PART-I

TECHNICAL STANDARDS TO PREVENT SHIP SOURCE POLLUTION

CHAPTER -2

TECHNICAL MEASURES TO PREVENT SHIP SOURCE POLLUTION

Shipping is a global industry. Merchant ships are used for carrying passengers and also for transporting various types of cargo across the world. Accordingly, they are classified as passenger ships, tankers, bulk carriers, reefer cargo ships etc. As stated in the previous chapter, all merchant ships and passenger ships which are undertaking international voyages, irrespective of their type, are designed, constructed, and their equipments installed and maintained as per the International Convention SOLAS-74 and national laws. The flag Administrations or their Recognized Organizations (Classification Societies) ensure that the ships and their equipments are constructed as per the above said rules. However, when the Flag Administration authorizes any of the classification society who is a member of the IACS, the society does the job on behalf of the Administration. The classification societies have their own rules based on the international conventions, national laws and rules of IACS. Even otherwise, all merchant ships are classed under any one of the international or national Classification Society for commercial reasons. Classification society ensures that the ships are designed and constructed with utmost care, particularly for the safety, sea worthiness and for the prevention of pollution from them. Further, the various equipments including those mandatory ones specially installed onboard for the prevention of pollution are tested and certified by the Classification Society/Administration. In order to maintain the ships in safe and sea worthy condition, it is necessary that initial surveys are carried out and necessary statutory and class certificates are issued. Thereafter, subsequent/periodical surveys and tests and inspections are also carried out by the Administration/ Classification society and the certificates are kept up to date.

In this chapter, an attempt has been made to find out whether the existing technical standards provided, at the national and international level, for the design and construction of different types of ships, and for the mandatory equipments provided on board for maintaining the sea worthiness of the ships and to prevent the pollution from them have helped in the reduction of pollution over the years. The pollution caused from the ships in the past few years is also forced to think who is at fault – is it the ship owner who is not maintaining the ships properly or the classification society, who is supposed to inspect

the ship on a continuous basis during the construction and thereafter at periodical intervals during the operation cycle, is not doing their jobs properly. In both the above said cases, the ship becomes a sub- standard one or a rust bucket as it is usually called in the shipping industry. These sub-standard ships are invariably found to be the main culprits for causing the pollution.

From the experience gained over the past many years, the classification societies like RINA and DNV have improvised their rules by introducing environmental management system within their rules for making the ships more environmental friendly and have started assigning new additional notations like "CLEAN SEA", "CLEAN AIR" and "GREEN STAR -3" etc. The design and system requirements for assigning the above said notations are also dealt with towards the end of this chapter. Green ship technologies tried out by different countries to make green ships in future are also discussed in the end.

In order to understand the various requirements of the technical standards for the Design, Construction, Equipment and Manning (generally they are called the CDEM standards) governed by the various regimes, it is necessary to study them separately and in detail.

2.1 Requirements of the Classification Society for the design and construction of ships:

In order to comply with the commercial and the legal requirements, it is mandatory that all ships, especially all merchant vessels, are designed and built as per the rules of any one of the members of the International Association of Classification Societies (IACS)or by any national classification society, like for example Indian Register of Shipping in India. The rules published by the society give the requirements for the assignment and maintenance of 'Class' for sea going ships. The classification consists of i) the development of Rules, guidance notes and other documents relevant to the ship, structure, material, equipment, machinery and any other items covered by such documents ii) the examination of plans and calculations and the surveys, checks and tests intended to ensure that the ship meets the Rules iii) the periodical, occasional and class renewal surveys performed to verify that the ship in service meets the conditions for maintenance of class[1].

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1. RINA Rules for the classification of ships, 2007 edition

Where defects are found further to an inspection by an Administration in pursuance of Port State Control or similar programmes, the classification society performs an occasional survey in order to verify that the deficiencies are rectified and/ or the necessary repair work is carried out within due time.

2.1.1 Main class symbol, construction marks, and other service notations:

All ships are assigned a main class symbol "C" which expresses the degree of compliance of the ship with the Rule requirements as regards its construction and maintenance and is given to a ship only when the hull, propulsion and auxiliary machinery installations, and equipment providing essential services have all been reviewed in relation to the requirements of the Rules. This main class symbol is compulsory for every classed ship and the period of class assigned to a ship is maximum 5 years. Besides, a construction mark with additional class notations is also assigned to all ships which identifies the procedure under which the ship and its main equipment or arrangements have been surveyed for initial assignment of the class. Ships are also given at least one service notation which defines the type and/or service of the ship. Every classed vessel is also assigned one navigation notation clearly showing its area of operation like "unrestricted navigation", "tropical zone", "coastal area", "sheltered area" etc. Bulk carriers, ore carriers, combination carriers and ships carrying liquid cargo in bulk (oil tankers, chemical tankers and liquefied gas carriers) are submitted to Enhanced Survey Programme (ESP)[2].

2.1.2 Procedure to be followed during construction of a ship to make it sea worthy and pollution free:

Before taking into class, during construction itself, the Society ensures that the ships classed with them are complying with those requirements of the Rules which are in force and applicable depending on the class of the ship and the procedure includes approval of plans and documents, appraisal of the design of the materials and equipment used for the construction of the ship and their inspection at work sites, obtaining of appropriate evidence by conducting surveys to satisfy that the scantlings and construction meet the rule requirements in relation to the approved drawings, attending tests and trials and finally assigning the construction mark.

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2. RINA Rules for the classification of ships, 2007 edition.

2.1.3 Use of materials, machinery, appliances and items:

In order to ensure the sea worthiness, safety and pollution free, all materials, machinery, auxiliary installations, equipment, items etc. which are covered by the class and used or fitted on board ships surveyed by the Society during construction are to be new and, where intended for essential services, tested by the Society. In particular, the testing of products manufactured according to quality assurance procedures approved by the Society and the approval of such procedures are governed by the requirements of the Rules. The Society may, at any time, reject items found to be defective or contrary to rule requirements or require supplementary inspections and tests and/or modifications, notwithstanding any previous certificates issued. The materials and equipment used for conversions, alterations or repairs are generally to meet the requirements the Rules.

2.1.4 Initial surveys and issue of Mandatory Class and Statutory certificates:

After construction of the ships as per the strict rules of the Society, initial surveys are done by the Society and Class certificates are issued to the ships. After the initial surveys, the Statutory certificates are also issued to the ships by the Flag Administration or by the Society duly authorized by the Administration as the case may be.

2.1.5 Measures taken for the Maintenance of Ships:

Classed ships are submitted to surveys for the maintenance of class. Maintenance of the class in other way means maintaining the ship in sea worthy and pollution free condition. These surveys include the class renewal survey, intermediate and annual survey, bottom survey, tail shaft survey, and surveys for the maintenance of additional class notations, where applicable. In addition to the above periodical surveys, ships are to be submitted to occasional surveys whenever the circumstances so require. Where the conditions for the maintenance of main class, service notations and additional class notations are not complied with, the main class and/or the service notation and/or the additional class notations as appropriate are suspended and/or withdrawn in accordance with the applicable Rules.

2.1.6 Periodical surveys:

The following surveys are carried out on board all vessels for maintaining the class as well as the sea worthy condition of the vessel. For oil tankers, chemical tankers, OBOs, bulk carriers and all other vessels having ESP notations, special surveys are also carried out. Even a ship put out of commission or laid up for a longer period, periodical surveys have to be carried out to keep the class alive.

