Environmental, Health, and Safety Guidelines for Shipping

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. 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

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 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 Shipping include information relevant to the operation and maintenance of ships used for the transport of bulk cargo, and goods. Cargo handling, vessel maintenance, and other in-port activities are covered under the EHS Guidelines for Ports and Harbors while issues specific to the transfer and storage of bulk fuels are covered in the EHS Guidelines for Crude Oil and Petroleum Product Terminals. The EHS Guidelines for Shipping apply to vessels operated with fossil fuels and do not address issues specific to nuclear-powered vessels.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] 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.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with the shipping industry, which occur during the operation and decommissioning phases, along with recommendations for their management. Recommendations for the management of EHS impacts common to most large industrial facilities during the construction phase are provided in the **General EHS Guidelines.**

1.1 Environmental

1.1.1 Marine Operations

Environmental issues associated with shipping operations primarily include the following:

- Petroleum[2] and hazardous materials management
- Wastewater and other effluents[3]
- Air emissions
- Solid waste generation and management

Petroleum and Hazardous Materials Management

Accidental releases of fuel and cargo may occur as the result of accidents while underway or during materials transfer at sea or in port. Anti-fouling paints used on ships' hulls to retard attachment and growth of marine organisms may release biocides into the water during normal operation of ships. Hazardous materials, such as chlorofluorocarbons (CFC), polychlorinated biphenyls (PCB), and asbestos have been used in ship construction and in onboard equipment, and may contribute to the generation of hazardous wastes during ship overhaul or decommissioning activities.

Hazardous Materials and Oil Spill Prevention

The most common causes of major accidental releases of hazardous materials and oil are associated with collisions, grounding / stranding, fire / explosion, and structural hull failure, of bulk transport ships (e.g. oil tankers and ships carrying dangerous chemicals in bulk), as well as failure of transfer equipment during loading / unloading from ship-to-ship and between ships and land-based structures.[4]

Recommendations to prevent, minimize, and control spills of hazardous materials or oil from vessels include:

- Operational certification of the ship according to applicable requirements depending on the purpose and capacity of the vessel;[5]
- For oil tankers, following applicable requirements, including those related to double-hull design and a phase-out timetable for existing single-hull tankers;[6]
- Preparing and implementing spill prevention procedures for bunkering activities in port and at sea;
- Conducting ship to ship transfer of cargo oil (lightering) activities in accordance with specific safety regulations and guidance to minimize the risk of spills;[7]

[2] Including bulk quantities of crude oil, fuel oil, Liquid Petroleum Gas (LPG), Liquefied Natural Gas (LNG), and refined products as well as sludge and oil refuse.

[3] Including issues related to the introduction of invasive species from the management of ship ballast and other effluents.

[4] The behavior of a liquid spill is influenced by properties of the material (density, viscosity, toxicity), and sea conditions and temperature. The severity of its impact is determined by the quantity released and the sensitivity of the local marine and coastal environment.

[5] International Oil Pollution Prevention Certificate according to Regulation 5, Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) applicable to oil tankers of 150 tons gross tonnage and above and any other ships of 400 tons gross tonnage and above; the International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk, Regulations 11, 12, and 12A, Annex II, MARPOL 73/78

[6] See Regulations 13E, 13F, and 13G of Annex I of MARPOL 73/78.

[7] For example, the Oil Companies Marine Forum (OCIMF) Ship to Ship Transfer Guide provides vessel operators with minimum standards for safe offshore lightering operations.

- Preparing and implementing spill prevention procedures for tanker loading and off-loading according to applicable standards and guidelines which specifically address advance communications and planning with the receiving terminal;[8]
- Adequately securing hazardous materials and oil containers on deck;
- Maintaing the nessessary emergency plans to address accidental releases of oil or noxious liquid substances;[9]
- Maintaining the necessary specific oil and noxious liquid substances spill prevention plans and procedures for operations in Special Areas.[10]

Additional guidance applicable to the release of oil in ship effluents is discussed in the "Wastewater and Other Effluents" section below.

Packaged Harmful Substances

Shipping companies should implement a system for the proper screening, acceptance, and transport of packaged harmful substances[11]. Since these materials may be provided by third parties, the screening and acceptance process should confirm compliance with requirements applicable to packaging, marking, and labeling of containers, as well the necessary certificates and manifests from the shipper.[12] The information provided should be sufficient to identify whether the materials are classified as a "hazardous material," as defined by international conventions, and whether the shipment is in compliance with applicable regulations.[13] Additionally, shipping companies should follow internationally applicable stowage and transport quantity limitations.[14]

Antifouling Paint

The underwater hull of most ships operating in marine waters is coated with anti-fouling paints containing biocides or metallic compounds such as tributyltin (TBT) or copper oxides that prevent barnacles and other organisms from attaching to the hull. TBT may leach and subsequently persist in the water and sediment, potentially impacting marine fauna and possibly entering the food chain. It is, however, essential to avoid biofouling, as increased hull resistance leads to higher fuel consumption and exhaust emissions.

