REPORT OF THE MARITIME SAFETY COMMITTEE ON
ITS NINETY-EIGHTH SESSION

Attached are annexes 11, 26 and 34 to 38 to the report of the Maritime Safety Committee on its ninety-eighth session (MSC 98/23).
ANNEX 11  DRAFT ASSEMBLY RESOLUTION ON THE CODE FOR THE TRANSPORT AND HANDLING OF HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES IN BULK ON OFFSHORE SUPPORT VESSELS (OSV CHEMICAL CODE)

ANNEX 26  DRAFT MSC-MEPC CIRCULAR ON REVISED GUIDELINES FOR FORMAL SAFETY ASSESSMENT (FSA) FOR USE IN THE IMO RULE-MAKING PROCESS

ANNEX 34  BIENNIAL STATUS REPORT OF THE SUB-COMMITTEES

ANNEX 35  PROVISIONAL AGENDAS FOR THE SUB-COMMITTEES

ANNEX 36  BIENNIAL STATUS REPORT OF THE MARITIME SAFETY COMMITTEE

ANNEX 37  POST-BIENNIAL AGENDA OF THE MARITIME SAFETY COMMITTEE ALIGNED TO THE NEW STRATEGIC DIRECTIONS AGREED BY C 117

ANNEX 38  OUTPUTS OF THE MARITIME SAFETY COMMITTEE FOR THE 2018-2019 BIENNium ALIGNED TO THE NEW STRATEGIC DIRECTIONS AGREED BY C 117

(See document MSC 98/23/Add.1 for annexes 1 to 10, 12 to 25, 27 to 33 and 39)

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DRAFT ASSEMBLY RESOLUTION

CODE FOR THE TRANSPORT AND HANDLING OF HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES IN BULK ON OFFSHORE SUPPORT VESSELS

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines regarding maritime safety and the prevention and control of marine pollution from ships,

RECALLING ALSO that regulation 11.2 of Annex II to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, calls for guidelines to be developed by the Organization on the basis of which Administrations shall establish appropriate measures in respect of ships other than chemical tankers carrying noxious liquid substances in bulk identified in chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemical in Bulk, in order to minimize the uncontrolled discharge into the sea of such substances,

RECALLING FURTHER that it adopted, by resolution A.673(16), Guidelines for the transport and handling of limited amounts of hazardous and noxious liquid substances in bulk on offshore support vessels (LHNS Guidelines),

RECOGNIZING the need to improve the provisions of the LHNS Guidelines in light of the evolution of the offshore industry and experience gained from implementing them,

HAVING CONSIDERED the recommendations of the Maritime Safety Committee, at its ninety-eighth session, and the Marine Environment Protection Committee, at its seventy-first session,

1 ADOPTS the Code for the Transport and Handling of Hazardous and Noxious Liquid Substances in Bulk on Offshore Support Vessels (OSV Chemical Code), set out in the annex to the present resolution;

2 INVITES Governments to take action to implement the OSV Chemical Code from [1 July 2018];

3 AUTHORIZES the Maritime Safety Committee and the Marine Environment Protection Committee to keep the OSV Chemical Code under review and update it as may be necessary;

4 SUPERSEDES resolution A.673(16).
ANNEX

CODE FOR THE TRANSPORT AND HANDLING OF HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES IN BULK ON OFFSHORE SUPPORT VESSELS (REFERRED TO AS THE OSV CHEMICAL CODE)

TABLE OF CONTENTS

PREAMBLE ..................................................................................................................................5

CHAPTER 1 – GENERAL ..............................................................................................................6
  1.1 APPLICATION .................................................................................................................... 6
  1.2 DEFINITIONS .................................................................................................................... 7
  1.3 EQUIVALENTS ................................................................................................................ 12
  1.4 SURVEYS AND CERTIFICATION ........................................................................................ 13

CHAPTER 2 – VESSEL SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS ............ 13
  2.1 GENERAL ...................................................................................................................... 13
  2.2 FREEBOARD AND INTACT STABILITY ................................................................................ 14
  2.3 NON-CARGO DISCHARGES BELOW THE FREEBOARD DECK ................................................... 14
  2.4 CONDITIONS OF LOADING ................................................................................................. 15
  2.5 FLOODING ASSUMPTIONS ................................................................................................. 15
  2.6 DAMAGE ASSUMPTIONS ................................................................................................... 16
  2.7 STANDARD OF DAMAGE .................................................................................................... 18
  2.8 SURVIVAL REQUIREMENTS ................................................................................................ 19
  2.9 LOCATION OF CARGO TANKS ............................................................................................. 20

CHAPTER 3 – VESSEL DESIGN ................................................................................................. 21
  3.1 CARGO SEGREGATION ..................................................................................................... 21
  3.2 ACCOMMODATION, SERVICE AND MACHINERYpaces AND CONTROL STATIONS ................. 22
  3.3 ACCESS TO SPACES IN THE CARGO AREA ............................................................................ 22

CHAPTER 4 – SPECIAL REQUIREMENTS FOR PRODUCTS WITH A FLASHPOINT NOT
  EXCEEDING 60°C, TOXIC PRODUCTS AND ACID .................................................................. 23
  4.1 GENERAL REQUIREMENTS FOR PRODUCTS WITH A FLASHPOINT NOT EXCEEDING 60°C, TOXIC
  PRODUCTS OR ACIDS .............................................................................................................. 23
  4.2 PRODUCTS WITH A FLASHPOINT NOT EXCEEDING 60°C ......................................................... 24
  4.3 TOXIC PRODUCTS ........................................................................................................... 24
  4.4 ACIDS ........................................................................................................................... 25

CHAPTER 5 – CARGO CONTAINMENT ...................................................................................... 25
  5.1 DEFINITIONS .................................................................................................................. 25
  5.2 TANK TYPE REQUIREMENTS FOR INDIVIDUAL PRODUCTS .................................................... 26

CHAPTER 6 – CARGO TRANSFER ............................................................................................. 26
  6.1 PIPING SCANTLINGS ........................................................................................................... 26
  6.2 PIPING FABRICATION AND JOINING DETAILS ....................................................................... 28
  6.3 FLANGE CONNECTIONS .................................................................................................... 29
  6.4 TEST REQUIREMENTS FOR PIPING ...................................................................................... 29
  6.5 PIPING ARRANGEMENTS ................................................................................................... 29
  6.6 CARGO-TRANSFER CONTROL SYSTEMS ............................................................................... 30
  6.7 VESSELS’ CARGO HOSES .................................................................................................. 31

CHAPTER 7 – CARGO TANK VENTING ...................................................................................... 31
  7.1 GENERAL ...................................................................................................................... 31
  7.2 TYPES OF TANK VENTING SYSTEMS .................................................................................. 32
  7.3 VENTING REQUIREMENTS FOR INDIVIDUAL PRODUCTS ....................................................... 33
  7.4 CARGO TANK GAS-FREEING .............................................................................................. 33
CHAPTER 8 – ELECTRICAL INSTALLATIONS ................................................................................. 34
  8.1 GENERAL REQUIREMENTS ............................................................................................... 34
  8.2 ELECTRICAL REQUIREMENTS FOR INDIVIDUAL PRODUCTS ........................................ 35

CHAPTER 9 – FIREFIGHTING REQUIREMENTS ............................................................................. 35
  9.1 APPLICATION .................................................................................................................... 35
  9.2 CARGO PUMP-ROOMS ...................................................................................................... 36
  9.3 PROTECTION OF THE CARGO AREA ............................................................................... 37
  9.4 SPECIAL REQUIREMENTS ............................................................................................... 37

CHAPTER 10 – MECHANICAL VENTILATION IN THE CARGO AREA ............................................... 37
  10.1 APPLICATION ................................................................................................................ 38
  10.2 SPACES NORMALLY ENTERED DURING NORMAL CARGO HANDLING OPERATIONS ....... 38
  10.3 SPACES NOT NORMALLY ENTERED .............................................................................. 39

CHAPTER 11 – INSTRUMENTATION AND AUTOMATION SYSTEMS ............................................. 39
  11.1 GENERAL ...................................................................................................................... 39
  11.2 LEVEL INDICATORS FOR CARGO TANKS .................................................................... 39
  11.3 OVERFLOW CONTROL .................................................................................................. 40
  11.4 VAPOUR DETECTION ..................................................................................................... 40

CHAPTER 12 – POLLUTION PREVENTION REQUIREMENTS ......................................................... 41

CHAPTER 13 – LIFE-SAVING APPLIANCES AND ARRANGEMENTS .......................................... 41

CHAPTER 14 – PERSONNEL PROTECTION ............................................................................... 41
  14.1 PROTECTIVE EQUIPMENT .............................................................................................. 41
  14.2 FIRST AID EQUIPMENT ................................................................................................ 41
  14.3 SAFETY EQUIPMENT .................................................................................................... 42
  14.4 EMERGENCY EQUIPMENT ........................................................................................... 43

CHAPTER 15 – OPERATIONAL REQUIREMENTS ........................................................................... 43
  15.1 GENERAL ...................................................................................................................... 43
  15.2 CARGO INFORMATION .................................................................................................. 43
  15.3 PERSONNEL TRAINING ............................................................................................... 44
  15.4 OPENING OF AND ENTRY INTO CARGO TANKS ............................................................. 44
  15.5 SIMULTANEOUS CARRIAGE OF DECK CARGO AND PRODUCTS ................................. 45

CHAPTER 16 – BACKLOADING OF CONTAMINATED BULK LIQUIDS .......................................... 46
  16.1 PREAMBLE .................................................................................................................. 46
  16.2 GENERAL ...................................................................................................................... 46
  16.3 DOCUMENTATION ...................................................................................................... 46
  16.4 OPERATION ................................................................................................................... 47

CHAPTER 17 – DISCHARGING AND LOADING OF PORTABLE TANKS ON BOARD ......................... 49
  17.1 PREAMBLE .................................................................................................................. 49
  17.2 GENERAL ...................................................................................................................... 49
  17.3 ARRANGEMENT OF DECK SPREAD ............................................................................ 50
  17.4 SHIPMENT OF CARGO IN PORTABLE TANKS USED AS DECK TANKS ....................... 50

CHAPTER 18 – CARRIAGE OF LIQUEFIED GASES ...................................................................... 51
  18.1 GENERAL REQUIREMENTS .......................................................................................... 51
  18.2 ACCOMMODATION, SERVICE AND MACHINERY SPACES AND CONTROL STATIONS .... 51
  18.3 CARGO CONTAINMENT ................................................................................................ 52
  18.4 MATERIALS OF CONSTRUCTION ................................................................................... 52
  18.5 VENT SYSTEM FOR CARGO CONTAINMENT ................................................................. 52
  18.6 CARGO TRANSFER ...................................................................................................... 52
  18.7 VAPOUR DETECTION ................................................................................................... 52
  18.8 GAUGING AND LEVEL DETECTION ............................................................................. 52
  18.9 EMERGENCY SHUTDOWN SYSTEM ............................................................................ 52
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.10</td>
<td>PERSONNEL PROTECTION</td>
<td>52</td>
</tr>
<tr>
<td>18.11</td>
<td>CARRIAGE ON OPEN DECK</td>
<td>53</td>
</tr>
<tr>
<td>18.12</td>
<td>CARRIAGE OF OTHER LIQUEFIED GASES LISTED IN CHAPTER 19 OF THE IGC CODE</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>APPENDIX 1 – MODEL FORM OF CERTIFICATE OF FITNESS</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>APPENDIX 2 – GUIDELINES FOR TESTING PRIOR TO BACKLOADING</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>APPENDIX 3 – MODEL FORMAT FOR THE PROCEDURE FOR THE DISCHARGING AND</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>LOADING OF PORTABLE TANKS CONTAINING DANGEROUS GOODS CARRIED AS DECK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TANKS ON OFFSHORE SUPPORT VESSELS</td>
<td></td>
</tr>
</tbody>
</table>
PREAMBLE

1 This Code has been developed for the design, construction and operation of offshore support vessels which transport hazardous and noxious liquid substances in bulk for the servicing and resupplying of offshore platforms, mobile offshore drilling units and other offshore installations, including those employed in the search for and recovery of hydrocarbons from the sea-bed.

2 This Code has been developed in accordance with the requirements set forth in regulation 11.2 of MARPOL Annex II and in recognition of the need for standards which provide an alternative to the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) for offshore support vessels.

3 The basic philosophy of this Code is to apply standards contained in the IBC Code and the IGC Code to the extent that is practicable and reasonable taking into account the unique design features and service characteristics of these vessels.

4 The Guidelines for the design and construction of offshore supply vessels, 2006 (resolution MSC.235(82), as amended) are also applicable to offshore support vessels subject to this Code.

5 It is recognized that the technology of the offshore industry is complex and subject to continued evolution as is evidenced by the growing need for specialized vessels such as well-stimulation vessels. To meet the needs of the industry, this Code should not remain static. Therefore the Organization will periodically review this Code, taking into account both experience and technical development. Amendments to this Code involving provisions for new cargoes will be circulated periodically as new cargoes are proposed for carriage and the provisions are developed.
CHAPTER 1 – GENERAL

To provide an international standard for the safe carriage, by sea in bulk, of chemicals by setting the design and construction standards of vessels involved in such carriage and the equipment, so as to minimize the risks to the vessel, its crew and the environment, having regard to the nature of the products including flammability, toxicity, asphyxiation, corrosivity and reactivity.

1.1 Application

1.1.1 This Code applies to offshore support vessels engaged in the carriage of the products identified in 1.1.9, regardless of size or voyage.

1.1.2 This Code should also apply when the cargoes indicated in 1.1.9 are a part of a blending or production process of cargoes used in the search and exploitation of seabed mineral resources on board vessels used to facilitate such operations.

1.1.3 Unless expressly provided otherwise, this Code applies to offshore support vessels (OSVs), the keels of which are laid or which are at the stage where:

- construction identifiable with the vessel begins; and
- assembly has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is less;

on or after [1 July 2018].

1.1.4 Existing OSVs, the keel of which was laid or which was at a similar stage of construction on or after 19 April 1990 and before the date specified in 1.1.3, may be permitted to carry products as being assigned for carriage on a type 2 ship in the IBC Code, provided that they comply with this Code, except for the stability provisions in chapter 2 of this Code, and subject to the satisfaction of the Administration.

1.1.5 A vessel, irrespective of the date of construction, which is converted for the carriage of bulk liquids subject to this Code on or after the date specified in 1.1.3 should be treated as a vessel constructed on the date on which such conversion commences. An offshore support vessel which transports a cargo subject to this Code and undergoes modification for the transport of additional cargoes falling under this Code should not be considered as a vessel which has undergone a conversion.

1.1.6 This Code applies only in the case of bulk carriage involving transfer of the cargo to or from its containment which forms part of the vessel or remains on board.

1.1.7 For requirements regulating the transport of dangerous goods and marine pollutants in packaged form, including transport of dangerous goods in portable tanks, refer to the International Maritime Dangerous Goods Code (IMDG Code).

1.1.8 This Code applies in addition to the Guidelines for the design and construction of Offshore Supply Vessels (resolution MSC.235(82), as amended). Where this Code sets forth alternative safety standards, the standards in this Code should be applied.
1.1.9 Products which may be carried subject to this Code are:

.1 only those offshore related products which are listed in chapters 17 or 18 of the IBC Code and the latest edition of the MEPC.2/Circular (Provisional categorization of liquid substances in accordance with MARPOL Annex II and the IBC Code) and their related references to chapters 15 and 19; or

.2 oil-based/water-based mud containing mixtures of products listed in chapters 17 and 18 of the IBC Code and the MEPC.2/Circular; or

.3 liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen; or

.4 contaminated backloads.

1.1.10 For a product proposed for carriage in bulk, but not listed in chapters 17 or 18 of the IBC Code, the Administration and port Administrations involved in such carriage should prescribe the suitable preliminary conditions for the carriage, having regard to the criteria for hazard evaluation of bulk chemicals. For the evaluation of the pollution hazard of such a product and assignment of its pollution category, the procedure specified in regulation 6.3 of MARPOL Annex II should be followed. The Organization should be notified of the preliminary conditions for consideration for inclusion of the product in the IBC Code.

1.2 Definitions

The following definitions apply unless expressly provided otherwise (additional definitions are given in individual chapters).

1.2.1 Accommodation spaces are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, barber shops, pantries containing no cooking appliances and similar spaces.

1.2.2 Administration means the Government of the State whose flag the vessel is entitled to fly.

1.2.3 Anniversary date means the day and the month of each year, which will correspond to the date of expiry of the Certificate of Fitness.

1.2.4 Backload means contaminated bulk liquids, taken on board a vessel offshore, for transport either back to shore or to alternate offshore site.

1.2.5 Blending additives means small amounts of liquid substances used during blending of products or production processes of cargoes for use in the search and exploitation of seabed mineral resources on board vessels used to facilitate such operations.

1.2.6 Breadth (B) means the maximum breadth of the vessel, measured amid vessels to the moulded line of the frame in a vessel with a metal shell and to the outer surface of the hull in a vessel with a shell of any other material. The breadth (B) should be measured in metres.

1.2.7 Cargo area is that part of the offshore support vessel where:

.1 a pollution hazard only substance having a flashpoint exceeding 60°C and not defined as toxic, is likely to be present and includes cargo tanks, portable tanks used as deck cargo tanks, slop tanks, cargo pump-rooms, pump-rooms
adjacent to cargo tanks and enclosed spaces in which pipes containing cargoes are located. Areas on open deck are not considered part of the cargo area.

.2 a safety hazard substance having a flashpoint exceeding 60°C and not defined as a toxic, is likely to be present and includes cargo tanks, portable tanks used as deck cargo tanks, slop tanks, cargo pump-rooms, pump-rooms adjacent to cargo tanks, hold spaces in which independent tanks are located, cofferdams surrounding integral tanks, enclosed spaces in which pipes containing cargoes are located and the following deck areas:

.1 within 3 m of cargo tank installed on deck or portable tanks used as deck cargo tanks;

.2 areas on open deck, or semi-enclosed spaces on deck, within 3 m of any cargo tank access outlet;

.3 areas on open deck over an integral tank without an overlaying cofferdam plus the open deck area extending transversely and longitudinally for a distance of 3 m beyond each side of the tank;

.4 areas on open deck, or semi-enclosed spaces on deck, within 3 m of cargo manifold valve, cargo valve, cargo pipe flange, except spaces within the 3 m zone that are separated by an enclosed bulkhead to the minimum height as given in 1.2.7.2.6;

.5 areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo tank vent outlet intended for the passage of large volumes of vapour mixture during cargo loading, within a vertical cylinder of unlimited height and 3 m radius upon the centre of the outlet, and within a hemisphere of 3 m radius below the outlet;

.6 areas on the open deck within spillage coamings surrounding cargo manifold valves and 3 m beyond these, up to a height of 2.4 m above the deck; and

.7 compartments for cargo hoses.

.3 a substance having a flashpoint not exceeding 60°C, or defined as toxic or vapours of such cargo, is likely to be present and includes cargo tanks, portable tanks used as deck cargo tanks, slop tanks, cargo pump-rooms, pump-rooms adjacent to cargo tanks, hold spaces in which independent tanks are located, cofferdams surrounding integral tanks, enclosed spaces in which pipes containing cargoes are located and the following deck areas:

.1 within 3 m of cargo tank installed on deck or portable tanks used as deck cargo tanks;

.2 areas on open deck, or semi-enclosed spaces on deck, within 4.5 m of gas or vapour outlet, cargo manifold valve, cargo valve, cargo pipe flange, cargo pump-room ventilation outlets and cargo tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variation;
areas on open deck, or semi-enclosed spaces on open deck above
and in the vicinity of any cargo gas outlet intended for the passage
of large volumes of gas or vapour mixture during cargo loading,
within a vertical cylinder of unlimited height and 10 m radius centred
upon the centre of the outlet, and within a hemisphere of 10 m
radius below the outlet;
areas on open deck, or semi-enclosed spaces on deck, within 3 m
of cargo pump-room entrances, cargo pump-room ventilation inlet,
openings into cofferdams;
areas on the open deck within spillage coamings surrounding cargo
manifold valves and 3 m beyond these, up to a height of 2.4 m
above the deck;
 compartments for cargo hoses; and
within the hose landing area.

1.2.8 Cargo control station means a location that is manned during cargo transfer
operations for the purpose of directing or controlling the loading or unloading of cargo.

1.2.9 Cargo pump-room is a space containing pumps and their accessories for the handling
of the products covered by this Code.

1.2.10 Cofferdam is the isolating space between two adjacent steel bulkheads or decks. This
space may be a void space or a ballast space.

1.2.11 Control stations are those spaces in which vessels’ radio or main navigating
equipment or the emergency source of power is located or where the fire-recording or
fire-control equipment is centralized. This does not include special fire-control equipment which
can be most practically located in the cargo area.

1.2.12 Conversion means a vessel in an un-related service modified for use as an offshore
support vessel. Special Purpose Ships (operated under the SPS Code) in support related
service configurations are not considered “in an unrelated service”.

1.2.13 Dangerous chemicals means any liquid chemicals designated as presenting a safety
hazard, based on the safety criteria for assigning products to chapter 17 of the IBC Code.

1.2.14 Dangerous goods mean the substances, materials and articles covered by the
IMDG Code.

1.2.15 Deadweight means the difference in metric tons between the displacement of an
offshore support vessel in water of a density of 1.025 at the load waterline corresponding to
the assigned summer freeboard and the lightweight of the vessel.

1.2.16 Deck spread means portable tanks, piping, equipment, processing equipment and
control stations secured to the vessel by permanent means and used in the operation of
the vessel.

1.2.17 Density is the ratio of the mass to the volume of a product, expressed in terms of
kilograms per cubic metre. This applies to liquids, gases and vapours.
1.2.18 **Flashpoint** is the temperature in degrees Celsius at which a product will give off enough flammable vapour to be ignited. Values given in the Code are those for a "closed cup test" determined by an approved flashpoint apparatus.

1.2.19 **Hazardous substance** is any substance either listed in chapter 17 of the International Bulk Chemical Code or having a hazard more severe than one of the minimum hazard criteria given in criteria for hazard evaluation of bulk chemicals as approved by the Organization.

1.2.20 **Hold space** is the space enclosed by the vessels' structure in which an independent cargo tank is situated.

1.2.21 **Hose landing area** means an area on the main deck, except those in compartments for cargo hoses, where cargo hoses of substances having a flashpoint not exceeding 60°C and/or defined as toxic are located during cargo transfer.

1.2.22 **Independent** means that a piping or venting system, for example, is in no way connected to another system and that there are no provisions available for the potential connection to other systems.

1.2.23 **International Bulk Chemical Code** (IBC) means the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (resolutions MSC.4(48) and MEPC.19(22), as amended).


1.2.25 **IMDG Code** means the International Maritime Dangerous Goods Code (resolution MSC.122(75), as amended).

1.2.26 **Length (L)** means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In vessels designed with a rake of keel, the waterline on which this length is measured should be parallel to the designed waterline. The length (L) should be measured in metres.

1.2.27 **Lightweight** means the displacement of an offshore support vessel in metric tons without cargo, fuel, lubricating oil, ballast water, fresh water and feed water in tanks, consumable stores, crew and their effects.

1.2.28 **Machinery spaces of category A** are those spaces and trunks to such spaces which either contain:

1. internal combustion machinery used for main propulsion;

2. internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

3. any oil-fired boiler or oil fuel unit or any oil fired equipment other than boilers, such as inert gas generators, incinerators, etc.
1.2.29  *Machinery spaces* are machinery spaces of category A and other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling station, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

1.2.30  *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, as amended.

1.2.31  *Noxious Liquid Substance* means any substance indicated in the Pollution Category column of chapter 17 or 18 of the International Bulk Chemical Code, or the current MEPC.2/Circular or provisionally assessed under the requirements of regulation 6.3 of MARPOL Annex II as falling into categories X, Y or Z.

1.2.32  *Offshore portable tank* means a portable tank specially designed for repeated use for transport of dangerous goods to, from and between offshore facilities. An offshore portable tank is designed and constructed in accordance with the *Guidelines for the approval of containers handled in open seas* (MSC/Circ.860).

1.2.33  *Offshore support vessels (OSVs)* are:

.1  multi-mission vessels which are primarily engaged in the transport of stores, materials and equipment to and from mobile offshore drilling units, fixed and floating platforms and other similar offshore installations; or

.2  multi-mission vessels, including well-stimulation vessels, but excluding mobile offshore drilling units, derrick barges, pipelaying barges and floating accommodation units, which are otherwise primarily engaged in supporting the work of offshore installations.

1.2.34  *Oil fuel unit* is the equipment used for the preparation of oil fuel for delivery to an oil fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a gauge pressure of more than 0.18 MPa.

1.2.35  *Open deck* is defined as an open or semi-enclosed space on cargo deck or inside of the cargo rail. Semi-enclosed spaces are those spaces that either:

.1  are open at two ends; or

.2  have an opening at one end, and are provided with adequate natural ventilation effective over their entire length through permanent openings distributed in the side plating or deckhead or from above, the openings having a total area of at least 10% of the total area of the space sides.

1.2.36  *Organization* is the International Maritime Organization (IMO).

1.2.37  *Permeability of a space* means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

1.2.38  *Pollution hazard only substance* means a substance having an entry only of "P" in column d in chapter 17 of the IBC Code.

1.2.39  *Port Administration* means the appropriate authority of the country for the port where the vessel is loading or unloading.
1.2.40 **Portable tank** means a multimodal tank used for the transport of dangerous goods.

1.2.41 **Propulsion shaft tunnel** is the tunnel or space in which the mechanical transfer of power to a propulsion unit is run.

1.2.42 **Public spaces** are those portions of the accommodation spaces which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

1.2.43 **Pump-room** is a space, located in the cargo area, containing pumps and their accessories for the handling of ballast and oil fuel.

1.2.44 **Recognized standards** are applicable international or national standards acceptable to the Administration or standards laid down and maintained by an organization which comply with the standards adopted by the Organization and which are recognized by the Administration.

1.2.45 **Safety hazard substance** means a substance having an entry of "S" or "S/P" in column d in chapter 17 of the International Bulk Chemical Code.

1.2.46 **Separate** means that a cargo piping system or cargo vent system, for example, is not connected to another cargo piping or cargo vent system.

1.2.47 **Service spaces** are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store-rooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

1.2.48 **SOLAS** means the International Convention for the Safety of Life at Sea, 1974, as amended.

1.2.49 **Underdeck access way** is a passage passing through the underdeck cargo area without being part of the cargo area providing access to essential areas for operation of the vessel, such as thruster room, propulsion room, steering gear room. The access way may be used to route non-cargo piping and cabling.

1.2.50 **Vapour pressure** is the equilibrium pressure of the saturated vapour above a liquid expressed in Pascal (Pa) at a specified temperature.

1.2.51 **Void space** is an enclosed space in the cargo area external to a cargo tank, other than a hold space, ballast space, oil fuel tank, cargo pump-room, pump-room, or any space in normal use by personnel.

1.2.52 **Well-stimulation vessel** means an offshore support vessel with specialized equipment and industrial personnel that deliver products and services directly into a well-head.

### 1.3 Equivalents

1.3.1 Where this Code requires that a particular fitting material, appliance, apparatus, item of equipment or type thereof should be fitted or carried in an offshore support vessel, or that any particular provision should be made, or any procedure or arrangement should be complied with, the Administration may allow any other fitting, material, appliance, apparatus, item of equipment or type thereof to be fitted or carried, or any other provision, procedure or arrangement to be made in that vessel, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by this Code.
However, the Administration may not allow operational methods or procedures to be made an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof, which are prescribed by this Code, unless such substitution is specifically allowed by this Code.

1.3.2 When the Administration so allows, any fitting, material, appliance, apparatus, item of equipment, or type thereof, or provision, procedure, or arrangement, or novel design or application to be substituted thereafter, it should communicate to the Organization the particulars thereof together with a report on the evidence submitted so that the Organization may circulate the same to other Parties to SOLAS or MARPOL, for the information of their officers.

1.4 Surveys and certification

1.4.1 Following a satisfactory initial survey of an offshore support vessel, the Administration or its duly authorized organization should issue a certificate, the model form of which is set out in appendix 1, suitably endorsed to certify compliance with the provisions of this Code. If the language used is not English, French or Spanish, the text should include the translation into one of these languages. The certificate should indicate the cargoes regulated by this Code that the vessel is permitted to carry with any relevant carriage conditions and should have a period of validity not to exceed five years.

1.4.2 The certificate issued under this Code should have the same force and receive the same recognition as the certificate issued under regulation 7 of Annex II of MARPOL and regulations VII/10 and VII/13 of the 1974 SOLAS Convention, as amended.

1.4.3 The validity of the certificate referred to in 1.4.1 should be subject to the renewal, intermediate, annual, and additional surveys required by the IBC Code, the IGC Code and MARPOL Annex II.

CHAPTER 2 – VESSEL SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS

To ensure that the cargo tanks are located in protected location(s) in the event of minor hull damage, and that the vessel can survive the assumed flooding conditions.

2.1 General

2.1.1 Offshore support vessels, subject to this Code, should survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the vessel and the environment, the cargo tanks should be protected from penetration in the case of minor damage to the vessel resulting, for example, from contact with a jetty or an offshore installation, 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 vessel's shell plating. Both the assumed damage and the proximity of the cargo tanks to the vessel's shell should be dependent upon the degree of hazard presented by the products to be carried.

2.1.2 The design standards of this chapter should be applied according to the ship type required for cargoes containing mixtures and individual products indicated in chapter 17 of the IBC Code and the latest edition of the MEPC.2/Circular.

2.1.3 Offshore support vessels subject to this Code may be designed without cargo tank capacity limitation; however, the requirements of this chapter will be applied according to the ship type classified in the IBC Code and quantity of products carried on any single voyage.
2.1.4 If a vessel is intended to carry more than one product listed in chapter 17 of the IBC Code and the latest edition of the MEPC.2/Circular, the standard of damage should correspond to that product having the most stringent ship type provision. The provisions for the location of individual cargo tanks, however, need only be applied based upon the vessel types related to the respective products certified to be carried.

