a Port Facility Security Plan depending on the outcome of the risk assessment.<sup>29</sup>

### Visual Impacts

Permanent and temporary installations and ships can result in visual changes to the landscape. One of the most significant changes attributable to ports is night illumination, depending on

<sup>28</sup> For additional information on the specific elements of an SMS, refer to the United Kingdom (UK) Department of Transport Port Marine Safety Code (2004) and Guide to Good Practice on Port Marine Operations (2003).

<sup>29</sup> Port security arrangements should follow IMO requirements and guidelines applicable to ports of the International Ship and Port Facility Security Code and Solas Amendments 2002 (2003).

its proximity to sensitive land uses such as residential or tourist areas, as well as bulk storage facilities. Excessive illumination may also result in changes to invertebrate flight paths and settlement / breeding patterns. Visual impacts, including excessive background illumination, should be prevented during the port planning process or managed during operations through the installation of natural visual barriers such as vegetation or light shades, as applicable. The location and color of bulk storage facilities also should be selected with consideration of visual impacts.

## 2.0 Performance Indicators and Monitoring

### 2.1 Environment

#### Emissions and Effluent Guidelines

A port is different from a traditional industry since it has few stationary effluents (wastewater and stormwater) and thus it is difficult to continuously monitor most emissions and effluents. Sanitary wastewater and storm water discharge quality is addressed in the **General EHS Guidelines**.<sup>30</sup>

Combustion source emissions guidelines associated with steam- and power-generation activities from sources with a capacity equal to or lower than 50 Megawatt thermal (MWth) are addressed in the **General EHS Guidelines**. Larger power source emissions are addressed in the **EHS Guidelines for Thermal Power**. Guidance on ambient considerations based on the total load of emissions is provided in the **General EHS Guidelines**.

#### Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to

have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

Additional recommended monitoring approaches include the European Sea Ports Organization's (ESPO) Self Diagnosis Methodology that ports can use to audit their environmental strengths and weaknesses (ESPO 2003). ESPO recommends that ports carry out the assessment annually.

### 2.2 Occupational Health and Safety

#### Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV<sup>®</sup>) occupational exposure guidelines and Biological Exposure Indices (BEIs<sup>®</sup>) published by American Conference of Governmental Industrial Hygienists (ACGIH),<sup>31</sup> the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),<sup>32</sup> Permissible Exposure Limits (PELs) published by the Occupational Safety and Health

<sup>30</sup> For guidance on effluent treatment levels applicable to tank barge or ocean/sea tanker cleaning operations, refer to US EPA 40 CFR 442.30 (Subpart C)

<sup>31</sup> Available at: <http://www.acgih.org/TLV/> and <http://www.acgih.org/store/>

<sup>32</sup> Available at: <http://www.cdc.gov/niosh/npg/>

Administration of the United States (OSHA),<sup>33</sup> Indicative Occupational Exposure Limit Values published by European Union member states,<sup>34</sup> or other similar sources.

## Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)<sup>35</sup>.

## Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals<sup>36</sup> as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

<sup>33</sup> Available at: [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9992](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992)

<sup>34</sup> Available at: [http://europe.osha.eu.int/good\\_practice/risks/ds/oel/](http://europe.osha.eu.int/good_practice/risks/ds/oel/)  
<sup>35</sup> <http://www.bls.gov/iif/> and <http://www.hse.gov.uk/statistics/index.htm>