Recommendations to prevent, minimize, and control releases of potentially toxic compounds from paint include:

- Avoidance of antifouling paint containing TBT, and removal or application of a sealer coat over existing TBT-based paint, in accordance with applicable regulations and guidance;[15]
- Avoidance of antifouling paint with biocides or other substances that may be harmful to the environment on ships that operate mainly in fresh or brackish water areas, where fouling may be less prevalent;

[8] For details about basic precautions, including those related to fire safety, refer to the International Safety Guide for Oil Tanker & Terminals (ISGOTT) which includes a Ship/Shore Safety Checklist for overall safety and spill prevention.

[9] The contents of an Oil Pollution Emergency Plan, applicable to oil tankers, are presented in Regulation 26, Annex I of MARPOL 73/78. Requirements of Shipboard Marine Pollution Emergency Plan for Noxious Liquid Substances are presented in Regulation 16, Annex II of MARPOL 73/78.

[10] The term "special area" means a sea area where, for recognized technical reasons in relation to its oceanographic and ecological condition and to the particular character of its traffic, the adoption of special mandatory methods for the prevention of sea pollution by oil, noxious liquid substances, or garbage is required. Areas designated as "special areas for the purposes of oil and noxious liquid substances" are respectively identified in Annex I and II of MARPOL 73/78.

[11] Harmful Substances include materials considered potentially harmful to the marine environment as defined by the International Maritime Dangerous Goods Code and Annex III of MARPOL. 73/78. 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/)

[12] See Regulations 2, 3, and 4 of Annex III, MARPOL. 73/78

[13] Basel Convention on Transboundary Shipment of Hazardous Waste

[14] See Regulations 5, 6, and 7 of Annex III, MARPOL. 73/78

[15] See International Maritime Organization (IMO) International Convention on the Control of Harmful Anti-fouling Systems on Ships, October 2001, as well as national legislation which may prohibit the use of TBT paint.

- For vessels operating in marine environments, paint with the minimum effective copper concentration should be used, taking into account the characteristics and expected use of the vessel. Operators should consider use of alternative non-toxic coatings, such as silicone-based, epoxy, and other low-friction paints, which are generally most effective on vessels that travel at speeds of 20 knots or greater, such as container ships, auto carriers, and cruise ships.[16,17]

Wastewater and Other Effluents

Ballast water

The two principal environmental concerns typically associated with discharges of ballast water are the potential release of oil or hazardous materials that may be mixed with ballast water, and the transfer of invasive alien aquatic organisms that may be taken up and discharged in ballasting operations. This is considered one of the most significant threats to marine ecosystems globally.[18]

Recommendations to prevent, minimize, and control impacts from ballast water include:

- To prevent or control the release of oil or hazardous materials that may be associated with ballast waste, following relevant, international regulations and guidelines for management of ballast water applicable to segregated and dedicated ballast tanks and crude oil washing activities[19] as well as maintaining a written record of cargo and ballast operations;[20]
- For oil tankers that carry ballast water in cargo tanks, oil-contaminated ballast water should be discharged to shore reception facilities before filling the cargo tank with oil;
- To prevent the transfer of invasive alien species and communicable diseases, following relevant international regulations and guidelines for management of ballast water, including:[21]
  - Implementation of a ballast water and sediment management plan, including the use of a ballast water record book for ships carrying ballast water between different sea areas
  - When safe to do so, exchanging of ballast water in deep open water as far as possible from the coast[22]
  - Uptake of organisms in ballast water should be avoided (e.g. by avoiding uptake in darkness, in very shallow water, where propellers disturb the sediment, or in other areas identified by local authorities)
  - Ballast tanks should be cleaned regularly and washing water delivered to reception facilities ashore[23]

Domestic Wastewater and Sewage

Ships generate grey water (e.g. from showers) and black water (e.g. sewage from toilets) which can contain high levels of biochemical oxygen demand (BOD_5), bacteria, and other