2.1.5 The provisions for cargo vessels in SOLAS chapter II-1 parts B, B-1, B-2 and B-4 should apply to vessels covered by this Code, except that SOLAS regulations II-1/6 to II-1/7-3 should not be applied, unless expressly provided otherwise.

2.2 Freeboard and intact stability

2.2.1 Vessels subject to this Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines in force.

2.2.2 The intact stability of the vessel in all seagoing conditions should comply with the International Code on Intact Stability, 2008, adopted by resolution MSC.267(85)), as amended.

2.2.3 Solid ballast should not normally be used in double-bottom spaces in the cargo area. Where, however, because of stability considerations, the fitting of solid ballast in such spaces becomes unavoidable, then its disposition should be governed by the need to ensure that the impact loads resulting from bottom damage are not directly transmitted to the cargo tank structure.

2.2.4 The master of the vessel should be supplied with a loading and stability information booklet. This booklet should contain details of typical service and ballast conditions, provisions for evaluating other conditions of loading and a summary of the vessel's survival capabilities. In addition, the booklet should contain sufficient information to enable the master to load and operate the vessel in a safe and seaworthy manner. All OSVs of 500 gross tonnage and above should comply with SOLAS regulation II-1/5-1.

2.2.5 OSVs subject to 2.6.1 and those vessels with a length of 80 metres or more subject to 2.6.2 should be fitted with a stability instrument\textsuperscript{1}, capable of verifying compliance with intact and damage stability provisions, approved by the Administration having regard to the performance standards recommended by the Organization\textsuperscript{2}.

2.3 Non-cargo discharges below the freeboard deck

2.3.1 The provision and control of valves fitted to non-cargo discharges led through the shell from spaces below the freeboard deck or from within superstructures and deck-houses on the freeboard deck fitted with weathertight doors should comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves should be limited to:

\begin{itemize}
\item one automatic non-return valve with a positive means of closing from above the freeboard deck; or
\end{itemize}

\begin{itemize}
\item Refer to the IBC Code, 2.2.6 and 2.2.7.
\item Refer to part B of chapter 4 of the International Code on Intact Stability, 2008 (2008 IS Code, resolution MSC.267(85)), as amended; the Guidelines for the Approval of Stability Instruments, section 4, (MSC.1/Circ.1229), as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461).
\end{itemize}
where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds 0.01\(L\), two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions.

2.3.2 For the purpose of this chapter, "summer load line" and "freeboard deck" have the meanings as defined in the International Convention on Load Lines in force.

2.3.3 The automatic non-return valves referred to in 2.3.1.1 and 2.3.1.2 should be fully effective in preventing admission of water into the vessel, taking into account the sinkage, trim and heel in survival provisions in 2.8, and should comply with recognized standards.

2.4 Conditions of loading

Damage survival capability should be investigated on the basis of loading information submitted to the Administration for all anticipated conditions of loading and variations in draught and trim for the conditions for cargoes which the vessels is certified to carry. Conditions where the offshore support vessel is not carrying products covered by this Code, or is carrying only residues of such products, need not be considered for the purpose of this Code.

2.5 Flooding assumptions

2.5.1 The provisions of 2.8 should be confirmed by calculations which take into consideration the design characteristics of the vessel; the arrangements, configuration and contents of the damaged compartments; the distribution, relative densities and the free surface effects of liquids; and the draught and trim for all conditions of loading.

2.5.2 The permeability of spaces assumed to be damaged should be as follows:

<table>
<thead>
<tr>
<th>Spaces</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriated to stores</td>
<td>0.60</td>
</tr>
<tr>
<td>Occupied by accommodation</td>
<td>0.95</td>
</tr>
<tr>
<td>Occupied by machinery</td>
<td>0.85</td>
</tr>
<tr>
<td>Voids</td>
<td>0.95</td>
</tr>
<tr>
<td>Intended for consumable liquids</td>
<td>0 to 0.95*</td>
</tr>
<tr>
<td>Intended for other liquids</td>
<td>0 to 0.95*</td>
</tr>
<tr>
<td>Intended for dry cargo</td>
<td>0.95</td>
</tr>
</tbody>
</table>

* The permeability of partially filled tanks should be consistent with the amount of liquid carried in the tank.

2.5.3 Wherever damage penetrates a tank containing liquids it should be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.
2.5.4 Every watertight division within the maximum extent of damage defined in 2.6.1 and 2.6.2 and considered to have sustained damage in positions given in 2.7 should be assumed to be penetrated. Where damage less than the maximum is being considered in accordance with 2.6.3, only watertight divisions or combinations of watertight divisions within the envelope of such lesser damage should be assumed to be penetrated:

1. where a transverse watertight bulkhead is located within the transverse extent of assumed damage and is stepped in way of a double bottom or side tank by more than 3.05 m, the double bottom or side tanks adjacent to the stepped portion of the transverse watertight bulkhead should be considered as flooded simultaneously; and

2. if the distance between the transverse planes passing through the nearest stepped portions of the bulkheads is less than the longitudinal extent of damage given in 2.6.1 and 2.6.2, only one of these bulkheads should be regarded as effective.

2.5.5 The vessel should be so designed as to keep unsymmetrical flooding to the minimum consistent with efficient arrangements.

2.5.6 Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, should not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the provisions of 2.8 and sufficient residual stability should be maintained during all stages where equalization is used. Spaces which are linked by ducts of large cross-sectional area may be considered to be common.

2.5.7 If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in 2.6, arrangements should be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

2.5.8 For vessels subject to 2.6.1 the buoyancy of any superstructure directly above the side damage should be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that:

1. they are separated from the damaged space by watertight divisions and the provisions of 2.8.2.2 in respect of these intact spaces are complied with; and

2. openings in such divisions are capable of being closed by remotely operated sliding watertight doors and unprotected openings are not immersed within the minimum range of residual stability required in 2.8; however, the immersion of any other openings capable of being closed weathertight may be permitted.

2.6 Damage assumptions

2.6.1 For vessels carrying more than 1,200 m$^3$ of products classified in the IBC Code as requiring type 3 ship or type 2 ship, or more than 150 m$^3$ of products classified in the IBC Code as requiring type 1 ship, the assumed maximum extent of damage should be:
.1 Side damage

<table>
<thead>
<tr>
<th>Longitudinal extent</th>
<th>Transverse extent</th>
<th>Vertical extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{3}L^{2/3} )</td>
<td>( B/5 ) (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)</td>
<td>Upwards without limit measured from the moulded line of the bottom shell plating at centreline</td>
</tr>
</tbody>
</table>

.2 Bottom damage

<table>
<thead>
<tr>
<th>Location of damage</th>
<th>Longitudinal extent</th>
<th>Transverse extent</th>
<th>Vertical extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 0.3( L ) measured from the forward perpendicular</td>
<td>( \frac{1}{3}L^{2/3} )</td>
<td>( B/6 )</td>
<td>B/15 or 6 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.9.2)</td>
</tr>
<tr>
<td>Any other part of the vessel</td>
<td>( \frac{1}{3}L^{2/3} ) or 5 m, whichever is less</td>
<td>( B/6 ) or 5 m, whichever is less</td>
<td>B/15 or 6 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.9.2)</td>
</tr>
</tbody>
</table>

2.6.2 For vessels carrying not more than 1,200 m\(^3\) of products classified in the IBC Code as requiring type 3 ship or type 2 ship, and no more than 150 m\(^3\) of products classified in the IBC Code as requiring type 1 ship the assumed maximum extent of damage should be:

.1 Side damage

<table>
<thead>
<tr>
<th>Vessel length</th>
<th>Longitudinal extent</th>
<th>Transverse extent</th>
<th>Vertical extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 24 \leq L \leq 43 ) m</td>
<td>0.1( L )</td>
<td>760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)</td>
<td>From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel</td>
</tr>
<tr>
<td>( 43 &lt; L &lt; 80 ) m</td>
<td>3 m + 0.03( L )</td>
<td>760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)</td>
<td>From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel</td>
</tr>
<tr>
<td>Vessel length</td>
<td>Longitudinal extent</td>
<td>Transverse extent</td>
<td>Vertical extent</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>80 ≤ L ≤ 100 m</td>
<td>1/3 L</td>
<td>B/20, but not less than 760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)</td>
<td>From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel</td>
</tr>
<tr>
<td>L &gt; 100 m</td>
<td>1/3 L</td>
<td>B/15, but not less than 760 mm (measured inboard from the vessel's side at right angles to the centreline at the level of the summer load line)</td>
<td>From the underside of the cargo deck, or continuation thereof, downward for the full depth of the vessel</td>
</tr>
</tbody>
</table>

2.6.3 If any damage of a lesser extent than the maximum damage specified in 2.6.1 or 2.6.2 would result in a more severe condition, such damage should be considered.

2.6.4 A transverse watertight bulkhead extending from the vessel's side to a distance inboard no less than the transverse extent of damage indicated in 2.6.2 measured at the level of the summer load line joining longitudinal watertight bulkheads may be considered as a transverse watertight bulkhead for the purpose of the damage calculations in 2.6.2.

2.7 Standard of damage

Vessels should be capable of surviving damage with the assumptions in 2.5 and 2.6 determined by the following standards:

1. a vessel that carries more than 150 m³ of ship type 1 products should be assumed to sustain damage described in 2.6.1 anywhere along the length;

2. a vessel with a length (L) greater than 150 m that carries more than 1,200 m³ of ship types 2 and 3 products should be assumed to sustain damage described in 2.6.1 anywhere along the length;

3. a vessel with a length (L) of 150 m or less that carries more than 1,200 m³ of ship types 2 and 3 products and no more than 150 m³ of ship type 1 products should be assumed to sustain damage described in 2.6.1 anywhere along the length except involving bulkheads bounding a machinery space of category A;

4. a vessel with a length (L) greater than 100 m that carries 800 m³ or more but no more than 1200 m³ of ship types 2 and 3 products and no more than 150 m³ of ship type 1 products should be assumed to sustain damage described in 2.6.2 anywhere along the length and should also comply with SOLAS regulations II-1/6 to II-1/7.3 (probabilistic damage stability standard for a cargo ship);
a vessel with a length \((L)\) of 100 m or less that carries 800 m\(^3\) or more but no more than 1200 m\(^3\) of ship types 2 and 3 products and no more than 150 m\(^3\) of ship type 1 products should be assumed to sustain damage described in 2.6.2 anywhere along the length;

\[
.6
\]
a vessel with a length \((L)\) greater than 100 m that carries less than 800 m\(^3\) of ship types 2 and 3 products and no more than 150 m\(^3\) of ship type 1 products should be assumed to sustain damage described in 2.6.2 anywhere along the length between transverse watertight bulkheads and should also comply with SOLAS regulations II-1/6 to II-1/7.3 (probabilistic damage stability standard for a cargo ship); and

\[
.7
\]
a vessel with a length \((L)\) of 100 m or less that carries less than 800 m\(^3\) of ship types 2 and 3 products and no more than 150 m\(^3\) of ship type 1 products should be assumed to sustain damage described in 2.6.2 anywhere along the length between transverse watertight bulkheads.

2.8 Survival requirements

2.8.1 Vessels subject to this Code should be capable of surviving the assumed damage specified in 2.6 to the standard provided in 2.7 in a condition of stable equilibrium and should satisfy the following criteria.

2.8.2 For vessels subject to 2.6.1:

\[
.1
\]
in any stage of flooding:

\[
.1
\]
the waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings should include air pipes and openings which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and watertight flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type;

\[
.2
\]
the maximum angle of heel due to unsymmetrical flooding should not exceed 25°, except that this angle may be increased to 30° if no deck immersion occurs; and

\[
.3
\]
the residual stability during intermediate stages of flooding should never be significantly less than that required by 2.8.2.2;

\[
.2
\]
at final equilibrium after flooding:

\[
.1
\]
the righting-lever curve should have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range should not be less than 0.0175 m radians. Unprotected openings should not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 2.8.2.1 and
other openings capable of being closed weathertight may be permitted; and

.2 the emergency source of power should be capable of operating.

2.8.3 For vessels subject to 2.6.2:

.1 the final waterline, taking into account sinkage, heel and trim, should be below the lower edge of any opening through which progressive flooding may take place. Such openings should include air pipes and those which are capable of being closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors and sidescuttles of the non-opening type;

.2 in the final stage of flooding, the angle of heel due to unsymmetrical flooding should not exceed 15°. This angle may be increased up to 17° if no deck immersion occurs; and

.3 the stability in the final stage of flooding should be investigated and may be regarded as sufficient if the righting-lever curve has, at least, a range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 100 mm within this range. Unprotected openings should not become immersed at an angle of heel within the prescribed minimum range of residual stability unless the space in question has been included as a floodable space in calculations for damage stability. Within this range, immersion of any openings referred to in 2.8.3.1 and any other openings capable of being closed weathertight may be authorized.

2.9 Location of cargo tanks

2.9.1 Cargo tanks should be located at the following distances inboard:

.1 cargo tanks for IBC Code ship type 1 products: from the side shell plating, not less than the transverse extent of damage specified in 2.6.1.1.1, and from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in 2.6.1.2.1, and nowhere less than 760 mm from the shell plating. This provision does not apply to tanks for diluted slops arising from tank washing;

.2 cargo tanks for IBC Code ship type 2 products: from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in 2.6.1.2, and nowhere less than 760 mm from the shell plating. This provision does not apply to tanks for diluted slops arising from tank washing; and

.3 cargo tanks for IBC Code ship type 3 products: nowhere less than 760 mm from the shell plating. This provision does not apply to tanks for diluted slops arising from tank washing.
2.9.2 Suction wells installed in cargo tanks for IBC Code ship types 2 and 3 products may protrude below the inner bottom plating provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less. Where there is no double bottom, the protrusion of the suction well of independent tanks below the upper limit of bottom damage should not exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

CHAPTER 3 – VESSEL DESIGN

To ensure that the cargo containment and handling system are located so that the consequences of any release of cargo will be minimized, and to provide safe access for operation and inspection.

This chapter describes the minimum containment and handling provisions for all liquid cargoes. Additional provisions for those products with higher levels of hazard are described in chapter 4.

3.1 Cargo segregation

3.1.1 Tanks containing cargoes, residues of cargoes or mixtures containing cargoes subject to this Code should be segregated from machinery spaces as defined in 1.2.28 and 1.2.29, accommodation, and service 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. On-deck stowage of permanently attached deck tanks or installing independent tanks in otherwise empty hold spaces should be considered as satisfying this provision.

3.1.1.1 For pollution hazards only substances having a flashpoint exceeding 60°C, the segregation provisions need only be met for accommodations spaces, drinking water and stores for human consumption.

3.1.2 Cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes or oil fuels should:

1. be segregated from such other cargoes or oil fuels by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible cargo;

2. have separate pumping and piping systems which should not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and

3. have separate tank venting systems.

3.1.3 Cargo piping should not pass through any accommodation, service spaces or machinery space of category A.

3.1.4 If cargo piping systems or cargo venting systems are required to be separated, this separation may be achieved by the use of design or operational methods. Operational methods should not be used within a cargo tank or a cofferdam surrounding the cargo tanks, if entering of the cofferdam is required, and should consist of one of the following types:

1. removing spool pieces or valves and blanking the pipe ends;

3 Refer to the interpretation of SOLAS regulation II-2/4.5.1 (MSC/Circ.1120).
2 arrangements of two spectacle flanges in series, with provisions for detecting leakage into the pipe between the two spectacle flanges; and

3 blind flange valve with double shut-off and with provisions for detecting leakage in valve body.

3.1.5 Pumps, ballast lines, vent lines and other similar equipment serving ballast tanks should be separated from similar equipment serving cargo tanks and of cargo tanks themselves.

3.1.6 For access to all spaces, the minimum spacing between cargo tank boundaries and adjacent vessels' structure should be 600 mm.

3.1.7 Cargo tanks other than those certified to carry substances subject to the provisions of chapter 4 may extend to the deck plating. Where cargo is handled on the deck area above a cargo tank, the cargo tank may not extend to the deck plating unless a continuous permanent deck sheathing of min 50 mm of wood or other suitable material of equivalent thickness and construction is fitted.

3.1.8 Cargoes subject to this Code should not be carried in either the fore or aft peak tanks.

3.2 Accommodation, service and machinery spaces and control stations

3.2.1 Accommodation or service spaces or control stations should not be located within the cargo area.

3.2.2 For a vessel certified to carry safety hazard substances, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations may be accepted in bulkheads facing the cargo deck area if they are spaced outside the deck area defined in 1.2.7.2.

3.2.3 Propulsion shafts may be routed through cargo pump-rooms.

3.3 Access to spaces in the cargo area

3.3.1 Unless expressly provided otherwise in chapter 4, the following should apply:

1 for pollution hazard only substances at least one access to cargo tanks should be direct from the open deck and designed such as to ensure their complete inspection;

2 for safety hazard substances at least one access to each cargo tank, cofferdams and other spaces in the cargo area should be direct from the open deck and designed such as to ensure their complete inspection; and

3 access to double bottom spaces within the cargo area may be through a cargo pump-room, pump-room, deep cofferdam, pipe tunnel or similar dry compartments with their own direct access from open deck, subject to consideration of ventilation aspects. Where cofferdams are provided over integral tanks, small trunks may be used to penetrate the cofferdam.

3.3.2 For accesses defined in 3.3.1 and 4.1.8 through horizontal openings, hatches or manholes, the dimensions should be sufficient to allow a person with a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without
obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening should be not less than 600 mm by 600 mm.

3.3.3 For accesses defined in 3.3.1 and 4.1.8 through vertical openings, or manholes providing passage through the length and breadth of space, the minimum clear opening should be not less than 600 mm by 800 mm at a height of not more than 600 mm from the bottom shell or deck plating, unless gratings or other footholds are provided.

3.3.4 Smaller dimensions may be approved, if at least one main access defined in 3.3.1 and 4.1.8 has dimensions not less than required in 3.3.2 and 3.3.3, respectively. The main access should clearly be identified in an access plan.

3.3.5 Cargo pump-rooms should be so arranged as to ensure unrestricted access to all valves necessary for cargo handling for a person wearing the required personal protective equipment.

CHAPTER 4 – SPECIAL REQUIREMENTS FOR PRODUCTS WITH A FLASHPOINT NOT EXCEEDING 60°C, TOXIC PRODUCTS AND ACID

To ensure that the designs of the vessels are such that the consequences of any release of liquid cargo with severe safety hazards will be minimized, and to provide protection to the vessel and crew from fire, toxic vapour and corrosive substances.

The provisions in this chapter are additional to the general provisions of chapter 3 of this Code.

4.1 General requirements for products with a flashpoint not exceeding 60°C, toxic products or acids

4.1.1 Unless expressly provided otherwise, the provisions of this section are applicable to products with a flashpoint not exceeding 60°C, toxic products and acids. These provisions are additional to the general provisions of this Code.

4.1.2 Cargo tanks certified for products or residues of products subject to the provisions of this chapter should be segregated from machinery spaces, propulsion shaft tunnels, solid bulk cargo and underdeck access way if fitted, by means of a cofferdam, void space, cargo pump-room, empty tank or other similar space.

4.1.3 Cargo tanks certified for products subject to the provisions of this chapter need to be separated from the deck plating by cofferdams.

4.1.4 Cargo piping should not pass through any underdeck access way or machinery spaces.

4.1.5 Discharge arrangements for ballast or fresh water sited immediately adjacent to cargo tanks certified for products or residues of products subject to the provisions of this chapter should be outside machinery spaces and accommodation spaces. Filling arrangements may be in the machinery spaces provided that such arrangements ensure filling from main deck level and non-return valves are fitted.

4.1.6 Bilge pumping systems serving spaces where cargoes or residues of cargoes may occur are to be independent from systems serving spaces outside such areas and are to be

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4 Refer to the interpretation of SOLAS regulation II-2/4.5.1 (MSC/Circ.1120).
entirely situated within the area related to cargoes subject to this chapter. The bilge system serving these spaces should be operable from outside the cargo area.

4.1.7 In order to guard against the danger of hazardous vapours, due consideration should be given to the location of air intakes and openings into accommodation, passageways, service and machinery spaces and control stations in relation to cargo piping and cargo vent systems as defined in 1.2.7.

4.1.8 All access to cargo tanks, cofferdams, void spaces, cargo pump-room, pump-room, empty tank, or other spaces adjacent to cargo tanks certified for products subject to the provisions of this chapter, should be direct from the open deck and such as to ensure their complete inspection. The dimensions of the accesses should be in accordance with 3.3.2 to 3.3.4.

4.1.9 High walkways should not be located within the cargo area as defined in 1.2.7.3.3.

4.2 Products with a flashpoint not exceeding 60°C

4.2.1 The provisions of this section are applicable to products with a flashpoint not exceeding 60°C. These provisions are in addition to the general provisions of chapter 3 of this Code.

4.2.2 Unless they are spaced at least 7 m away from the deck area as defined in 1.2.7.3 entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo deck area. Doors to spaces not having access to accommodation, service and machinery spaces and control stations, such as cargo control stations and store-rooms, may be permitted within the such deck area, provided the boundaries of the spaces are insulated to A-60 standard. When arranged within such deck area, windows and sidescuttles facing the deck area should be of a fixed (non-opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

4.3 Toxic products

4.3.1 The provisions of this section are applicable to toxic products. These provisions are additional to general provisions of chapter 3 of this Code and to the special requirements specified in section 15.12 of the IBC Code.

4.3.2 Unless they are spaced at least 15 m away from the deck area as defined in 1.2.7.3 entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo deck area. Doors to spaces not having access to accommodation, service and machinery spaces and control stations, such as cargo control stations and store-rooms, may be permitted within the such deck area, provided the boundaries of the spaces equivalent gas tightening to "A-60" class standard. Wheelhouse doors and wheelhouse windows may be located within the limits specified above so long as they are so designed that a rapid and efficient gas – and vapour-tightening of the wheelhouse can be ensured. Windows and sidescuttles facing the deck area and on the sides of the superstructures and deck-houses within the limits specified above should be of the fixed (non-opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

4.3.3 For a vessel certified to carry toxic products only subject to the requirements of 15.12.3 and 15.12.4 of the IBC Code, entrances, air inlets and openings to accommodation,
service and machinery spaces and control stations may be accepted in bulkheads facing the cargo deck area if they are spaced outside the deck area as defined in 1.2.7.3.

4.3.4 Cargo tanks certified to carry toxic products should be fitted with fixed tank washing arrangements. Other arrangement allowing cleaning of the tank(s) without the need for personnel to enter during the cleaning process may be fitted, if proper safety equipment is used.

4.3.5 The cargo deck area should be such to promote natural ventilation and to prevent toxic gas from accumulate in closed or partly closed spaces on deck. A high closed cargo rail in the stern are prohibited. However, if proper natural ventilation can be documented, higher aft bulwark/cargo rail may be accepted.

4.3.6 Means to minimize the range of a possible leak in the hose landing area on main deck should be provided. Example of means may be transverse gutter bars on both sides of the hose landing area in way of the loading stations.

4.3.7 The set point of the pressure side of the P/V-valves should be set at minimum 0.6 bar gauge.

4.4 Acids

4.4.1 The provisions of this section are applicable to acids. These provisions are additional to general provisions of this Code and to the special requirements specified in section 15.11 of the IBC Code.

4.4.2 Floors or decks under acid storage tanks and pumps and piping for acid should have a lining or coating of corrosion-resistant material extending up to a minimum height of 500 mm on the bounding bulkheads or coamings. Hatches or other openings in such floors or decks should be raised to a minimum height of 500 mm; however, where the Administration determines that this height is not practicable, a lesser height may be required.

4.4.3 Flanges or other detachable pipe connections should be covered by spray shields.

4.4.4 Portable shield covers for connecting the flanges of the loading manifold should be provided. Drip trays of corrosion-resistant material should be provided under loading manifolds for acids.

4.4.5 Spaces for acid storage tanks and acid pumping and piping should be provided with drainage arrangements of corrosion-resistant materials.

4.4.6 Deck spills should be kept away from accommodation and service areas by means of a permanent coaming of suitable height and extension.

CHAPTER 5 – CARGO CONTAINMENT

To ensure the safe containment of cargo under all design and operating conditions having regard to the nature of the cargo carried.

5.1 Definitions

5.1.1 Independent tank means a cargo-containment envelope, which is not contiguous with, or part of, the hull structure. An independent tank is built and installed so as to eliminate whenever possible (or in any event to minimize) its stressing as a result of stressing or motion
of the adjacent hull structure. An independent tank is not essential to the structural completeness of the vessels' hull.

5.1.2 **Integral tank** means a cargo-containment envelope which forms part of the vessels' hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the vessels' hull.

5.1.3 **Gravity tank** means a tank having a design pressure not greater than 0.07 MPa gauge at the top of the tank. A gravity tank may be independent or integral. A gravity tank should be constructed and tested according to recognized standards, taking account of the temperature of carriage and relative density of the cargo.

5.1.4 **Pressure tank** means a tank having a design pressure greater than 0.07 MPa gauge. A pressure tank should be an independent tank and should be of a configuration permitting the application of pressure-vessel design criteria according to recognized standards.

5.2 **Tank type requirements for individual products**

5.2.1 Requirements for both installation and design of tank types for individual products are shown in column f in the table of chapter 17 of the IBC Code.

5.2.2 Instead of the use of permanently attached cargo deck-tanks complying with the requirements of the IBC Code, portable tanks meeting the construction requirements of the IMDG Code or other portable tanks specifically approved by the Administration, may be used for cargoes indicated in 1.1.9 provided that the provisions of chapter 17 are complied with. The applicable tank instruction for the products listed as dangerous goods in the IMDG Code should apply. Products, with pollution hazard only and a flashpoint above 60°C, falling within the scope of this code but for which the IMDG Code is not applicable, when carried in packaged form, should be shipped under the tank instruction and special tank requirements as included in the IMDG Code for goods with UN number 3082.

**CHAPTER 6 – CARGO TRANSFER**

To ensure the safe handling of all cargoes, under all normal operating conditions and foreseeable emergency conditions, to minimize the risk to the vessel, its crew and the environment, having regard to the nature of the products involved. This will:

.1 ensure the integrity of integral liquid product tanks, piping systems and cargo hoses;

.2 prevent the uncontrolled transfer of cargo; and

.3 ensure reliable means to fill and empty the cargo tank.

**6.1 Piping scantlings**

6.1.1 Subject to the conditions stated in 6.1.4, the wall thickness (t) of pipes should not be less than:

\[
t = \frac{(t_0 + b + c)}{(1 - a/100)} \text{ (mm)}
\]
where:

\[ t_0 = \text{theoretical thickness} \]

\[ t_0 = \frac{P \times D}{(2Ke + P)} \text{ (mm)} \]

with

\[ P = \text{design pressure (bar) referred to in 6.1.2} \]
\[ D = \text{outside diameter (mm)} \]
\[ K = \text{allowable stress (MPa) referred to in 6.1.5} \]
\[ e = \text{efficiency factor equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, which are considered equivalent to seamless pipes when non-destructive testing on welds is carried out in accordance with recognized standards. In other cases, an efficiency factor of less than 1.0, in accordance with recognized standards, may be required depending on the manufacturing process.} \]

\[ B = \text{allowance for bending (mm). The value of } b \text{ should be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, } b \text{ should be not less than:} \]

\[ b = \frac{D t_0}{2.5r} \text{ (mm)} \]

with

\[ r = \text{mean radius of the bend (mm)} \]

\[ c = \text{corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of piping should be increased over that required by the other design provisions.} \]

\[ A = \text{negative manufacturing tolerance for thickness (%).} \]

6.1.2 The design pressure \( P \) in the formula in 6.1.1 is the maximum gauge pressure to which the system may be subjected in service, taking into account the highest set pressure on the relief valve on the system.

6.1.3 Piping and piping-system components which are not protected by a relief valve, or which may be isolated from their relief valve, should be designed for at least the greatest of:

.1 piping systems or components, which may contain some liquid, the saturated vapour pressure at 45°C;

.2 the pressure setting of the associated pump discharge relief valve;

.3 the scantlings’ maximum possible total pressure head at the outlet of the associated pumps when a pump discharge relief valve is not installed; and
.4 systems or components which may be separated from their relief valves and which contain only vapour at all times: the superheated vapour pressure at 45°C, assuming an initial condition of saturated vapour in the system at the system operating pressure and temperature.

6.1.4 The design pressure should not be less than 1 MPa gauge except for open-ended lines, where it should be not less than 0.5 MPa gauge.

6.1.5 For pipes, the allowable stress $K$ to be considered in the formula in 6.1.1 is the lower of the following values:

$$R_m/A \text{ or } R_e/B$$

where:

- $R_m$ = specified minimum tensile strength at ambient temperature (MPa).
- $R_e$ = specified minimum yield stress at ambient temperature (MPa). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.

$A$ and $B$ should have values of at least $A = 2.7$ and $B = 1.8$.

6.1.5.1 The minimum wall thickness should be in accordance with recognized standards.

6.1.5.2 Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to weight of pipes and content and to superimposed loads from supports, vessel deflection or other causes, the wall thickness should be increased over that required by 6.1.1 or, if this is impracticable or would cause excessive local stresses, these loads should be reduced, protected against or eliminated by other design methods.

6.1.5.3 Flanges, valves and other fittings should be in accordance with recognized standards, taking into account the design pressure defined under 6.1.2.

6.1.5.4 For flanges not complying with a standard, the dimensions for flanges and associated bolts should be to the satisfaction of the Administration.

6.2 Piping fabrication and joining details

6.2.1 The provisions of this section apply to piping inside and outside the cargo tanks. However, relaxations from these provisions may be accepted in accordance with recognized standards for open-ended piping and for piping inside cargo tanks except for cargo piping serving other cargo tanks.

6.2.2 Cargo piping should be joined by welding except:

1. for approved connections to shutoff valves and expansion joints; and
2. for any practical vessel building and pipe corrosion protection limits taking into account the provisions as stated in 6.2.5 and 6.3 in relation to any additional flanged connections, the use of flanged connections should be limited as far as possible.