2.1.7 Class Renewal surveys:

Class renewal surveys are done for Hull and Machinery on completion of the class validity period of 5 years.

2.1.8 Annual surveys:

In the five-year period of class, in order to ensure the maintenance of the technical standard, five annual surveys are to be carried out for the inspection of both hull and machinery of the ship as per the Rules of the society. These surveys are to be carried out within the window period provided by the society and the class certificates are endorsed to keep the class of the ship alive.

2.1.9 Intermediate surveys:

In addition to annual surveys, an intermediate survey for both hull and machinery is to be carried out within the window from three months before the second to three months after the third anniversary date. Detailed inspections of both hull and machinery are carried out during this survey. The intermediate survey is applicable to all types of ships.

2.1.10 Bottom survey:

Bottom surveys are carried out for the examination of the outside of the ship's bottom and related items to maintain the seaworthiness and to prevent pollution. This examination may be carried out with the ship either in dry dock (or on a slipway) or afloat. There should be a minimum of two examinations of the outside of the ship's bottom and related items during each five year class renewal survey period. One such examination is to be carried out in conjunction with the class renewal survey. In all cases the interval between any two such examinations is not to exceed 36 months. For ships with ESP notation exceeding 15 years of age, such examinations are to be carried out with the ship in dry dock[3]. For ships with the ESP notation, a bottom survey in dry condition is to be part of the class renewal survey.

2.1.11 Thickness measurements:

Ships are subjected to corrosion and wastage of material occurs in due course. Hence, thickness measurements of the hull plates and other areas are to be carried out by firms approved by the society, normally by using ultra sonic test equipments, for the maintenance of class during annual, intermediate and class renewal surveys, and the analysis of these measurements is a prominent factor in the determination and extent of

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3. RINA Rules for the Classification of Ships, 2007 edition.

repairs and renewals of the ship's structure. For this, systematic thickness measurements are taken at many points on the ship as per the procedure detailed in the Rules in order to assess the overall and local strength of the ship. Where substantial corrosion is found, the extent of thickness measurements are increased to the surveyor's satisfaction. From the measurements taken, the buckling strength and the longitudinal strength are worked out. The ship's longitudinal strength is also evaluated by using the thickness of structural members measured, renewed and reinforced, as appropriate, during the class renewal survey carried out after the ship reached 10 years of age[4].

2.2 National Requirements:

In addition to meeting all the class requirements, all the Indian vessels have to meet the following national requirements prescribed by the Government of India during the design and construction for the safety and prevention of pollution from them.

2.2.1 Merchant Shipping Act- 1958:

The Merchant Shipping Act, 1958 prescribes the construction requirements of the ships[5]. As per M.S Act, the Central Government may make rules for the construction of passenger and cargo ships prescribing the requirements for the hull, equipment and machinery. Further, it states that the rules thus made shall include such requirements as appear to the Central Government to implement the provisions of the Safety Convention adopted by IMO for the safety, seaworthiness and pollution prevention of the ships. The Central Government is empowered as per section (iii) to prescribe the necessary requirements. The MS Act is very old and is mainly based on the UK Law on Merchant Shipping, 1931. Hence, the basic structure of the law as visualized by the 1958 Act has, therefore, been similar to that of the Commonwealth countries with, of course, certain essential modifications where special arrangements to suit Indian conditions were considered necessary. The main draw back is that the relevant sections of the MS Act regarding the construction requirements are applicable only to ships registered in India or only while any vessel is within India, including the territorial waters thereof. It may also be seen that the requirements prescribed by M.S Act are not detailed out.

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4. See supra note 3.
5. Section 284 of Merchant Shipping Act-1958 from the official website of DG Shipping.

2.2.2 Merchant Shipping (Construction and Survey of Passenger Ships) Rules, 1984:

The requirements of passenger ships for the safety, seaworthiness and pollution prevention are different from that of cargo vessels. These Rules are applicable to all sea going passenger ships and describe in detail the various technical measures related to the structural strength, water tight subdivisions, peaks, bulk heads, machinery space, double bottom tanks, construction and testing of water tight bulk heads, water tight decks, watertight doors, fore peak tank and deep tanks, water tight tunnels, means of opening and closing of water tight bulk heads, and subdivisions and stability[6] which are to be considered while constructing all sea going passenger ships for the prevention and control of pollution from ships.

2.2.3 The Merchant Shipping (Cargo Ship Construction and Survey) Rules, 1991:

These Rules are applicable to all sea-going cargo ships of 500 tons gross or more, registered in India. The provisions of this Rules, except Chapter 3, and Part III applies to all cargo ships of Class I (Indian Cargo ships engaged on international voyages) and Class II (Indian Cargo ships other than ships of Class III no engaged on international voyages) and the provisions of Chapter 3 applies to cargo ships Class I and Class II having periodically unattended machinery spaces. The Rules describe the requirements of structural strength of a cargo ship and the requirements of collision bulkheads. The construction and testing of water tight bulkheads and decks, tunnels, duct keels, ventilators and the construction and testing of water tight doors are also elaborated in detail under the Rules[7]. The Act further stipulates the following requirements.

Chapter III describes in detail about the special requirements for periodically unattended machinery spaces. Under Part III of Chapter II, the special requirements for the tankers are given. All the regulations stated in these rules are in line with the IMO international convention SOLAS, 74.

It may be seen that the national laws of India for the design and construction of ships are not complete by themselves. Hence, India, being a party to the conventions of IMO, has also been using the following international laws and regulations as technical

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6. Rules 4 to 28 of Merchant Shipping (Construction &Survey of Passenger Ships) Rules, 1984.
7. The Merchant Shipping (Cargo ship construction& surveys) Rules, 1991-from DG shipping website.

standards for construction of Indian ships.

B - International Requirements:

2.3 Requirements of International Association of Classification Societies (IACS):

IACS makes a unique contribution to maritime safety and regulation through technical support, compliance verification and research and development. More than 90 percentage of the world's cargo carrying tonnage is covered by the classification design, construction and through-life compliance Rules and standards set by the ten Member Societies and one Associate of IACS. IACS has made the Common Structural Rules (CSR) for Bulk Carriers, Common Structural Rules for Double Hull Oil Tankers and Standard for Protective Coatings. Unified Requirements are minimum requirements. Each Member and Associate remains free to set more stringent requirements. These rules are mandatory for all vessels whose length is more than 90 metres[8] and are meant for the sea worthiness and pollution prevention.

IACS recommends that shipbuilders, equipment manufacturers and ship owners' work towards excluding principal hazardous materials through design and replacement, and that new ship should be delivered with statements from the shipyards/manufacturers that the ship and its equipment are free of such hazards. As part of their statutory duties as an Recognized Organization (RO), IACS members will check the ship builders, and/or component manufacturer's statement which declares that a ship or component is free of certain hazards for issuance of a relevant certificate or statement of fact. All the above measures taken will enable to construct green ships in the future.

2.4 MARPOL 73/78 Requirements:

The most important international convention on Marine Pollution is IMO Convention MARPOL 73/78. This had replaced the OIL POL 54 convention. One of the most important modifications brought out by this convention is the requirement of Segregated Ballast Tanks (SBT) on board all new tankers[9] over 70,000 deadweight tones, to ensure that ballast water does not get contaminated by oil carried as cargo or fuel.