[16] Non-toxic paints typically require more frequent cleaning than copper-based antifouling paints, but epoxy coatings can last much longer than conventional anti-fouling paint.
[17] Geoffrey Swain, University Research on Antifouling Strategies and Environmental Considerations, Presentation to Alternative Antifouling Strategies Conference, September 21 – 22, 2000, San Diego, CA; and Geoffrey Swain, C. Kavanagh, B. Kovach, and R. Quinn, The Antifouling Performance of Non-Toxic Silicone Fouling Release Coatings, Proceedings of Symposium on Prevention of Pollution from Ships and Shipyards, April 4 – 5, 2001, Miami, FL.
[18] Additional information is available at http://globallast.imo.org/.
[19] See Regulation 13 of Annex I of MARPOL 73/78.
[20] Oil Record Book as noted in Annex I of MARPOL. 73/78
[21] See IMO Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens, Resolution A.868(20), February 1997; International Convention for the Control and Management of Ships Ballast Water & Sediments, February 2004; and national regulations including those of Argentina, Australia, Canada, Chile, Israel, New Zealand, United Kingdom, and USA.
[22] Annex I of MARPOL 73/78 provides specific conditions, including minimum acceptable distances from shore and water depth.
[23] Cleaning may be conducted while at sea. Complementary or alternative measures, such as filtration, ultraviolet treatment technology, heat treatment, and additives to neutralize harmful organisms, are under development and could be used if effectiveness is demonstrated.

constituents potentially harmful to marine organisms. Grey water and black water are typically collected and managed separately.

Recommendations to prevent, minimize, and control domestic wastewater and sewage include:

- Use and operation of a certified on-board sewage treatment system, as applicable according to international standards;[24]
- For vessels operating in coastal waters, all black water should be collected in holding tanks onboard and delivered to port reception facilities for further treatment at land-based wastewater treatment plants, in accordance with international regulations and guidance;[25]

Other Wastewater

Other wastewater discharged by ships includes bilge water and cargo tank wash water. These wastewaters can contain oil and hazardous substances that are potentially harmful if discharged to the sea. Recommendations to prevent, minimize, and control pollution from wastewater include:

- After unloading of chemical tankers, water used to wash the cargo tanks should be discharged to reception facilities ashore;
- All bilge water, separated oily residues, and sludge should be discharged to port reception facilities, except where ships are equipped with certified oily water separators (OWS), which may discharge treated water to sea in accordance with MARPOL 73/78 provisions. Additional bilge area effluent management elements may include:
  - Sludge tanks with appropriate storage capacity
  - Alarm system that can automatically detect and close the discharge effluent from the oil / water separator when an oil concentration of 15 parts per million (ppm) is reached
  - Secondary containment for high pressure fuel delivery systems

Air Emissions

Engine Exhaust

Diesel engine exhaust gases contain nitrogen oxides (NO_x), sulfur dioxide (SO_2), hydrocarbons, carbon monoxide (CO), carbon dioxide (CO_2), and particulate matter (PM).[26]

Recommendations to prevent, minimize, and control exhaust emissions from ships include:

- Considering fuel efficiency and air emissions in ship design, including hull shape, propeller shape and interaction with the hull, primary and auxiliary engine design, and emission control systems;
- Compliance with international regulations and guidelines regarding emissions of nitrogen oxides (NO_x) and sulphur oxides (SO_x) from ships, including limitations on the sulphur content of fuels and special restrictions on ships sailing in SO_X Emission Control Areas (SECAs);[27]
- Considering equipping vessels to enable connection to land-based electrical power (sometimes referred to as 'going cold iron'), or use of land-based emission control units to collect and treat vessel emissions while in port;

[24] As noted in Annex IV, MARPOL 73/78. For vessels engaged in overseas trade, onboard treatment plants should be installed to ensure that processed black water can be discharged in accordance with applicable regulations without causing adverse environmental impacts or health risk.
[25] See MARPOL 73/78 Annex IV.

[26] Anthony Fournier, University of California Santa Barbara, Controlling Air Emissions from Marine Vessels: Problems and Opportunities, February 2006, Available at: http://www-igcc.ucsd.edu/pdf/Marine_Emissions_(2-11-06).pdf#search=%22air%20emissions%20shipping% 22.
[27] Refer to Regulations 13, 14, and 18 of Annex VI, MARPOL 73/78. Further information may be found in U.S. Environmental Protection Agency, Control of Emissions from Marine Compression-Ignition Engines, 40 CFR Part 94.

- For appropriately configured vessels, consider the use of shore-based power (referred to as "Onshore Power Supply" [OPS]) in ports where it is available in a manner that does not compromise ship and / or port safety and security. Other options may include the use land-based emissions control units provided by the port / harbor for ships that possess the necessary equipment / hardware and where the operation can be accomplished in a manner that does not compromise ship and / or port safety and security.