6.2.3 Cargo piping for products or residues of products which are subject to the provisions of chapter 4 should be joined by welding.
6.2.4 The following direct connections of pipe lengths without flanges may be considered:

.1 butt-welded joints with complete penetration at the root may be used in all applications;

.2 slip-on welded joints with sleeves and related welding having dimensions in accordance with recognized standards should only be used for pipes with an external diameter of 50 mm or less. This type of joint should not be used when crevice corrosion is expected to occur; and

.3 screwed connections, in accordance with recognized standards, should only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.

6.2.5 Expansion of piping should normally be allowed for by the provision of expansion loops or bends in the piping system.

.1 bellows, in accordance with recognized standards and installed in an easily accessible location, may be specially considered; and

.2 slip joints should not be used.

6.2.6 Welding, post-weld heat treatment and non-destructive testing should be performed in accordance with recognized standards.

6.3 Flange connections

6.3.1 Flanges should be of the welded-neck, slip-on or socket-welded type. However, socket welded type flanges should not be used with an external diameter above 50 mm.

6.3.2 Flanges should comply with recognized standards as to their type, manufacture and test.

6.4 Test requirements for piping

6.4.1 The test provisions of this section apply to piping inside and outside cargo tanks. However, relaxations from these provisions may be accepted in accordance with recognized standards for piping inside tanks and open-ended piping.

6.4.2 After assembly, each cargo piping system should be subject to a hydrostatic test to at least 1.5 times the design pressure. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the hydrostatic test may be conducted prior to installation aboard the vessel. Joints welded on board should be hydrostatically tested to at least 1.5 times the design pressure.

6.4.3 After assembly on board, each cargo piping system should be tested for leaks to a pressure depending on the method applied.

6.5 Piping arrangements

6.5.1 Cargo piping should not be installed under deck between the out-board side of the cargo containment spaces and the skin of the vessel unless clearances required for damage protection (see 2.9) are maintained; but such distances may be reduced where damage to the
pipe would not cause release of cargo provided that the clearance required for inspection purposes is maintained.

6.5.2 Cargo piping located below the main deck may run from the tank it serves and penetrate tank bulkheads or boundaries common to longitudinally or transversally adjacent cargo tanks, ballast tanks, empty tanks, pump-rooms or cargo pump-rooms provided that inside the tank it serves it is fitted with a stop-valve operable from the weather deck and provided cargo compatibility is ensured in the event of piping failure. As an exception, where a cargo tank is adjacent to a cargo pump-room, the stop valve operable from the weather deck may be situated on the tank bulkhead on the cargo pump-room side, provided an additional valve is fitted between the bulkhead valve and the cargo pump. A totally enclosed hydraulically operated valve located outside the cargo tank may, however, be accepted, provided that the valve is:

.1 designed to preclude the risk of leakage;
.2 fitted on the bulkhead of the cargo tank which it serves;
.3 suitably protected against mechanical damage;
.4 fitted at a distance from the shell as required for damage protection; and
.5 operable from the weather deck.

6.5.3 If a cargo pump serves more than one tank, a stop valve should be fitted in the line to each tank.

6.5.4 Cargo piping installed in pipe tunnels should also comply with the provisions of 6.5.1 and 6.5.2. Pipe tunnels should satisfy all tank provisions for construction, location and ventilation and electrical hazard provisions. Cargo compatibility should be ensured in the event of a piping failure. The tunnel should not have any other openings except to the weather deck and cargo pump-room or pump-room.

6.5.5 Cargo piping passing through bulkheads should be so arranged as to preclude excessive stresses at the bulkhead and should not utilize flanges bolted through the bulkhead.

6.5.6. In order to prevent any generation of static electricity, the outlets of filling lines should be led as low as possible in the tanks, except for vessels intended to carry pollution hazard only substances having a flashpoint exceeding 60°C or oil products having a flashpoint exceeding 60°C.

6.6 Cargo-transfer control systems

6.6.1 For the purpose of adequately controlling the cargo, cargo-transfer systems should be provided with:

.1 one stop-valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if an individual deep well pump is used to discharge the contents of a cargo tank, a stop-valve is not required on the discharge line of that tank;
.2 one stop valve and break-away fitting at each cargo-hose connection; and
.3 remote shutdown devices for all cargo pumps and similar equipment should be capable of being activated from a dedicated cargo control location which is manned at the time of cargo transfer and from at least one other location outside the cargo area and at a safe distance from it. Cargo controls located in the vessel wheelhouse are acceptable as one of the cargo control locations.

6.6.2 For certain products, additional cargo-transfer control requirements are shown in column o in the table of chapter 17 of the IBC Code.

6.6.3 Pump discharge pressure gauges or readouts should be provided outside the cargo pump-room.

6.7 Vessels' cargo hoses

6.7.1 Liquid and vapour hoses used for cargo transfer should be compatible with the cargo and suitable for the cargo temperature.

6.7.2 Hoses subject to tank pressure or the discharge pressure of pumps should be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

6.7.3 Drip trays for collecting cargo residues in cargo lines and hoses should be provided in the area of pipe and hose connections under the manifold area.

6.7.4 Each type of cargo hose, complete with end-fittings, should be prototype tested at a normal ambient temperature with 200 pressure cycles from zero to at least twice the specified maximum working pressure. After this cycle pressure test has been carried out, the prototype test should demonstrate a bursting pressure of at least 5 times its specified maximum working pressure at the extreme service temperature. Hoses used for prototype testing should not be used for cargo service. Thereafter, before being placed in service, each new length of cargo hose produced should be 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. The hose should be stencilled or otherwise marked with the date of testing, its specified maximum working pressure and, if used in services other than the ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure should not be less than 10 bar gauge.

CHAPTER 7 – CARGO TANK VENTING

To protect cargo containment systems from harmful over-pressure or under-pressure at all times.

7.1 General

7.1.1 All cargo tanks should be provided with a venting system appropriate to the cargo being carried and these systems should be independent of the air pipes and venting systems of all other compartments of the vessel. Tank venting systems should be designed so as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation, service and machinery spaces and control stations and, in the case of flammable vapours, entering or collecting in spaces or areas containing sources of ignition. Tank venting systems should be arranged to prevent entrance of water into the cargo tanks.
7.1.2 The venting systems should be connected to the top of each cargo tank and, as far as practicable, the cargo vent lines should be self-draining back to the cargo tanks under all normal operational conditions of list and trim. Where it is necessary to drain venting systems above the level of any pressure/vacuum valve, capped or plugged drain cocks should be provided.

7.1.3 Provision should be made to ensure that the liquid head in any tank does not exceed the design head of the tank. Suitable high-level alarms, overflow control systems or spill valves, together with gauging and tank filling procedures, may be accepted for this purpose. Where the means of limiting cargo tank overpressure includes an automatic closing valve, the valve should comply with the appropriate requirements of 15.19 of the IBC Code.

7.1.4 Tank venting systems should be designed and operated so as to ensure that neither pressure nor vacuum created in the cargo tanks during loading or unloading exceeds tank design parameters. The main factors to be considered in the sizing of a tank venting system are as follows:

1. design loading and unloading rate;
2. gas evolution during loading: this should be taken account of by multiplying the maximum loading rate by a factor of at least 1.25;
3. density of the cargo vapour mixture;
4. pressure loss in vent piping and across valves and fittings; and
5. pressure/vacuum settings of relief devices.

7.1.5 Tank vent piping connected to cargo tanks of corrosion-resistant material or to tanks which are lined or coated to handle special cargoes as required by chapter 15 of the IBC Code, should be similarly lined or coated or constructed of corrosion-resistant material.

7.1.6 The master should be provided with the maximum permissible loading and unloading rates for each tank or group of tanks consistent with the design of the venting systems.

7.2 Types of tank venting systems

7.2.1 An open tank venting system is a system which offers no restriction except for friction losses to the free flow of cargo vapours to and from the cargo tanks during normal operations. An open venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard to cargo segregation. In no case should shut-off valves and all other means of stoppage, including spectacle blanks and blank flanges be fitted either to the individual vents or to the header.

7.2.2 A controlled tank venting system is a system in which pressure- and vacuum-relief valves or pressure/vacuum valves are fitted to each tank to limit the pressure or vacuum in the tank. A controlled venting system may consist of individual vents from each tank or such individual vents on the pressure side only as may be combined into a common header or headers, with due regard to cargo segregation. In no case should shut-off valves and all other means of stoppage, including spectacle blanks and blank flanges be fitted either above or below pressure- or vacuum-relief valves or pressure/vacuum valves. Provision may be made for bypassing a pressure- or vacuum-relief valve or pressure/vacuum valve under certain operating conditions provided that the requirement of 7.2.6 is maintained and that there is suitable indication to show whether or not the valve is bypassed.
7.2.3  Controlled tank venting systems should consist of a primary and a secondary means of allowing full flow relief of vapour to prevent over-pressure or under-pressure in the event of failure of one means. Alternatively, the secondary means may consist of pressure sensors fitted in each tank with a monitoring system in the vessels' cargo control room or position from which cargo operations are normally carried out. Such monitoring equipment should also provide an alarm facility which is activated by detection of over pressure or under pressure conditions within a tank.

7.2.4  The outlets of a controlled tank venting system should direct the vapour discharge upwards in the form of unimpeded jets and the position should be arranged at a height of not less than 6 m above the weather deck.

7.2.5  The outlet height referred to in 7.2.4 may be reduced to 3 m above weather deck provided that high-velocity venting valves of an approved type with an exit velocity of at least 30 m/s, are fitted.

7.2.6  Controlled tank venting systems fitted to tanks to be used for cargoes having a flashpoint not exceeding 60°C should be provided with devices to prevent the passage of flame into the cargo tanks. The design, testing and locating of the devices should comply with the provisions of the Administration, which should contain at least the standards adopted by the Organization.

7.2.7  In designing venting systems and in the selection of devices to prevent the passage of flame for incorporation into the tank venting system, due attention should be paid to the possibility of the blockage of these systems and fittings by, for example, the freezing of cargo vapour, polymer build up, atmospheric dust or icing up in adverse weather conditions. In this context it should be noted that flame arresters and flame screens are more susceptible to blockage. Provisions should be made such that the system and fittings may be inspected, operationally checked, cleaned or renewed as applicable.

7.2.8  Pressure tanks should be fitted with pressure relief devices that are so designed as to direct the discharge away from personnel and have a set pressure and capacity which is in accordance with standards acceptable to the Administration taking into account the design pressure referred to in 6.1.5.

7.3  Venting requirements for individual products

Venting requirements for individual products are shown in column g, and additional requirements in column o in the table of chapter 17 of the IBC Code.

7.4  Cargo tank gas-freeing

7.4.1  The arrangements for gas-freeing cargo tanks used for cargoes other than those for which open venting is permitted should be such as 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. Accordingly, gas-freeing operations should be carried out such that vapour is initially discharged:

.1 through the vent outlets specified in 7.2.4 and 7.2.5; or

.2 through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 30 m/s maintained during the gas-freeing operation; or
.3 through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 20 m/s which are protected by suitable devices to prevent the passage of flame.

When the flammable vapour concentration at the outlets has been reduced to 30% of the lower flammable limit and, in the case of a toxic product, the vapour concentration does not present a significant health hazard, gas-freeing may thereafter be continued at cargo tank deck level.

7.4.2 The outlets referred to in 7.4.1.2 and 7.4.1.3 may be fixed or portable pipes.

7.4.3 In designing a gas-freeing system in conformity with 7.4.1, particularly in order to achieve the required exit velocities of 7.4.1.2 and 7.4.1.3, due consideration should be given to the following:

.1 materials of construction of system;
.2 time to gas-free;
.3 flow characteristics of fans to be used;
.4 the pressure losses created by ducting, piping, cargo tank inlets and outlets;
.5 the pressure achievable in the fan driving medium (e.g. water or compressed air); and
.6 the densities of the cargo vapour/air mixtures for the range of cargoes to be carried.

CHAPTER 8 – ELECTRICAL INSTALLATIONS

To ensure electrical installations are designed so as to minimize the risk of fire and explosion from flammable products; and ensure availability of electrical generation and distribution systems relating to the safe carriage, handling and conditioning of cargoes.

8.1 General requirements

8.1.1 The provisions of this chapter are applicable to vessels carrying cargoes which are inherently, or due to their reaction with other substances, flammable or corrosive to the electrical equipment, and should be applied in conjunction with applicable electrical requirements of part D of chapter II-1 of SOLAS.

8.1.2 Electrical installations should be such as to minimize the risk of fire and explosion from flammable products. Appropriate precautions should be taken to recognizing the risks that might be associated with deterioration of the electrical system and equipment from environment created by the products.

8.1.3 Electrical installation should be in accordance with standards acceptable to the Organization.

8.1.4 Electrical equipment or wiring should not be installed in hazardous areas unless essential for operational purposes or safety enhancement.

Reference is made to the recommendations published by the International Electrotechnical Commission, in particular to Publication IEC 60092-502: 1999.
8.1.5 Where electrical equipment is installed in hazardous areas as provided in 8.1.4 it should be selected, installed and maintained in accordance with standards not inferior to those acceptable to the Organization. Equipment for hazardous areas should be evaluated and certified or listed by an accredited testing authority or notified body recognized by the Administration. Automatic isolation of non-certified equipment on detection of a flammable gas should not be accepted as an alternative to the use of certified equipment.

8.1.6 To facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones in accordance with recognized standards.

8.1.7 The lighting system in hazardous areas should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and should be located in a non-hazardous area.

8.2 Electrical requirements for individual products

Electrical requirements for individual products are shown in column i in the table of chapter 17 of the IBC Code.

CHAPTER 9 – FIREFIGHTING REQUIREMENTS

To ensure that suitable systems are provided to protect the vessel and crew from fire in the cargo area.

9.1 Application

9.1.1 For the carriage of liquids covered by this Code, the requirements for tankers in chapter II-2 of SOLAS should apply to vessels covered by this Code, irrespective of tonnage, including vessels of less than 500 gross tonnage, except that:

.1 regulations 10.8 (cargo tank protection) and 10.9 (protection of cargo pump-rooms in tankers) should not be applied;

.2 the provisions of 9.3 of this Code should be applied in lieu of regulation 10.8 (cargo tank protection);

.3 the provisions of 9.2 of this Code should be applied in lieu of regulation 10.9 (protection of cargo pump-rooms in tankers);

.4 regulation 4.5.1.1 (i.e. positioning of machinery spaces aft of cargo tanks, slop tanks, cargo pump-rooms and cofferdams), regulation 4.5.1.2 (i.e. the requirements for location of the main cargo control station), regulations 4.5.1.4 (combination carriers) and 4.5.2.1 (access to accommodations, boundary bulkheads) to 4.5.2.3 (windows facing cargo area) need not be applied;

.5 with regard to regulation 9.2.4.1, the Administration may permit use of a method other than IC as defined in regulation 9.2.3.1.1.1;

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6 Ibid.

7 Ibid.
.6 for spaces other than cargo pump-room spaces, the requirements of
regulation 9.2.3 (cargo vessels except tankers) may be applied in lieu of
those in regulation 9.2.4.2. Additionally, regulation 9.2.4.2.5
("A-60" standard) need not be applied provided that the exterior boundaries
of superstructures and deckhouses enclosing accommodation and including
any overhanging decks which support such accommodation are spaced
outside the cargo deck area defined in 1.2.7.3;

.7 regulations 4.5.3 (cargo tank venting), 4.5.4 (ventilation), 4.5.7 (gas
measurement) and 4.5.8 (air supply to double hull spaces and double bottom
spaces) need not be applied where alternative arrangements are provided,
having due regard to the provisions of this Code;

.8 for vessels below 2,000 gross tonnage, regulations 10.2 (water supply
systems), 10.4 (fixed fire-extinguishing systems) and 10.5 (fire-extinguishing
arrangements in machinery spaces) should apply as they would apply to
cargo vessels of 2,000 gross tonnage and over;

.9 regulation 4.5.10 should apply to vessels of 500 gross tonnage and over,
replacing "hydrocarbon gases" by "flammable vapours" in the regulation; and

.10 regulations 13.3.4 (EEBDs) and 13.4.3 (EEBDs) should apply to vessels
of 500 gross tonnage and over.

9.1.2 Notwithstanding the provisions of 9.1.1, vessels engaged solely in the carriage of
products which are identified in chapter 17 of the IBC Code as non-flammable (entry "NF" in
column i of the table of minimum requirements) need not comply with requirements for tankers
specified in SOLAS chapter II-2, provided that they comply with the requirements for cargo
vessels of that chapter, except that regulation 10.7 (fire-extinguishing arrangements in
cargo spaces) need not apply to such vessels and 9.2 and 9.3, hereunder, need not apply.

9.1.3 For vessels engaged solely in the carriage of products with a flashpoint
exceeding 60°C (entry "Yes" in column i of the table of minimum requirements), the
requirements of SOLAS chapter II-2 may apply as specified in regulation II-2/1.6.4 (tankers
carrying petroleum products with a flashpoint exceeding 60°C) in lieu of the provisions of this
chapter.

9.1.4 For vessels engaged in both carriage of products with a flashpoint exceeding 60°C
and products with a flashpoint not exceeding 60°C, the provisions of 9.2 and 9.3 are only
applicable to the cargo areas and pump-rooms in connection with the tanks for carriage of
products with a flashpoint not exceeding 60°C. Further, the requirement for tankers, given in
SOLAS chapter II-2 as given in 9.1.1 above, is only applicable to cargo areas, cargo space,
cargo tanks, pump-rooms, control stations and other spaces in connection with the tanks for
carriage of products with a flashpoint not exceeding 60°C.

9.2 Cargo pump-rooms

9.2.1 The cargo pump-room of any vessel to which the provisions of 9.1.4 apply should be
provided with a fixed carbon dioxide fire-extinguishing system as specified in SOLAS
regulation II-2/10.9.1.1. A notice should be exhibited at the controls stating that the system is
only to be used for fire-extinguishing and not for inerting purposes, due to the electrostatic
ignition hazard. The alarms referred to in SOLAS regulation II-2/10.9.1.1.1 (safe alarms)
should be safe for use in a flammable cargo vapour/air mixture. For the purpose of this
requirement, an extinguishing system should be provided which would be suitable for
machinery spaces. However, the amount of gas carried should be sufficient to provide a quantity of free gas equal to 45% of the gross volume of the cargo pump-room in all cases.

9.2.2 Cargo pump-rooms of vessels which are dedicated to the carriage of a restricted number of cargoes should be protected by an appropriate fire-extinguishing system approved by the Administration.

9.2.3 If cargoes are to be carried which are not suited to extinguishment by carbon dioxide or equivalent media, the cargo pump-room should be protected by a fire-extinguishing system consisting of either a fixed pressure water spray or high expansion foam system. The International Certificate of Fitness should reflect this conditional requirement.

9.3 Protection of the cargo area

9.3.1 Every vessel should be provided with a fixed deck foam system in accordance with the provisions of 9.3.2 to 9.3.8.

9.3.2 The system should be located and sized to supply simultaneously foam to the deck area as defined in 1.2.7.3 through .5 and .7.

9.3.3 All parts of the areas are to be protected by either fixed foam monitor(s) or fixed nozzles or a combination of both.

9.3.4 In case of foam monitors, one monitor may be sufficient and the distance from the monitor to the farthest extremity of the protected area should not be more than 75% of the monitor throw in still air conditions. The monitor(s) should be in a location that is not above the cargo tanks and is readily accessible and operable in the event of fire in the areas protected.

9.3.5 The deck foam system should be capable of simple and rapid operation. The main control station for the system should be suitably located outside of the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fires in the areas protected.

9.3.6 Application rate should be 10 l/minute/m² with sufficient supply for at least 30 minutes for tanks without an overlying cofferdam and 20 minutes for tanks with an overlying cofferdam. Water supply to the fixed foam fire extinguishing system should be in addition to the water supply required for the vessels fire main.

9.3.7 The foam concentrates should be compatible with the cargo carried.

9.3.8 In addition, the vessel should carry in a readily available position, at cargo deck level, two portable foam applicator units with at least 4 portable 20 l containers with foam concentrate, for use with water supplied by the vessels fire main.

9.4 Special requirements

All fire-extinguishing media determined to be effective for each product are listed in column ℓ in the table of chapter 17 in the IBC Code. Refer to the MSDS for each product to be carried.

CHAPTER 10 – MECHANICAL VENTILATION IN THE CARGO AREA

To ensure that arrangements are provided for enclosed spaces in the cargo area to control the accumulation of flammable and/or toxic vapours.
10.1 Application

10.1.1 For vessels to which this Code applies, the provisions of this chapter replace the requirements of SOLAS regulations II-2/4.5.2.6 and 4.5.4.1.

10.1.2 However, for products addressed under 9.1.3, except acids and products for which 15.12 and/or 15.17 of the IBC Code applies, SOLAS regulations II-2/4.5.2.6 and 4.5.4.1 may apply in lieu of the provision of 10.2 of this chapter.

10.1.3 For non-flammable products addressed under 9.1.2, except acids and products for which 15.12 and/or 15.17 of the IBC Code applies, the provisions for permanent installations in 10.3 may apply for spaces required to be entered during normal cargo handling operations.

10.2 Spaces normally entered during normal cargo handling operations

10.2.1 Cargo pump-rooms, spaces containing cargo handling equipment and other enclosed spaces where cargo vapours may accumulate should be fitted with fixed mechanical ventilation systems, capable of being controlled from outside such spaces. The ventilation should be run continuously to prevent the accumulation of toxic vapours. A warning notice requiring the use of such ventilation prior to entering should be placed outside the compartment.

10.2.2 Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid accumulation of toxic or asphyxiant vapours, and to ensure a safe working environment.

10.2.3 The ventilation system should have a capacity of not less than 30 changes of air per hour, based upon the total volume of the space.

10.2.4 Where a space has an opening into an adjacent more hazardous space or area, it should be maintained at an over-pressure. It may be made into a less hazardous space or non-hazardous space by over-pressure protection in accordance with standards acceptable to the Organization.

10.2.5 Ventilation systems should be permanent and should normally be of extraction type. Extraction from above and below the floor plates should be possible.

10.2.6 Ventilation intakes should be so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening.

10.2.7 Ventilation ducts serving hazardous areas should not be led through accommodation, service and machinery spaces or control stations.

10.2.8 Electric motors driving fans should be placed outside the ventilation ducts that may contain flammable vapours. Ventilation fans should not produce a source of ignition in either the ventilated space or the ventilation system associated with the space. For hazardous areas, ventilation fans and ducts, adjacent to the fans, should be of non-sparking construction, as defined below:

1. impellers or housing of non-metallic construction, with due regard being paid to the elimination of static electricity;

2. impellers and housing of non-ferrous materials;

Refer to IEC 60092-502:1999.
.3 impellers and housing of austenitic stainless steel; and

.4 ferrous impellers and housing with not less than 13 mm design tip clearance.

10.2.9 Any combination of an aluminium or magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and should not be used in these places.

10.2.10 Where fans are required by this chapter, full required ventilation capacity for each space should be available after failure of any single fan or spare parts should be provided comprising a motor, starter spares and complete rotating element, including bearings of each type.

10.2.11 Protection screens of not more than 13 mm square mesh should be fitted to outside openings of ventilation ducts.

10.2.12 Where spaces are protected by over-pressure the ventilation should be designed and installed in accordance with standards acceptable to the Organization⁹.

10.3 Spaces not normally entered

Enclosed spaces where cargo vapours may accumulate should be capable of being ventilated to ensure a safe environment when entry into them is necessary. This should be capable of being achieved without the need for prior entry. For permanent installations, the capacity of eight air changes per hour should be provided and for portable systems, the capacity of 16 air changes per hour. Fans or blowers should be clear of personnel access openings, and should comply with 10.2.8.

CHAPTER 11 – INSTRUMENTATION AND AUTOMATION SYSTEMS

To ensure that the instrument and automation systems provide for the safe carriage and handling of cargoes.

11.1 General

11.1.1 Each cargo tank should be provided with a means for indicating level.

11.1.2 If loading and unloading of the vessel is performed by means of remotely controlled valves and pumps, all controls and indicators associated with a given cargo tank should be concentrated in at least one cargo control station.

11.1.3 Instruments should be tested to ensure reliability under the working conditions and recalibrated at regular intervals. Test procedures for instruments and the intervals between recalibration should be in accordance with manufacturer's recommendations.

11.2 Level indicators for cargo tanks

11.2.1 Each cargo tank should be fitted with liquid level gauging device(s), arranged to ensure a level reading is always obtainable whenever the cargo tank is operational. The device(s) should be designed to operate throughout the design pressure range of the cargo tank and at temperatures within the cargo operating temperature range.

⁹ Ibid.
11.2.2 Where the installation of liquid level gauging devices are impractical due to the properties of the cargo, such as liquid muds, a visual means of indicating the cargo tank level should be provided for cargo loading operations, subject to approval by the Administration.

11.2.3 Where only one liquid level gauge is fitted it should be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank.

11.2.4 Cargo tank liquid level gauges may be of the following types, subject to special requirements for particular cargoes shown in column j in the table of chapter 17 of the IBC Code.

.1 open device: which makes use of an opening in the tanks and may expose the gauge to the cargo or its vapour. An example of this is the ullage opening;

.2 restricted device: which penetrates the tank and which, when in use, permits a small quantity of cargo vapour or liquid to be exposed to the atmosphere. When not in use, the device is completely closed. The design should ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device; and

.3 closed device: which penetrates the tank, but which is part of a closed system and keeps tank contents from being released. Examples are the float-type systems, electronic probe, magnetic probe and protected sight-glass. Alternatively, an indirect device which does not penetrate the tank shell and which is independent of the tank may be used. Examples are weighing of cargo, pipe flowmeter.

11.3 Overflow control

The requirements of 15.19 of the IBC Code are applicable where specific reference is made in column o in the table of chapter 17 thereof, and are in addition to the provisions for gauging devices as stated in 11.2.

11.4 Vapour detection

11.4.1 Vessels carrying toxic or flammable products or both should be equipped with at least two instruments designed and calibrated for testing for the specific vapours in question. If such instruments are not capable of testing for both toxic concentrations and flammable concentrations, then two separate sets of instruments should be provided.

11.4.2 Vapour-detection instruments may be portable or fixed. If a fixed system is installed, at least one portable instrument should be provided.

11.4.3 When toxic-vapour-detection equipment is not available for some products which require such detection, as indicated in column k in the table of chapter 17 of the IBC Code, the Administration may exempt the vessel from the requirement, provided an appropriate entry is made on the Certificate of Fitness. When granting such an exemption, the Administration should recognize the necessity for additional breathing-air supply and an entry should be made on the Certificate of Fitness drawing attention to the requirements of 14.2.7 and 16.4.2.2 of the IBC Code.

11.4.4 Vapour-detection requirements for individual products are shown in column k in the table of chapter 17 of the IBC Code.
CHAPTER 12 – POLLUTION PREVENTION REQUIREMENTS

To ensure control of pollution from noxious liquid substances from offshore support vessels.

12.1 Each vessel certified to carry noxious liquid substances should be provided with a Cargo Record Book, a Procedure and Arrangements Manual and a Shipboard Marine Pollution Emergency Plan developed for the vessel in accordance with MARPOL Annex II and approved by the Administration.

12.2 Discharge into the sea of residues of noxious liquid substances permitted for carriage under this Code, tank washings, or other residues or mixtures containing such substances, is prohibited. Any discharges of residues and mixtures containing noxious liquid substances should be to port reception facilities. As a consequence of this prohibition, there are no requirements for efficient stripping and underwater discharge arrangements in MARPOL Annex II.

CHAPTER 13 – LIFE-SAVING APPLIANCES AND ARRANGEMENTS

To ensure that life-saving appliances and arrangements are provided in such a way to protect the life and safety of personnel on OSVs, having regard to the nature and volume of cargo carried.

For vessels carrying more than 1,200 m³ of cargoes with a flashpoint not exceeding 60°C or carrying cargoes emitting toxic vapours or gases, the requirements for chemical tankers of SOLAS chapter III should apply.

CHAPTER 14 – PERSONNEL PROTECTION

To ensure that protective equipment is provided for crew members, taking into account both routine operations or emergency situations and possible short-term or long-term effects of the product being handled.

14.1 Protective equipment

14.1.1 Suitable protective equipment, including eye protection to a recognized national or international standard, should be provided for protection of crew members engaged in normal cargo operations, taking into account the characteristics of the products being carried.

14.1.2 Personal protective and safety equipment required in this chapter should be kept in suitable, clearly marked lockers located in readily accessible places. Special arrangements should apply to contaminated clothing as appropriate.

14.2 First aid equipment

14.2.1 A stretcher that is suitable for hoisting an injured person from spaces below deck should be kept in a readily accessible location.

14.2.2 The vessel should have on board medical first aid equipment, including oxygen resuscitation equipment, based on the provisions of the Medical First Aid Guide for use in accident involving dangerous goods (MFAG) for the cargoes listed on the Certificate of Fitness.
14.3 Safety equipment

14.3.1 Vessels carrying cargoes for which "15.12", "15.12.1" or "15.12.3" is indicated in column o in the table of chapter 17 of the IBC Code should have on board sufficient but not less than three complete sets of safety equipment, each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 min. Such equipment should be in addition to that required by SOLAS regulation II-2/10.10.

14.3.2 Each complete set of safety equipment should consist of:

.1 one self-contained positive pressure air breathing apparatus incorporating full face mask, not using stored oxygen and having a capacity of at least 1,200 l of free air. Each set should be compatible with that required by SOLAS regulation II-2/10.10;

.2 protective clothing, boots and gloves to a recognized standard;

.3 steel cored rescue line with belt; and

.4 explosion proof lamp.