2.4.1 1978 Protocol of MARPOL 73/78:

This Protocol expanded the requirements for SBTs to all new crude oil tankers of

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8. From the official website of IACS (www.iacs.org.uk). The Rules for the oil tankers are due for change with effect from 1st April, 2007.
9. New vessels were those for which building contract was placed after 31 December 1975, or whose keels were laid after 30 June 1976, or were delivered after 31 June 1979.

20,000 tonnes deadweight and above and to all new product carriers of 30,000 tonnes deadweight and above. The Protocol also required segregated ballast tanks to be protectively located, in other words, placed in areas of the ship where they will minimise the possibility of oil outflow from cargo tanks after a collision or grounding. Further, new tankers over 20,000 tonnes deadweight were also required to be fitted with Crude Oil Washing system (COW). This reduces the quantity of oil cargo remaining on board after discharge. The Protocol also called for existing tankers over 40,000 tonnes deadweight to be fitted with either segregated ballast tanks or crude oil washing systems; while for an interim period, it also allowed for some tankers to use Clean Ballast Tanks (CBTs), whereby specific cargo tanks are dedicated to carry ballast water only.

Additional measures for tanker safety were incorporated into the 1978 Protocol and to the International Convention for the Safety of Life at Sea (SOLAS), 1974. These included the requirement for Inert Gas Systems on all new tankers over 20,000 tonnes deadweight and specified existing tankers. The SOLAS Protocol also included requirements for steering gear of tankers; stricter requirements for carrying of radar and collision avoidance aids; and stricter regimes for surveys and certification. Both the 1978 MARPOL and SOLAS Protocols were seen as major steps in raising construction and equipment standards for tankers for pollution prevention through more stringent regulations.

2.4.2 The 1984 amendments to MARPOL 73/78:

The first amendments to MARPOL 73/78 were adopted in 1984, which entered into force in 1986. They were designed to improve and strengthen existing provisions, such as Regulation 25 concerning subdivision and stability - intended to ensure that tankers can survive assumed damage. The 1984 MARPOL amendments also banned the carriage of oil in the forepeak tank - the ship's most vulnerable point in the event of a collision.

2.4.3 The 1992 Amendments to MARPOL 73/78:

The 1992 Amendments made it mandatory for all tankers of 5000 deadweight and more ordered after 6th July, 1993 to be fitted with double hulls, or an alternative design approved by IMO[10] to prevent or reduce the environmental impact in case of accidents/grounding. The requirement for double hulls that applies to new tankers has also been applied to existing ships under a programme that began in 1995[11]. The

Amendments also stated that all tankers would have to be converted or taken out of service when they reached a certain age (up to 30 years old).

1992 Amendments introduced a new chapter in Annex-1, requiring oil tankers and other ships to carry a Shipboard Oil Pollution Emergency Plan (SOPEP) detailing the procedure to be followed in reporting an oil pollution incident, authorities to be contacted in the event of an oil pollution incident, a description of the action which must be taken and the procedures and point of contact on the ship for co-coordinating shipboard actions with national and local authorities.

In September 1997, the Marine Environmental Protection Committee (MEPC) adopted a new Regulation 25A to Annex 1, specifying intact stability criteria for double hull tankers. The amendments, which entered into force on 1st February, 1999, were deemed necessary after experience had shown that a small number of double hull tankers were being constructed without enough bulkheads to maintain stability.

In October, 2000 IMO agreed on the first, formal step towards a global timetable for the accelerated phasing-out of single-hull oil tankers. The approval paves the way for the adoption of a revised regulation 13G of MARPOL at in April 2001 to accommodate the swiftest possible introduction of new rules and ship's are classified into the following three categories.

- Category 1 oil tanker means oil tankers of 20,000 tonnes deadweight and above carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of 30,000 tonnes deadweight and above carrying other oils, which do not comply with the requirements for protectively located segregated ballast tanks (commonly known as Pre-MARPOL tankers).

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10. Regulation 13F in Annex I of MARPOL 73/78 and Regulation 19 in the revised Annex I which entered into force on 1st January, 2007.
11. Regulation 13G in Annex I of MARPOL 73/78 and regulation 20 in the revised Annex I which entered into force on 1st January, 2007.

- Category 2 oil tanker means oil tankers of 20,000 tonnes deadweight and above carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of 30,000 tonnes deadweight and above carrying other oils, which do comply with the protectively located Segregated ballast tank requirements (MARPOL Tankers).

- Category 3 oil tanker means an oil tanker of 5,000 tonnes deadweight and above but less than the tonnage specified for Category 1 and 2 tankers.

The revision has set out two clear alternative schemes, A and B, for phasing-out single-hull tankers. Both schemes would see Category 1 vessels phased-out progressively between 1st January, 2003 and 1st January 2007, depending on their year of delivery. Category 2 tankers built in 1986 or earlier would be phased out after their 25th year of operation under both schemes, but Category 2 ships built after 1986 would be phased out between 2012 and 2015 under Alternative A and between 2012 and 2017 under Alternative B. For Category 3 tankers, both schemes entail progressive phasing out of tankers built in or before 1987 phased-out between 2003 and 2013, but ships built after 1987 would be phased out between 2013 and 2015 for ships under scheme A and between 2013 and 2017 under scheme B.

Under the revised regulation, the Condition Assessment Scheme (CAS) is applicable to all single-hull tankers of 15 years, or older. The working group also agreed that continued operation of Category 2 oil tankers beyond 2010 should only be permitted to high quality ships that had been subject to a Condition Assessment Scheme (CAS). There was general agreement at the meeting that phasing-out of single-hull tankers should be seen as just one of several measures needed to help eliminate sub-standard tankers which are liable to cause pollution.

In a related development, IMO's MEPC held a Research and Development Forum in March, 2002, which focused primarily on response to spills of high-density oil. France hosted the forum, which was the third R&D Forum sponsored by IMO. High-density fuel oils, or heavy fuel oil, such as that carried by the vessel **"Erika"**, are among the most difficult and most costly to deal with when spilled because of their highly persistent nature and the damage they cause to the marine environment.

2.4.4 Accelerated phase-out for single-hull tankers:

Under the revised regulation 13G (regulation 20 in the revised Annex I which entered into force on 1st January, 2007) of Annex I of MARPOL, the final phasing-out date for Category 1 tankers (pre-MARPOL tankers) was 2005. The final phasing-out date for category 2 and 3 tankers (MARPOL tankers and smaller tankers) was brought forward to 2010, from 2015.

The amendments, which entered into force on 3 March 1996, are also applied to Annex II, which is concerned with pollution by noxious liquid substances; Annex III, containing regulations for the prevention of pollution by harmful substances in packaged form; and Annex V, which deals with garbage. Similar amendments were made to the SOLAS, 1974 in May, 1995. A number of IMO Conventions contain provisions for Port State Control inspections but previously these have been limited primarily to certification and the physical condition of the ship and its equipment. Extending port State control to operational requirements was seen as an important way of improving the efficiency with which international safety and anti-pollution treaties are implemented.

Independent Rules Adopted by United Nations and European Communities:

Independent of MARPOL 73/78 Convention, United Nations and European countries made their own regulations and implemented in their areas for the prevention and control of pollution from ships. Some of them have later acknowledged and adopted by MARPOL as well. These are described in brief below.