Shipboard Incineration

Potentially hazardous emissions associated with shipboard incineration such as dioxins, furans and other Persistent Organic Pollutants (POPs), as well as heavy metals, depend on numerous factors including the design of the incineration system, the type of waste incinerated, and the management / operation of the system. Hazardous emissions from shipboard incinerators should be prevented and controlled through:

- Application of waste segregation and selection including materials that may not be incinerated;[28]
- Implementation of operational controls including combustion and flue gas outlet temperatures (combustion temperatures should be above 850°C while flue gases need to be quenched very quickly to avoid formation and reformation of POPs) as well as use of flue gas cleaning devices that comply with applicable international requirements;[29, 30]
- Management of incineration residues such as fly ash, bottom ash and liquid effluents from flue gas cleaning as a hazardous waste (see **General EHS Guidelines**) as they may contain high concentrations of POPs.

Ozone Depleting Substances

Ozone depleting substances (ODS) such as CFCs and halons may be found on board in refrigeration and fire-fighting equipment and systems. Recommendations to prevent, minimize, and control emissions of ODS include:

- Avoiding installation of fire fighting or refrigeration systems containing chlorofluorocarbons (CFCs), in accordance with applicable phase-out requirements;[31]
- Recovery of ODS during maintenance activities and preventing deliberate venting of ODS to the atmosphere.

Waste

General Solid Waste

Solid waste generated onboard ships includes non-hazardous garbage (similar to household waste) and hazardous wastes, such as equipment maintenance fluids, solvents, and batteries. Some components of garbage, such as plastics, can take hundreds of years to decompose or dissolve.

Recommendations to prevent, minimize, and control impacts from solid waste generation and management include:

- Compliance with applicable international regulations and guidance for waste management, as well as requirements and practices of the port of call, including:[32]
  - Disposal of garbage at sea with conditions depending on the type of garbage, level of physical processing,

[28] Refer to MARPOL Annex VI, which provides an indicative list of substances that cannot be incinerated at sea.
[29] For additional information and a list of designated "special areas" refer to Regulation 16, Annex VI, MARPOL 73/78, for waste incineration prohibitions and operational requirements.
[30] Refer to Guidelines on BAT/BEP practices relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants, Section V
[31] Refer to Regulation 12 of Annex VI, MARPOL. 73/78 and Montreal Protocol on Substances that Deplete the Ozone Layer.
[32] See MARPOL 73/78 Annex V; and 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, which came into effect in February 2006; and Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

and ship location (relative to shore and to protected areas ("Special Areas")[33]

- Implementation of a garbage management plan that includes written procedures for collecting, storing, processing, and disposing of garbage, including the use of equipment on-board
- Maintenance of a Garbage Record Book to record all disposal and incineration operations
- Avoidance of plastic waste dumping

Hazardous Waste

Ships may generate a variety of additional wastes that can potentially be classified as hazardous. These materials may include bilge sludge, mechanical maintenance solvents and waste oils, flourescent light ballasts and lamp bulbs (which may contain PCBs and mercury), lead-acid batteries, toxic paints and incinerator ashes. Recommended hazardous waste management strategies include:

- Reduction in the use of consumable materials to the extent feasible;
- Reduction in the volume of generated wastes. For example, a sludge de-watering unit may be used to minimize the volume of bilge sludge delivered ashore;
- Remaining materials should be segregated and safely stored on ship for disposal at a port-of-call with access to adequate hazardous waste management infrastructure.[34]
- Guidance applicable to the storage and management of hazardous waste is provided in the **General EHS Guidelines**.

Ship Breaking Wastes

Some ships, especially older vessels, can contain hazardous materials, including asbestos, polychlorinated biphenyls (PCBs), and chlorofluorocarbons (CFCs) and may also possess heavy metals (e.g. lead-containing paint). They also carry hazardous and flammable chemicals used for painting, repair, and maintenance. Even if the use of some substances are currently banned or restricted, they may be found in ships destined for scrapping. These materials present a potential occupational and environmental risk if handled by untrained workers and in locations that lack hazardous waste management infrastructure.

Recommendations to prevent, minimize, and control discharges, emissions, and human exposure to toxic wastes from scrapping of ships include:

- Ensuring that environmental issues are considered in the selection and specification of construction materials, coating systems, and other substances used in all ship parts, components, and equipment, over the complete product life cycle, including eventual disposal or recycling;
- Creating an inventory of potentially hazardous materials onboard that is documented and regularly updated in a "Green Passport" that follows the ship from owner to owner and facilitates safe final scrapping;
- When selecting ship breaking contractors, necessary procedures and guidelines should be specified, and decommissioning activities monitored to ensure scrapping is conducted in an environmentally sound manner, consistent with applicable standards and guidelines;[35]

[33] Refer to the Regulations for the Prevention of Pollution by Garbage from Ships, Annex V of MARPOL. 73/78

[34] Any waste classified as a "hazardous waste" should be managed accordingly, respecting applicable legal requirements and international conventions (e.g. Basel Convention on Transboundary Shipment of Hazardous Waste).