<sup>36</sup> Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

## 3.0 References and Additional Sources

- ABP Research & Consultancy Ltd. 1999. Good Practice Guidelines for Ports and Harbours Operating In or Near UK European Marine Sites. Southampton, UK: ABP Research.
- American Association of Port Authorities. 1998. Environmental Management Handbook. Alexandria, VA: AAPA. Available at <http://www.aapa-ports.org/home.cfm>
- Associated British Ports Holdings PLC. <http://www.abports.co.uk/>
- Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR). 1998. OSPAR Guidelines for the Management of Dredged Materials. Available at <http://www.dredging.org/documents/ceda/downloads/environment-ospar-dmguidelines.pdf>
- Egyptian Environmental Affairs Agency (EEAA). 2005. Environmental Impact Assessment: Guidelines for Development of Ports, Harbours and Marinas. Available at [http://www.eeaa.gov.eg/arabic/main/guides/harbour\\_main.pdf](http://www.eeaa.gov.eg/arabic/main/guides/harbour_main.pdf)
- European Seaports Organization (ESPO). 2004. Annex to the Environmental Code of Practice of ESPO. Brussels: ESPO.
- ESPO. 2003. Environmental Code of Practice. Brussels: ESPO
- ESPO. 2001. Environmental Review. Brussels: ESPO
- European Commission (EC). 2006. Integrated Pollution Prevention and Control. Reference Document on Best Available Techniques (BREF) on Emissions from Storage. Available at: <http://eippcb.jrc.es/pages/FActivities.htm>
- European Union (EU). Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues - Commission declaration. Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0059:EN:HTML>
- Global Environment Facility (GEF)/United Nations Development Programme (UNDP)/International Maritime Organization (IMO). Global Ballast Water Management Program. Available at <http://globallast.imo.org/>
- Gupta, A. K., S. K. Gupta, R. S. Patil. 2005. Environmental Management Plan for Port and Harbour Projects, Clean Technology Environmental Policy (2005) 7: 133–141.
- International Labor Organization (ILO). 2005. Safety and Health in Ports. ILO Code of Practice. Geneva: ILO.
- ILO. General Conference of the International Labour Organisation. 1979a. Convention concerning Occupational Safety and Health in Dock Work, C-152. Geneva: ILO.
- ILO. The General Conference of the International Labour Organisation. 1979b. Recommendation concerning Occupational Safety and Health in Dock Work, R-160. Geneva: ILO.
- International Maritime Organization (IMO). 2004. Code of Practice for Solid Bulk Cargoes (BC Code). London: IMO.
- IMO. 2004. International Convention for the Control and Management of Ships Ballast Water and Sediments. London: IMO.
- IMO. 2004. International Maritime Dangerous Goods (IMDG) Code. London: IMO.
- IMO. 2004. MEPC.3/Circ.4/Add.1, 20 December 2004. London: IMO.
- IMO. 2004. International Ship and Port Facility Security (ISPS) Code and Amendments to 1974 Solas Convention (2002). London: IMO.
- IMO. 2001. International Convention on the Control of Harmful Anti-fouling Systems in Ships. London: IMO.
- IMO. 1999. Comprehensive Manual on Port Reception Facilities. London: IMO.
- IMO. 1998. Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code). London: IMO.
- IMO. 1997. Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens. London: IMO.
- IMO. 1995. Manual on Oil Pollution - Section II - Contingency Planning. London: IMO.
- IMO. 1991. International Code for the Safe Carriage of Grain in Bulk (International Grain Code). London: IMO.
- IMO. 1974. International Convention for the Safety of Life at Sea (SOLAS) Chapter VII: Carriage of Dangerous Goods. London: IMO.
- IMO. 1973. International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). London: IMO.
- IMO. 1972. London Convention. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. 1972 and 1996 Protocol Thereto. London: IMO. Available at <https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx/>
- Port of Auckland. [www.poal.co.nz](http://www.poal.co.nz)
- Port of Stockholm. [www.portofstockholm.se](http://www.portofstockholm.se)
- Port of Brisbane. [www.portbris.com.au/](http://www.portbris.com.au/)
- United Kingdom (UK) Department of Transport (DfT). 2004. Port Marine Safety Code. London: DfT. Available at [http://www.dft.gov.uk/stellent/groups/dft\\_shipping/documents/page/dft\\_shipping\\_505324.hcsp](http://www.dft.gov.uk/stellent/groups/dft_shipping/documents/page/dft_shipping_505324.hcsp)
- UK Department of Transport (DfT). 2003. Guide to Good Practice on Port Marine Operations. London: DfT. Available at [http://www.dft.gov.uk/stellent/groups/dft\\_shipping/documents/page/dft\\_shipping\\_505271.hcsp](http://www.dft.gov.uk/stellent/groups/dft_shipping/documents/page/dft_shipping_505271.hcsp)
- UK Health and Safety Executive. <http://www.hse.gov.uk/statistics/>
- United States Environmental Protection Agency (US EPA). 1996. Indicators of the Environmental Impacts of Transportation. Highway, Rail, Aviation and Maritime Transport. Washington, DC: US EPA.
- US EPA. 2000. 40 CFR Part 442.30. Subpart C – Tank Barges and Ocean/Sea Tankers Transporting Chemical and Petroleum Cargos. Washington, DC: US EPA.
- US EPA. 1997. Office of Compliance Sector Notebook Project, Profile of the Water Transportation Industry. Washington, DC: US EPA.
- World Bank. 1990. Technical Considerations for Port and Harbor Developments, Technical Paper Number WPT -0126. Washington DC: World Bank.