2.5 Oil Pollution Act-1990 (OPA 1990):

In March 1989, the **Exxon Valdez**, loaded with 1,264,155 barrels of crude oil, ran aground in the north-eastern portion of Prince William Sound, spilling about one-fifth of its cargo. It was the largest crude spill in US waters and - probably the one that gained the biggest media coverage. The United States introduced its Oil Pollution Act of 1990 (OPA 90), making it mandatory for all tankers calling at U.S ports to have double hulls[12]. The amendments introducing double hulls (or an alternative) were contained in Regulation 13F, adopted in March 1992 and entered into force in July 1993. Regulation 13F applies to new tankers -defined as delivered on or after 6 July 1996 - while existing

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12. Please refer OPA Act,1990.

tankers must comply with the requirements of 13F not later than 30 years after their date of delivery.

Further, tankers of 5000 deadweight and above are to be fitted with double bottoms and wing tanks extending the full depth of the ship's side. The regulation allows mid-deck height tankers with double-sided hulls, such as those developed by Japanese and European shipbuilders, as an alternative to double hull construction. Oil tankers of 600 deadweight and above but less than 5,000 deadweight are to be fitted with double bottom tanks and the capacity of each cargo tank is limited to 700 cubic metres, unless they are fitted with double hulls. The Marine Environmental Protection Committee (MEPC) also adopted Regulation 13G, concerned with existing tankers, which makes provision for an enhanced programme of inspections to be implemented, particularly for tankers more than five years old. Regulation 13G also allowed for future acceptance of other structural or operational arrangements - such as Hydrostatic Balance Loading (HBL)[13] - as alternatives to the protective measures in the Regulation. The MEPC also adopted amendments to MARPOL drastically reducing the amount of oil which can be discharged into the sea as a result of routine operations, by forbidding non-tankers to discharge oily wastes if the oil content exceeds 15 parts per million and permitting tankers to discharge oily mixtures only at a rate of 30 litres per nautical mile (and only outside special areas). In November 1994, the MEPC adopted amendments to MARPOL aimed at improving implementation of the Convention, by making it possible for ships to be inspected when in the ports of other Parties to the Convention, to ensure that crews are able to carry out essential shipboard procedures relating to marine pollution prevention.

2.6 European Community (EC) Requirements:

Regulation (EC) 3051/95 on the safety management of roll-on/roll-of passenger ferries was adopted on December, 1995. It implied an early application of the ISM (International Safety Management) code as from 1st July, 1996 by all companies operating regular Ro-Ro passenger ferry services in the European Union. In March, 1998, **Directive 98/18/EC** came into force harmonising safety standards for all new and

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13. Hydrostatic balance loading (HBL) is based on the principle that if a hull is breached, the pressure from outside would be greater than that from the oil inside so seawater would flow in, pushing the oil upwards through non-return valves into ballast tanks; rather than an outflow of oil into the sea.

existing passenger vessels and high speed craft engaged on domestic voyages. In December, 2004, under the Committee procedure on Safe Seas and the Prevention of Pollution from Ships (COSS), **Directive 2003/25** of the European Parliament and of the Council on specific stability requirements for Ro-Ro passenger ships was modified.

2.7 European Communities (Minimum requirements for vessels carrying dangerous or polluting goods) (Amendment) Regulations, 1998:

These Regulations give effect to Commission Directive 96/39/EC of 19 June, 1996 and Commission Directive 97/34/EC of 6 June, 1997, both of which amend Council Directive 93/75/EEC concerning minimum requirements for vessels bound for or leaving European Community ports and carrying dangerous or polluting goods. These Regulations also amended the European Communities (Minimum Requirements for Vessels Carrying Dangerous or Polluting Goods) Regulations, 1995.

Additional Requirements of IMO for specialized tankers:

2.8 The International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code):

The Code provides an international standard for the safe carriage, in bulk by sea, of dangerous chemicals and noxious liquid substances listed in chapter 17 of the Code and prescribes the design and construction standards of ships, regardless of tonnage, involved in such carriage and the equipment they shall carry to minimize the risk to the ship, its crew and the environment, having regard to the nature of the products involved. The Code applies to ships regardless of size, including those of less than 500 gross tonnage, engaged in the carriage of bulk cargoes of dangerous chemicals or noxious liquid substances (NLS). Liquids covered by the Code are those having a vapour pressure not exceeding 0.28 MPa absolute at a temperature of 37.8°C.

The conditions of the ship and its equipment are to be maintained to conform with the provisions of the Code to ensure that the ship will remain fit to proceed to sea without danger to the ship or persons on board or without presenting an unreasonable threat of harm to the marine environment[14].

2.8.1 Ship survival capability and location of cargo tanks:

Ships, subject to the Code, shall survive the normal effects of flooding following

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14. IBC Code (International Convention-IMO).

assumed hull damage caused by some external force. In addition, to safeguard the ship and the environment, the cargo tanks of certain types of ships are protected from penetration in the case of minor damage to the ship resulting, for example, from contact with a jetty or tug, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the ship's shell plating. Both the assumed damage and the proximity of the cargo tanks to the ship's shell are dependent upon the degree of hazard presented by the products to be carried. Ships subject to the Code are designed mainly belonging to three classes – type 1, type 2 and type-3 depending on the hazards of the products the ship carries.

2.8.2 Shipside discharges below the freeboard deck:

The IBC Code has made provision for control of valves fitted to discharges led through the shell from spaces below the freeboard deck or from within the super-structures and deck-houses on the freeboard deck fitted with weather tight doors meeting the requirements of the relevant regulation of the Convention on Load Lines in force. IBC Code also prescribes the location of cargo tanks for different types of ships.

2.8.3 Ship arrangements - Cargo segregation:

Tanks containing cargo or residues of cargo subject to the Code are segregated from accommodation, service and machinery spaces and from drinking water and stores for human consumption by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, oil fuel tank or other similar space. Cargo piping is not taken through any accommodation, service or machinery space other than cargo pump-rooms or pump-rooms. Cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes, residues or mixtures are segregated from such other cargoes by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible cargo. The cargo piping systems or cargo ventilation systems are separated, by the use of design or operational methods. Cargoes subject to the Code shall not be carried in either the fore or aft peak tank.

An International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk is issued after an initial or renewal survey to a chemical tanker engaged in international voyages which comply with the relevant provisions of the Code. The Certificate should be kept on board in valid condition for examination, at all times.

2.8.4 Ship's cargo hoses:

In order to prevent pollution, hoses subject to tank pressure or the discharge pressure of pumps are designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer. For cargo hoses installed on board ships on or after 1st July, 2002, each new type of cargo hose, complete with end-fittings, are prototype-tested at a normal ambient temperature with 200 pressure cycles from zero to at least twice the specified maximum working pressure. Thereafter, before being placed in service, each new length of cargo hose produced is hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure but not more than two-fifths of its bursting pressure.

2.8.5 Materials of construction, protective linings and coatings:

The Code prescribes the quality of the structural materials (steel) used for tank construction, together with associated piping, pumps, valves, vents and their jointing materials and they shall be suitable at the temperature and pressure for the cargo to be carried in accordance with recognized standards.

2.8.6 Cargo tank gas-freeing:

In order to prevent air pollution due to cargo vapours, the arrangements for gas-freeing cargo tanks used for cargoes, other than those for which open venting is permitted, is designed to minimize the hazards due to the dispersal of flammable or toxic vapours in the atmosphere and to flammable or toxic vapour mixtures in a cargo tank.