[35] See Secretariat of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships, Basel Convention series/SBC No. 2003/2, 2003; International Maritime Organization (IMO), Guidelines on Ship Recycling, Resolution A.962(23), 2003; and IMO Guidelines for Development of the Ship Recycling Plan, Circular 419, 2004.

1.1.2 Ship Maintenance

Dockside and drydock ship maintenance activities can vary signficantly in complexity, depending on the degree of repair and maintenance services performed and the types of ships serviced. Environmental issues typically encountered may include:

- Air emissions
- Wastewater and other effluents
- Waste management
- Hazardous materials management

Air Emissions

Volatile organic compounds (VOCs) may be emitted primarily from painting activities, especially when solvent-based paints are used. VOC emissions from painting activities should be minimized by selecting paints containing low levels of VOCs, and avoiding use of paint stripping agents with highly hazardous VOCs, such as methylene chloride.

Wastewater and Other Effluents

Water effluents from ship maintenance activities may include stormwater runoff contaminated with a variety fuels, lubricating oils, heavy metals (from stripped paints), and cleaning solvents. Management recommendations include:

- Conducting vessel maintenance work, including paint stripping and painting, in dry docks and preventing contaminated stormwater runoff by installing temporary or permanent roofs or tarps;
- In uncovered dry-docks, provision of a storm water capture system equipped with stormwater treatment, as appropriate (e.g. oil / water separators and sand filters), or discharge to sewerage system with an adequate trapping system (such as a sump) for extraction and subsequent removal. Dry-dock areas with the potential for releases of hazardous substances should be equipped with secondary containment as described in the **General EHS Guidelines**.

Waste Management

Hazardous or potentially hazardous waste may be associated with vessel and vehicle maintenance operations (e.g. used lubricating oils, stripped paint from hull maintenance, and painting and cleaning chemicals, including degreasing solvents, from hull and engine work). Recommended waste management strategies include:

- Ship hull painting and stripping should be conducted in dry docks whenever possible;
- Stripping wastes should be cleaned up immediately to reduce potential releases related to wind or stormwater;
- Chemical paint strippers based on methylene chloride should be avoided, or reused and recycled until their effectiveness is compromised, and they should then be disposed of in an environmentally sound manner;
- Water-based cutting oils and degreasers should be used wherever possible. If oil- or solvent-based materials must be used, they should be reused and recycled until their effectiveness is compromised;
- Waste containing asbestos or lead paint should be disposed of as hazardous waste in accordance with applicable regulations and guidelines.

Hazardous Materials Management

Vessel maintenance activities may include the use of potentially hazardous materials such as anti-fouling paints, solvents, and lubricants. Maintenance operations may also need to manage the contents of fuel tanks and oil insulating equipment. In addition to the hazardous materials management strategies

presented in the **General EHS Guidelines**, specific ship maintenance strategies include:

- Oil and chemical-handling facilities should be located with respect to natural drainage systems and environmentally-sensitive areas such as mangroves, corals, aquaculture projects, and beaches, providing physical separation distance whenever possible;
- During painting and stripping activities, shrouds should be used between the vessel and pier / shore to prevent spillage into the water. Spray techniques should be considered to minimize paint overspray;
- Anti-fouling paints should comply with applicable regulations and not present a threat to local fisheries or shellfish resources (refer to recommendations on "Antifouling Paints" presented above).
- Stripped paint that may contain hazardous compounds, as well as existing stocks of these paints, should be disposed of as hazardous waste as described in the **General EHS Guidelines**.

1.2 Occupational Health and Safety

1.2.1 Marine Operations

Specific occupational health and safety issues relevant to operation of ships primarily include the following:

- Crew accomodations and working spaces
- Physical hazards
- Confined spaces
- Chemical hazards (including risk of fire and explosions)
- Security issues

Crew Accomodations and Working Spaces

Due to the nature of most shipping activities, crew members may sometimes be required to spend considerable amounts of time aboard vessels, including overnight stays for extended periods. Ships also represent a peculiar working environment given the compartmentalized and compact nature of interior working and ammenity areas. Crew accomodations and working spaces should meet internationally applicable standards including those related to the provision of sanitary facilities, ventilation, heating and lighting, control of harmful noise, sanitation of galley areas, and fire prevention and control (e.g. smoke detectors, fire doors, and means of egress. For additional information refer to "Fire Safety" section below).[36]