14.3.3 For the safety equipment required in 14.3.1, all vessels should carry either:

.1 one set of fully charged spare air bottles for each breathing apparatus;

.2 a special air compressor suitable for the supply of high-pressure air of the required purity;

.3 a charging manifold capable of dealing with sufficient spare air bottles for the breathing apparatus; or

.4 fully charged spare air bottles with a total free air capacity of at least 6,000 l for each breathing apparatus on board in excess of the requirements of SOLAS regulation II-2/10.10.

14.3.4 A cargo pump-room on vessels carrying cargoes which are subject to the requirements of 15.18 of the IBC Code or cargoes for which in column k in the table of chapter 17 thereof toxic-vapour-detection equipment is required but is not available should have either:

.1 a low-pressure line system with hose connections suitable for use with the breathing apparatus required by 14.3.1. This system should provide sufficient high-pressure air capacity to supply, through pressure-reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at least 1 h without using the air bottles of the breathing apparatus. Means should be provided for recharging the fixed air bottles and the breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity; or

.2 an equivalent quantity of spare bottled air in lieu of the low-pressure air line.

14.3.5 Safety equipment as required by 14.3.2 should be kept in a suitable clearly marked locker in a readily accessible place near the cargo pump-room or cargo area.
14.3.6 The breathing apparatus should be inspected at least once a month by a responsible officer, and the inspection recorded in the vessels' log-book. The equipment should be inspected and tested by an expert at least once a year.

14.4 Emergency equipment

14.4.1 Vessels carrying cargoes, for which "Yes" is indicated in column n of chapter 17 of the IBC Code, should be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

.1 filter-type respiratory protection is unacceptable;

.2 self-contained breathing apparatus should have at least a duration of service of 15 min; and

.3 emergency escape respiratory protection should not be used for fire fighting or cargo handling purposes and should be marked to that effect.

14.4.2 One or more suitably marked decontamination showers and eyewash stations should be available on deck, taking into account the size and layout of vessel. The showers and eyewashes should be operable in all ambient conditions.

CHAPTER 15 – OPERATIONAL REQUIREMENTS

To ensure that all crew members involved in cargo operations have sufficient information about cargo properties and operating the cargo system so they can conduct cargo operations safely.

15.1 General

15.1.1 The quantity of a cargo required to be carried should be in accordance with the requirements contained in 16.1.1 and 16.1.2 of the IBC Code.

15.1.2 Tanks carrying liquids at ambient temperatures should be so loaded as to avoid the tank becoming liquid-full during the voyage, having due regard to the highest temperature which the cargo may reach.

15.1.3 When carrying cargo requiring controlled venting in column g in the table of chapter 17 of the IBC Code, the access to any surrounding areas in the horizontal plane and upwards of the vent outlet should be restricted within a 4 m horizontal zone.

15.2 Cargo information

15.2.1 A copy of this Code and the IBC Code, or national regulations incorporating the requirements of this Code and the IBC Code, should be on board every vessel covered by this Code.

15.2.2 Any cargo offered for bulk shipment should be indicated in the shipping documents by the product name, under which it is listed in chapter 17 or 18 of the IBC Code or the latest edition of MEPC.2/Circular or under which it has been provisionally assessed. Where the cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product should be provided, or a complete analysis if this is available. Such an analysis should be certified by the manufacturer or by an independent expert acceptable to the Administration.
15.2.3 Information should be on board, and available to all concerned, giving the necessary data for the safe carriage of the cargo in bulk. Such information should include a cargo stowage plan, to be kept in an accessible place, indicating all cargo on board, including each dangerous chemical carried:

- a full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo;
- action to be taken in the event of spills or leaks;
- countermeasures against accidental personal contact;
- fire-fighting procedures and fire-fighting media; and
- procedures for cargo transfer, tank cleaning, gas-freeing and ballasting.

15.2.4 For those cargoes required to be stabilized or inhibited, the cargo should be refused if the certificate required by these paragraphs is not supplied.

15.2.5 If sufficient information, necessary for the safe transportation of the cargo, is not available, the cargo should be refused.

15.2.6 Where column o in the table of chapter 17 of the IBC Code refers to this paragraph, the cargo's viscosity at 20°C should be specified on a shipping document, and if the cargo's viscosity exceeds 50 mPa•s at 20°C, the temperature at which the cargo has a viscosity of 50 mPa•s should be specified in the shipping document.

15.2.7 Where column o in the table of chapter 17 of the IBC Code refers to this paragraph, the cargo's melting point should be indicated in the shipping document.

15.3 Personnel training

15.3.1 All personnel should be adequately trained in the use of protective equipment and have basic training in the procedures appropriate to their duties necessary under emergency conditions.

15.3.2 Personnel involved in cargo operations should be adequately trained in handling procedures.

15.3.3 Officers should be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them should be instructed and trained in essential first aid for cargoes carried, based on the guidelines developed by the Organization.

15.4 Opening of and entry into cargo tanks

15.4.1 During handling and carriage of cargoes producing flammable and/or toxic vapours or when ballasting after the discharge of such cargo, or when loading or unloading cargo, cargo

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10 Refer to parts A and B of the Seafarers' Training, Certification and Watchkeeping (STCW) Code.

11 Refer to the IMO/WHO/ILO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), as amended.
tank lids should always be kept closed. With any hazardous cargo, cargo tank lids, ullage and sighting ports and tank washing access covers should be open only when necessary.

15.4.2 Enclosed space entry should be planned and conducted in a safe manner, taking into account, as appropriate, the guidance provided in the recommendations developed by the Organization.\textsuperscript{12}

15.4.3 Personnel should not enter such spaces when the only hazard is of a purely flammable nature, except under the close supervision of a responsible officer\textsuperscript{13}.

15.5 Simultaneous carriage of deck cargo and products

15.5.1 Deck cargo and products covered by this Code should not be loaded or unloaded simultaneously.

15.5.2 Notwithstanding the provisions of 15.5.1, deck cargo and pollution hazard only products having a flashpoint exceeding 60°C, may be loaded or unloaded simultaneously provided that:

\begin{enumerate}
\item each operation is defined and assigned to qualified personnel dedicated to that specific operation;
\item a safe working distance between the operations on board is observed; and
\item the procedures, plans and instructions on board identify specific criteria for when the simultaneously performed operations should not be conducted.
\end{enumerate}

15.5.3 During loading or unloading operations covered by this Code only personnel engaged in cargo operation should be permitted to be in the cargo deck area; personnel not engaged in cargo operation should be minimized in the adjacent open main deck.

15.5.4 For toxic cargoes, cargo tank pressure indication including audible and visual alarms situated at cargo control station and cargo area should meet the following:

\begin{enumerate}
\item arrangement is to be in accordance with the alternative means as defined in 7.2.3, with the activation point for over/under-pressure to be set at 110% and 90%, respectively of the P/V-valve setting;
\item an independent audible and visual pressure alarm, set to be activated at 90% of the P/V-valve opening set pressure, is to be fitted to warn crew of imminent vapour release; and
\item the arrangement in subparagraph 2 is capable of being deactivated during loading.
\end{enumerate}

15.5.5 During loading of toxic cargoes, deck cargo should not be located in the cargo deck area as defined in 1.2.7.3. Once a cargo loading operation is completed, deck cargo may be

\textsuperscript{12} Refer to the Revised recommendations for entering enclosed space aboard ships (resolution A.1050(27)).

\textsuperscript{13} Refer to the IMO/WHO/ILO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), as amended, which provides advice on the treatment of casualties in accordance with the symptoms exhibited as well as equipment and antidotes that may be appropriate for treating the casualty, and to the relevant provisions of parts A and B of the Seafarers’ Training, Certification and Watchkeeping (STCW) Code.
carried in the area defined in 1.2.7.3.3, provided that the area in 1.2.7.3.2 is kept free from
deck cargo and relevant cargo deck areas clearly marked.

CHAPTER 16 – BACKLOADING OF CONTAMINATED BULK LIQUIDS

To ensure that arrangements and procedures are provided to control potential accumulation
of hydrogen sulphide, an explosive atmosphere, and other potential hazardous of cargoes
back loaded from the installation.

16.1 Preamble

16.1.1 Backloading of contaminated bulk liquids could present a threat to human health and
to the marine environment.

16.1.2 Backloading of contaminated bulk liquids should therefore be:

.1 transported and handled in accordance with the provisions of this Code; and

.2 returned to shore for treatment or disposal.

16.2 General

16.2.1 Unless expressly provided otherwise, this chapter should apply to new and existing
vessels.

16.2.2 The provisions of this chapter should apply in conjunction with all other provisions of
this Code.

16.2.3 For the carriage of contaminated backloads, the requirements in chapter 17 of the
IBC Code should apply as described in 16.4.4.

16.2.4 Contaminated bulk liquids should not contain traces of hydrogen sulphide (H₂S) prior
to or during loading of the cargo.

16.2.5 Even if the test carried out before back-loading indicate that H₂S is not present and
that the contaminated bulk liquid has a flashpoint exceeding 60°C, a separation of the chemical
components may occur during the voyage, resulting in a release of hydrogen sulphide and
corresponding lowering the flashpoint to 60°C or less.

16.2.6 Hydrogen sulphide (H₂S) detection equipment should be provided on board vessels
carrying contaminated backloads prone to H₂S formation. It should be noted that scavengers
and biocides, when used, may not be a 100% effective in controlling the formation of H₂S.

16.2.7 Contaminated bulk liquids should not contain radioactive materials which are subject
to the applicable requirements for such materials.

16.3 Documentation

16.3.1 In lieu of the cargo information specified in 15.2.3, the shipper and/or owner of the
contaminated bulk liquids should provide the master or his representative with information as
required in 16.3.2 prior to backloading.
16.3.2 Information of the contaminated bulk liquid should be confirmed in writing by appropriate analysis form. An example of the analysis form is set out in appendix 2. The information of the contaminated bulk liquid should at least include:

1. sample description;
2. descriptions of the components in the mixture; name, concentration and Material Safety Data Sheet (MSDS), if available;
3. flashpoint (°C);
4. hydrogen sulphide (H₂S) level (ppm)\(^{14}\);
5. lower explosive limit (LEL) level (%);
6. oxygen level (%);
7. pH;
8. bulk specific gravity (kg/m\(^3\));
9. water content (% volume);
10. oil content (% volume);
11. solids content (% volume);
12. date and time of the analysis;
13. details of any treatment to remove or prevent the formation of H₂S;
14. any other relevant information; and
15. conclusions of the test results; including confirmation that the components of the mixtures are compatible.

16.4 Operation

16.4.1 Responsibilities

16.4.1.1 The master should not accept loading of any contaminated bulk liquid which is not properly documented in accordance with 16.3.

16.4.1.2 The master should ascertain that the contaminated bulk liquid is within the safe limits of the vessel and tanks, especially with regard to the flashpoint of the specific liquid, before back-loading commences.

16.4.1.3 The responsibility for ensuring that cargoes are properly prepared for carriage on board the vessel rests with the shipper and/or owner of the cargoes concerned.

\(^{14}\) H₂S level should be 0 ppm.
16.4.2 Carriage requirements

16.4.2.1 Contaminated bulk liquids should be carried in accordance with the applicable minimum carriage requirements for contaminated bulk liquids, specified in chapter 17 of the IBC Code or the latest edition of the MEPC.2/Circular.

16.4.2.2 In addition to provisions as specified in 16.4.2.1, H₂S and LEL gas detection is required for carriage of contaminated bulk liquid as follows:

.1 fixed vapour detection instruments with audible and visual alarms to indicate H₂S and LEL levels exceeding 5 ppm and 10% respectively, installed in the venting system of the relevant tanks; and

.2 portable instruments for all personnel on the working deck.

16.4.3 H₂S precaution

16.4.3.1 Contaminated bulk liquid should be discharged from the vessel as soon as possible, preferably at the first port of call.

16.4.3.2 The need to clean the dirty tanks should be reviewed on each voyage to minimize the risk of biological activity and H₂S build up from any residue.

16.4.3.3 Prior to back-loading to a dirty tank, the potential for biological activity resulting in H₂S in the dead volume and sludge should be considered. The offshore analysis of the previous contaminated bulk liquid should be compared with analyses of a sample representative for the liquid when unloading.

16.4.3.4 If H₂S or flammable vapour is detected during loading of contaminated bulk liquids the transfer should be stopped immediately.

16.4.3.5 Vessels-specific procedures of measures to be taken when H₂S is detected during loading, transport, discharge and cleaning of contaminated bulk liquids should be included in the vessel's Safety Management System.

16.4.4 Contaminated backloads

16.4.4.1 Based on the information contained in 16.3.2, the entry for "offshore contaminated bulk liquid P" in chapter 17 of the IBC Code should be used for backloads that:

.1 are pollutant only and do not present any safety hazards¹⁵ or where the pre-backloading tests do not indicate any safety hazards (the backload may contain components with safety hazards, as long as they are so diluted that the final mixture presents no safety hazard);

.2 have a flashpoint greater than 60°C; or

.3 do not have the potential of becoming more hazardous during transport.

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¹⁵ Safety hazards are defined in 21.3.1 of the IBC Code.
16.4.4.2 Based on the information contained in 16.3.2, the entry for "offshore contaminated bulk liquid S" in chapter 17 of the IBC Code should be used for backloads that:

.1 have been treated to remove or prevent breakout of H₂S;
.2 are expected to present both pollution and safety hazards or where the initial pre-backloading tests indicate a potential or actual safety hazard;
.3 may contain substances with a flashpoint not exceeding 60°C;
.4 have the potential of becoming more hazardous during transport; or
.5 are to be backloaded to a dirty tank, the content of which has not been analysed.

CHAPTER 17 – DISCHARGING AND LOADING OF PORTABLE TANKS ON BOARD

To ensure the safe handling of all cargoes to and from portable tanks which forms part of the vessel or remains on board, under all normal operating conditions and foreseeable emergency conditions, to minimize the risk to the vessel, its crew and the environment, having regard to the nature of the products involved.

17.1 Preamble

17.1.1 This Code applies only in the case of bulk carriage involving transfer of the cargo to or from its containment. The carriage of dangerous goods in packaged form is regulated under SOLAS chapter VII Part A and should comply with the relevant requirements of the IMDG Code. The IMDG Code is also applicable for environmentally hazardous substances in packaged form under MARPOL Annex III. 4.2.1 of the IMDG Code provides "portable tanks shall not be filled or discharged while they remain on board".

17.1.2 The current operation practice is to carry portable tanks in two ways:

.1 offshore portable tanks and their contents are loaded and off-loaded to the offshore installation by the use of a crane, in which case the IMDG Code applies; or
.2 offshore portable tanks and portable tanks are loaded with their contents onto a vessel by crane or filled whilst on board and used as deck tanks in a "deck spread". Then the contents are pumped to the offshore installation or to the seabed. These tanks can also be used to receive backloads from the installation and will be secured to the deck, in which case the cargo is shipped under this Code.

17.2 General

17.2.1 This chapter applies when using offshore portable tanks and portable tanks allowed under 5.2.2.

17.2.2 A portable tank, for the purpose of this section, means a multimodal tank used for the transport of dangerous goods of class 1 and classes 3 to 9. The portable tank includes a shell fitted with service equipment and structural equipment necessary for the transport of dangerous substances. The portable tank should be capable of being filled and discharged without the removal of its structural equipment. It should possess stabilizing members external
to the shell, and should be capable of being lifted when full. It should be designed primarily to be loaded onto a vehicle or vessel and should be equipped with skids, mountings or accessories to facilitate mechanical handling. Road tank-vehicles, rail tank-wagons, non-metallic tanks and intermediate bulk containers are not considered to fall within the definition for portable tanks.

17.2.3 The provisions of this chapter should apply in conjunction with all other provisions of this Code.

17.2.4 Chemicals, including blending additives, transported in portable deck tanks which are considered to fall outside the scope of 1.1.9 may be carried in limited amounts in accordance with provisions acceptable to the Administration. The aggregate amount of such chemicals which may be transported should not exceed 10% of the vessel's maximum authorized quantity of products subject to this Code. An individual tank should contain no more than 10 m³ of these chemicals. The discharge of these chemicals into the sea from OSVs is prohibited.

17.3 **Arrangement of deck spread**

17.3.1 All pumping equipment, processing equipment, pipe work, valves and hoses should be compatible with the substances being transferred.

17.3.2 Pipe work connecting deck spread tanks to bulk tanks within the cargo area of the vessel should have two valve separation and should comply with the provisions of chapter 6 of this Code.

17.3.3 In addition to the cargo segregation required by chapters 3 and 4, the general stowage and segregation requirements given in chapter 7 of the IMDG Code should apply. The segregation requirements may be relaxed subject to approval by the Administration.

17.3.4 Cargo tank vent systems of portable tanks allowed under 5.2.2 should be to the satisfaction of the Administration, taking into account the requirements of chapter 6 of the IMDG Code.

17.3.5 Arrangements of products with a flashpoint not exceeding 60°C, toxic and acids should comply with the provisions in chapter 4, as applicable.

17.3.6 Deck spills should be kept away from accommodation and service areas by means of a coaming of suitable height and extension.

17.4 **Shipment of cargo in portable tanks used as deck tanks**

17.4.1 A procedure for the carriage of portable tanks should be completed and submitted to the Administration or any organization recognized by it, for consideration and approval prior to arranging the deck spread. A model format for the procedure is set out in appendix 3.

17.4.2 The portable tank should be physically secured to the vessel, in accordance with the vessels' Cargo Securing Manual to prevent loss in the event of an incident whilst at sea. The arrangements for securing the portable tanks to the vessel should be of such strength to withstand the forces likely to be encountered during the voyage to and from the area of operation.

17.4.3 The portable tank(s) and pumping system should be monitored regularly on the sea passage to ensure the physical security of the portable tanks.
17.4.4 The pipe work and valves should be secured to prevent movement.

17.4.5 The loading and unloading of the portable tanks should not be undertaken at the same time as other deck cargo is being handled.

17.4.6 Portable tank(s) should be filled through a manifold system.

17.4.7 Discharge into the sea of portable tank contents, residues, tank washings, or other residues or mixtures containing such substances, is prohibited. Any discharges of residues and mixtures containing noxious liquid substances should be to port reception facilities.

CHAPTER 18 – CARRIAGE OF LIQUEFIED GASES

To ensure that the vessel's design, arrangement and operational procedures are such as to minimize the risk to the vessel, its crew and the environment, when carrying liquefied gases in bulk.

18.1 General requirements

18.1.1 The provisions of this chapter should apply when liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen are carried.

18.1.2 The Administration may allow adjustments to specific requirements in the IGC Code regarding the cargo containment, materials of construction, vent system for cargo containment and cargo transfer, taking into account existing industry standards and practices, if it is at least as effective as that required by the IGC Code.

18.1.3 Unless expressly provided otherwise, these provisions are additional to the general provisions of this Code.

18.1.4 In regard to the provisions connected to the cargo area, the vessel survival capability and location of the cargo tanks, liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen should be regarded as a safety hazard substance with type 2 ship having a flashpoint exceeding 60°C and not defined as a toxic.

18.1.5 The liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen should be carried in accordance with the applicable minimum carriage requirements specified in chapter 19 of the IGC Code and the special requirements specified in chapter 17 of the IGC Code for respective product.

18.2 Accommodation, service and machinery spaces and control stations

Unless they are spaced at least 7 m away from the deck area as defined in 1.2.7.2, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the cargo deck area. Doors to spaces not having access to accommodation, service and machinery spaces and control stations, such as cargo control stations and store-rooms, may be permitted within such deck area, provided the boundaries of the spaces equivalent gas tightening to "A-60" class standard. Wheelhouse doors and wheelhouse windows may be located within the limits specified above as long as they are so designed that a rapid and efficient gas and vapour tightening of the wheelhouse can be ensured. Windows and sidescuttles facing the deck area and on the sides of the superstructures and deck-houses within the limits specified above should be of the fixed (non-opening) type. Such sidescuttles in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.
18.3 Cargo containment

The cargo tank should be in accordance with chapter 4 of the IGC Code. The design and testing of the tanks for liquid nitrogen should be as required for independent tanks type C.

18.4 Materials of construction

Material of construction should comply with the requirements of chapter 6 of the IGC Code.

18.5 Vent system for cargo containment

Vent system for cargo containment should comply with the requirements of chapter 8 of the IGC Code.

18.6 Cargo transfer

18.6.1 The cargo transfer system should comply with the requirements of chapter 5 of the IGC Code.

18.6.2 Drip trays resistant to cryogenic temperatures should be provided at manifolds transferring liquefied gases or at other flanged connections in the liquefied gas system.

18.7 Vapour detection

Each enclosed space used for handling or storage of a liquefied gas should be fitted with a sensor continuously monitoring the oxygen content of the space and an alarm indicating low oxygen concentration. For semi-enclosed spaces portable equipment may also be acceptable.

18.8 Gauging and level detection

The gauging and level detection arrangements should comply with the requirements of chapter 13 of the IGC Code.

18.9 Emergency shutdown system

18.9.1 Emergency shut-off valves should be provided in liquid outlet lines from each liquefied gas tank. The controls for the emergency shut-off valves should meet the provisions given in 6.6.1.3 for remote shutdown devices.

18.9.2 In the case of transfer operations involving pressures in excess of 5 Mpa, arrangements for emergency depressurizing and disconnection of the transfer hose should be provided. The controls for activating emergency depressurization and disconnection of the transfer hose should meet the provisions given in 6.6.1.3 for remote shutdown devices.

18.10 Personnel protection

Vessels carrying liquefied gases should have on board safety equipment in accordance with 14.3.
18.11 Carriage on open deck

Instead of the use of permanently attached deck-tanks, portable tanks meeting the design of independent tanks type C may be used provided that the provisions of section 17.3 are complied with.

18.12 Carriage of other liquefied gases listed in chapter 19 of the IGC Code

18.12.1 This Code does not consider liquefied gases other than liquid carbon dioxide (high purity and reclaimed quality) and liquid nitrogen. When a vessel is intended for carriage of other liquefied gases listed in chapter 19 of the IGC Code, flag Administration and coastal State Administrations involved should take appropriate steps to ensure implementation of the relevant requirements of the IGC Code, taking into account the unique design features and service characteristics of the vessel, as well as the limitation. Furthermore, additional provisions should be established based on the principles of this Code as well as recognized standards that address specific risks not envisaged by it. Such risks may include, but not be limited to:

.1 fire and explosion;
.2 evacuation;
.3 extension of hazardous areas;
.4 pressurized gas discharge to shore;
.5 high-pressure gas venting;
.6 process upset conditions;
.7 storage and handling of flammable refrigerants;
.8 continuous presence of liquid and vapour cargo outside the cargo containment system;
.9 tank over-pressure and under-pressure;
.10 vessel-to-vessel transfer of liquid cargo; and
.11 collision risk during berthing manoeuvres.

18.12.2 The Organization should be notified of the conditions for carriage prescribed by the flag Administration and coastal State Administrations involved, so that the specific liquefied gases may be considered for inclusion in this Code.
APPENDIX 1

MODEL FORM OF CERTIFICATE OF FITNESS

CERTIFICATE OF FITNESS

(Official seal)

Issued under the provisions of the

CODE FOR THE TRANSPORT AND HANDLING OF HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES IN BULK ON OFFSHORE SUPPORT VESSELS

(resolution [A…(30)])

under the authority of the Government of

(full official designation of country)

by ........................................................................................................................................................................

(full designation of the competent person or organization recognized by the Administration)

Particulars of vessel

Name of vessel ...........................................................................................................................................

Distinctive number or letters .........................................................................................................................

IMO number2 ...............................................................................................................................................

Port of registry ................................................................................................................................................

Gross tonnage ................................................................................................................................................

Date on which keel was laid or on which the vessel was at a similar stage of construction or (in the case of a converted vessel) date on which conversion to offshore support vessel was commenced

........................................................................................................................................................................

The vessel also complies fully with the following amendments to the Code:

........................................................................................................................................................................

........................................................................................................................................................................

1 Alternatively, the particulars of the vessel may be placed horizontally in boxes.

2 In accordance with the IMO ship identification number scheme, adopted by the Organization by resolution A.1078(28).
The vessel is exempted from compliance with the following provisions of the Code:


THIS IS TO CERTIFY:

1 That the vessel has been surveyed in accordance with the provisions of section 1.4 of the Code;

2 That the survey showed that the construction and equipment of the vessel and the condition thereof are in all respects satisfactory and that the vessel complies with the relevant provisions of the Code;

3 That the vessel has been provided with a Manual in accordance with Appendix 4 of Annex II of MARPOL as called for by regulation 14 of Annex II, and that the arrangements and equipment of the vessel prescribed in the Manual are in all respects satisfactory;

4 That the vessel meets the requirements for the carriage in bulk of the following products, provided that all relevant operational requirements of the Code and MARPOL Annex II are observed:

<table>
<thead>
<tr>
<th>Product</th>
<th>Conditions of carriage (tank numbers, etc.)</th>
<th>Pollution Category</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

Continued on attachment 1, additional signed and dated sheets³. Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan.

5 That, in accordance with 1.3, the provisions of the Code are modified in respect of the vessel in the following manner:


6 That the vessel should be loaded:

.1 in accordance with the loading conditions provided in the approved loading manual, stamped and dated .......................... and signed by a responsible officer of the Administration, or of an organization recognized by the Administration³;

.2 in accordance with the loading limitations appended to this Certificate³.

³ Delete as appropriate.
Where it is required to load the vessel other than in accordance with the above instruction, then the necessary calculations to justify the proposed loading conditions should be communicated to the certifying Administration who may authorize in writing the adoption of the proposed loading condition.\footnote{Instead of being incorporated in the Certificate, this text may be appended to the Certificate if signed and stamped.}

This Certificate is valid until (dd/mm/yyyy) \footnote{Insert the date of expiry, as specified by the Administration, which should not exceed five years from the date of initial survey or the periodical survey.} subject to surveys in accordance with 1.4 of the Code.

Completion date of the survey on which this certificate is based: ..............................................

(dd/mm/yyyy)

Issued at .................................................................

(Place of issue of certificate)

(Date of issue) ...........................................................

(Signature of authorized official issuing the certificate)

(Seal or stamp of the authority, as appropriate)

Notes on completion of Certificate:

1. The Certificate can be issued only to vessels entitled to fly the flags of States which are both a Contracting Government to SOLAS and a Party to MARPOL.

2. Products: products listed in 1.1.9 of the Code, or which have been evaluated by the Administration in accordance with 1.1.10 of the Code should be listed. In respect of the latter "new" products, any special provisions provisionally prescribed should be noted.

3. Products: the list of products the vessel is suitable to carry should include the noxious liquid substances of category Z which are not covered by the IBC Code and should be identified as "IBC Code chapter 18 Category Z".
ENDORSEMENT FOR ANNUAL AND INTERMEDIATE SURVEYS

THIS IS TO CERTIFY that at a survey required by 1.5.2 of the IBC Code the vessel was found to comply with the relevant provisions of the Code.

Annual survey: Signed

(Signature of duly authorized official)

Place ........................................
Date (dd/mm/yyyy) ..........................

(Seal or stamp of the Authority, as appropriate)

Annual/Intermediate\(^3\) survey: Signed

(Signature of duly authorized official)

Place ........................................
Date (dd/mm/yyyy) ..........................

(Seal or stamp of the Authority, as appropriate)

Annual/Intermediate\(^3\) survey: Signed

(Signature of duly authorized official)

Place ........................................
Date (dd/mm/yyyy) ..........................

(Seal or stamp of the Authority, as appropriate)

Annual survey: Signed

(Signature of duly authorized official)

Place ........................................
Date (dd/mm/yyyy) ..........................

(Seal or stamp of the Authority, as appropriate)

\(^3\) Delete as appropriate.
ANNUAL/INTERMEDIATE SURVEY IN ACCORDANCE
WITH 1.5.6.8.3 OF THE IBC CODE

THIS IS TO CERTIFY that, at an annual/intermediate\(^3\) survey in accordance with 1.5.6.8.3 of the IBC Code, the vessel was found to comply with the relevant requirements of the Convention:

Signed ........................................................................
(Signature of duly authorized official)

Place ........................................................................
Date (dd/mm/yyyy) .....................................................
(Seal or stamp of the Authority, as appropriate)

ENDORSEMENT TO EXTEND THE CERTIFICATE IF VALID
FOR LESS THAN 5 YEARS WHERE 1.5.6.3 OF THE IBC CODE APPLIES

The vessel complies with the relevant requirements of the Convention, and this Certificate should, in accordance with 1.5.6.3 of the IBC Code, be accepted as valid until ......................

Signed ........................................................................
(Signature of duly authorized official)

Place ........................................................................
Date (dd/mm/yyyy) .....................................................
(Seal or stamp of the Authority, as appropriate)

ENDORSEMENT WHERE THE RENEWAL SURVEY HAS BEEN
COMPLETED AND 1.5.6.4 OF THE IBC CODE APPLIES

The vessel complies with the relevant requirements of the Convention, and this Certificate should, in accordance with 1.5.6.4 of the IBC Code, be accepted as valid until ......................

Annual survey: Signed ........................................................................
(Signature of duly authorized official)

Place ........................................................................
Date (dd/mm/yyyy) .....................................................
(Seal or stamp of the Authority, as appropriate)

\(^3\) Delete as appropriate.
ENDORSEMENT TO EXTEND THE VALIDITY OF THE CERTIFICATE UNTIL REACHING THE PORT OF SURVEY OR FOR A PERIOD OF GRACE WHERE 1.5.6.5 OR 1.5.6.6 OF THE IBC CODE APPLIES

This Certificate should, in accordance with 1.5.6.5/1.5.6.6\(^3\) of the IBC Code, be accepted as valid until ..........................................

Signed .................................................................

(Signature of duly authorized official)

Place .................................................................

Date (dd/mm/yyyy) ...................................................

(Seal or stamp of the Authority, as appropriate)

ENDORSEMENT FOR ADVANCEMENT OF ANNIVERSARY DATE WHERE 1.5.6.8 OF THE IBC CODE APPLIES

In accordance with 1.5.6.8 of the IBC Code, the new anniversary date is ..........................................

Signed .................................................................

(Signature of duly authorized official)

Place .................................................................

Date (dd/mm/yyyy) ...................................................