2.8.7 Vapour detection:

Ships carrying toxic or flammable products or both are equipped with at least two instruments designed and calibrated for testing for the specific vapours in question.

2.8.8 Overflow control:

The provisions of this section are in addition to the requirements for gauging devices. In the event of a power failure on any system essential for safe loading, an alarm shall be given to the operators concerned. Loading operations are terminated at once in the event of any system essential for safe loading becoming inoperative. The high-level alarm is independent of the overflow-control system. Cargo tanks are fitted with a visual and audible high-level alarm which indicates when the liquid level in the cargo tank approaches the normal full condition.

2.8.9 Operational requirements-Maximum allowable quantity of cargo per tank:

The tanks of type 1 ship and in a type 2 ship are designed in such a way that the maximum allowable cargo to be carried in any one tank of those ships should not exceed 1,250 m^3 and 3,000 m^3 respectively. Cargoes which evolve highly toxic imperceptible vapours are transported only after perceptible additives are introduced into the cargo.

2.8.10 Personnel training:

IBC Code stipulates that all personnel are to be adequately trained in the use of protective equipment and have basic training in the procedures appropriate to their duties necessary under emergency conditions. Personnel involved in cargo operations are to be adequately trained in handling emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them shall be instructed and trained in essential first aid for cargoes carried, based on the guidelines developed by the Organization.

2.9 International Gas Carrier Code (IGC Code) for the gas carrier ships:

The Code made by IMO for the gas carrier ships applies to all ships regardless of their size, including those of less than 500 tonnes gross tonnage, engaged in the carriage of liquefied gases having a vapour pressure exceeding 2.8 bar absolute at a temperature of 37.8°C, when carried in bulk[15]. A ship, irrespective of the date of construction, which is converted to a gas carrier on or after 1st July, 1998 should be treated as a gas carrier constructed on the date on which such conversion commences. When cargo tanks contain products for which the Code requires a type 1G ship, no flammable liquids having a flashpoint of 60°C (closed cup test) or less should be carried in tanks located within the protective zones described in Rules. Similarly, when cargo tanks contain products for which the Code requires a type 2G/2PG ship, the above-mentioned flammable liquids should not be carried in tanks located within the protective zones. In each case the restriction applies to the protective zones within the longitudinal extent of the hold spaces for the cargo tanks loaded with products for which the Code requires a type 1G or 2G/2PGship. The above-mentioned flammable liquids and products may be carried

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15. Unless expressly provided otherwise, the Code applies to ships the keels of which are laid on or after 1st July, 1998. Ships constructed before 1st July, 1998 are to comply with resolution MSC.5(48) adopted on 17th June, 1983 subject to amendments by resolution MSC.30(61) adopted on 11th December,1992.

within these protective zones when the quantity retained in the cargo tanks of products for which the Code requires a type 1G or 2G/2PG ship is solely used for cooling, circulation or fuelling purposes[16].

2.9.1 Ship survival capability and location of cargo tanks:

As per the Code, ships should survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the ship and the environment, the cargo tanks should be protected from penetration in the case of minor damage to the ship resulting, for example, from contact with a jetty or tug, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the ship's shell plating. Both the damage to be assumed and the proximity of the tanks to the ship's shell should be dependent upon the degree of hazard presented by the product to be carried. The ships are designed accordingly.

2.9.2 Ship arrangements - Segregation of the cargo area:

For ships constructed on or after 1st January, 2007, the cargo spaces are segregated from machinery and boiler spaces, accommodation spaces, service spaces and control stations, chain lockers, drinking and domestic water tanks and from stores.

Where cargo is carried in a cargo containment system requiring a secondary barrier, segregation of cargo spaces from spaces or spaces either below or outboard of the cargo spaces which contain a source of ignition or fire hazard should be affected by cofferdams or fuel oil tanks. If there is no source of ignition or fire hazard in the adjoining space, segregation may be by a single A-0 class division which is gastight.

When cargo is carried in a cargo containment system requiring a secondary barrier:

1. at temperatures below - 10^0C, cargo spaces should be segregated from the sea by a double bottom ; and
2. at temperatures below – 55^0C, the ship should also have a longitudinal bulkhead forming side tanks.

2.9.3 Materials:

The shell and deck plating of the ship and all stiffeners attached thereto should be in

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16. The details described above and below are the extracts taken from IGC Code- IMO Convention.

accordance with Recognized Standards, unless the calculated temperature of the material in the design condition is below $-5^{\circ}C$ due to the effect of the low temperature cargo, in which case the material should be assuming the ambient sea and air temperature of $0^{\circ}C$ and $5^{\circ}C$ respectively.

Hull material forming the secondary barrier, metallic materials used in secondary barriers not forming part of the hull structure, and insulation materials forming a secondary barrier should be in accordance with rules of the society. Materials used in the construction of cargo tanks should also be in accordance with the Rules. Materials used in the construction of the ship which are subject to reduced temperature due to the cargo and which do not form part of the secondary barrier should be as determined by the Rules. This includes inner bottom plating, longitudinal bulkhead plating, transverse bulkhead plating, floors, webs, stringers and all attached stiffening members. The insulation materials should be suitable for loads which may be imposed on them by the adjacent structure. Where applicable, due to location or environmental conditions, insulation materials should have suitable properties of resistance to fire and flame spread and should be adequately protected against penetration of water vapour and mechanical damage.

2.10 SOLAS-1974 - Structural, mechanical and electrical requirements for ships:

In addition to the requirements contained elsewhere in the present regulations, ships are designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification society which is recognized by the Administration in accordance with the provisions of regulation XI-1/1, or with applicable national standards of the Administration which provide an equivalent level of safety and pollution prevention. These rules are included in the classification society rules described earlier.

2.10.1 New installation of materials containing asbestos:

For all ships, new installation of materials which contain asbestos is prohibited except for vanes used in rotary vane compressors and rotary vane vacuum pumps.

2.10.2 Double bottoms in passenger ships:

SOLAS-74 convention clearly specifies the requirement of double bottom on passenger ships also for the prevention of pollution due to grounding of the ships. As per this convention, a double bottom need to be fitted extending from the forepeak bulkhead

to the after peak bulkhead as far as this is practicable and compatible with the design and proper working of the ship. In the case of ships whose length is between 50-61 metres, double bottoms need to be fitted at least from the machinery space to the forepeak bulkhead, or as near thereto as practicable. In ships whose length is between 61-76 metres double bottoms are to be fitted at least outside the machinery space, and these have to be extended to the fore and after peak bulkheads, or as near thereto as practicable. However, in ships of more than 76 m in length, double bottoms are to be fitted amidships, and shall extend to the fore and after peak bulkheads, or as near thereto as practicable. Wherever a double bottom is fitted, its depth shall be to the satisfaction of the Administration and the inner bottom shall be continued out to the ship's sides in such a manner as to protect the bottom to the turn of the bilge. However, a double bottom need not be fitted in way of watertight compartments of moderate size used exclusively for the carriage of liquids, provided the safety of the ship, in the event of bottom or side damage, is not, in the opinion of the Administration, thereby impaired.