Physical Hazards

The most common accidents in ships include slips and falls, manual handling accidents (e.g. lifting, setting down, pushing, pulling, carrying, or moving weight by hand), and machine operation accidents.[37] Recommendations to prevent, minimize, and control health and safety hazards associated with personnel accidents are discussed in the **General EHS Guidelines.** Examples of additional measures specific to ships include:

- Ensuring all seafarers are trained to manage the types of hazards applicable to their assigned responsibilities;[38]
- Providing adequate and appropriate first aid and medical facilities;
- Ensuring all seafarers wear shoes with slip-resistant soles at all times;

[36] See International Convention for the Safety of Life at Sea (SOLAS), 1974; International Labour Conference, Maritime Labour Convention, 2006; and International Labour Organization, Accident Prevention On Board Ship At Sea and In Port, 1996.
[37] K. X. Li, Maritime Professional Safety: Prevention and Legislation on Personal Injuries On Board Ships, Proceedings of the International Association of Maritime Economists (IAME) Panama 2002 Conference, November 2002. Available at: http://www.eclac.cl/Transporte/perfil/iame_papers/papers.asp
[38] For additional information refer to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978

- Regular inspection and maintenance of decks areas, including railings, catwalks, stairs, and other walking areas to prevent the existence of cracks, worn or missing parts, and other falling and tripping hazards;
- Decks and gratings should be kept clear of grease, garbage, and ice to avoid risk of slipping, and any spillage should be cleaned up immediately.

Confined Spaces

Activities on board may also include confined space entry (e.g. to inspect, repair, or clean tanks and cargo holds). As in any industry sector, confined space hazards can be potentially fatal. Ship 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 and fueling of combustion equipment in the interior of cargo holds and that provide for alternative means of egress.[39]

Chemical Hazards

Occupational chemical hazards associated with shipping may be associated with oil, fuels, and chemical tanker operations, particularly during loading and unloading activities. In addtion to potential exposures to chemicals by inhalation or dermal contact, there is also a signficant potential risk of fires and explosion. These types of shipping operations should prepare and implement detailed training and procedures to prevent or minimize chemical exposures, including through the application of chemical hazards management recommendations presented in the **General EHS Guidelines**. In addition to the recommendations provided above in the petroleum and hazardous material management section, tanker operations should prepare and implement safety management systems specific to the type of materials transported in accordance with internationally applicable standards.[40] Examples of management issues related to fire and explosion prevention and response include:

- Implementation of smoking and naked light regulations during materials transfer activities and hot work permits during ship maintenance;[41]
- Proper tank cleaning and venting, and operation, maintenance and inspection of inert gas systems;[42]
- Installation and maintenance of intrinsically safe electrical equipment;[43]
- Avoiding electrostatic hazards related to the buildup of static electricity;[44]
- Preparing a Tanker Emergency Plan to address the response to fires.[45]

Workers may also be exposed to chemical hazards during routine operations and maintenance activities, cargo handling (e.g. leaks or accidents involving dangerous cargo), and during ship breaking activities. Recommended management techniques include:

- Prevention of exposures through the implementation of occupational health and safety management programs and measures described in the **General EHS Guidelines** applicable to hazardous materials and chemical exposures;
- Preparation of emergency response procedures to address accidental release from packaged harmful substances (see Packaged Harmful Substances above);

[39] For additional guidance refer to the latest edition of the International Safety Guide for Oil Tankers and Terminals (ISGOTT).

[40] For examples refer to the latest edition of ISGOTT.
[41] For additional guidance refer to the latest edition of ISGOTT.
[42] Ibid.
[43] Ibid.
[44] Ibid.
[45] Ibid.

- Applying the special precautions and recommendations provided in the waste management section above (see Ship Breaking Wastes).

Security Issues

Piracy and armed robbery of vessels is a serious security and safety issue in some regions, posing a hazard to crew and passengers alike. Recommended measures to prevent, control, or minimize sea piracy include:[46]

- Implementation of a ship security plan emphasizing prevention and early detection of attacks and covering, at a minimum, the need for enhanced surveillance and detection equipment, and use of lighting; crew responses if a potential attack is detected or an attack is underway; radio alarm procedures; and reporting an attack / attempt;
- Securing or controlling all possible access points to the ship and any key onboard areas in port, at anchor, and when underway in threat areas. Doors allowing access to the bridge, engine room, steering gear compartments, officers' cabins, and crew accommodations should be secured, controlled, and regularly inspected;
- If possible, ships should be routed away from areas where attacks are known to have taken place and, in particular, seek to avoid bottlenecks;
- Ships should maintain a constant radio watch with appropriate shore or naval authorities, and on all distress and safety frequencies, especially in areas where attacks have occurred;
- Operators should implement additional watches and / or electronic surveillance to detect the approach of potential attackers;
- Operators should exercise caution when transmitting information on cargo or valuables on board by radio in areas where attacks have occurred;
- Crew members going ashore at ports in high risk areas should not discuss voyage or cargo particulars with persons unconnected with the ship's business.