(Seal or stamp of the Authority, as appropriate)

In accordance with 1.5.6.8 of the IBC Code, the new anniversary date is ..........................................

Signed .................................................................

(Signature of duly authorized official)

Place .................................................................

Date (dd/mm/yyyy) ...................................................

(Seal or stamp of the Authority, as appropriate)

\(^3\) Delete as appropriate.
ATTACHMENT 1

TO THE CERTIFICATE OF FITNESS

Continued list of products to those specified in section 4, and their conditions of carriage.

<table>
<thead>
<tr>
<th>Products</th>
<th>Conditions of carriage (tank numbers, etc.)</th>
<th>Pollution Category</th>
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<tbody>
<tr>
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</tbody>
</table>

Date ........................................ (dd/mm/yyyy) .................................................. (Signature of official issuing the Certificate and/or seal of issuing authority) (as for Certificate)
ATTACHMENT 2

TO THE CERTIFICATE OF FITNESS

TANK PLAN (specimen)

Name of vessel: ........................................................................................................................................

Distinctive number or letters: ........................................................................................................................

Date (dd/mm/yyyy) (as for Certificate)

(Signature of official issuing the Certificate and/or seal of issuing authority)
APPENDIX 2

GUIDELINES FOR TESTING PRIOR TO BACKLOADING

1 General

1.1 The results of these tests will allow the master, through confirmation with the attached checklist, to establish if the backload is acceptable for carriage on board the vessel. Acceptance is based on the reported analytical data and the measured physical properties, the known nature of the chemical composition and the previous cargo carried in the vessels tanks. A generic risk assessment should be available on board the vessel and updated when new information and circumstances become apparent. Offshore installation crew should be aware that in certain circumstances the master of the vessel may require advice from the vessels onshore technical advisors and that a response from onshore may take time to receive.

1.2 Recognizing the relatively complex nature of the cargo, the material intended for backloading should be subjected to a series of test to provide an indicative overview of the constituent composition and reactive properties of the material.

1.3 The tests carried out prior to backloading should reflect the conditions in the vessels tanks, i.e. there will be no agitation and no forced ventilation unless specifically required/requested.

1.4 If there is any doubt regarding the result of the test, the test should be repeated and reviewed.

2 Testing prior to backloading

2.1 Flashpoint

The minimum acceptable flashpoint of 60°C (Pensky Martin closed cup method or equivalent) is applicable to wet bulk waste. Sampling should be set up to detect the worst case situation, particularly where there is potential for crude oil or condensate contamination where the oil will rise to the surface of the tank. Base oils typically have flashpoints in the range of 70-100°C. If the only oil component in a bulk waste is base oil then the flashpoint cannot be lower than that of the base oil itself. If the flashpoint is relatively low (60-70°C) an explanation should be provided before the analysis form is presented to the vessels master. Prior to sampling, the material should be left without agitation for at least 30 minutes and then surface sampled.

2.2 Lower Explosive Limit (LEL)

The LEL gas detector will confirm potential flashpoint issues. The noxious gas test is modified to simulate the unvented vessels tanks. The sample is placed in a closed container with a sampling port on top and left to equilibrate for 30 minutes. A tube is then connected from the port to the gas analyser and the sample is analysed. The flashpoint and LEL results should be consistent with each other. LEL gas meters are normally set so that the alarm goes off in the range of 10 to 20% LEL methane equivalent. Any number above 25% would be considered high. Other gases potentially present can have a different LEL range than methane.
2.3 **Hydrogen sulphide** (H₂S)

2.3.1 H₂S most commonly arises from the activity of sulphate reducing bacteria (SRB). SRB will become active provided there is a “food” source and low oxygen conditions. This would be typical of stagnant oil-contaminated fluid stored for a long time. H₂S is an extremely poisonous gas which is heavier than air. The maximum exposure limit is 10 ppm over an 8 hour period. Offshore sensors and routine offshore analysis methods will detect if H₂S is a potential problem in backloads. In the event of a positive test another sample should be collected to confirm the result. If this second result is positive further work may be required to determine the source of the H₂S. The sample should be taken from below the surface of the unagitated tank. Most oil will be in the top layer and will give a worst case oil content.

2.3.2 As a precaution, treatment of the material may be required. The SRB organisms thrive in a pH range of 5.5 to 8.0. The lower the pH the greater the breakout of H₂S. The backload can be treated on the installation to prevent breakout of H₂S in the vessel tanks. Biocides kill the bacteria but do not remove dissolved H₂S. H₂S scavengers will remove dissolved H₂S but do not stop biological activity. Caustic soda will raise the pH and prevent H₂S gas breakout. In the event that H₂S is detected, tests should be carried out offshore to determine the best treatment prior to backloading. After treatment a final H₂S test should be carried out to confirm zero H₂S and noted on the analysis form before the hose is connected to the vessel for back-loading.

2.4 **pH**

The pH of seawater is typically 8.3. Oil mud is alkaline and could raise the pH slightly. Cement contaminant is highly alkaline. In general alkaline pH (above 7) protects from corrosion. Highly alkaline materials can be caustic and require care in handling. Cement and sodium silicate can lead to high pH value. Low pH (less than 4) is highly acidic and an explanation should be provided on the analysis form. Acids such as citric acid or acidic chemicals such as hydrochloric acid can lead to low pH. It should be noted that pH less than 9 means that H₂S will already have broken out as a gas.

2.5 **Retort analysis (solids, water, oil volume %)**

This should match the estimated composition (volume %) on the analysis form. It should be noted that it may be difficult to get representative samples if the liquid tends to separate. Some divergence is expected, e.g. if oil is noted as 5%, the range could be 3 to 10%. If separation is likely, a range is preferred, e.g. 5 to 10%. The solids component can form a residue in the vessel tank and be a potential location for SRB activity and H₂S.

2.6 **Specific gravity (SG)**

The specific gravity of common water based fluids cover the range of 1.03 (seawater), sodium chloride (1.2), and calcium chloride (1.33). Rarely used brines such as caesium formate can reach an SG of 2.2. Oil mud is typically 1.1 to 1.5, but can exceed 2.0. Mixtures will have intermediate values, most tending towards 1.03 as seawater is the major component. It should be noted that if mixtures separate the top half can have a different density than the bottom half.
EXAMPLE OF THE ANALYSIS FORM

TO BE COMPLETED AND PROVIDED TO OSV MASTER PRIOR TO BACKLOADING

<table>
<thead>
<tr>
<th>Sample description</th>
<th>Sample reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel</td>
<td>Date</td>
</tr>
<tr>
<td>Offshore asset</td>
<td>Producer</td>
</tr>
<tr>
<td>Well name &amp; number</td>
<td>Waste company</td>
</tr>
<tr>
<td>Total number of barrels</td>
<td>Waste note number</td>
</tr>
</tbody>
</table>

WASTE COMPONENTS

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Concentration</th>
<th>Units</th>
<th>MSDS Available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Volume</td>
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<td>% Volume</td>
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<td>% Volume</td>
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</tbody>
</table>

LABORATORY ANALYSIS RESULTS

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Units</th>
<th>Results</th>
<th>Range of Results / Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity (Chloride)</td>
<td>Titration</td>
<td>mg / l</td>
<td></td>
<td>Should be &gt;60°C to backload</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If flashpoint is low (&lt;70°C)</td>
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<td></td>
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<td></td>
<td>then explanation should be</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>provided</td>
</tr>
<tr>
<td>Flash Point</td>
<td>Closed cup Flashpoint</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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16 Refer to the Guidelines for Offshore Marine Operations (GOMO), developed by a group of organizations, and other industry standard of best practices.
<table>
<thead>
<tr>
<th>TO BE COMPLETED AND PROVIDED TO OSV MASTER PRIOR TO BACKLOADING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gas test (H₂S)</strong></td>
</tr>
<tr>
<td><strong>Gas test (LEL)</strong></td>
</tr>
<tr>
<td><strong>Gas test (Oxygen)</strong></td>
</tr>
<tr>
<td><strong>pH</strong></td>
</tr>
<tr>
<td><strong>Water</strong></td>
</tr>
<tr>
<td><strong>Oil content</strong></td>
</tr>
<tr>
<td><strong>Solids</strong></td>
</tr>
<tr>
<td><strong>Bulk specific gravity</strong></td>
</tr>
<tr>
<td><strong>Appearance</strong></td>
</tr>
<tr>
<td><strong>Odour</strong></td>
</tr>
<tr>
<td><strong>Date and time of analysis</strong></td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

<table>
<thead>
<tr>
<th>Analysis to be conducted by person competent to do so</th>
<th>Comments (Yes / No / Details)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This liquid has been analysed as per GOMO appendix 10 – F and it is my opinion that it is safe for carriage in a standard clean OSV bulk tank.</td>
<td></td>
</tr>
<tr>
<td>This liquid has been analysed as per GOMO appendix 10 – F and will be loaded into a tank with residues / existing cargo. Compatibility has been risk assessed and found to be safe for carriage.</td>
<td></td>
</tr>
<tr>
<td><strong>TO BE COMPLETED AND PROVIDED TO OSV MASTER PRIOR TO BACKLOADING</strong></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>H₂S Avoidance</strong></td>
<td></td>
</tr>
<tr>
<td>Details of mandatory wet bulk waste treatment with biocide</td>
<td></td>
</tr>
<tr>
<td>(chemical / quantity)</td>
<td></td>
</tr>
<tr>
<td>Details of wet bulk waste treatment in order to produce pH</td>
<td></td>
</tr>
<tr>
<td>of between 9.5 and 10.5 (chemical / quantity)</td>
<td></td>
</tr>
<tr>
<td>Has waste handling facility been informed of volume and ETA</td>
<td></td>
</tr>
<tr>
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APPENDIX 3

MODEL FORMAT FOR THE PROCEDURE FOR THE DISCHARGING AND LOADING OF PORTABLE TANKS CONTAINING DANGEROUS GOODS CARRIED AS DECK TANKS ON OFFSHORE SUPPORT VESSELS

Table of Contents

1 Purpose
2 Application
3 References, definitions and responsibilities
4 Description of the deck spread equipment and arrangements
   4.1 general arrangements of deck spread
   4.2 discharging and loading operations of portable tanks
   4.3 additional operational information

Attachments: 1 Summary covering description of the intended offshore campaign
             2 Related discharge permits from local water jurisdictions
             3 Material safety data sheets
             4 Sea fastening arrangements and calculations
             5 Deck arrangements and pipeline drawing
             6 Portable tank information and details

1 PURPOSE

1.1 The purpose of this Procedure is to identify the arrangements and equipment required to enable compliance with MARPOL Annex II and the IMDG Code, and to identify for the vessels’ officers all operational procedures with respect to cargo handling, tank cleaning, slops handling, ballasting and deballasting, which should be followed in order to comply with the requirements of MARPOL Annex II.

1.2 This Procedure covers all marine transportation aspects of the shipment for the products identified in the cargo list of the Certificate of Fitness issued, and in accordance with chapter 16 of this Code describing the provisions of loading, sea passage, offshore discharge; return voyage and the subsequent unloading of those tanks to shore.

1.3 This Procedure should include:
   
   .1 summary covering description of the intended offshore campaign;
   
   .2 related discharge permits from local water jurisdictions;
   
   .3 Material Safety Data Sheets;
   
   .4 sea fastening arrangements and calculations;
   
   .5 deck arrangements and pipeline drawing; and
   
   .6 portable tank information and details.
2 APPLICATION

This Procedure applies to all personnel on the OSV involved in the handling and discharging/loading of the products listed in the cargo list of the Certificate of Fitness issued, and in accordance with chapter 17 of this Code. It is intended to be an informative document for those involved in the safe management of the installed deck spread and for the Administration concerned with enforcing safe working practices whilst these operations are being conducted.

3 REFERENCES, DEFINITIONS AND RESPONSIBILITIES

3.1 References

The proposed operations should be carried out in accordance with the following:

.1 International Maritime Dangerous Goods (IMDG) Code, as amended

The IMDG Code, as amended is used as a basis for national regulations in pursuance of their obligation under SOLAS chapter VIII and MARPOL Annex III. Observance of the Code harmonizes the practices and procedures followed in the carriage of dangerous goods by sea and ensures compliance with the mandatory requirements of SOLAS and MARPOL Annex III.


These Guidelines have been developed for the design and construction of new offshore supply vessels with a view to promoting the safety of such vessels and their personnel, recognizing the unique design features and service characteristics of these vessels;

These Guidelines furthermore provide a standard of safety equivalent to the relevant requirements of SOLAS, and in particular to the stability criteria of the Code on Intact Stability for all Types of Ships Covered by IMO Instruments (IS Code), as amended.

.3 International Bulk Chemical (IBC) Code

The IBC Code was adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.19(22), as amended, provided that such amendments are adopted and brought into force in accordance with the requirements of article 16 of MARPOL concerning amendment procedures applicable to an appendix to an annex.

.4 Code for the Transport and Handling of Hazardous and Noxious Liquid Substances in Bulk on Offshore Support Vessels.

3.2 Definitions

3.2.1 Dangerous goods are those substances (including mixtures and solutions) and articles subject to the requirements of the IMDG Code assigned to one of the Classes 1-9 according to the hazard or the most predominant of the hazards present.
3.2.2 *Marine pollutants* are environmentally hazardous substances identified as marine pollutants in the IMDG Code and are considered a threat to marine life, and are carried under the provision of MARPOL Annex III.

3.3 Responsibilities

3.3.1 The OSV should be in compliance with section 17.3 of this Code.

3.3.2 Master: The Master of the supply vessel involved in the transportation is responsible for all activities carried out on his vessel. He has the authority to stop any operation he considers to be unsafe, which puts personnel or his vessel at risk or which could pollute the environment.

3.3.3 Specialist operator: The specialist operator, if required, will be the person/contractor responsible for the cargo transfer operations with regards to the deck spread. He will be additional to the normal vessel crew, and directly responsible to the Master.

4 DESCRIPTION OF THE DECK SPREAD EQUIPMENT AND ARRANGEMENTS

4.1 General arrangements of deck spread

4.1.1 This should contain a brief description of the cargo deck area of the vessel with the main features of the portable tanks and their positions on the deck taking into consideration the definition of "cargo area" in 1.2.7 of this Code.

4.1.2 Brief description of the physical arrangements for the securing of the portable tanks, pipelines and other equipment to the deck of the vessel should also contain details of deck protection systems, etc.

4.1.3 Description of deck spread pumping and piping arrangements

4.1.3.1 This section should contain a description of the pumping and piping arrangements. Line or schematic drawings should be provided showing the following and be supported by textual explanation where necessary:

.1 cargo piping arrangements with diameters;
.2 cargo piping arrangements that cross connect to the vessels bulk tanks;
.3 cargo pumping arrangements with pump capacities;
.4 location of suction points of cargo lines and valve position for every portable tank;
.5 stripping or blowing back arrangements;
.6 quantity and pressure of nitrogen or carbon dioxide required for line blowing and inerting if applicable; and
.7 tank ventilation arrangements and position of vent outlets, etc.
4.1.4 **Description of the portable tank ventilation systems**

This section should contain a description of the portable tank ventilation system and details to prevent accumulation of vapours on the deck area, based on the properties of the tank contents.

4.1.5 **Description of securing arrangements of tanks and pipelines**

This section should contain a description of securing arrangements of tanks and pipelines.

4.2 **Discharging and loading operations of portable tanks**

This section should contain a description and operational procedures in respect to the loading and discharging of the portable tank whilst on board the vessel and are supported by text regarding the following:

.1 inerting systems if required when carrying low flashpoint products;

.2 suitable firefighting media determined to be effective for the substance being carried will be provided and available for immediate use during the transfer operation;

.3 spillage clean up material specific to the substance, if required, is available in the event of an incident;

.4 personal protective equipment, if required, will be provided for the operator loading the portable tank. This will be worn at all times, by those involved, during cargo handling operations. Equipment supplied should be in addition to equipment required when carrying dangerous good; and

.5 emergency procedures in the event of an incident.

4.3 **Additional operational information**

This section should contain additional details and description of the operational procedures involved when the deck spread is in operation and should cover the following points:

.1 procedures to be followed in the event of a spillage and the disposal of the clean-up material;

.2 details of the blow back system and whether the residues are to be blown to the installation or to the tanks on deck;

.3 details of the process that will be carried out on board when the deck spread is in operation;

.4 emergency shut-down procedures for the deck spread; and

.5 details of the hose coupling arrangements to the installation and method of quick release.
Attachments:

The following attachments should be prepared:

1. summary covering description of the intended offshore campaign;
2. related discharge permits from local water jurisdictions;
3. material safety data sheets;
4. sea fastening arrangements and calculations;
5. deck arrangements and pipeline drawing; and
6. portable tank information and details.

***
Revised Guidelines for Formal Safety Assessment (FSA) for Use in the IMO Rule-Making Process

1 The Maritime Safety Committee, at its seventy-fourth session (30 May to 8 June 2001), and the Marine Environment Protection Committee, at its forty-seventh session (4 to 8 March 2002), approved Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process (MSC/Circ.1023-MEPC/Circ.392, as amended by MSC/Circ.1180-MEPC/Circ.474 and MSC-MEPC.2/Circ.5).

2 The Maritime Safety Committee, at its ninety-first session (26 to 30 November 2012), and the Marine Environment Protection Committee, at its sixty-fifth session (13 to 17 May 2013), reviewed the above guidelines and approved Revised guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process (MSC-MEPC.2/Circ.12).

3 The Maritime Safety Committee, at its ninety-fourth session (17 to 21 November 2014) and the Marine Environment Protection Committee, at its sixty-eighth session (11 to 15 May 2015), approved draft amendments to paragraph 9.3.3 of the aforementioned Revised FSA guidelines, for circulation of the amended revised guidelines as MSC-MEPC.2/Circ.12/Rev.1.

4 The Maritime Safety Committee, at its ninety-eighth session (7 to 16 June 2017) and the Marine Environment Protection Committee, at its [seventy-second session (9 to 13 April 2018)], approved the amendment to the flow chart shown in figure 2 referred to in paragraph 27 of appendix 10 to the revised FSA guidelines, for circulation of the amended revised guidelines, as set out in the annex, as [MSC-MEPC.2/Circ.12/Rev.2].

5 Member States and non-governmental organizations are invited to apply the revised guidelines contained in the annex.

6 This circular supersedes MSC-MEPC.2/Circ.12/Rev.1.

***
ANNEX

REVISED GUIDELINES FOR FORMAL SAFETY ASSESSMENT (FSA)
FOR USE IN THE IMO RULE-MAKING PROCESS

Table of contents

1 INTRODUCTION
   1.1 Purpose of FSA
   1.2 Scope of the Guidelines
   1.3 Application

2 BASIC TERMINOLOGY

3 METHODOLOGY
   3.1 Process
   3.2 Information and data
   3.3 Expert judgement
   3.4 Incorporation of the human element
   3.5 Evaluating regulatory influence

4 PROBLEM DEFINITION
   4.1 Preparation for the study
   4.2 Generic model
   4.3 Results

5 FSA STEP 1 – IDENTIFICATION OF HAZARDS
   5.1 Scope
   5.2 Methods
   5.3 Results

6 FSA STEP 2 – RISK ANALYSIS
   6.1 Scope
   6.2 Methods
   6.3 Results

7 FSA STEP 3 – RISK CONTROL OPTIONS
   7.1 Scope
   7.2 Methods
   7.3 Results

8 FSA STEP 4 – COST-BENEFIT ASSESSMENT
   8.1 Scope
   8.2 Methods
   8.3 Results
9 FSA STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING

9.1 Scope
9.2 Methods
9.3 Results

10 PRESENTATION OF FSA RESULTS

11 APPLICATION AND REVIEW PROCESS OF FSA

List of figures

Figure 1 – Flow chart of the FSA methodology
Figure 2 – Example of loss matrix
Figure 3 – Components of the integrated system
Figure 4 – Incorporation of Human Reliability Analysis (HRA) into the FSA process
Figure 5 – Risk matrix
Figure 6 – Example of a risk contribution tree

List of appendices

Appendix 1 – Guidance on Human Reliability Analysis (HRA)
Appendix 2 – Examples of hazards
Appendix 3 – Hazard identification and risk analysis techniques
Appendix 4 – Initial ranking of accident scenarios
Appendix 5 – Measures and tolerability of risks
Appendix 6 – Attributes of risk control measures
Appendix 7 – Examples of calculation of indices for cost-effectiveness
Appendix 8 – Standard format for reporting an application of FSA to IMO
Appendix 9 – Degree of agreement between experts concordance matrix
Appendix 10 – Guidance for practical application and review process of FSA
1 INTRODUCTION

1.1 Purpose of FSA

1.1.1 Formal Safety Assessment (FSA) is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk analysis and cost-benefit assessment.

1.1.2 FSA can be used as a tool to help in the evaluation of new regulations for maritime safety and protection of the marine environment or in making a comparison between existing and possibly improved regulations, with a view to achieving a balance between the various technical and operational issues, including the human element, and between maritime safety or protection of the marine environment and costs.

1.1.3 FSA is consistent with the current IMO decision-making process and provides a basis for making decisions in accordance with resolutions A.500(XII) on Objectives of the Organization in the 1980s, A.777(18) on Work methods and organization of work in committees and their subsidiary bodies and A.900(21) on Objectives of the Organization in the 2000s.

1.1.4 The decision makers at IMO, through FSA, will be able to appreciate the effect of proposed regulatory changes in terms of benefits (e.g. expected reduction of lives lost or of pollution) and related costs incurred for the industry as a whole and for individual parties affected by the decision. FSA should facilitate the development of regulatory changes equitable to the various parties thus aiding the achievement of consensus.

1.2 Scope of the Guidelines

These guidelines are intended to outline the FSA methodology as a tool, which may be used in the IMO rule-making process. In order that FSA can be consistently applied by different parties, it is important that the process is clearly documented and formally recorded in a uniform and systematic manner. This will ensure that the FSA process is transparent and can be understood by all parties irrespective of their experience in the application of risk analysis and cost-benefit assessment and related techniques.

1.3 Application

1.3.1 The FSA methodology can be applied by:

.1 a Member State or an organization in consultative status with IMO, when proposing amendments to maritime safety, pollution prevention and response-related IMO instruments in order to analyse the implications of such proposals; or

.2 a Committee, or an instructed subsidiary body, to provide a balanced view of a framework of regulations, so as to identify priorities and areas of concern and to analyse the benefits and implications of proposed changes.

1.3.2 It is not intended that FSA should be applied in all circumstances, but its application would be particularly relevant to proposals which may have far-reaching implications in terms of either costs (to society or the maritime industry), or the legislative and administrative burdens which may result. FSA may also be useful in those situations where there is a need for risk reduction but the required decisions regarding what to do are unclear, regardless of the scope of the project. In these circumstances, FSA will enable the benefits of proposed changes to be properly established, so as to give Member States a clearer perception of the scope of the proposals and an improved basis on which they take decisions.
2 BASIC TERMINOLOGY

The following definitions apply in the context of these guidelines:

**Accident:** An unintended event involving fatality, injury, ship loss or damage, other property loss or damage, or environmental damage.

**Accident category:** A designation of accidents reported in statistical tables according to their nature, e.g. fire, collision, grounding, etc.

**Accident scenario:** A sequence of events from the initiating event to one of the final stages.

**Consequence:** The outcome of an accident.

**Frequency:** The number of occurrences per unit time (e.g. per year).

**Generic model:** A set of functions common to all ships or areas under consideration.

**Hazard:** A potential to threaten human life, health, property or the environment.

**Initiating event:** The first of a sequence of events leading to a hazardous situation or accident.

**Probability (Objective/frequentistic):** The relative frequency that an event will occur, as expressed by the ratio of the number of occurrences to the total number of possible occurrences.

**Probability (Subjective/Bayesian):** The degree of confidence in the occurrence of an event, measured on a scale from zero to one. An event with a probability of zero means that it is believed to be impossible; an event with the probability of one means that it is believed it will certainly occur.

**Risk:** The combination of the frequency and the severity of the consequence.

**Risk contribution tree:** The combination of all fault trees and event trees that constitute the risk model.

**Risk control measure:** A means of controlling a single element of risk.

**Risk control option:** A combination of risk control measures.

**Risk evaluation criteria:** Criteria used to evaluate the acceptability/tolerability of risk.
3 METHODOLOGY

3.1 Process

3.1.1 Steps

3.1.1.1 FSA should comprise the following steps:

.1 identification of hazards;
.2 risk analysis;
.3 risk control options;
.4 cost-benefit assessment; and
.5 recommendations for decision-making.

3.1.1.2 Figure 1 is a flow chart of the FSA methodology. The process begins with the decision makers defining the problem to be assessed along with any relevant boundary conditions or constraints. These are presented to the group who will carry out the FSA and provide results to the decision makers for use in their resolutions. In cases where decision makers require additional work to be conducted, they would revise the problem statement or boundary conditions or constraints, and resubmit this to the group and repeat the process as necessary. Within the FSA methodology, step 5 interacts with each of the other steps in arriving at decision-making recommendations. The group carrying out the FSA process should comprise suitably qualified and experienced people to reflect the range of influences and the nature of the "event" being addressed.

3.1.2 Screening approach

3.1.2.1 The depth or extent of application of the methodology should be commensurate with the nature and significance of the problem; however, experience indicates that very broad FSA studies can be harder to manage. To enable the FSA to focus on those areas that deserve more detailed analysis, a preliminary coarse qualitative analysis is suggested for the relevant ship type or hazard category, in order to include all aspects of the problem under consideration. Whenever there are uncertainties, e.g. in respect of data or expert judgement, the significance of these uncertainties should be assessed.

3.1.2.2 Characterization of hazards and risks should be both qualitative and quantitative, and both descriptive and mathematical, consistent with the available data, and should be broad enough to include a comprehensive range of options to reduce risks.

3.1.2.3 A hierarchical screening approach may be utilized. This would ensure that excessive analysis is not performed by utilizing relatively simple tools to perform initial analyses, the results of which can be used to either support decision-making (if the degree of support is adequate) or to scope/frame more detailed analyses (if not). The initial analyses would therefore be primarily qualitative in nature, with a recognition that increasing degrees of detail and quantification will come in subsequent analyses as necessary.

3.1.2.4 A review of historical data may also be useful as a preparation for a detailed study. For this purpose a loss matrix may be useful. An example can be found in figure 2.
3.2 Information and data

3.2.1 The availability of suitable data necessary for each step of the FSA process is very important. When data are not available, expert judgment, physical models, simulations and analytical models may be used to achieve valuable results. Consideration should be given to those data which are already available at IMO (e.g. casualty and deficiency statistics) and to potential improvements in those data in anticipation of an FSA implementation (e.g. a better specification for recording relevant data including the primary causes, underlying factors and latent factors associated with a casualty).

3.2.2 Data concerning incident reports, near misses and operational failures may be very important for the purpose of making more balanced, proactive and cost-effective legislation, as required in paragraph 4.2 of appendix 8. Such data must be reviewed objectively and their reliability, uncertainty and validity assessed and reported. The assumptions and limitations of these data must also be reported.

3.2.3 However, one of the most beneficial qualities of FSA is the proactive nature. The proactive approach is reached through the probabilistic modelling of failures and development of accident scenarios. Analytical modelling has to be used to evaluate rare events where there is inadequate historical data. A rare event is decomposed into more frequent events for which there is more experience available (e.g. evaluate system failure based on component failure data).

3.2.4 Equally, consideration should also be given to cases where the introduction of recent changes may have affected the validity of historic data for assessing current risk.

3.3 Expert judgment

3.3.1 The use of expert judgment is considered to be an important element within the FSA methodology. It not only contributes to the proactive nature of the methodology, but is also essential in cases where there is a lack of historical data. Further historical data may be evaluated by the use of expert judgment by which the quality of the historical data may be improved.

3.3.2 In applying expert judgment, different experts may be involved in a particular FSA study. It is unlikely that the experts’ opinions will always be in agreement. It might even be the case that the experts have strong disagreements on specific issues. Preferably, a good level of agreement should be reached. It is highly recommended to report the level of agreement between the experts in the results of an FSA study. It is important to know the level of agreement, and this may be established by the use of a concordance matrix or by any other methodology. For example, appendix 9 describes the use of a concordance matrix.

3.4 Incorporation of the human element

3.4.1 The human element is one of the most important contributory aspects to the causation and avoidance of accidents. Human element issues throughout the integrated system shown in figure 3 should be systematically treated within the FSA framework, associating them directly with the occurrence of accidents, underlying causes or influences. Appropriate techniques for incorporating human factors should be used.

3.4.2 The human element can be incorporated into the FSA process by using human reliability analysis (HRA). Guidance for the use of HRA within FSA is given in appendix 1 and diagrammatically in figure 4. To allow easy referencing the numbering system in appendix 1 is consistent with that of the rest of the FSA Guidelines.
3.5 Evaluating regulatory influence

It is important to identify the network of influences linking the regulatory regime to the occurrence of the event. Construction of Influence Diagrams may assist (see appendix 3).

4 PROBLEM DEFINITION

4.1 Preparation for the study

The purpose of problem definition is to carefully define the problem under analysis in relation to the regulations under review or to be developed. The definition of the problem should be consistent with operational experience and current requirements by taking into account all relevant aspects. Those which may be considered relevant when addressing ships (not necessarily in order of importance) are:

1. ship category (e.g. type, length or gross tonnage range, new or existing, type of cargo);
2. ship systems or functions (e.g. layout, subdivision, type of propulsion);
3. ship operation (e.g. operations in port and/or during navigation);
4. external influences on the ship (e.g. Vessel Traffic System, weather forecasts, reporting, routeing);
5. accident category (e.g. collision, explosion, fire); and
6. risks associated with consequences such as injuries and/or fatalities to passengers and crew, environmental impact, damage to the ship or port facilities, or commercial impact.

4.2 Generic model

4.2.1 In general, the problem under consideration should be characterized by a number of functions. Where the problem relates for instance to a type of ship, these functions include carriage of payload, communication, emergency response, manoeuvrability, etc. Alternatively, where the problem relates to a type of hazard, for instance fire, the functions include prevention, detection, alarm, containment, escape, suppression, etc.