2.10.3 Double bottoms in cargo ships other than tankers:

For all cargo ships other than tankers, constructed on or after 1st February, 1992, a double bottom is fitted extending from the collision bulkhead to the after peak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship. Where a double bottom is required to be fitted, its depth shall be to the satisfaction of the Administration and the inner bottom is continued out to the ship's side in such a manner as to protect the bottom to the turn of the bilge. However, a double bottom is not fitted in way of watertight compartments used exclusively for the carriage of liquids, provided the safety of the ship in the event of bottom damage is not affected.

2.11 IMO Requirements for Equipments to prevent pollution:

IMO has prescribed the following equipments which are to be installed on board all ships as per the details given below[17].

A- Requirements of equipments as per MARPOL 73/78 Convention:

As per Annexure-I of MARPOL 73/78 Convention, the following equipments,

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17. Installations fitted to ships the keel of which were laid or which were at a similar stage of construction before 1st January, 2005 should comply either with the Recommendation on International Performance and Test Specifications for Oily-Water Separating Equipment and Oil Content Meters adopted under resolution A.393(X), for equipment installed on board on or after 14th November, 1978, as applicable; or with the Guidelines and Specifications adopted under resolution MEPC.60(33), for pollution prevention equipment installed on board on or after 30th April, 1994, as applicable; or with the requirements contained in these Guidelines and Specifications.

approved by the Administration, are to be installed on board all ships for the prevention of pollution from ships. The technical requirements are detailed below.

(a) - 15 ppm Bilge Separator:

The 15 ppm Bilge Separator should be strongly constructed and suitable for shipboard use. Any electrical equipment which is part of the 15 ppm Bilge Separator should be certified by the Administration as safe for use in a hazardous area. Any moving parts which are fitted in hazardous areas should be arranged so as to avoid the formation of static electricity. The 15 ppm Bilge Separator should be so designed that it functions automatically. However, fail-safe arrangements to avoid any discharge in case of malfunction should be provided. Changing the feed to the 15 ppm Bilge Separator from bilge water to oil, bilge water to emulsified bilge water, or from oil and/or water to air should not result in the discharge overboard of any mixture containing more than 15 ppm of oil. The system should require the minimum of attention to bring it into operation. The equipment should be capable of operating for at least 24 hours of normal duty without attention.

(b) - 15 ppm Bilge Alarm:

The 15 ppm Bilge Alarm should resist corrosion in conditions of the marine environment. Any electrical equipment which is part of the 15 ppm Bilge Alarm should be certified by the Administration as safe for use in a hazardous atmosphere. Any moving parts which are fitted in hazardous areas should be arranged so as to avoid the formation of static electricity. A ppm display should be provided. The ppm display should not be affected by emulsions and/or the type of oil given that the test fluid detailed in the annex is deemed to represent a mixture that may be expected in the machinery space bilges of a ship. The accuracy of the readings should at all times remain within the limit specified in annex. The response time of the 15 ppm Bilge Alarm, that is, the time which elapses between an alteration in the sample being supplied to the 15 ppm Bilge Alarm and the ppm display showing the correct response, should not exceed 5 seconds.

The 15 ppm Bilge Alarm should sound when the effluent exceeds 15 ppm. The 15 ppm Bilge Alarm should record date, time and alarm status, and operating status of the 15 ppm Bilge Separator. The recording device should also store data for at least eighteen months and should be able to display or print a protocol for official inspections as required. In the event the 15 ppm Bilge Alarm is replaced, means should be provided to

ensure the data recorded remains available on board for 18 months. The accuracy of the 15 ppm Bilge Alarms should be checked at IOPP Certificate renewal surveys according to the manufacturers instructions. The calibration certificate for the 15 ppm Bilge Alarm, certifying date of last calibration check, should be retained onboard for inspection purposes.

c) Monitoring system requirements:

The requirements of Annex I of MARPOL 73/78 relating to oil content monitoring of oil tanker ballast and tank washing water are set out in regulation 15(3)(a), which stipulates that oil tankers of 150 tons gross tonnage and above should be equipped with an approved monitoring system and that such system should record continuously: the discharge of oil in litres per nautical mile; and the total quantity of oil discharged, or alternatively, the oil content of the effluent and the rate of discharge. In both cases, the record should be identifiable as to time and date and should be kept for at least three years. Regulation 15 also stipulates that the system should come into operation when there is any discharge of effluent into the sea and should be such as will ensure that any discharge of oily mixture is automatically stopped when the instantaneous rate of discharge of oil exceeds that permitted by regulation.

The overboard discharge control should be able to stop the discharge of the effluent into the sea automatically by either closing all relevant overboard discharge valves or stopping all relevant pumps. The discharge control arrangement should be fail-safe so that all effluent discharge is stopped when the monitoring system is not in operation, at alarm conditions, or when the monitoring system fails to function.

The recording device of a control section should include a digital printer, which may be formatted electronically, if preferred. The recorded parameters should be explicitly identified on the printout. The printout should be legible and should remain so once removed from the recording device and should be retained for at least three years. Any information inserted manually as a result of an override action should be identified on the printout. Data required as specified in the Guidelines and Specifications should be printed out, as applicable, or may be stored electronically with printout capability. The recording device should be located in a position easily accessible to the person in-charge of the overboard discharge operation.

In addition to the recorded print out, the current data should be visibly displayed and should as a minimum contain instantaneous rate of discharge of oil (litres per nautical mile, total quantity of oil discharged (cubic metres or litres), instantaneous oil content (ppm), flow rate, ship's speed, and status of the overboard discharge control or arrangement. The data display should be located in a position easily observed by the person in charge of the overboard discharge operation.

There should be an alternative means of obtaining information in the event of any failure in the monitoring system. Audio-visual alarms should be activated for the set conditions and the monitoring system should be so arranged that the discharge of effluent into the sea is stopped as soon as the set limits are exceeded.

2.12 Recent Improvements made by Classification Society to Prevent Pollution from Ships- Assigning special notations:

Based on their experience in the past, some of the classification societies like RINA and DNV have made certain improvements in their Rules relating to prevention of pollution from ships and are assigning special notations like "Clean Sea", "Clean Air" and "Green Star-3" to ships. These are in addition to the conventional ones and are assigned only if the ships satisfy the following additional requirements to prevent pollution from them. It may be seen that most of the requirements to be complied with for assigning the above said notations are procedural requirements or the discharge requirements rather than design requirements. Therefore, except for the few design requirements given below, all the procedural requirements to be complied with for the above said special notations are described in the next chapter.

2.12.1 Additional Design Requirements for ships assigned with CLEAN SEA notation:

Prevention of sea pollution by oils, Annex-I- Tank arrangement:

All tanks such as fuel oil , sludge tanks and lubricating oil tanks (whether or not for waste) of capacity exceeding the greater of 20 m^3 and V/100, where V is the total aggregate volume of such tanks, are to be considered for this purpose. Overflow tanks are to be included unless they are provided with an alarm for detection of liquid and operational procedures are foreseen for keeping such tanks empty.

Double bottoms for lubricating oil located under the main engine or such tanks, irrespective of their location, are to have the bottom at a distance of minimum 0.7 m

above the base line. The minimum distance from the bottom or side shell plating, measured at any cross section at right angles to the outer shell, should be 2 m for tanks whose volume is more than 2000m^3. The above said minimum distances prevents spill of oil in case of grounding of the ships. Tanks of any volume intended to contain fuel or lubricating oil are not to be used also for ballast water. All tanks and cofferdams, if any, around the tanks are to be so arranged as to be adequately inspected; such cofferdams are to be effectively protected against corrosion by means of proper protective coatings of a light colour so that the leakages can be easily detected.