1.2.2 Ship Maintenance

Occupational hazards typcially associated with ship maintenance activities may include physical, chemical, and biological hazards, as well as confined space entry hazards. Physical hazards may be associated with work at heights (including work above water in dockside maintenance activites) as well as machine, portable tool, and electrical sefety issues. Chemical hazards may include potential exposures to a variety of hazardous materials such as asbestos, PCBs, toxic paint, heavy metals, and VOCs (e.g. from the use of solvent-based paints and cleaning solvents in enclosed spaces). Other chemical hazards may include the potential for fire and explosion during the conduct of hot work in storage tank systems. Biological hazards may include potential exposures to pathogens present in ship garbage, sewage, and ballast water, the contents of which may still be present inside ships during maintenance activities. Confined spaces may include tanks and cargo holds that may need to be accessed for repair and maintenance. All of these occupational health and safety hazards, which apply equally to workers involved in ship maintenance and decommissioning activities, should be managed based on the recommendations provided in the **General EHS Guidelines** and in the guidelines outlined by the International Labor Organization (ILO).[47]

[46] IMO, Piracy and Armed Robbery Against Ships: Guidance to Shipowners and Ship Operators, Shipmastes and Crews on Preventing and Suppressing Acts of Piracy and Armed Robbery Against Ships, Circular 623/Rev 3, May 2002.

[47] Also refer to the recommendations on ship breaking activities described previously in this document.

1.3 Community Health and Safety

Some of the environmental and occupational health and safety impacts described above may also influence the health and safety of communities and members of the public including, for example the potential for transmission of communicable diseases through the dischage of ballast water; exposure to hazardous materials during ship breaking activities; or the risk of fire and explosion during fueling and bulk tankering activities. Additional issues may include the following:

General Safety

Accident scenarios, including sinking / capsizing of ships or fire and explosion have potential to result in significant casualties. Such scenarios may result from collisions, groundings, structural hull failures, and other events. The primary causes of such accidents may include human error, technical failures, inadequate maintenance, and severe weather conditions. Safety management recommendations depend on the type of ship and its intended use and may include:

- Purchasing ships that comply with the construction, subdivision, machinery, and electrical installations requirements;
- Management of the ship operation according to the provisions of the International Safety Management (ISM) Code, including the preparation of a formal, written, Safety Management System (SMS). The SMS should identify the assignment of roles and responsibilities, the resources available, and emergency procedures, among others.[48]

Life Safety

Operators should comply with internationally applicable requirements for life-safety applicance and arrangements which include the provision and operational upkeep of such equipment as lifeboats, life-rafts, and rescue boats, life-jackets and immersion suits, life buoys, and other life saving equipment.[49]

Fire Safety

Operators should also apply the fire safety provisions specifically applicable to cargo ships and tankers according to applicable international standards[50]. These may include, for example, division of the ship by thermal and structural boundaries; separation of accomodation spaces; restricted use of combustible materials; fire detection and containment at the place of origin; protection of escape routes; ready accessibility to fire fighting equipment; and avoidance of flammable and explosive atmospheres.[51] Fire prevention considerations specifically applicable to engine rooms include fire doors, fire pumps, and emergency fuel flow stopping devices.

Security

Operators should prepare and maintain a Ship Security Plan that includes assignment of roles and responsibilities (the Ship Security Officer); procedures to provide ship access screening and controls (requiring identification of visitors); training of crew members; procedures for communications between ships and ports, and other applicable elements.[52]

[48] As required by the SOLAS Convention. See also International Labour Conference, Maritime Labour Convention, 2006; and International Labour Organization, Accident Prevention On Board Ship At Sea and In Port, 1996.
[49] As noted in Chapter III of the SOLAS Convention and the International Life-Saving Appliance (LSA) Code.
[50] As noted in Chapter II of the SOLAS Convention, which includes specific provisions for each type of ship, and the International Fire Safety Systems (FSS) Code.
[51] Summary of SOLAS requirements, IMO.
[52] Additional details on the contents of a Ship Security Plan are presented in the IMO's Maritime Safety Committee Document 76/4/1/Add.1 "Measures to Enhance Maritime Security."