4.2.2 For application of FSA, a generic model should therefore be defined to describe the functions, features, characteristics and attributes which are common to all ships or areas relevant to the problem in question.

4.2.3 The generic model should not be viewed as an individual ship in isolation, but rather as a collection of systems, including organizational, management, operational, human, electronic and hardware aspects which fulfil the defined functions. The functions and systems should be broken down to an appropriate level of detail. Aspects of the interaction of functions and systems and the extent of their variability should be addressed.

4.2.4 A comprehensive view, such as the one shown in figure 3, should be taken, recognizing that the ship’s technical and engineering system, which is governed by physical laws, is in the centre of an integrated system. The technical and engineering system is integrally related to the passengers and crew which are a function of human behaviour. The passengers and crew interact with the organizational and management infrastructure and
those personnel involved in ship and fleet operations, maintenance and management. These systems are related to the outer environmental context, which is governed by pressures and influences of all parties interested in shipping and the public. Each of these systems is dynamically affected by the others.

4.3 Results

The output of the problem definition comprises:

.1 problem definition and setting of boundaries; and

.2 development of a generic model.

5 FSA STEP 1 – IDENTIFICATION OF HAZARDS

5.1 Scope

The purpose of step 1 is to identify a list of hazards and associated scenarios prioritized by risk level specific to the problem under review. This purpose is achieved by the use of standard techniques to identify hazards which can contribute to accidents, and by screening these hazards using a combination of available data and judgement. The hazard identification exercise should be undertaken in the context of the functions and systems generic to the ship type or problem being considered, which were established in paragraph 4.2 by reviewing the generic model.

5.2 Methods

5.2.1 Identification of possible hazards

5.2.1.1 The approach used for hazard identification generally comprises a combination of both creative and analytical techniques, the aim being to identify all relevant hazards. The creative element is to ensure that the process is proactive and not confined only to hazards that have materialized in the past. It typically consists of structured group reviews aiming at identifying the causes and effects of accidents and relevant hazards. Consideration of functional failure may assist in this process. The group carrying out such structured reviews should include experts in the various appropriate aspects, such as ship design, operations and management and specialists to assist in the hazard identification process and incorporation of the human element. A structured group review session may last over a number of days. The analytical element ensures that previous experience is properly taken into account, and typically makes use of background information (for example applicable regulations and codes, available statistical data on accident categories and lists of hazards to personnel, hazardous substances, ignition sources, etc.). Examples of hazards relevant to shipboard operations are shown in appendix 2.

5.2.1.2 A coarse analysis of possible causes and initiating events and outcome of each accident scenario should be carried out. The analysis may be conducted by using established techniques (examples are described in appendix 3), to be chosen according to the problem in question, whenever possible and in line with the scope of the FSA.

5.2.2 Ranking

The identified hazards and their associated scenarios relevant to the problem under consideration should be ranked to prioritize them and to discard scenarios judged to be of minor significance. The frequency and consequence of the scenario outcome requires
assessment. Ranking is undertaken using available data, supported by judgement, on the scenarios. A generic risk matrix is shown in figure 5. The frequency and consequence categories used in the risk matrix have to be clearly defined. The combination of a frequency and a consequence category represents a risk level. Appendix 4 provides an example of one way of defining frequency and consequence categories, as well as possible ways of establishing risk levels for ranking purposes.

5.3 Results

The output from step 1 comprises:

.1 a list of hazards and their associated scenarios (including initiating events); and

.2 an assessment of accident scenarios (prioritized by risk level).

6 FSA STEP 2 – RISK ANALYSIS

6.1 Scope

6.1.1 The purpose of the risk analysis in step 2 is a detailed investigation of the causes and initiating events and consequences of the more important accident scenarios identified in step 1. This can be achieved by the use of suitable techniques that model the risk. This allows attention to be focused upon high-risk areas and to identify and evaluate the factors which influence the level of risk.

6.1.2 Different types of risk (i.e. risks to people, the environment or property) should be addressed as appropriate to the problem under consideration. Measures of risk are discussed in appendix 5.

6.2 Methods

6.2.1 There are several methods/tools that can be used to perform a risk analysis. The scope of the FSA, types of hazards identified in step 1, and the level of failure data available will all influence which method/tool works best for each specific application. Examples of the different types of risk analysis methods/tools are outlined in appendix 3.

6.2.2 Quantification makes use of accident and failure data and other sources of information as appropriate to the level of analysis. Where data is unavailable, calculation, simulation or the use of established techniques for expert judgement may be used.

6.2.3 Sensitivity analysis and uncertainty analysis should be considered in the quantified and/or qualified risk and risk models and the results should be reported together with the quantitative data and explanation of models used. Methodologies of sensitivity analysis and uncertainty analysis would depend on the method of risk analysis and/or risk models used.

6.3 Results

The output from step 2 comprises:

.1 the identification of the high-risk areas which need to be addressed; and
7 FSA STEP 3 – RISK CONTROL OPTIONS

7.1 Scope

7.1.1 The purpose of step 3 is to first identify Risk Control Measures (RCMs) and then to group them into a limited number of Risk Control Options (RCOs) for use as practical regulatory options. Step 3 comprises the following four stages:

.1 focusing on risk areas needing control;
.2 identifying potential RCMs;
.3 evaluating the effectiveness of the RCMs in reducing risk by re-evaluating step 2; and
.4 grouping RCMs into practical regulatory options.

7.1.2 Step 3 aims at creating risk control options that address both existing risks and risks introduced by new technology or new methods of operation and management. Both historical risks and newly identified risks (from steps 1 and 2) should be considered, producing a wide range of risk control measures. Techniques designed to address both specific risks and underlying causes should be used.

7.2 Methods

7.2.1 Determination of areas needing control

The purpose of focusing risks is to screen the output of step 2 so that the effort is focused on the areas most needing risk control. The main aspects to making this assessment are to review:

.1 risk levels, by considering frequency of occurrence together with the severity of outcomes. Accidents with an unacceptable risk level become the primary focus;
.2 probability, by identifying the areas of the risk model that have the highest probability of occurrence. These should be addressed irrespective of the severity of the outcome;
.3 severity, by identifying the areas of the risk model that contribute to highest severity outcomes. These should be addressed irrespective of their probability; and
.4 confidence, by identifying areas where the risk model has considerable uncertainty either in risk, severity or probability. These uncertain areas should be addressed.

7.2.2 Identification of potential RCMs

7.2.2.1 Structured review techniques are typically used to identify new RCMs for risks that are not sufficiently controlled by existing measures. These techniques may encourage the development of appropriate measures and include risk attributes and causal chains. Risk attributes relate to how a measure might control a risk, and causal chains relate to where, in the "initiating event to fatality" sequence, risk control can be introduced.
7.2.2.2 RCMs (and subsequently RCOs) have a range of attributes. These attributes may be categorized according to the examples given in appendix 6.

7.2.2.3 The prime purpose of assigning attributes is to facilitate a structured thought process to understand how an RCM works, how it is applied and how it would operate. Attributes can also be considered to provide guidance on the different types of risk control that could be applied. Many risks will be the result of complex chains of events and a diversity of causes. For such risks the identification of RCMs can be assisted by developing causal chains which might be expressed as follows:

causal factors → failure → circumstance → accident → consequences

7.2.2.4 RCMs should in general be aimed at one or more of the following:

.1 reducing the frequency of failures through better design, procedures, organizational polices, training, etc.;

.2 mitigating the effect of failures, in order to prevent accidents;

.3 alleviating the circumstances in which failures may occur; and

.4 mitigating the consequences of accidents.

7.2.2.5 RCMs should be evaluated regarding their risk reduction effectiveness by using step 2 methodology, including consideration of any potential side effects of the introduction of the RCM.

7.2.3 Composition of RCOs

7.2.3.1 The purpose of this stage is to group the RCMs into a limited number of well thought out Risk Control Options (RCOs). There is a range of possible approaches to grouping individual measures into options. The following two approaches, related to likelihood and escalation, can be considered:

.1 "general approach" which provides risk control by controlling the likelihood of initiation of accidents and may be effective in preventing several different accident sequences; and

.2 "distributed approach" which provides control of escalation of accidents, together with the possibility of influencing the later stages of escalation of other, perhaps unrelated, accidents.

7.2.3.2 In generating the RCOs, the interested entities, who may be affected by the combinations of measures proposed, should be identified.

7.2.3.3 Some RCMs/RCOs may introduce new or additional hazards, in which case steps 1, 2 and 3 should be reviewed and revised as appropriate.

7.2.3.4 Before adopting a combination of RCOs for which a quantitative assessment of the combined effects was not performed, a qualitative evaluation of RCO interdependencies should be performed. Such an evaluation could take the form of a matrix as illustrated in the following table:
Table: Interdependencies of RCOs

<table>
<thead>
<tr>
<th>RCO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Strong</td>
<td>No</td>
<td>Weak</td>
</tr>
<tr>
<td>2</td>
<td>Weak</td>
<td></td>
<td>Weak</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>Weak</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Weak</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

The above matrix table lists the RCOs both vertically as horizontally. Reading horizontally, the table indicates in the first row any dependencies between RCO 1 and each of the other proposed RCOs (2 to 4). For example, in this case the table states that if RCO 1 is implemented, RCO 2, being strongly dependent on RCO 1, needs to be re-evaluated before adopting it in conjunction with RCO 1. On the other hand, RCO 3 is not dependent on RCO 1, and therefore its cost-effectiveness is not altered by the adoption of RCO 1. RCO 4 is weakly dependent on RCO 1, so re-evaluation may not be necessary. In principle, one dependency table could be given for cost, benefits and risk reduction. The interdependencies in the above matrix may or may not be symmetric.

7.2.3.5 Where more than one RCOs are proposed to be implemented at the same time, the effectiveness of such combination in reducing the risk should be assessed.

7.2.3.6 Sensitivity analysis and uncertainty analysis should be considered in the analysis of effectiveness of RCMs and RCOs, and the results of sensitivity analysis and uncertainty analysis should be reported.

7.3 Results

The output from step 3 comprises:

.1 a list of RCOs with their effectiveness in reducing risk, including the method of analysis;

.2 a list of interested entities affected by the identified RCOs;

.3 a table stating the interdependencies between the identified RCOs; and

.4 results of analysis of side effects of RCOs.

8 FSA STEP 4 – COST-BENEFIT ASSESSMENT

8.1 Scope

8.1.1 The purpose of step 4 is to identify and compare benefits and costs associated with the implementation of each RCO identified and defined in step 3. A cost-benefit assessment may consist of the following stages:

.1 consider the risks assessed in step 2, both in terms of frequency and consequence, in order to define the base case in terms of risk levels of the situation under consideration;

.2 arrange the RCOs, defined in step 3, in a way to facilitate understanding of the costs and benefits resulting from the adoption of an RCO;

.3 estimate the pertinent costs and benefits for all RCOs;
estimate and compare the cost-effectiveness of each option, in terms of
the cost per unit risk reduction by dividing the net cost by the risk reduction
achieved as a result of implementing the option; and

rank the RCOs from a cost-benefit perspective in order to facilitate
the decision-making recommendations in step 5 (e.g. to screen those which
are not cost-effective or impractical).

8.1.2 Costs should be expressed in terms of life cycle costs and may include initial, operating,
training, inspection, certification, decommission, etc. Benefits may include reductions in fatalities,
injuries, casualties, environmental damage and clean-up, indemnity of third party liabilities, etc.
and an increase in the average life of ships.

8.2 Methods

8.2.1 Definition of interested entities

8.2.1.1 The evaluation of the above costs and benefits can be carried out by using various
methods and techniques. Such a process should be conducted for the overall situation and
then for those interested entities which are the most influenced by the problem in question.

8.2.1.2 In general, an interested entity can be defined as the person, organization, company,
coastal State, flag State, etc., who is directly or indirectly affected by an accident or by
the cost-effectiveness of the proposed new regulation. Different interested entities with similar
interests can be grouped together for the purpose of applying the FSA methodology and
identifying decision-making recommendations.

8.2.2 Calculation indices for cost-effectiveness

There are several indices which express cost-effectiveness in relation to safety of life such as
Gross Cost of Averting a Fatality (Gross CAF) and Net Cost of Averting a Fatality (Net CAF)
as described in appendix 7. Other indices based on damage to and effect on property and
environment may be used for a cost-benefit assessment relating to such matters. Comparisons
of cost-effectiveness for RCOs may be made by calculating such indices.

8.2.3 For evaluation of RCOs focusing on prevention of oil spill from ships, environmental
risk evaluation criteria as described in appendix 7 can be used.

8.2.4 Sensitivity analysis and uncertainty analysis should be considered in the cost-benefit
analysis and cost-effectiveness, and the results should be reported.

8.3 Results

The output from step 4 comprises:

.1 costs and benefits for each RCO identified in step 3 from an overview
perspective;

.2 costs and benefits for those interested entities which are the most influenced
by the problem in question; and

.3 cost-effectiveness expressed in terms of suitable indices.
9  FSA STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING

9.1  Scope

9.1.1  The purpose of step 5 is to define recommendations which should be presented to the relevant decision makers in an auditable and traceable manner. The recommendations would be based upon the comparison and ranking of all hazards and their underlying causes; the comparison and ranking of risk control options as a function of associated costs and benefits; and the identification of those risk control options which keep risks as low as reasonably practicable.

9.1.2  The basis on which these comparisons are made should take into account that, in ideal terms, all those entities that are significantly influenced in the area of concern should be equitably affected by the introduction of the proposed new regulation. However, taking into consideration the difficulties of this type of assessment, the approach should be, at least in the earliest stages, as simple and practical as possible.

9.2  Methods

9.2.1  Scrutiny of results

Recommendations should be presented in a form that can be understood by all parties irrespective of their experience in the application of risk and cost-benefit assessment and related techniques. Those submitting the results of an FSA process should provide timely and open access to relevant supporting documents and a reasonable opportunity for and a mechanism to incorporate comments.

9.2.2  Risk evaluation criteria

There are several standards for risk acceptance criteria, none as yet universally accepted. While it is desirable for the Organization and Member States which propose new regulations or modifications to existing regulations to determine agreed risk evaluation criteria after wide and deep consideration, those used within an FSA should be explicit.

9.3  Results

The output from step 5 comprises:

1. an objective comparison of alternative options, based on the potential reduction of risks and cost-effectiveness, in areas where legislation or rules should be reviewed or developed;

2. feedback information to review the results generated in the previous steps; and

3. recommended RCO(s) submitted in SMART (specific, measurable, achievable, realistic, time-bound) terms and accompanied with the application of the RCO(s), e.g. application of ship type(s) and construction date and/or systems to be fitted on board.
10 PRESENTATION OF FSA RESULTS

10.1 To facilitate the common understanding and use of FSA at IMO in the rule-making process, each report of an FSA process should:

.1 provide a clear statement of the final recommendations, ranked and justified in an auditable and traceable manner;

.2 list the principal hazards, risks, costs and benefits identified during the assessment;

.3 explain and reference the basis for significant assumptions, limitations, uncertainties, data models, methodologies and inferences used or relied upon in the assessment or recommendations, results of hazard identifications and risk analysis, risk control options and results of cost-benefit analysis to be considered in the decision-making process;

.4 describe the sources, extent and magnitude of significant uncertainties associated with the assessment or recommendations;

.5 describe the composition and expertise of groups that performed each step of the FSA process by providing a short curriculum vitae of each expert and describing the basis of selection of the experts; and

.6 describe the method of decision-making in the group(s) that performed the FSA process (see paragraph 3.3).

10.2 The standard format for reporting the FSA process is shown in appendix 8.

11 APPLICATION AND REVIEW PROCESS OF FSA

The Guidance for practical application and review process of FSA is contained in appendix 10.
FIGURE 1

FLOW CHART OF THE FSA METHODOLOGY

Decision makers

FSA Methodology

- Step 1: Hazard identification
- Step 2: Risk assessment
- Step 3: Risk Control Options
- Step 4: Cost-Benefit Assessment
- Step 5: Decision-making recommendations
FIGURE 2

EXAMPLE OF LOSS MATRIX

<table>
<thead>
<tr>
<th>Accident type</th>
<th>Ship accident cost</th>
<th>Environmental damage and clean up</th>
<th>Risk to life</th>
<th>Risk of injuries and ill health</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision</td>
<td>£</td>
<td>£/tonne x number of tonnes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire/explosion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hull damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machinery damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>War loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grounding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other ship accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other oil spills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* DALY = Disabled Adjourned Life Years (The World Health Report 2000; www.who.int)

FIGURE 3

COMPONENTS OF THE INTEGRATED SYSTEM

- Environmental context
- Organizational/management infrastructure
- Personnel subsystem
  - Technical/engineering system
FIGURE 4
INCORPORATION OF HUMAN RELIABILITY ANALYSIS (HRA) INTO THE FSA PROCESS

<table>
<thead>
<tr>
<th>FSA PROCESS</th>
<th>TASKS REQUIRED TO INCORPORATE HRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Hazard Identification</td>
</tr>
<tr>
<td></td>
<td>Human-related hazards (appendix 1-5.2)</td>
</tr>
<tr>
<td></td>
<td>High level task analysis (appendix 1-5.2)</td>
</tr>
<tr>
<td></td>
<td>Preliminary description of outcome (appendix 1-5.3)</td>
</tr>
<tr>
<td>Step 2</td>
<td>Risk Analysis</td>
</tr>
<tr>
<td></td>
<td>Detailed task analysis for critical tasks (appendix 1-6.2)</td>
</tr>
<tr>
<td></td>
<td>Human error analysis (appendix 1-6.3)</td>
</tr>
<tr>
<td></td>
<td>Human error quantification (appendix 1-6.4)</td>
</tr>
<tr>
<td>Step 3</td>
<td>Risk Control Options</td>
</tr>
<tr>
<td></td>
<td>Risk control options for human element (appendix 1-7.2)</td>
</tr>
<tr>
<td>Step 4</td>
<td>Cost-Benefit Assessment</td>
</tr>
<tr>
<td>Step 5</td>
<td>Recommendations for Decision-Making</td>
</tr>
</tbody>
</table>

FIGURE 5
RISK MATRIX

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>CONSEQUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>High Risk</td>
</tr>
<tr>
<td>Reasonably probable</td>
<td></td>
</tr>
<tr>
<td>Remote</td>
<td>Low Risk</td>
</tr>
<tr>
<td>Extremely remote</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td></td>
</tr>
<tr>
<td>Catastrophic</td>
<td></td>
</tr>
</tbody>
</table>

MSC 98/23/Add.2
Annex 26, page 19
FIGURE 6
EXAMPLE OF A RISK CONTRIBUTION TREE*

* As defined in the context of these Guidelines.
APPENDIX 1

GUIDANCE ON HUMAN RELIABILITY ANALYSIS (HRA)

1 INTRODUCTION

1.1 Purpose of Human Reliability Analysis (HRA)

1.1.1 Those industries which routinely use quantitative risk assessment (QRA) to assess the frequency of system failures as part of the design process or ongoing operations management, have recognized that in order to produce valid results it is necessary to assess the contribution of the human element to system failure. The accepted way of incorporating the human element into QRA and FSA studies is through the use of human reliability analysis (HRA).

1.1.2 HRA was developed primarily for the nuclear industry. Using HRA in other industries requires that the techniques be appropriately adapted. For example, because the nuclear industry has many built-in automatic protection systems, consideration of the human element can be legitimately delayed until after consideration of the overall system performance. On board ships, the human has a greater degree of freedom to disrupt system performance. Therefore, a high-level task analysis needs to be considered at the outset of an FSA.

1.1.3 HRA is a process which comprises a set of activities and the potential use of a number of techniques depending on the overall objective of the analysis. HRA may be performed on a qualitative or quantitative basis depending on the level of FSA being undertaken. If a full quantitative analysis is required then Human Error Probabilities (HEPs) can be derived in order to fit into quantified system models such as fault and event trees. However, in many instances a qualitative analysis may be sufficient. The HRA process usually consists of the following stages:

1. identification of key tasks;
2. task analysis of key tasks;
3. human error identification;
4. human error analysis; and
5. human reliability quantification.

1.1.4 Where a fully-quantified FSA approach is required, HRA can be used to develop a set of HEPs for incorporation into probabilistic risk assessment. However, this aspect of HRA can be over-emphasized. Experienced practitioners admit that greater benefit is derived from the early, qualitative stages of task analysis and human error identification. Effort expended in these areas pays dividends because an HRA exercise (like an FSA study) is successful only if the correct areas of concern have been chosen for investigation.

1.1.5 It is also necessary to bear in mind that the data available for the last stage of HRA, human reliability quantification, are currently limited. Although several human error databases have been built up, the data contained in them are only marginally relevant to the maritime industry. In some cases where an FSA requires quantitative results from the HRA, expert judgement may be the most appropriate method for deriving suitable data. Where expert judgement is used, it is important that the judgement can be properly justified as required by appendix 8 of the FSA Guidelines.
1.2 Scope of the HRA Guidance

1.2.1 Figure 4 of the FSA Guidelines shows how the HRA Guidance fits into the FSA process.

1.2.2 The amount of detail provided in this guidance is at a level similar to that given in the FSA Guidelines, i.e. it states what should be done and what considerations should be taken into account. Details of some techniques used to carry out the process are provided in the appendices of this guidance.

1.2.3 The sheer volume of information about this topic prohibits the provision of in-depth information: there are numerous HRA techniques, and task analysis is a framework encompassing dozens of techniques. Table 1 lists the main references which could be pursued.

1.2.4 As with FSA, HRA can be applied to the design, construction, maintenance and operations of a ship.

1.3 Application

It is intended that this guidance should be used wherever an FSA is conducted on a system which involves human action or intervention which affects system performance.

2 BASIC TERMINOLOGY

Error producing condition: Factors that can have a negative effect on human performance.

Human error: A departure from acceptable or desirable practice on the part an individual or a group of individuals that can result in unacceptable or undesirable results.

Human error recovery: The potential for the error to be recovered, either by the individual or by another person, before the undesired consequences are realized.

Human error consequence: The undesired consequences of human error.

Human error probability: Defined as follows:

\[
HEP = \frac{Number \ of \ human \ errors \ that \ have \ occurred}{Number \ of \ opportunities \ for \ human \ error}
\]

Human reliability: The probability that a person: (1) correctly performs some system-required activity in a required time period (if time is a limiting factor) and (2) performs no extraneous activity that can degrade the system. Human unreliability is the opposite of this definition.

Performance shaping factors: Factors that can have a positive or negative effect on human performance.

Task analysis: A collection of techniques used to compare the demands of a system with the capabilities of the operator, usually with a view to improving performance, e.g. by reducing errors.
3 METHODOLOGY

HRA can be considered to fit into the overall FSA process in the following way:

.1 identification of key human tasks consistent with step 1;
.2 risk assessment, including a detailed task analysis, human error analysis and human reliability quantification consistent with step 2; and
.3 risk control options consistent with step 3.

4 PROBLEM DEFINITION

Additional human element issues which may be considered in the problem definition include:

.1 personal factors, e.g. stress, fatigue;
.2 organizational and leadership factors, e.g. manning level;
.3 task features, e.g. task complexity; and
.4 onboard working conditions, e.g. human-machine interface.

5 HRA STEP 1 – IDENTIFICATION OF HAZARDS

5.1 Scope

5.1.1 The purpose of this step is to identify key potential human interactions which, if not performed correctly, could lead to system failure. This is a broad scoping exercise where the aim is to identify areas of concern (e.g. whole tasks or large sub-tasks) requiring further investigation. The techniques used here are the same as those used in step 2, but in step 2 they are used much more rigorously.

5.1.2 Human hazard identification is the process of systematically identifying the ways in which human error can contribute to accidents during normal and emergency operations. As detailed in paragraph 5.2.2 below, standard techniques such as Hazard and Operability (HazOp) study and Failure Mode and Effects Analysis (FMEA) can be, and are, used for this purpose. Additionally, it is strongly advised that a high-level functional task analysis is carried out. This section discusses those techniques which were developed solely to address human hazards.

5.2 Methods for hazard identification

5.2.1 In order to carry out a human hazard analysis, it is first necessary to model the system in order to identify the normal and emergency operating tasks that are carried out by the crew. This is achieved by the use of a high-level task analysis (as described in table 2) which identifies the main human tasks in terms of operational goals. Developing a task analysis can utilize a range of data collection techniques, e.g. interviews, observation, critical incident, many of which can be used to directly identify key tasks. Additionally, there are many other sources of information which may be consulted, including design information, past experience, normal and emergency operating procedures, etc.
5.2.2 At this stage it is not necessary to generate a lot of detail. The aim is to identify those key human interactions which require further attention. Therefore, once the main tasks, sub-tasks and their associated goals have been listed, the potential contributors to human error of each task need to be identified together with the potential hazard arising. There are a number of techniques which may be utilized for this purpose, including human error HazOp, Hazard Checklists, etc. An example of human-related hazards identifying a number of different potential contributors to sub-standard performance is included in table 3.

5.2.3 For each task and sub-task identified, the associated hazards and their associated scenarios should be ranked in order of their criticality in the same manner as discussed in section 5.2.2 of the FSA Guidelines.

5.3 Results

The output from step 1 is a set of activities (tasks and sub-tasks) with a ranked list of hazards associated with each activity. This list needs to be coupled with the other lists generated by the FSA process, and should therefore be produced in a common format. Only the top few hazards for critical tasks are subjected to risk assessment, less critical tasks are not examined further.

6 HRA STEP 2 – RISK ANALYSIS

6.1 Scope

The purpose of step 2 is to identify those areas where the human element poses a high risk to system safety and to evaluate the factors influencing the level of risk.

6.2 Detailed task analysis

6.2.1 At this stage, the key tasks are subjected to a detailed task analysis. Where the tasks involve more decision-making than action, it may be more appropriate to carry out a cognitive task analysis. Table 2 outlines the extended task analysis which was developed for analysing decision-making tasks.

6.2.2 The task analysis should be developed until all critical sub-tasks have been identified. The level of detail required is that which is appropriate for the criticality of the operation under investigation. A good general rule is that the amount of detail required should be sufficient to give the same degree of understanding as that provided by the rest of the FSA exercise.

6.3 Human error analysis

6.3.1 The purpose of human error analysis is to produce a list of potential human errors that can lead to the undesired consequence that is of concern. To help with this exercise, some examples of typical human errors are included in figure 1.

6.3.2 Once all potential errors have been identified, they are typically classified along the following lines. This classification allows the identification of a critical subset of human errors that must be addressed:

.1 the supposed cause of the human error;

.2 the potential for error-recovery, either by the operator or by another person (this includes consideration of whether a single human error can result in undesired consequences); and
the potential consequences of the error.

6.3.3 Often, a qualitative analysis should be sufficient. A simple qualitative assessment can be made using a recovery/consequence matrix such as that illustrated in figure 2. Where necessary, a more detailed matrix can be developed using a scale for the likely consequences and levels of recovery.

6.4 Human error quantification

6.4.1 This activity is undertaken where a probability of human error (HEP) is required for input into a quantitative FSA. Human error quantification can be conducted in a number of ways.

6.4.2 In some cases, because of the difficulties of acquiring reliable human error data for the maritime industry, expert judgement techniques may need to be used for deriving a probability for human error. Expert judgment techniques can be grouped into four categories:

.1 paired comparisons;
.2 ranking and rating procedures;
.3 direct numerical estimation; and
.4 indirect numerical estimation.

It is particularly important that experts are provided with a thorough task definition. A poor definition invariably produces poor estimates.

6.4.3 Absolute Probability Judgement (APJ) is a good direct method. It can be used in various forms, from the single expert assessor to large groups of individuals whose estimates are mathematically aggregated (see table 4). Other techniques which focus on judgements from multiple experts include: brainstorming; consensus decision-making; Delphi; and the Nominal Group technique.

6.4.4 Alternatives to expert opinion are historic data (where available) and generic error probabilities. Two main methods for HRA which have databases of human error probabilities (mainly for the nuclear industry) are the Technique for Human Error Rate Prediction (THERP) and Human Error Assessment and Reduction Technique (HEART) (see table 4).

6.4.5 Technique for Human Error Rate Prediction (THERP)

THERP was developed by Swain and Guttmann (1983) of Sandia National Laboratories for the US Nuclear Regulatory Commission, and has become the most widely used human error quantitative prediction technique. THERP is both a human reliability technique and a human error databank. It models human errors using probability trees and models of dependence, but also considers performance shaping factors (PSFs) affecting action. It is critically dependent on its database of human error probabilities. It is considered to be particularly effective in quantifying errors in highly procedural activities.
6.4.6 **Human Error Assessment and Reduction Technique (HEART)**

HEART is a technique developed by Williams (1985) that considers particular ergonomics, tasks and environmental factors that adversely affect performance. The extent to which each factor independently affects performance is quantified and the human error probability is calculated as a function of the product of those factors identified for a particular task.

6.4.7 HEART provides specific information on remedial risk control options to combat human error. It focuses on five particular causes and contributions to human error: impaired system knowledge; response time shortage; poor or ambiguous system feedback; significant judgement required of operator; and the level of alertness resulting from duties, ill health or the environment.

6.4.8 When applying human error quantification techniques, it is important to consider the following:

.1 Magnitudes of human error are sufficient for most applications. A "gross" approximation of the human error magnitude is sufficient. The derivation of HEPs may be influenced by modelling and quantitative uncertainties. A final sensitivity analysis should be presented to show the effect of uncertainties on the estimated risks.

.2 Human error quantification can be very effective when used to produce a comparative analysis rather than an exact quantification. Then human error quantification can be used to support the evaluation of various risk control options.

.3 The detail of quantitative analysis should be consistent with the level of detail of the FSA model. The HRA should not be more detailed than the technical elements of the FSA. The level of detail should be selected based upon the contribution of the activity to the risk, system or operation being analysed.