2.12.2 Systems requirements:

To comply with this requirement, all fuel oil and lubricating oil tanks of capacity greater than 10 m^3 are to be fitted with an overflow system and a high level alarm and the alarm signals are to be given in a suitable station. On the weather and/or superstructure decks overflows and fill pipe connection is to be fitted with a fixed container or enclosed deck area with a capacity of 80 litres if the gross tonnage of the ship is between 300 and 1600 and 160 litres if the gross tonnage of the ship is greater than 1600. If the ship is fitted with bilge water separating or filtering equipment, a holding tank is to be fitted for the pre-separation of bilge water before conveying it to the separating or filtering equipment. Further, ships operating with heavy fuel oil are to be provided with tanks for sludge from the fuel oil purifiers without internal structures and with a suitable heating system.

2.13 Additional Design Requirements for ships assigned with 'GREEN STAR 3' notation:

Compliance with MARPOL 73/78 Annex I:

The applicable requirements of MARPOL 73/78 Annex I, as amended, are to be complied with. In addition to that, all machinery spaces bilges are to be drained into a holding tank for pre-separation upstream of the oil separation and filtering equipment. Alternative installations may be considered on a case-by-case basis. In any event, it is not required that the volume V is greater than 15 m^3. Taking into account the ship service, navigation and installed power, a smaller volume V may be accepted on a case-by-case basis. The oil filtering equipment is to be provided with an oil content meter and with a 15 ppm alarm combined with automatic stopping device. The effluent from the 15 ppm filtering equipment is to be capable of being recirculated to the bilge or bilge water holding tank. The tank is to be so arranged as to allow periodical removal of sediments.

The sludge tank is to be so arranged as to allow periodical removal of sediments. Sludge is to be disposed of on board through the incinerator or discharged ashore and is to be recorded in the oil record book. Use of boilers for sludge disposal on board is not allowed. Besides, irrespective of their volume, tanks intended for fuel or lubricating oil cannot be used for ballast.

All fuel oil and lubricating oil tanks of capacity greater than 10m3 are to be fitted with an overflow system and a high level alarm or an overflow system and flow alarm in the overflow main or two high level alarms (90% and 95% of filling). The alarm signals are to be given in a suitable station from which bunkering or transfer operations are controlled. On the weather and/or superstructure decks each fuel or lubricating oil tank vent, overflows and fill pipe connection is to be fitted with a fixed container or enclosed deck area with a capacity of 80 litres if the gross tonnage of the ship is between 300 and 1600, and 160 litres if the gross tonnage of the ship is greater than 1600.

2.13.1 Inspections and testing during construction and surveys:

Materials, systems or equipment which are installed on board or modified in order to comply with the requirements are to be surveyed and tested according to the applicable Rules of the Society for both the said notations.

Following the satisfactory review and approval of the plans and other documentation, an initial survey is to be carried out on board in order to verify that the hull and machinery arrangements are in accordance with the approved documentation, test, in the presence of the Surveyor and under working conditions, the equipment and systems covered by these Rules including their control, monitoring and alarms, verify the presence on board of the certificates, record and log-books, and Environmental Management Plan requested by these Rules, and carry out the engine parameter check according to the engine technical file, of the engines. Periodic surveys are also done in order to verify the continued compliance and to keep all the class and statutory certificates alive.

2.14 Standards/ Specifications for Shipboard Incinerators:

This specification[22] covers the design, manufacture, performance, operation and

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22. IMO Resolution MEPC.76(40) Adopted on 25th September, 1997

testing of incinerators intended to incinerate garbage and other shipboard wastes generated during the ship's normal service. This specification applies to those incinerator plants with capacities up to 1500 kW per unit. This specification may involve hazardous materials, operations and equipment. The materials used in the individual parts of the incinerator are to be suitable for the intended application with respect to heat resistance, mechanical properties, oxidation, corrosion, etc., as in other auxiliary marine equipment.

In systems equipped for incinerating liquid wastes, safe ignition and maintenance of combustion are to be ensured, e.g. by a supplementary burner using gas oil/diesel oil or equivalent. For batch loaded incinerators there are no preheating requirements. However, the incinerator should be designed such that the temperature in the actual combustion space reaches 600°C within 5 minutes after start. To avoid building up of dioxins, the flue gas should be shock-cooled to a maximum 350°C within 2,5 metres from the combustion chamber flue gas outlet.

The control equipment should be so designed that any failure of the following will prevent continued operations and cause the fuel supply to be cut off. The design should provide an audible alarm connecting to a local alarm system or a central alarm system and the visible indicator provided should show the cause of failure. The visible indicator should have a manual reset in case of shut down. After shutdown of the oil burner, provision should be made for the fire box to cool sufficiently.

All devices and components should, as fitted in the ship, be designed to operate when the ship is upright and when inclined at any angle of list up to and including 15° either way under static conditions and 22.5° under dynamic conditions (rolling) either way and simultaneously inclined dynamically (pitching) 7.5° by bow or stern. Incinerators are to be fitted with an energy source with sufficient energy to ensure a safe ignition and complete combustion. The combustion is to take place at sufficient negative pressure in the combustion chamber(s) to ensure that no gases or smoke leak out to the surrounding areas.

An operating test after installation should be conducted to ensure that all of the control components have been properly installed and that all parts of the incinerator,

including controls and safety devices, are in satisfactory operating condition. The operation of the flame safeguard system should be verified by causing flame and ignition failures. Operation of the audible alarm (where applicable) and visible indicator should be verified. All safety interlocks provided should be tested for proper operation as specified by the unit Manufacturer. The combustion controls should be stable and operate smoothly.

2.15 Manning of Ships:

As per the regulation V/13 of international Convention SOLAS-74, and regulation VIII/2 of Convention STCW-78 and as amended in 1995, all Contracting Governments undertake to ensure that all their ships are sufficiently and efficiently manned[23]. It shall be the duty of the ship owner of every ship to which these Regulations apply to ensure that

- a safe manning document issued by the Administration is in force in respect of the ship and the manning of the ship,
- the safe manning document that is kept aboard the ship at all times, and
- the manning of the ship is maintained at all times to at least the levels specified in the safe manning document.

The master of any ship to which these Regulations apply shall ensure that the ship does not proceed to sea unless there is on board a valid safe manning document issued in respect of the ship and the manning of the ship complies with that document. The safe manning ensures that the ships are sufficiently and efficiently manned by the competent officers and crew for the safe operation and for pollution prevention from the ship.

In addition to the CDEM standards described in detail above, of late, various new concepts like green ship concepts or clean ship concepts are being tried out by individual countries to produce 'Green Ships'. No doubt, this will pick up momentum in the coming years. A brief study is made below regarding the same.

2.16 Green ship Technologies To Prevent/Control pollution:

Green ship or the clean ship concept is an integrated approach of ships with no harmful pollutions and emissions, operated in a clean way from cradle to grave. A green ship concept has to start during ship building itself, and that there is an urgent necessity

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23. Refer to the Principle of safe manning adopted by the organization as per IMO resolution A.890 (21).

to substitute numerous hazardous substances that are still in use in the building and repairing process. Introduction of "theory of economic incentives" within clean shipping is very important and result oriented. The need for economic incentives to influence the decision making process is a must. However, in view of the expected mixed reaction, it is necessary to study in depth the limitations this would have, if introduced. At this point, it is worth to remember that there is no "silver bullet" to bring about the transfer to clean shipping[24]. Political commitment is another important factor which is very crucial in bringing the clean concept of shipping.