## Annex A: General Description of Industry Activities

A harbor is a stretch of water where vessels can anchor, or secure to buoys or alongside wharves to obtain protection (by natural or artificial features) from storms and rough water. A port is a commercial harbor or commercial part of a harbor with terminals, quays, wharves, enclosed docks, and facilities for transferring cargo from shore to vessel or vessel to shore. This includes onshore facilities and structures for receiving, handling, holding, consolidating, and loading or delivering waterborne shipments or passengers. Port may include terminals, which serve a single function (e.g. containers, bulk shipments of cement, iron ore, grain) or are operated by a single company. Ports may also provide ship support facilities and services, including waste management and effluent discharge, maintenance of vehicles and equipment, painting and other vessel maintenance.

Ports are located either in marine and estuarine zones or on rivers at inland sites far from the sea and may range in size from small harbors accommodating pleasure craft to large international ports covering several miles of waterfront.<sup>37</sup> Most ports are controlled by government-owned port authorities and governed by national and local legislation tailored to meet the needs of each port. Under these laws and regulations, the port authority is responsible for administering ports and coastal waters within its jurisdiction and safe navigation of vessels therein.

Port ownership and operation typically falls into three categories:

- Operating ports, where the port authority itself operates the majority of activities;
- Landlord ports, where the port provides basic services and infrastructure and tenants conduct the majority of activities

<sup>37</sup> An example being the Port of Los Angeles, which comprises 7500 acres, 43 miles of waterfront, and 26 cargo terminals.

- Combination ports, where the port authority may operate some activities and tenants operate other activities

Operating ports have direct responsibility for managing components of its operations that may affect the environment. While landlord ports generally do not have direct control over the activities of their tenants, they have a significant stake in tenants' activities and the impact of those activities on the environment.<sup>38</sup>

### Onshore Construction

Onshore construction typically includes site preparation and development, the removal of any existing vegetation, and the grading and excavation of soils for the installation of structural foundations and site utilities that are typical of industrial development projects. Port development may include construction of new infrastructure and / or rehabilitation of existing infrastructure, such as piers and buildings. Onshore facilities typically include:

- Cargo storage and handling facilities (e.g. crane tracks and bridges for loading / unloading cargo, pipelines, roads, railway lines, and other areas for cargo distribution, storage and stacking areas, above-ground and underground storage tanks, warehouses, and silos);
- Facilities for embarking / debarking of passengers (e.g. parking areas and administration buildings);
- Vessel support facilities (e.g. to store and supply water, power, food and oil / used oil);
- Drainage networks;

<sup>38</sup> American Association of Port Authorities, Environmental Management Handbook, September 1998, p. 41.

- Waste management and effluent treatment and discharge systems (e.g. including wastewater / sewage, oil contaminated wastewater, and ballast water);
- Port administration buildings;
- Equipment maintenance and repair facilities (e.g. vehicle maintenance bays);
- Flood defenses (e.g. gates and dikes) in ports exposed to high water and flood risks).

## Waterside Construction

Waterside facilities include berthing facilities (e.g. harbor basins, approaches, access channels, locks, harbor dams, and breakwaters), cargo handling and ferry facilities (e.g. goods transfer quays and piers, shoreline protection, and landing bridges), shipbuilding berths, and fitting quays or wharfs and dry docks. Offshore construction activities specific to ports include preparing the waterside including dredging (and disposal of dredged material); excavation and blasting; and filling and other work related to the construction of quays, piers, harbor basins, access channels, dams, breakwaters, and dry docks.