.4 The human error quantification tool selected should fit the needs of the analysis. There are a significant number of human error quantification techniques available. The selection of a technique should be assessed for consistency, usability, validity of results, usefulness, effective use of resources for the HRA and the maturity of the technique.

6.5 **Results**

6.5.1 The output from this step comprises:

.1 an analysis of key tasks;

.2 an identification of human errors associated with these tasks; and

.3 an assessment of human error probabilities (optional).

6.5.2 These results should then be considered in conjunction with the high-risk areas identified elsewhere in step 2.
7 HRA STEP 3 – RISK CONTROL OPTIONS

7.1 Scope

The purpose of step 3 is to consider how the human element is considered within the evaluation of technical, human, work environment, personnel and management-related risk control options.

7.2 Application

7.2.1 The control of risks associated with the human interaction with a system can be approached in the same way as for the development of other risk control measures. Measures can be specified in order to:

1. reduce the frequency of failure;
2. mitigate the effects of failure;
3. alleviate the circumstances in which failures occur; and
4. mitigate the consequences of accidents.

7.2.2 Proper application of HRA can reveal that technological innovations can also create problems which may be overlooked by FSA evaluation of technical factors only. A typical example of this is the creation of long periods of low workload when a high degree of automation is used. This in turn can lead to an inability to respond correctly when required or even to the introduction of "risk-taking behaviour" in order to make the job more interesting.

7.2.3 When dealing with risk control concerning human activity, it is important to realize that more than one level of risk control measure may be necessary. This is because human involvement spans a wide range of activities from day-to-day operations through to senior management levels. Secondly, it must also be stressed that a basic focus on good system design utilizing ergonomics and human factor principles is needed in order to achieve enhanced operational safety and performance levels.

7.2.4 In line with figure 3 of the FSA Guidelines, risk control measures for human interactions can be categorized into four areas as follows: (1) technical/engineering subsystem, (2) working environment, (3) personnel subsystem and (4) organizational/management subsystem. A description of the issues that may be considered within each of these areas is given in figure 3.

7.2.5 Once the risk control measures have been initially specified, it is important to reassess human intervention in the system in order to assess whether any new hazards have been introduced. For example, if a decision had been taken to automate a particular task, then the new task would need to be re-evaluated.

7.3 Results

The output from this step comprises a range of risk control options categorized into 4 areas as presented in figure 3, easing the integration of human-related risk into step 3.

8 HRA STEP 4 – COST-BENEFIT ASSESSMENT

No specific HRA guidance for this section is required.
9 HRA STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING

Judicious use of the results of the HRA study should contribute to a set of balanced decisions and recommendations of the whole FSA study.

FIGURE 1

TYPICAL HUMAN ERRORS

<table>
<thead>
<tr>
<th>Physical Errors</th>
<th>Mental Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action omitted</td>
<td>Lack of knowledge of system/situation</td>
</tr>
<tr>
<td>Action too much/little</td>
<td>Lack of attention</td>
</tr>
<tr>
<td>Action in wrong direction</td>
<td>Failure to remember procedures</td>
</tr>
<tr>
<td>Action mistimed</td>
<td>Communication breakdowns</td>
</tr>
<tr>
<td>Action on wrong object</td>
<td>Miscalculation</td>
</tr>
</tbody>
</table>

FIGURE 2

RECOVERY/CONSEQUENCE MATRIX

<table>
<thead>
<tr>
<th>Consequence</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>May need to consider</td>
<td>MUST CONSIDER</td>
</tr>
<tr>
<td>Low</td>
<td>No need to consider</td>
<td>May need to consider</td>
</tr>
</tbody>
</table>

Recovery

FIGURE 3

EXAMPLES OF RISK CONTROL OPTIONS

Technical/engineering subsystem

- ergonomic design of equipment and work spaces
- good layout of bridge, machinery spaces
- ergonomic design of the man-machine interface/human computer interface
- specification of information requirements for the crew to perform their tasks
- clear labelling and instructions on the operation of ship systems and control/communications equipment

Working environment

- ship stability, effect on crew of working under conditions of pitch/roll
- weather effects, including fog, particularly on watch-keeping or external tasks
- ship location, open sea, approach to port, etc.
- appropriate levels of lighting for operations and maintenance tasks and for day and night time operations
- consideration of noise levels (particularly for effect on communications)
- consideration of the effects of temperature and humidity on task performance
- consideration of the effects of vibration on task performance
Personnel subsystem

- development of appropriate training for crew members
- crew levels and make up
- language and cultural issues
- workload assessment (both too much and too little workload can be problematic)
- motivational and leadership issues

Organizational/management subsystem

- development of organization policies on recruitment, selection, training, crew levels and make up, competency assessment, etc.
- development of operational and emergency procedures (including provisions for tug and salvage services)
- use of safety management systems
- provision of weather forecasting/routing services

**TABLE 1**

**REFERENCES**


**TABLE 2**

**SUMMARY OF TASK ANALYSIS TYPES**

1 **High-level task analysis**

1.1 High-level task analysis here refers to the type of task analysis which allows an analyst to gain a broad but shallow overview of the main functions which need to be performed to accomplish a particular task.

1.2 High-level task analysis is undertaken in the following way:

1.2.1 describe all operations within the system in terms of the tasks required to achieve a specific operational goal; and

1.2.2 consider goals associated with normal operations, emergency procedures, maintenance and recovery measures.

1.3 The analysis is recorded either in a hierarchical format or in tabular form.

2 **Detailed task analysis**

2.1 Detailed task analysis is undertaken to identify:

2.1.1 the overall task (or job) that is done;

2.1.2 sub-tasks;

2.1.3 all of the people who contribute to the task and their interactions;

2.1.4 how the work is done, i.e. the working practices in normal and emergency situations;

2.1.5 any controls, displays, tools, etc. which are used; and
.6 factors which influence performance.

2.2 There are many task analysis techniques – Kirwan and Ainsworth (1992) list more than twenty. They note that the most widely used, hierarchical task analysis (HTA), can be used as a framework for applying other techniques:

.1 data collection techniques, e.g. activity sampling, critical incident, questionnaires;

.2 task description techniques, e.g. charting and network techniques, tabular task analysis;

.3 tasks simulation methods, e.g. computer modelling and simulation;

.4 task behaviour assessment methods, e.g. management and oversight risk trees; and

.5 task requirement evaluation methods, e.g. ergonomics checklists.

3 Extended task analysis (XTA)

3.1 Traditional task analysis was designed for investigating manual tasks, and is not so useful for analysing intellectual tasks, e.g. navigation decisions. Extended task analysis or other cognitive task analyses (see Annett and Stanton, 1998) can be used where the focus is less on what actions are performed and more on understanding the rationale for the decisions that are taken.

3.2 XTA is used to map out the logical bases of the decision-making process which underpin the task under examination. The activities which comprise XTA techniques are described in Johnson and Johnson (1987). In summary, they are:

.1 Interview. The interviewer asks about the conditions which enable or disable certain actions to be performed, and how a change in the conditions affects those choices. The interviewer examines the individual's intentions to make sure that all relevant aspects of the situation have been taken into account. This enables the analyst to build up a good understanding of what the individual is doing and why, and how it would change under varying conditions.

.2 Qualitative analysis of data. The interview is tape-recorded, transcribed and subsequently analysed. Methods for analysing qualitative data are well-established in social science and more recently utilized in safety engineering. The technique (called Grounded Theory) is described in detail by Pidgeon et al. (1991).

.3 Representation of the analysis in an appropriate format. The representation scheme used in XTA is called systemic grammar networks – a form of associative network – see Johnson and Johnson (1987).

.4 Validation activities, e.g. observation, hypothesis.
TABLE 3
EXAMPLES OF HUMAN-RELATED HAZARDS

1 Human error occurs on board ships when a crew member’s ability falls below what is needed to successfully complete a task. Whilst this may be due to a lack of ability, more commonly it is because the existing ability is hampered by adverse conditions. Below are some examples (not complete) of personal factors and unfavourable conditions which constitute hazards to optimum performance. A comprehensive examination of all human-related hazards should be performed. During the "design stage" it is typical to focus mainly on task features and on board working conditions as potential human-related hazards.

2 Personal factors

.1 Reduced ability, e.g. reduced vision or hearing;
.2 Lack of motivation, e.g. because of a lack of incentives to perform well;
.3 Lack of ability, e.g. lack of seamanship, unfamiliarity with vessel, lack of fluency of the language used on board;
.4 Fatigue, e.g. because of lack of sleep or rest, irregular meals; and
.5 Stress.

3 Organizational and leadership factors

.1 Inadequate vessel management, e.g. inadequate supervision of work, lack of coordination of work, lack of leadership;
.2 Inadequate shipowner management, e.g. inadequate routines and procedures, lack of resources for maintenance, lack of resources for safe operation, inadequate follow-up of vessel organization;
.3 Inadequate manning, e.g. too few crew, untrained crew; and
.4 Inadequate routines, e.g. for navigation, engine-room operations, cargo handling, maintenance, emergency preparedness.

4 Task features

.1 Task complexity and task load, i.e. too high to be done comfortably or too low causing boredom;
.2 Unfamiliarity of the task;
.3 Ambiguity of the task goal; and
.4 Different tasks competing for attention.
5 Onboard working conditions

.1 Physical stress from, e.g. noise, vibration, sea motion, climate, temperature, toxic substances, extreme environmental loads, night-watch;

.2 Ergonomic conditions, e.g. inadequate tools, inadequate illumination, inadequate or ambiguous information, badly-designed human-machine interface;

.3 Social climate, e.g. inadequate communication, lack of cooperation; and

.4 Environmental conditions, e.g. restricted visibility, high traffic density, restricted fairway.

TABLE 4

SUMMARY OF HUMAN ERROR ANALYSIS TECHNIQUES

The two main HRA quantitative techniques (HEART and THERP) are outlined below. CORE-DATA provides data on generic probabilities. As the data from all of these sources are based on non-marine industries, they need to be used with caution. A good alternative is to use expert judgement and one technique for doing this is Absolute Probability Judgement.

1 Absolute Probability Judgement (APJ)

1.1 APJ refers to a group of techniques that utilize expert judgement to develop human error probabilities (HEPs) detailed in Kirwan (1994) and Lees (1996). These techniques are used when no relevant data exist for the situation in question, making some form of direct numerical estimation the only way of developing values for HEPs.

1.2 There are a variety of techniques available. This gives the analyst some flexibility in accommodating different types of analysis. Most of the techniques avoid potentially detrimental group influences such as group bias. Typically the techniques used are: the Delphi technique, the Nominal Group Technique and Paired Comparisons. The number and type of experts that are required to participate in the process are similar to that required for Hazard Identification techniques such as HazOp.

1.3 Paired Comparisons is a significant expert judgement technique. Using this technique, an individual makes a series of judgements about pairs of tasks. The results for each individual are analysed and the relative values for HEPs for the tasks derived. Use of the technique rests upon the ability to include at least two tasks with known HEPs. CORE-DATA and data from other industries may be useful.

1.4 The popularity of these techniques has reduced in recent times, probably due to the requirement to get the relevant groups of experts together. However, these techniques may be very appropriate for the maritime industry.

2 Technique for Human Error Rate Prediction (THERP)

2.1 THERP is one of the best known and most often utilized human reliability analysis techniques. At first sight the technique can be rather daunting due to the volume of information provided. This is because it is a comprehensive methodology covering task analysis, human error identification, human error modelling and human error quantification. However, it is best known for its human error quantification aspects, which includes a series of human error probability (HEP) data tables and data quantifying the effects of various performance shaping
factors (PSFs). The data presented is generally of a detailed nature and so not readily transferable to the marine environment.

2.2 THERP contains a dependence model which is used to model the dependence relationship between errors. For example, the model could be used to assess the dependence between the helmsman making an error and the bridge officer noticing it. Operational experience does show that there are dependence effects between people and between tasks. Whilst this is the only human error model of its type, it has not been comprehensively validated.

2.3 A full THERP analysis can be resource-intensive due to the level of detail required to utilize the technique properly. However, the use of this technique forces the analyst to gain a detailed appreciation of the system and of the human error potential. THERP models humans as any other subsystem in the FSA modelling process. The steps are as follows:

.1 identify all the systems in the operation that are influenced and affected by human operations;
.2 compile a list and analyse all human operations that affect the operations of the system by performing a detailed task analysis;
.3 determine the probabilities of human errors through error frequency data and expert judgements and experiences; and
.4 determine the effects of human errors by integrating the human error into the PRA modelling procedure.

2.4 THERP includes a set of performance shaping factors (PSFs) that influence the human errors at the operator level. These performance factors include experience, situational stress factors, work environment, individual motivation, and the human-machine interface. The PSFs are used as a basis for estimating nominal values and value ranges for human error.

2.5 There are advantages to using THERP. First, it is a good tool for relative risk comparisons. It can be used to measure the role of human error in an FSA and to evaluate risk control options not necessarily in terms of a probability or frequency, but in terms of risk magnitude. Also, THERP can be used with the standard event-tree/fault-tree modelling approaches that are sometimes preferred by FSA practitioners. THERP is a transparent technique that provides a systematic, well-documented approach to evaluating the role of human errors in a technical system. The THERP database can be used through systematic analysis or, where available, external human error data can be inserted.

3 Human Error Assessment and Reduction Technique (HEART)

3.1 HEART is best known as a relatively simple way of arriving at human error probabilities (HEPs). The basis of the technique is a database of nine generic task descriptions and an associated human error probability. The analyst matches the generic task description to the task being assessed and then modifies the generic human error probability according to the presence and strength of the identified error producing conditions (EPCs). EPCs are conditions that increase the order of magnitude of the error frequency or probability measurements, similar in concept to PSFs in THERP. A list of EPCs is supplied as part of the technique, but it is up to the analyst to decide on the strength of effect for the task in question.
3.2 Whilst the generic data is mainly derived from the nuclear industry, HEART does appear amenable to application within other industries. It may be possible to tailor the technique to the marine environment by including new EPCs such as weather. However, it needs careful application to avoid ending up with very conservative estimates of HEPs.

4 CORE-DATA

4.1 CORE-DATA is a database of human error probabilities. Access to the database is available through the University of Birmingham in the United Kingdom. The database has been developed as a result of sponsorship by the UK Health and Safety Executive with support from the nuclear, rail, chemical, aviation and offshore industries and contains up to 300 records as of January 1999.

4.2 Each record is a comprehensive presentation of information including, e.g. a task summary, industry origin, country of origin, type of data collection used, a database quality rating, description of the operation, performance shaping factors, sample size and HEP.

4.3 As with all data from other industries, care needs to be taken when transferring the data to the maritime industry. Some of the offshore data may be the most useful.
APPENDIX 2

EXAMPLES OF HAZARDS

1 SHIPBOARD HAZARDS TO PERSONNEL

.1 asbestos inhalation;
.2 burns from caustic liquids and acids;
.3 electric shock and electrocution;
.4 falling overboard; and
.5 pilot ladder/pilot hoist operation.

2 HAZARDOUS SUBSTANCES ON BOARD SHIP

Accommodation areas:

.1 combustible furnishings;
.2 cleaning materials in stores; and
.3 oil/fat in galley equipment;

Deck areas:

.4 cargo; and
.5 paint, oils, greases etc., in deck stores;

Machinery spaces:

.6 cabling;
.7 fuel and diesel oil for engines, boilers and incinerators;
.8 fuel, lubricating and hydraulic oil in bilges, save alls, etc.;
.9 refrigerants; and
.10 thermal heating fluid systems.

3 POTENTIAL SOURCES OF IGNITION

General:

.1 electrical arc;
.2 friction;
.3 hot surface;
.4 incendiary spark;
.5 naked flame; and
.6 radio waves;

Accommodation areas (including bridge):

.7 electronic navigation equipment; and
.8 laundry facilities – irons, washing machines, tumble driers, etc.;

Deck areas:

.9 deck lighting;
.10 funnel exhaust emissions; and
.11 hot work sparking;
Machinery spaces:

.12 air compressor units; and
.13 generator engine exhaust manifold.

4 HAZARDS EXTERNAL TO THE SHIP

.1 storms;
.2 lightning;
.3 uncharted submerged objects; and
.4 other ships.
APPENDIX 3
HAZARD IDENTIFICATION AND RISK ANALYSIS TECHNIQUES

1 FAULT TREE ANALYSIS

1.1 A Fault Tree is a logic diagram showing the causal relationship between events which singly or in combination occur to cause the occurrence of a higher level event. It is used in Fault Tree Analysis to determine the probability of a top event, which may be a type of accident or unintended hazardous outcome. Fault Tree Analysis can take account of common cause failures in systems with redundant or standby elements. Fault Trees can include failure events or causes related to human factors.

1.2 The development of a Fault Tree is by a top-down approach, systematically considering the causes or events at levels below the top level. If two or more lower events need to occur to cause the next higher event, this is shown by a logic "and" gate. If any one of two or more lower events can cause the next higher event, this is shown by a logic "or" gate. The logic gates determine the addition or multiplication of probabilities (assuming independence) to obtain the values for the top event.

2 EVENT TREE ANALYSIS

2.1 An Event Tree is a logic diagram used to analyse the effects of an accident, a failure or an unintended event. The diagram shows the probability or frequency of the accident linked to those safeguard actions required to be taken after occurrence of the event to mitigate or prevent escalation.

2.2 The probabilities of success or failure of these actions are analysed. The success and failure paths lead to various consequences of differing severity or magnitude. Multiplying the likelihood of the accident by the probabilities of failure or success in each path gives the likelihood of each consequence.

3 FAILURE MODE AND EFFECT ANALYSIS (FMEA)

FMEA is a technique in which the system to be analysed is defined in terms of functions or hardware. Each item in the system is identified at a required level of analysis. This may be at a replaceable item level. The effects of item failure at that level and at higher levels are analysed to determine their severity on the system as a whole. Any compensating or mitigating provisions in the system are taken account of and recommendations for the reduction of the severity are determined. The analysis indicates single failure modes which may cause system failure.

4 HAZARD AND OPERABILITY STUDIES (HAZOP)

4.1 These studies are carried out to analyse the hazards in a system at progressive phases of its development from concept to operation. The aim is to eliminate or minimize potential hazards.

4.2 Teams of safety analysts and specialists in the subject system, such as designers, constructors and operators are formally constituted. The team members may change at successive phases depending on the expertise required. In examining designs they systematically consider deviations from the intended functions, looking at causes and effects. They record the findings and recommendations and follow-up actions required.
5 WHAT IF ANALYSIS TECHNIQUE

5.1 What If Analysis Technique is a hazard identification technique suited for use in a hazard identification meeting. The typical participants in the meeting may be: a facilitator leader, a recorder and a group of carefully selected experienced persons covering the topics under consideration. Usually a group of 7 to 10 persons is required.

5.2 The group first discusses in detail the system, function or operation under consideration. Drawings, technical descriptions etc. are used, and the experts may have to clarify to each other how the details of the system, function or operation work and may fail.

5.3 The next phase of the meeting is brainstorming, where the facilitator leader guides by asking questions starting with "what if?". The questions span topics like operation errors, measurement errors, equipment malfunction, maintenance, utility failure, loss of containment, emergency operation and external influences. When the ideas are exhausted, previous accident experience may be used to check for completeness.

5.4 The hazards are considered in sequence and structured into a logical sequence, in particular to allow cross-referencing between hazards.

5.5 The hazard identification report is usually developed and agreed in the meeting, and the job is done and reported when the meeting is adjourned.

5.6 The technique requires that the participants are senior personnel with detailed knowledge within their field of experience. A meeting typically takes three days. If the task requires long meetings it should be broken down into smaller sub-tasks.

5.7 SWIFT (Structured What If Technique) is one example of a What If Analysis Technique (http://www.dnv.nl/Syscert/training&consultancy.htm).

6 RISK CONTRIBUTION TREE (RCT)

6.1 RCT may be used as a mechanism for displaying diagrammatically the distribution of risk amongst different accident categories and sub-categories, as shown in figure 6 of the FSA Guidelines. Structuring the tree starts with the accident categories, which may be divided into sub-categories to the extent that available data allow and logic dictates. The preliminary fault and event trees can be developed based on the hazards identified in step 1 to demonstrate how direct causes initiate and combine to cause accidents (using fault trees), and also how accidents may progress further to result in different magnitudes of loss (using event trees). Whilst the example makes use of fault and event tree techniques, other established methods could be used if appropriate.

6.2 Quantifying the RCT is typically undertaken in three stages using available accident statistics:

.1 categories and sub-categories of accidents are quantified in terms of the frequency of accidents;

.2 the severity of accident outcomes is quantified in terms of magnitude and consequence; and

.3 the risk of the categories and sub-categories of accidents can be expressed as F-N curves (see appendix 5) or potential loss of lives (PLL) based on the frequency of accidents and the severity of the outcome of the accidents.
Thus, the distribution of risks across all the sub-categories of accidents is determined in risk terms, so as to display which categories contribute how much risk.

7 INFLUENCE DIAGRAMS

The purpose of the Influence Diagram approach is to model the network of influences on an event. These influences link failures at the operational level with their direct causes, and with the underlying organizational and regulatory influences. The Influence Diagram approach is derived from decision analysis and, being based on expert judgements, is particularly useful in situations for which there may be little or no empirical data available. The approach is therefore capable of identifying all the influences (and therefore underlying causal information) that help explain why a marine risk profile may show high risk levels in one aspect (or even vessel type) and low risk level in another aspect. As the Influence Diagram recognizes that the risk profile is influenced, for example by human, organizational and regulatory aspects, it allows a holistic understanding of the problem area to be displayed in a hierarchical way.

8 BAYESIAN NETWORK

Bayesian network is a probabilistic graphical model (a type of statistical model) that represents a set of random variables and their conditional dependencies via a directed acyclic graph (DAG; see diagram below). For example, a Bayesian network could represent the probabilistic relationships between diseases and symptoms. Given symptoms, the network can be used to compute the probabilities of the presence of various diseases.

9 SENSITIVITY ANALYSIS AND UNCERTAINTY ANALYSIS

Sensitivity analysis is the study of how the uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input. A related practice is uncertainty analysis which focuses rather on quantifying uncertainty in model output. Ideally, uncertainty and sensitivity analysis should be run in tandem.

Uncertainty analysis investigates the uncertainty of variables that are used in decision-making problems in which observations and models represent the knowledge base. In other words, uncertainty analysis aims to make a technical contribution to decision-making through the quantification of uncertainties in the relevant variables.

Uncertainty and sensitivity analysis investigate the robustness of a study when the study includes some form of statistical modelling.
APPENDIX 4

INITIAL RANKING OF ACCIDENT SCENARIOS

1. At the end of step 1, hazards are to be prioritized and scenarios ranked. Scenarios are typically the sequence of events from the initiating event up to the consequence, through the intermediate stages of the scenario development.

2. To facilitate the ranking and validation of ranking, it is generally recommended to define consequence and probability indices on a logarithmic scale. A risk index may therefore be established by adding the probability/frequency and consequence indices. By deciding to use a logarithmic scale, the Risk Index for ranking purposes of an event rated "remote" (FI=3) with severity "Significant" (SI=2) would be RI=5.

   \[
   \text{Risk} = \text{Probability} \times \text{Consequence} \\
   \log(\text{Risk}) = \log(\text{Probability}) + \log(\text{Consequence})
   \]

3. The following table gives an example of a logarithmic severity index, scaled for a maritime safety issue. Consideration of environmental issues or of passenger vessels may require additional or different categories.

<table>
<thead>
<tr>
<th>SI</th>
<th>SEVERITY</th>
<th>EFFECTS ON HUMAN SAFETY</th>
<th>EFFECTS ON SHIP</th>
<th>S (Equivalent fatalities)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minor</td>
<td>Single or minor injuries</td>
<td>Local equipment damage</td>
<td>0.01</td>
</tr>
<tr>
<td>2</td>
<td>Significant</td>
<td>Multiple or severe injuries</td>
<td>Non-severe ship damage</td>
<td>0.1</td>
</tr>
<tr>
<td>3</td>
<td>Severe</td>
<td>Single fatality or multiple severe injuries</td>
<td>Severe damage</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Catastrophic</td>
<td>Multiple fatalities</td>
<td>Total loss</td>
<td>10</td>
</tr>
</tbody>
</table>

4. The following table gives an example of a logarithmic probability/frequency index.

<table>
<thead>
<tr>
<th>FI</th>
<th>FREQUENCY</th>
<th>DEFINITION</th>
<th>F (per ship year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Frequent</td>
<td>Likely to occur once per month on one ship</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Reasonably probable</td>
<td>Likely to occur once per year in a fleet of 10 ships, i.e. likely to occur a few times during the ship's life</td>
<td>0.1</td>
</tr>
<tr>
<td>3</td>
<td>Remote</td>
<td>Likely to occur once per year in a fleet of 1,000 ships, i.e. likely to occur in the total life of several similar ships</td>
<td>$10^{-3}$</td>
</tr>
<tr>
<td>1</td>
<td>Extremely remote</td>
<td>Likely to occur once in the lifetime (20 years) of a world fleet of 5,000 ships</td>
<td>$10^{-5}$</td>
</tr>
</tbody>
</table>
5. The following table gives an example of a risk matrix based on the tables above.

<table>
<thead>
<tr>
<th>Risk Index (RI)</th>
<th>SEVERITY (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
</tr>
</tbody>
</table>

6. In case of FSA on prevention of oil spill from ships, the following severity index can be used.

<table>
<thead>
<tr>
<th>Severity Index</th>
<th>SEVERITY</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Category 1</td>
<td>Oil spill size &lt; 1 tonne</td>
</tr>
<tr>
<td>2</td>
<td>Category 2</td>
<td>Oil spill size between 1-10 tonnes</td>
</tr>
<tr>
<td>3</td>
<td>Category 3</td>
<td>Oil spill size between 10-100 tonnes</td>
</tr>
<tr>
<td>4</td>
<td>Category 4</td>
<td>Oil spill size between 100-1,000 tonnes</td>
</tr>
<tr>
<td>5</td>
<td>Category 5</td>
<td>Oil spill size between 1,000-10,000 tonnes</td>
</tr>
<tr>
<td>6</td>
<td>Category 6</td>
<td>Oil spill size &gt;10,000 tonnes</td>
</tr>
</tbody>
</table>
APPENDIX 5

MEASURES AND TOLERABILITY OF RISKS

1 INTRODUCTION

The following information on measures and tolerability of risks is provided for conceptual understanding and is not intended to provide prescriptive thresholds for acceptability of risks.

2 TERMINOLOGY

Individual Risk (IR): The risk of death, injury and ill health as experienced by an individual at a given location, e.g. a crew member or passenger on board the ship, or belonging to third parties that could be affected by a ship accident. Usually IR is taken to be the risk of death and is determined for the maximally exposed individual. Individual Risk is person and location specific.

\[ IR_{\text{for Person I}} = F_{\text{of undesired Event}} \times P_{\text{for Person I}} \times E_{\text{of Person I}} \]

- \( F \): frequency
- \( P \): resulting casualty probability
- \( E \): fractional exposure to that risk

Societal Risk: Average risk, in terms of fatalities, experienced by a whole group of people (e.g. crew, port employees or society at large) exposed to an accident scenario. Usually Societal Risk is taken to be the risk of death and is typically expressed as FN-diagrams or Potential Loss of Life (PLL) (refer to section 2). Societal Risk is determined for the all exposed, even if only once a year. Societal Risk is not person and location specific.

FN-Curve: A continuous graph with the ordinate representing the cumulative frequency distribution of N or more fatalities and the abscissa representing the consequence (N fatalities). The FN-curve represents the cumulative distribution of multiple fatality events and therefore useful in representing societal risk. The FN-curve is constructed by taking each hazard or accident scenario in turn and estimating the number of fatalities. With the estimated frequency of occurrence of each accident scenario the overall frequency with which a given number of fatalities may be equalled or exceeded can be calculated and plotted in the form of an FN-curve.

ALARP (As Low As Reasonably Practicable): Refers to a level of risk that is neither negligibly low nor intolerable high. ALARP is actually the attribute of a risk, for which further investment of resources for risk reduction is not justifiable. The principle of ALARP is employed for the risk assessment procedure. Risks should be As Low As Reasonably Practicable. It means that accidental events whose risks fall within this region have to be reduced unless there is a disproportionate cost to the benefits obtained.

3 PRINCIPLES OF RISK EVALUATION

Risk can be expressed in several complementary fashions. Concerning life safety, the most commonly used expressions are Individual Risk and Societal Risk. This is risk of death, injuries and ill health experienced by an individual and/or a group of people. The notion of risk combines frequency and an identified level of harm. Commonly, the level of harm is narrowed
down to the loss of life and risk is an expression of frequency and number of fatalities. In other words, life safety is usually taken to refer to the risk of loss of life, and usually expressed as fatalities per year. In order to address not only fatalities, but also disabilities and injuries, the Equivalent Fatality Concept as specified below is advocated. Risk should at least be judged from two viewpoints. The first point of view is that of the individual, which is dealt with by the Individual Risk. The second point of view is that of society, considering whether a risk is acceptable for (large) group of people. This is dealt with by the Societal Risk.

### 3.1 The use of Individual Risk

3.1.1 This risk expression is used when the risk from an accident is to be estimated for a particular individual at a given location. Individual Risk considers not only the frequency of the accident and the consequence (here: fatality or injury), but also the individual's fractional exposure to that risk, i.e. the probability of the individual of being in the given location at the time of the accident.

3.1.2 Example: The risk for a person to be killed or injured in a harbour area, due to a tanker explosion, is the higher the closer the person is located to the explosion location, and the more likely the person will be in that location at the time of the explosion. Therefore, the Individual Risk for a worker in the vicinity of the explosion will be higher than for an occupant in the neighbourhood of the harbour terminal.

3.1.3 The purpose of estimating the Individual Risk is to ensure that individuals, who may be affected by a ship accident, are not exposed to excessive risks.