Clean ship is a ship which is socially and environmentally acceptable. In this regard, emission free energy for ships like solar energy, skysails etc may be considered. The concept of using skysails onboard is also becoming popular. The skysails build towing kites as additional propulsion for commercial ships. Skysails are capable of reducing fuel costs by 50 per cent. A German operator involved in the development of skysails and the first merchant vessel operated by skysails has just come out. The real benefits of this will be made known very soon. Also, use improved engines using gas turbines and electric propulsion system to reduce air emission. When the vessel is in port, where possible, use plugging into shore side supply. This will not only save the fuel but also prevents the exhaust gas pollution from ships.

Another new idea which has come out recently is worth trying by all the ships. According to Mr. Byeong Kweon Kang, President of M/s Korean Tech Co. Ltd, Korea, his company has produced a machine that can produce fuel oils (gasoline, kerosene, and diesel) from waste plastic and waste synthetic resin. As claimed by the company, the dioxin materials in the exhaust gas created by the oil recycling device operation are neutralized during the process[25]. This type of novel ideas should be tried out on commercial basis and should be made applicable if found economically viable.

Henceforth, in the design parameters of new ships, environmental parameters should also be included. Development in clean ships will speed up with subsidies for green

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24. Clean ship concept- from website www.prosea.info.
25. Korean tech to manage plastic pollution- from internet edition of Business Line, dt: 3-10-2002

technologies. It is worth to remember the famous quote "Even the longest march starts with one step". Since ships have a long life, look at all the possible solutions for clean shipping on the existing ships also. This would enhance the clean ship network. Also, promote exchange of information on clean shipping globally.

Within the last decade, a number of proactive efforts to encourage environmental management improvements within the shipping industry have emerged. These have collectively been referred to as green shipping initiatives. These initiatives are taken voluntary by various countries and different organizations[26]. The most important initiatives taken are shown below:

1. Green ship design done by Sweden for constructing an environmentally friendly containership called "Ecoship".
2. TRESHIP(Technologies for Reduced Environmental Impact from Ships)- An initiative taken by the Norvegian Ship Owners Association to construct environmental friendly ships.
3. Super Ecoships designed by Japan for the Cruise Industry.
4. Green ship design by the Taiwanese Company, Evergreen Marine Corporation for the eco friendly container ships.
5. Green ship Awards- Initiative taken by the Rotterdam Muncipal Port Authority and Dutch Ministry of Transport and Water Management to promote quality shipping.
6. Green Passport (MEPC / IMO) - The Green passport consists of a document listing an inventory of all potentially dangerous materials that would have an adverse effect on human health and/ or the environment. The listed materials include all those used in the construction of the ship and the passport of this inventory will accompany the ship throughout its entire life span right through to decommissioning.

It is difficult, if not impossible, to quantify the benefits of green shipping initiatives. However, the various initiatives mentioned above only apply to and represent a small percentage of the world fleet. The present suite of green initiatives is disparate

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26. Clean Seas and Green ship Technology: Understanding the technological advances for environmentally friendly shipping, "Lloyd's List Events", April, 2004.

rather than global. They are promoted by individual companies or small groups of coastal states. This research has detected an element of competition between initiatives and something of a 'copy cat' culture.

2.17 Analysis and Summary:

In this chapter, an overview of the existing national legislation of India, the conventions/ rules/regulations of the international bodies like IMO and IACS and the national legislation of the United States and the European Community dealing with the technical standards regarding the design and construction requirements, IMO requirements for installation and maintenance of various equipments on board to prevent the pollution from ships and the safe manning requirements (CDEM standards) have been dealt with. The role of the classification society functioning as recognized organization of the flag state and the need to class all merchant and passenger ships have been described in detail.

Mention has also been made of the requirement of assigning the constructional mark and the various class notations for the merchant ships including the passenger ships. It was seen that design plans and drawings are approved by the Society and regular inspections are carried out during construction after appraisal of the materials used for the construction as per the rules of the Society.

Initial surveys are carried out for the Class and Statutory Certificates and necessary certificates are also issued by the Society. Periodical surveys are carried out for the maintenance of the Class and Statutory certificates so that the ship and its equipments are kept well maintained for the safety, seaworthiness and prevention of pollution from them. The additional design and system requirements, related to prevention of sea and air pollution, for the allocation of the special notations like "Clean Sea", Clean Air", "Green Star 3" to ships to make them more greener, environmental friendly and different from the other ships have also been dealt with in detail.

It may be noted that the International Convention MARPOL 73/78 and its subsequent amendments adopted by IMO and the domestic legislation Oil Pollution Act, 1990 of United States and the EU directives made for the benefit of the European countries were all made as reactive measures, after the major accidents of many ships that had occurred

in the last thirty years. Further, it was seen that although IMO acts as the supreme body and is primarily responsible for the safety, seaworthiness and pollution prevention and control of ships, the United Nations and the European Community had enacted many acts and directives by taking unilateral decisions for the prevention and control of ship source pollution. Although India has become a signatory to almost all the conventions adopted by IMO, India has not been able to enact the necessary national Acts/rules for the implementation of all of them, till date. It may be noted that during the design and construction stage of a ship there is hardly any pollution caused to the coastal waters as most of the work in a ship yard is done on land and kept under strict control. However, the CDEM standards are brought under this study mainly because these standards play an important role for the safety and pollution prevention of the vessel when the ship is under operation. Also green ship technologies are required to be incorporated at the design and construction stage of the ship to make the ship into a green ship. Some of the Green ship initiatives taken by individual countries to make environmental friendly ships were also discussed in this study. However, those studies made by individual countries will not come to the limelight and accepted by others unless they are promoted by an international organization like IMO. To what extent the CDEM standards formulated by IMO through its various conventions have really helped in preventing and/or reducing the vessel source pollution, in the operation cycle of a ship, over the past several years is described in detail with case studies in chapter VII.

The M.S Act of India and the other Acts for the construction of cargo and the passenger ships are inadequate as the same is not covering all amendments of IMO conventions. As stated earlier in this chapter, the MS Act is very old and is mainly based on the UK Law on Merchant Shipping, 1931. Hence, the basic structure of the law as visualized by the 1958 Act has, therefore, been similar to that of the Commonwealth countries with certain essential modifications where special arrangements to suit Indian conditions were considered necessary. The main draw back is that the relevant sections of the MS Act regarding the construction requirements are applicable only to ships registered in India or only while any vessel is within India, including the territorial waters thereof. It may also be seen that the requirements prescribed by M.S Act with respect to design or construction aspects are not detailed out.

Although India is a signatory to all the six annexes of MARPOL convention, including the latest Annex-VI dealing with air pollution from ships, national legislation covering all the annexes has not been made till date. As seen earlier in this chapter, all the conventions adopted by the IMO in the past were the after effects of major oil spills that had occurred around USA or around European ports. The conversion of single hull tankers to the double hull type for the prevention of pollution is under process globally and it will take a few more years to complete.