### Capital Dredging and Disposal of Dredged Material

Capital dredging for new ports includes the excavation of sediments to increase depth of berths and navigation channels for access by larger vessels. Sediments, even in new port developments, may contain contaminants. Much of this contamination originates from land-use practices in the adjacent watershed and is transported by rivers and surface runoff to lakes, bays, and the sea, where certain contaminants, such as polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), metals, and pesticides, tend to concentrate in the sediments.

In areas affected by sedimentation from rivers, estuaries, and land runoff, sediments are usually deposited over a period of

time. Therefore, concentrations of contaminants can vary substantially over a vertical profile of the dredge cut. Typically, the upper layer is organic-rich and fine-grained, and is the most contaminated. The deeper materials are typically coarse-grained or hard-pan materials that are less contaminated. However, historical contamination (e.g. from previous shipyards and spills) can result in contamination even in these materials. Material dredged from channels or outer harbor areas tend to be relatively coarse-grained and uncontaminated, although the nature of the materials is a function of the historical activities within the region. Sediment quality can be assessed by sampling and testing.

The re-suspension of sediment during the dredging or the excavation process may be reduced by selecting an appropriate dredging method:

- *Grab or clamshell dredgers* collect sediments in a crane mounted bucket helping to keep material consolidated (e.g. lower water content)
- *Bucket dredgers* pick up sediment by mechanical means, often with many buckets attached to a wheel or chain
- *Backhoe dredgers* are shore-based or "pontoon mounted" diggers used in shallow waters and confined spaces
- *Trailing suction hopper dredgers* are typically used for maintenance dredging in coastal areas. Sediments from seabed are pumped through trailing drag-heads into a reception tank (hopper)
- *Water-injection dredgers* inject water in a small jet under low pressure into the seabed to bring up sediment in suspension as a turbidity current that flows downslope before being moved by a second burst of water from the dredger, or carried away by sea currents

Non-contaminated, dredged materials can usually be disposed of in open waters or used to counter shoreline erosion, for beach nourishment or as fill materials, although a license from

national authorities is typically required for discharge of dredged material. Contaminated sediments are generally placed in confined disposal sites located either on land or in the water.

### **Excavation / Blasting and Disposal of Crushed Material**

Installation of pier columns / piles and other underwater foundations and construction of harbor basins and access channels may require excavation of sediment and underlying material. Soft material can be excavated using conventional means such as flight augers, however, excavation of hard materials often involves blasting. Foundations can penetrate natural low-permeability layers and facilitate vertical migration of saline water and contaminants. As with dredging, these construction activities also cause turbidity and generate crushed material and other debris requiring disposal. The use of explosives usually releases nitrogen and blasted material into the water. Other contaminants, including metals and petroleum products, may also be released from sediments.

Uncontaminated material can be disposed of in open water, or used to construct breakwaters and other features, or for land reclamation. Contaminated material may need to be placed in a confined disposal facility.

### **Construction of Piers, Breakwaters, Bulkheads, and Other Structures**

Piers, wharves, and similar structures create the ship berths and provide the platforms for waterside cargo handling. These structures are typically constructed of concrete, steel, or lumber treated with chromated copper arsenate (CCA) or creosote as a preservative. Preservatives can leach from treated lumber, and use of CCA-treated lumber is being phased out due to toxicity concerns. Filled structures, such as breakwaters, are crucial elements of port design and constitute sizable areas of artificial shoreline often projected into a bay, harbor, or estuary. Rubble mound breakwaters are commonly used and constructed by

dumping rocks (or debris) of various size distributions from dump truck, barges, or from fall pipes by barges.

## **Onshore Operations**

Land-based operations at ports include cargo handling; fuel and chemical storage and handling; passenger embarking / disembarking; ship support services; waste and wastewater management; vehicle and equipment maintenance; and buildings and grounds maintenance.

### **Cargo Handling**

Cargo handling includes unloading, storage / stacking and loading of dry and liquid cargo. Cargo typically includes containers, dry bulk, liquid bulk, and general cargo. Cargo handling includes use of vehicular traffic such as harbor vessels, trucks, buses, and trains and on-dock cranes, terminal trucks, and track cranes. Bulk cargo may be transferred using cranes with grab buckets and front-end loaders, or pneumatic continuous ship loaders and unloaders, or belt conveyors.