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

For ships engaged in national traffic only, environmental performance requirements are usually dictated by the flag state's maritime administration. Guideline values for process emissions and effluents in this sector are indicative of good international industry practice as reflected in relevant standards of countries with recognized regulatory frameworks. Ships engaged in international routes should also comply with environmental requirements set by international regulations, principally effluent standards for oil / grease and sewage as described in Annex I and IV of MARPOL, emissions standards for ozone depleting substances, and marine diesel engine emissions and shipboard incinerator emissions described in Annex VI of MARPOL. Other regional regulations (e.g. European Union Directives) and specific port state regulations, as well as more stringent requirements, may apply in some specifically defined sea areas.

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**.[53]

2.1 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®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[54] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[55] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[56] Indicative Occupational Exposure Limit Values published by European Union member states,[57] 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

[53] For additional information refer to the Oil Companies International Marine Forum for additional information on key performance indicators used in this industry sector.
[54] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[55] Available at: http://www.cdc.gov/niosh/npg/
[56] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)[58].

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[59] as part of an occupational health and safety monitoring program. Operations 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**.

Operators should also consider the implementation of a monitoring program specifically developed by industry groups such as the Oil Companies International Marine Forum (OCIMF).[60]

[57] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/
[58] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm
[59] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.
[60] For additional information refer to the Tanker Management Self Assessment program developed by OCIMF (http://www.ocimf.com/)

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Annex A: General Description of Industry Activities

The shipping industry involves a number of entities specialized for various functions including ownership, freight contracting, operation, and management. Vessels are generally constructed of steel and typically operate for 7,000 hours / year for 20 to 25 years. Regular dry-docking intervals for maintenance and overhaul may range from two to five years. Ship breaking (the process of dismantling a vessel's structure for scrapping, disposal, or recycling) is labor intensive and associated with a number of environmental, health, and safety hazards. Shipping companies are responsible for crew and cargo safety during operation.

Shipping operations depend on port, harbor, and terminals infrastructure and services for the movement of cargo. Examples of these services include port traffic control, cargo storage and handling, passenger screening for security purposes, waste management, and mechanical maintenance services. A port may offer ship support services such as waste management, 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.

Power for propulsion of the ship and auxiliary energy is typically generated by diesel engines. Heavy fuel oil (HFO), Marine Diesel Oil (MDO), and gas oil (GO) are carried in bunker tanks. Alternate powering arrangements are possible, including those associated with LNG ships that may include Boiler / Steam Turbine power with HFO / natural gas burning equipment or Dual Fuel (DF) diesel engine-electric propulsion. Other supplies required for the operation of the ship include lubrication oil, hydraulic fluids, chemicals, paint, fresh water, and food supplies for the crew.

Shipping companies may also conduct ship repair and maintenance activities which can be conducted dockside or on drydock, depending the nature of the repair. These activities may include structural modifications, mechanical repairs including engine overhauls, and hull repair and painting.

Summary of Vessel Categories and Functions

- **Wet bulk**: Transported in tankers, including three main sub-categories:
  - *Crude carriers:* Length 250–450 meters (m), speed 12-16 knots. Four main size classes: Aframax, up to 120 000 dwt (deadweight tons), Suezmax, up to 150 000 dwt; VLCC (Very Large Crude Carrier) more than 200 000 dwt; and ULCC (Ultra Large Crude Carrier) more than 350 000 dwt.
  - *Gas tankers*: Length 80-345 m, speed 14-20 knots. Two main types: LNG (Liquefied Natural Gas) transported pressurized and / or refrigerated at –160°C, and LPG (Liquefied Petroleum Gas) transported at –50°C.
  - *Product tankers*: Length 80–150 m, speed 13-17 knots. Transport refined oil products or chemicals. One ship may carry different products in separate tanks.
- **Dry bulk**: Transported in bulk carriers:
  - *Ocean-going bulk carriers*: Length 200-300 m, Speed 11-16 knots, Panamax and Capesize.
  - *Coasters*: Length 70-120 m, Speed 10-15 knots.
- **Container** – Transported by container vessels, two main sub-categories:

- *Ocean-going vessels*: Length 220–370 m, speed 17-26 knots. A limited number of large shipping companies operate approximately 100 large vessels. The largest, the Post-Panamax vessels, carry up to 8,000 twenty-foot equivalent units (TEU).
- *Feeder vessels*: Length 80-120 m, speed 13-17 knots. Container capacity 250-600 TEU.

- **General cargo:** In addition to general cargo ships the following types of cargo are transported by specialized vessels:
  - *Roll-on Roll-off (RoRo):* Length 120–240 m, speed 16-22 knots.
  - *Reefers:* For refrigerated cargo. Length 100–200 m, speed 17-26 knots.
  - *Car carriers*: Length 120–200 m, speed 19-22 knots.