### **Chemical and Petroleum Storage and Handling**

Hazardous cargo, such as oil, liquefied gas, pesticides, and industrial chemicals, may require specific handling facilities or areas within the port, including separation from other cargo by cofferdam, void space, cargo pump room, or empty tanks. Pipe systems are required for handling bulk fuels and liquid chemicals. Hazardous cargo may be released through leaks and spill during transfer and storage, contaminating soil, surface water, or groundwater. Volatile organic chemicals may also evaporate and be released to the air.

## Embarking / Disembarking of Passengers

Passenger terminals may be required within the port area for embarking / disembarking passengers, including provision of parking facilities and temporary holding areas.

## Ship Support Services

A port may offer ship support services such as solid waste and wastewater reception, electricity supply, fuels, and fresh water. The port or a separate company located within the port area may offer ship fuels and fuel may be supplied by bunker boats. Fresh water may also be offered and pumped onboard ships.

## Waste and Wastewater

Port operations generate and manage their own waste and wastewater. Solid waste may be generated from property upkeep and administrative operations while wastewater may originate from storm drainage and from domestic wastewater and sewage. However, the most significant sources of wastes and wastewater are ships and government-owned port authorities are often responsible for providing receiving facilities for these and other waste streams. The following sections summarize the types of ship-generated wastes that must be managed in these shore-based facilities.

### *Solid Waste*

Waste materials generated on vessels and at the port include plastic, paper, glass, metal, and food wastes. Hazardous wastes generated on vessels and by maintenance activities include waste oil, batteries, paints, solvents, and pesticides. Ports typically manage collection and storage of hazardous and non-hazardous wastes, with transportation, treatment, and disposal managed by third parties. The port may provide reception facilities for waste such as containers, general-use skips, and bins.

### *Water Effluents*

Water effluents generated by ships include sewage, tank cleaning water, bilge water, and ballast water. Water effluents are typically collected and transported using trucks or pipes within the port area. Ports may collect and treat the wastewater before discharging to surface water, or to on-site water treatment systems, or municipal sewage treatment plants.

## Waterside Operations

### Ship Berthing

Ships may enter and leave the port under their own power or assisted by tugboats. While berthed in the harbor, vessels need an ongoing source of power for cargo handling, climate control, communications, and other daily operations. Power can be supplied by the ships' engines or supplied by shore-based utilities. Most vessels are powered by diesel engines, although some vessels may be steam powered. Air emissions from vessels consist primarily of particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides from propulsion and auxiliary boilers and engines. Coal-fired boilers generate a large quantity of particulate matter. Heavy particulate matter emissions are also generated when carbon deposits are blown from coal- and oil-fired boilers.

### Maintenance Dredging

Maintenance dredging involves the routine removal of material / sediment in harbor basins, access channels, and dams. This activity is important to maintain or improve depths and widths and ensure safe access for the ships as well as efficient navigation depth in the neighborhoods and dock gates to ensure access to basins and dry docks. Maintenance dredging may take place continuously or once every few years, depending on the port.

## **Vessel Repair and Maintenance**

Vessel repair and maintenance, including repainting, is typically conducted in a dry dock. Chemical stripping agents used for paint removal commonly contain methylene chloride, although less hazardous alternatives, such as dibasic esters, semi-aqueous terpene-based products, aqueous solutions of caustic soda, and detergent-based strippers, are available. Abrasive blasting may also be used to remove old paint. Steel shot is most often used as a blasting agent, although plastic shot may be used. Paint is usually applied by spray or by hand. Anti-fouling paints used on hulls are solvent-based containing heavy metals or organometallic biocides to minimize growth of marine organisms on ships' hulls. Water-based paints are generally used on areas of the vessel that are not immersed in water. Other repair work might include sheet metal work and metal finishing, among others. Wastes produced from vessel repairs and maintenance include oils, oil emulsifiers, paints, solvents, detergents, bleach, dissolved heavy metals, antifouling paint scrapings, and sandblasting waste. In the case of metal finishing operations, wastewater may also contain cyanide, heavy metal sludge, and corrosive acids and alkalis.