### 3.2 The use of Societal Risk

3.2.1 Societal Risk is used to estimate risks of accidents affecting many persons, e.g. catastrophes, and acknowledging risk averse or neutral attitudes. Societal Risk includes the risk to every person, even if a person is only exposed on one brief occasion to that risk. For assessing the risk to a large number of affected people, Societal Risk is desirable because Individual Risk is insufficient in evaluating risks imposed on large numbers of people. Societal Risk expressions can be generated for each type of accident (e.g. collision), or a single overall Societal Risk expression can be obtained, e.g. for a ship type, by combining all accidents together (e.g. collision, grounding, fire). Societal Risk may be expressed as:

1. FN-diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multidimensional diagram.

2. Annual fatality rate: frequency and fatality are combined into a convenient one-dimensional measure of societal risk. This is also known as Potential Loss of Life (PLL).

**FN diagrams**

3.2.2 Society in general has a strong aversion to multiple casualty accidents. There is a clear perception that a single accident that kills 1,000 people is worse than 1,000 accidents that kill a single person. Societal Risk expressed by an FN-diagram show the relationship between the frequency of an accident and the number of fatalities (see figure 1 below).
3.2.3 A simple measure of Societal Risk is the PLL which is defined as the expected value of the number of fatalities per year. PLL is a type of risk integral, being a summation of risk as expressed by the product of consequence and frequency. The integral is summed up over all potential undesired events that can occur.

3.2.4 Compared to the FN-diagram, the distinction between high frequency/low consequence accidents and low frequency/high consequence accidents is lost: all fatalities are treated as equally important, irrespective of whether they occur in high fatality or low fatality accidents. PLL is a simpler format of Societal Risk than the FN-diagram. PLL is typically measured as fatality per ship-year.

3.3 Comparing Societal Risk and Individual Risk

3.3.1 Societal Risk expressed in an FN-diagram allows a more comprehensive picture of risk than Individual Risk measures. The FN-diagram allows the assessment not only of the average number of fatalities but also of the risk of catastrophic accidents killing many people at once.

3.3.2 However, unlike Individual Risk, both FN-diagrams and PLL values give no indication of the geographical distribution of a particular risk. Societal Risk represents the risk to a (large) group of people. In this group, the risk to individuals may be quite different, depending, e.g. on the different locations of the individuals when the accident occurs. The Societal Risk value therefore represents an average risk. There is a general agreement in society that it is not sufficient to just achieve a minimal average risk. It is also necessary to reduce the risk to the

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**Figure 1: FN-diagram (from MSC 72/16)**

**Potential Loss of Life (PLL)**

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most exposed individual. It is therefore adequate to look at both Societal Risk and Individual Risk to achieve a full risk picture.

3.3.3 Societal Risk is difficult to apply to the task of risk reduction, specifically because it is multidimensional.

3.4 Risk equivalence concept

3.4.1 Normally, from a given activity in industry, there tends to be a relationship between fatalities and injuries of different severities resulting from an accident. Furthermore, measures that will reduce the occurrence of fatalities also tend to reduce injuries in proportion. In the literature there exist some studies on the ratio between accidental outcomes, e.g. from Bird and German (1966). In document MSC 68/INF.6, a straightforward approach was introduced, suggesting an equivalence ratio between fatalities, major injuries and minor injuries:

1 one (1) fatality equals ten (10) severe injuries; and
2 one (1) severe injury equals ten (10) minor injuries.

3.4.2 The QALY and DALY concepts (refer to appendix 7) would represent more general approaches for measuring injuries and health effects, and are used by e.g. the World Health Organization (WHO).

4 ALARP PRINCIPLE

By using different forms of risk expressions, risk criteria can be created that meet the requirement of different principles. The commonly accepted principle is known as the ALARP principle. Risk criteria are used to translate a risk level into value judgement.

4.1 General

4.1.1 The purpose of FSA is to reduce the risk to a level that is tolerable. IMO has a moral responsibility to limit the risks to people life and health, to the marine environment and to property. In addition, IMO should also account for maintaining a healthy industry. Spending resources on regulations whose benefits are grossly disproportionate to their costs will put the industry in a less than competitive position.

4.1.2 This is realized in the ALARP principle, which is shown in figure 2.

![Figure 2: The ALARP principle](image-url)
4.1.3 It states that there is a risk level that is intolerable above an upper bound. In this region, risk cannot be justified and must be reduced, irrespectively of costs. The principle also states that there is a risk level that is "broadly acceptable" below a lower bound. In this region risk is negligible and no risk reduction required. If the risk level is in between the two bounds, the ALARP region, risk should be reduced to meet economic responsibility: Risk is to be reduced to a level as low as is reasonably practicable. The term reasonable is interpreted to mean cost-effective. Risk reduction measures should be technically practicable and the associated costs should not be disproportionate to the benefits gained. This is examined in a cost-effectiveness analysis.

4.2 Cost-effectiveness Analysis (CEA)

With this approach the amount of risk reduction that can be justified in the ALARP region is determined. Several researchers have proven that most risks in shipping fall into this region. As such, most of risk-based decisions will require a CEA. However, it should be noted that this has not yet been verified for all ship types. There are several indices which express cost-effectiveness in relation to safety of life such as GCAF and NCAF, as described in appendix 7.

5 RECOMMENDED RISK EVALUATION CRITERIA

5.1 Individual Risk

5.1.1 Individual Risk criteria for hazardous activities are often set using risk levels that have already been accepted from other industrial activities.

5.1.2 The level of risk that will be accepted for an individual depends upon two aspects:

.1 if the risk is taken involuntarily or voluntarily; and

.2 if the individual has control over the risk or no control.

5.1.3 If a person is voluntarily exposing himself to a risk and/or has some control over it, then the risk level that is accepted is higher as if this person was exposed involuntarily to that risk or had no control over it.

5.1.4 For example: A passenger on a cruise ship or an occupant living in the vicinity of a port have little or no control over the risks they are exposed to from the ship and/or the port activity. They are involuntarily exposed to risks. A crew member on a ship, instead, has chosen his work place on a voluntary basis, and due to skills and training has some control over the risks he/she is exposed to at the work place.

5.1.5 An appropriate level for the risk acceptance criteria would be substantially below the total accident risks experienced in daily life, but might be similar to risks that are accepted from other involuntary sources.

5.1.6 The lower and upper bound risk acceptance criteria as listed in table 1 are provided for illustrative purposes only. The specific values selected as appropriate should be explicitly defined in FSA studies.
5.2 Societal Risk/FN-Diagram

5.2.1 When setting upper and lower bounds for societal risk acceptance, both an anchor point and a slope should be defined. The slope reveals the risk inherent attitude: risk prone, neutral or averse. It is recommended to use a slope equal of -1 on a log/log scale to reflect the risk aversion.

5.2.2 In document MSC 72/16 it was pointed out that Societal Risk acceptance criteria cannot be simply transferred from one industrial activity to another. This could lead to illogical and unpredictable results. A method was introduced where the Societal Risk acceptance criteria reflect the importance of the activity to the society (for more detail, refer to document MSC 72/16, Skjong and Eknes (2001, 2002)).

5.2.3 For a given activity, an average acceptable Potential Loss of Life (PLL) is developed by considering the economic value of the activity and its relation to the gross national product. This can be done for crew/workers, passengers and other third parties. The risk is defined to be intolerable if it exceeds the average acceptable risk by more than one order of magnitude, and it is negligible (broadly acceptable), if it is one order of magnitude below the average acceptable risk. These upper and lower bounds represent the ALARP region, which thus ranges over two orders of magnitude, which is in agreement with other published Societal Risk acceptance criteria.

5.2.4 It is recommended to apply this method to define Societal Risk acceptance criteria on different ship types and/or marine activities, as the method can contribute to transparency in using risk acceptance criteria for Societal Risk. In document MSC 72/16, Societal Risk criteria developed with this method and expressed in FN-diagrams are provided for different ship types.

5.3 Examples of risk acceptance criteria

5.3.1 The following criteria are broadly used in other industries and have been also published in HSE (2001).
5.3.2 It is important to understand, that the above risk acceptance criteria always refer to the total risk to the individual and/or group of persons. Total risk means the sum of all risks that, e.g. a person on board a ship is exposed to. The total risk therefore would contain risks from hazards such as fire, collision, etc. There is no criterion available to determine the acceptability of specific hazards. Therefore, the above criteria can be used to assess the acceptability of the total risk on being, e.g. on a passenger ship, but not for assessing the specific risk of dying on a passenger ship due to a fire.

<table>
<thead>
<tr>
<th>Decision Parameter</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower bound for ALARP region</td>
</tr>
<tr>
<td>Negligible (broadly acceptable) fatality risk per year</td>
<td>Maximum tolerable fatality risk per year</td>
</tr>
<tr>
<td>Individual Risk</td>
<td>to crew member 10^-5 10^-3</td>
</tr>
<tr>
<td></td>
<td>to passenger 10^-6 10^-4</td>
</tr>
<tr>
<td></td>
<td>to third parties, member of public ashore 10^-5 10^-4</td>
</tr>
<tr>
<td></td>
<td>target values for new ships 10^-5 Above values to be reduced by one order of magnitude</td>
</tr>
<tr>
<td>Societal Risk</td>
<td>to groups of above persons To be derived by using economic parameters as per MSC 72/16</td>
</tr>
</tbody>
</table>

Table 1: Quantitative risk evaluation upper and lower bounds

*) While it is recommended that the maximum tolerable criteria for Individual Risk as listed should apply to all ships, it is proposed, in accordance with MSC 72/16, that for comprehensive FSA studies for new ships a more demanding target is appropriate.
APPENDIX 6

ATTRIBUTES OF RISK CONTROL MEASURES

1 CATEGORY A ATTRIBUTES

1.1 Preventive risk control is where the risk control measure reduces the probability of the event.

1.2 Mitigating risk control is where the risk control measure reduces the severity of the outcome of the event or subsequent events, should they occur.

2 CATEGORY B ATTRIBUTES

2.1 Engineering risk control involves including safety features (either built in or added on) within a design. Such safety features are safety critical when the absence of the safety feature would result in an unacceptable level of risk.

2.2 Inherent risk control is where at the highest conceptual level in the design process, choices are made that restrict the level of potential risk.

2.3 Procedural risk control is where the operators are relied upon to control the risk by behaving in accordance with defined procedures.

3 CATEGORY C ATTRIBUTES

3.1 Diverse risk control is where the control is distributed in different ways across aspects of the system, whereas concentrated risk control is where the risk control is similar across aspects of the system.

3.2 Redundant risk control is where the risk control is robust to failure of risk control, whereas single risk control is where the risk control is vulnerable to failure of risk control.

3.3 Passive risk control is where there is no action required to deliver the risk control measure, whereas active risk control is where the risk control is provided by the action of safety equipment or operators.

3.4 Independent risk control is where the risk control measure has no influence on other elements.

3.5 Dependent risk control is where one risk control measure can influence another element of the risk contribution tree.

3.6 Involved human factors is where human action is required to control the risk but where failure of the human action will not in itself cause an accident or allow an accident sequence to progress.

3.7 Critical human factors is where human action is vital to control the risk either where failure of the human action will directly cause an accident or will allow an accident sequence to progress. Where a critical human factor attribute is assigned, the human action (or critical task) should be clearly defined in the risk control measure.
3.8 *Auditable or Not Auditable* reflects whether the risk control measure can be audited or not.

3.9 *Quantitative or Qualitative* reflects whether the risk control measure has been based on a quantitative or qualitative assessment of risk.

3.10 *Established or Novel* reflects whether the risk control measure is an extension to existing marine technology or operations, whereas novel is where the measure is new. Different grades are possible, for example the measure may be novel to shipping but established in other industries or it is novel to both shipping and other industries.

3.11 *Developed or Non-developed* reflects whether the technology underlying the risk control measure is developed both in its technical effectiveness and its basic cost. Non-developed is either where the technology is not developed but it can be reasonably expected to develop, or its basic cost can be expected to reduce in a given timescale. The purpose of considering this attribute is to attempt to anticipate development and produce forward looking measures and options.
APPENDIX 7

EXAMPLES OF CALCULATION OF INDICES FOR COST-EFFECTIVENESS

1  Indices for cost-effectiveness on safety

1.1  Introduction

The purpose of this appendix is to suggest a set of cost-effectiveness criteria, which may be used in FSA studies. The use of these cost-effectiveness criteria would enable the FSA studies to be conducted in a more consistent manner, making results and the way they were achieved better comparable and understandable. This appendix provides clarification on available criteria to assess the cost-effectiveness of risk control options so-called cost-effectiveness criteria. It is also recommended how these criteria should be applied.

1.2  Terminology

1.2.1  DALY (Disability Adjusted Life Years)/QALY (Quality Adjusted Life Years): The basic idea of a QALY is one year of perfect health-life expectancy to be worth 1, but regards one year of less than perfect health-life expectancy as less than 1. Unlike QALY, the DALY assigns that one year of perfect health-life to be 0 and one year of less than perfect as more than 0.

1.2.2  LQI (Life Quality Index): The index for expressing the social, health, environment and economic dimensions of the quality of life at working conditions. The LQI can be used to comment on key issues that affect people and contribute to the public debate about how to improve the quality of life in our communities.

1.2.3  GCAF (Gross Cost of Averting a Fatality): A cost-effectiveness measure in terms of ratio of marginal (additional) cost of the risk control option to the reduction in risk to personnel in terms of the fatalities averted; i.e.

\[ \text{GCAF} = \frac{\Delta \text{Cost}}{\Delta \text{Risk}} \]

1.2.4  NCAF (Net Cost of Averting a Fatality): A cost-effectiveness measure in terms of ratio of marginal (additional) cost, accounting for the economic benefits of the risk control option to the reduction in risk to personnel in terms of the fatalities averted, i.e.

\[ \text{NCAF} = \frac{\Delta \text{Cost} - \Delta \text{Economic Benefit}}{\Delta \text{Risk}} \]

= \text{GCAF} - \frac{\Delta \text{Economic Benefit}}{\Delta \text{Risk}}

1.3  NCAF and GCAF

1.3.1  The common criteria used for estimating the cost-effectiveness of risk reduction measures are NCAF and GCAF. In principle there are several approaches to derive NCAF and GCAF criteria:

.1  Observation of the Willingness-To-Pay to avert a fatality;

.2  Observation of past decisions and the costs involved with them; and
.3 Consideration of societal indicators such as the Life Quality Index (LQI).

For further detail, reference is made to Nathwani et al., Rackwitz (2002).

1.3.2 The proposed values for NCAF and GCAF in table 2 were derived by considering societal indicators (refer to document MSC 72/16, UNDP 1990, Lind 1996). They are provided for illustrative purposes only. The specific values selected as appropriate and used in an FSA study should be explicitly defined. These criteria given in table 2 are not static, but should be updated every year according to the average risk free rate of return (approximately 5%) or by use of the formula based on LQI (Nathwani et al. (1996), Skjong and Ronold (1998, 2002), Rackwitz (2002 a,b)).

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>...</td>
<td>3 million</td>
<td>3 million</td>
</tr>
<tr>
<td>...</td>
<td>1.5 million</td>
<td>1.5 million</td>
</tr>
</tbody>
</table>

**Table 2: Cost Effectiveness Criteria**

*) NCAF and GCAF criteria are normally used covering not only fatalities from accidents, but implicitly also injuries and/or ill health from them. This is an adequate approach, because, as was mentioned above, many accidents involve both consequence categories: fatalities and injuries/ill health.

However, if accidents are analysed that involve only one of the two categories, the criteria should be adjusted to cover explicitly only the category relevant to the accident under consideration. In MSC 72/16 a proposal was made, that the NCAF and GCAF criteria are split equally for the two consequence categories.

**) refer also to QALY approach

1.3.3 It is recommended that the following approach is applied in using GCAF and NCAF criteria:

.1 GCAF or NCAF:

In principle, either of the two criteria can be used. However, it is recommended to firstly consider GCAF instead of NCAF. The reason is that NCAF also takes into account economic benefits from the RCOs under consideration. This may be misused in some cases for pushing certain RCOs, by considering more economic benefits on preferred RCOs than on other RCOs.

If the cost-effectiveness of an RCO is in the range of criterion, then NCAF may be also considered.

.2 Negative NCAF:

Recent FSA studies have come up with some risk control options (RCO) where the associated NCAF was negative. Assuming that the RCO has a positive risk reduction potential \( \Delta R \) (i.e. reduces the risk), a negative NCAF means that the benefits in monetary units are higher than the costs associated with the RCO. It should be noted that a high negative NCAF with positive \( \Delta R \) may result from either of the following two facts:
1.3.4 Therefore, RCOs with high negative NCAFs should always be considered in connection with the associated risk reduction capability.

QALY and/or DALY

1.3.5 The QALY or DALY criterion can be used for risks that only involve injuries and/or ill health, but no fatalities. It can be derived from the GCAF criterion, by assuming that one prevented fatality implies 35 Quality Adjusted Life Years gained (refer to document MSC 72/16):

$$QALY = \frac{GCAF \text{ (covering injuries/ill health)}}{35} = \text{US$42,000.}$$

2 Environmental risk evaluation criteria on prevention of oil spill from ships

2.1 Noting that the most appropriate conversion formula to use will depend on the specific scope of each FSA to be performed, a general approach to be followed is outlined in the following suggested examples.

Cost for compensating oil spills

2.2 Consolidated oil spill database based on IOPCF data; US Data; and Norwegian data.

2.3 Figure 1 shows the data of the consolidated oil spill database in terms of specific costs per tonne spilled (figure 5 of document MEPC 62/INF.24). Further information with respect to the basis of the database can be found in document MEPC 62/INF.24. It should be acknowledged that the consolidated oil spill database has limitations and possible deficiencies. These are described in document MEPC 62/INF.24 and may also involve incomplete or missing data on costs or other information.
Figure 1: All specific oil spill cost data in 2009 USD (spill cost per tonne)
Source: document MEPC 62/INF.24

2.4 The submitter of the FSA can amend this database with new oil spill data, however, this amendment should be properly documented.

2.5 Some regression formulae derived from the consolidated oil spill database are summarized in table 1 in which \( V \) is spill size in tonnes.

### Table 1: Regression formulae derived from the consolidated database

<table>
<thead>
<tr>
<th>Dataset</th>
<th>( f(V) = \text{Total Spill Cost (TSC)} ) (2009 US dollars)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>All spills</td>
<td>67,275 ( V^{0.5893} )</td>
<td>MEPC 62/INF.24</td>
</tr>
<tr>
<td>( V &gt; 0.1 ) tonnes</td>
<td>42,301 ( V^{0.7233} )</td>
<td>MEPC 62/18¹</td>
</tr>
</tbody>
</table>

2.6 FSA analysts are free to use other conversion formulae, so long as these are well documented by the data. For example, if an FSA is considering only small spills, the submitter may filter the data and perform his or her own regression analysis.

2.7 It is recommended that the FSA analyst use the following formula to estimate the societal oil spill costs (SC) used in the analysis:

\[
SC(V) = F_{\text{Assurance}} \cdot F_{\text{Uncertainty}} \cdot f(V)
\]

This equation considers:

.1 Assurance factor \( F_{\text{Assurance}} \): allowing for society's willingness to pay to avert accidents;

.2 Uncertainty factor \( F_{\text{Uncertainty}} \): allowing for uncertainties in the cost information from occurred spill accidents; and

.3 Volume-dependent total cost function \( f(V) \): representing the fact that the cost per unit oil spilled decreases with the spill size in US$ per tonne oil spilled.

2.8 The values of both assurance and uncertainty factors should be well documented. In addition, if value of \( F_{\text{Assurance}} \) and \( F_{\text{Uncertainty}} \) other than 1.0 are used, a cost-effective analysis using \( F_{\text{Assurance}} = 1.0 \) and \( F_{\text{Uncertainty}} = 1.0 \) should be included in the FSA results, for reference.

2.9 In order to consider the large scatter, the FSA analyst may perform a regression to determine a function \( f(V) \) that covers a percentile different than 50% and document it in the report.

### Application in RCO evaluation

2.10 The FSA analyst should perform a cost-benefit and cost-effectiveness evaluation of the RCOs identified and provide all relevant details in the report, as outlined below.

¹ Updated regression made on the final consolidated dataset.
**RCOs affecting oil spills only**

2.11 In case an RCO affects oil spills only:

**RCO is cost-effective if** $\Delta C < \Delta SC$

$\Delta C =$ Expected cost of the RCO

$\Delta SC = (Expected \ SC \ without \ the \ RCO) - (Expected \ SC \ with \ the \ RCO) = Expected \ benefit \ of \ the \ RCO$

**RCOs affecting both safety and environment**

2.12 In case of RCOs addressing both safety and environment the following formula is recommended:

$$NCAF = \frac{(\Delta C - \Delta SC)}{\Delta PLL}$$

In the above,

$\Delta C =$ Expected cost of the RCO

$\Delta SC = (Expected \ SC \ without \ the \ RCO) - (Expected \ SC \ with \ the \ RCO) = Expected \ benefit \ of \ the \ RCO$

$\Delta PLL =$ Expected reduction of fatalities due to the RCO

2.13 The criteria for NCAF are as per table 2 of appendix 7 of document MSC 83/INF.2.

2.14 In case there is an economic benefit ($\Delta B$), $\Delta C$ should be replaced by $\Delta C - \Delta B$.

2.15 It is also emphasized that all cost and benefit components of the cost-benefit or cost-effectiveness inequality should be shown in an FSA study for better transparency.

**Other indices**

2.16 The user is free to develop new approaches, taking into account the objectives of the FSA.
APPENDIX 8

STANDARD FORMAT FOR REPORTING AN APPLICATION OF FSA TO IMO

1 This standard format is intended to facilitate the compilation of the results of applications according to these guidelines and the consistent presentation of those results to IMO.

2 Interested parties having carried out an FSA application should provide the most significant results in a clear and concise manner, which can also be understood by other parties not having the same experience in the application of risk assessment techniques.

3 The report of an FSA application should contain an executive summary and the following sections: definition of the problem, background information, method of work, description of the results achieved in each step and final recommendations arising from the FSA study.

4 The level of detail of the report depends on the problem under consideration. In order for users and reviewers to understand the results of FSA, the results of the FSA should be reported by:

   .1 a summary report of limited length (i.e. maximum 20 pages);
   .2 a full report that includes a detailed presentation and an explanation; and
   .3 if necessary, background data on an Internet site which is accessible by reviewers of the Organization.

5 Those submitting the results of the FSA application should provide the other interested parties with timely and open access to relevant supporting documentation and sources of information or data which are referred to in the above-mentioned report, as reflected in paragraph 9.2.1 of the FSA Guidelines.

6 The following section presents the standard format of FSA application reports. The subjects expected to be presented in each section of the report are listed in italic characters and reference is made, in brackets, to the relevant paragraph(s) of the FSA Guidelines.

STANDARD REPORTING FORMAT

1 TITLE OF THE APPLICATION OF FSA

2 SUMMARY (maximum 1/2 page)

   2.1 Executive summary: scope of the application and reference to the paragraph defining the problem assessed and its boundaries.

   2.2 Actions to be taken: type of action requested (e.g. for information or review) and summary of the final recommendations listed in section 7.

   2.3 Related documents: reference to any supporting documentation.
3 DEFINITION OF THE PROBLEM (maximum 1 page)  
(refer to paragraphs 4.1 and 4.2 of these guidelines)

3.1 Definition of the problem to be assessed in relation to the proposal under consideration by the decision-makers.

3.2 Reference to the regulation(s) affected by the proposal to be reviewed or developed (in an annex).

3.3 Definition of the generic model (e.g. functions, features, characteristics or attributes which are relevant to the problem under consideration, common to all ships of the type affected by the proposal).

4 BACKGROUND INFORMATION (maximum 3 pages)  
(refer to paragraph 3.2 of these guidelines)

4.1 Lessons learned from recently introduced measures to address similar problems.

4.2 Casualty statistics concerning the problem under consideration (e.g. ship types or accident category) including data analysis (i.e. time dependence, ship size influence, variability assessment, hypothesis testing, etc.).

4.3 Any other sources of data and relevant limitations.

5 METHOD OF WORK (maximum 3 pages)  
(refer to paragraph 3.1.1.2 of these guidelines)

5.1 Composition and expertise of those having performed each step of the FSA process by providing e.g. name and expertise of the experts involved in the application and name and contact point (email address, telephone number and mailing address) of the coordinator of the FSA.

5.2 Description of how the assessment has been conducted in terms of organization of working groups and, method of decision-making in the group(s) that performed each step of the FSA process.

5.3 Start and finish date of the assessment.

6 DESCRIPTION OF THE RESULTS ACHIEVED IN EACH STEP (max. 10 pages)

For each step, describe:

.1 method and techniques used to carry out the assessment;

.2 assumptions, limitations or uncertainties and the basis for them; and

.3 outcomes of each step of the FSA methodology, including:

STEP 1 – HAZARD IDENTIFICATION:  
(refer to paragraph 5.3 of these guidelines)

- prioritized list of hazards and description of their associated scenarios
- identified significant accident scenarios including causes and initiating events in line with the scope of the FSA
STEP 2 – RISK ANALYSIS:
(refer to paragraph 6.3 of these guidelines)

- types of risk (e.g. individual, societal, environmental, business)
- presentation of the distribution of risks depending on the problem under consideration
- identified significant risks
- principal influences that affect the risks
- sources of accident and reliability statistics

STEP 3 – RISK CONTROL OPTIONS:
(refer to paragraph 7.3 of these guidelines)

- what hazards are covered by current regulations
- identified risk control options
- assessment of the control options as a function of their effectiveness against risk reduction

STEP 4 – COST-BENEFIT ASSESSMENT:
(refer to paragraph 8.3 of these guidelines)

- identified types of cost and benefits involved for each risk control option
- cost-benefit assessment for the entities which are influenced by each option
- identification of the cost-effectiveness expressed in terms of cost per unit risk reduction

STEP 5 – RECOMMENDATIONS FOR DECISION-MAKING:
(refer to paragraph 9.3 of these guidelines)

- objective comparison of alternative options
- discussion on how recommendations could be implemented by decision-makers

7 FINAL RECOMMENDATIONS FOR DECISION-MAKING (maximum 2 1/2 pages)

List of final recommendations, ranked and justified in an auditable and traceable manner
(refer to paragraph 9.3 of these guidelines)

ANNEXES (as necessary)

.1 explanation of the background of each expert (e.g. a short curriculum vitae) and the basis of selection of the experts;
.2 list of references;
.3 sources of data;
.4 accident statistics;
.5 technical support material; and
.6 any further information.
APPENDIX 9

DEGREE OF AGREEMENT BETWEEN EXPERTS CONCORDANCE MATRIX

1. Experts are sometimes used to rank risks associated with accident scenarios, or to rank the frequency or severity of hazards. One example is the ranking that takes place at the end of FSA Step 1 – Hazard Identification. This is a subjective ranking, where each expert may develop a ranked list of accident scenarios, starting with the most severe. To enhance the transparency in the result, the resulting ranking should be accompanied by a concordance coefficient, indicating the level of agreement between the experts.

Calculation of concordance coefficient

2. Assume that a number of experts (J experts in total) have been tasked to rank a number of accident scenarios (I scenarios), using the natural numbers (1, 2, 3, .., I). Expert "j" has thereby assigned rank x_ij to scenario "i". The concordance coefficient "W" may then be calculated by the following formula:

\[ W = \frac{12 \sum_{i=1}^{I} \sum_{j=1}^{J} x_{ij} - \frac{J(I+1)}{2}}{J^2(I^3-I)} \]

3. The coefficient W varies from 0 to 1. W=0 indicates that there is no agreement between the experts as to how the scenarios are ranked. W=1 means that all experts rank scenarios equally by the given attribute.

Examples

4. The following three tables are examples. In each example there are 6 experts (J=6) that are ranking 10 scenarios (I=10). In order to show the role of the concordance coefficient, the final combination by \( \sum x_{ij} \) constructed by the importance of hazards 1-10 for all three groups. From tables 1 to 3 it is quite evident how various degrees of concordance have been formed.

5. Assessment of significance of the concordance coefficient is determined by parameter Z:

\[ Z = \frac{1}{2} \ln \frac{(J-1)W}{1-W} \]

which has the Fischer distribution with degrees of freedom \( v_1 = J-1 - \frac{2}{J} \) and \( v_2 = (J-1)k_1 \). If \( I > 7 \) Pearson's criteria \( \chi^2 \) may be used. The value of \( J(I-1)W \) has a \( \chi^2 \)-distribution with \( \nu = I-1 \) degrees of freedom.
### Table 1: Group of experts with high degree of agreement

<table>
<thead>
<tr>
<th>Experts</th>
<th>Hazards</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<th>10</th>
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<td>36</td>
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</tbody>
</table>

* Numbers correspond to the initial list of hazards.

Calculations based on Table 1 result in \( W = 0.909 \); \( \chi^2 = 47.5 < \chi^2(9) = 25.5 \); confidence level of probability \( \alpha = 0.999 \).

### Table 2: Group of experts with medium degree of agreement

<table>
<thead>
<tr>
<th>Experts</th>
<th>Hazards</th>
<th>1</th>
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</tr>
</tbody>
</table>

Calculations based on the ranking in Table 2 result in \( W = 0.413 \); \( \chi^2 = 25.4 < \chi^2(9) = 36.2 \); \( \alpha = 0.995 \), where \( \alpha \) is the confidence level of probability.

### Table 3: Group of experts with low degree of agreement

<table>
<thead>
<tr>
<th>Experts</th>
<th>Hazards</th>
<th>1</th>
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</table>

Calculations based on the ranking in Table 3 result in \( W = 0.102 \); \( \chi^2 = 5.4 < \chi^2(9) = 21.0 \); \( \alpha = 0.20 \).
6 The level of agreement is characterized in table 4:

<table>
<thead>
<tr>
<th>Table 4: Concordance coefficients</th>
</tr>
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<tbody>
<tr>
<td>W</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>W</td>
</tr>
</tbody>
</table>

Other use

7 The method described can be used in all cases where a group of experts are asked to rank objects according to one attribute using the natural numbers [1,1].

8 Generalizations of the method may be used when experts assign values to parameters, when pair comparison methods are used, etc. David (1969), Kendall (1970). An FSA application is published by Paliy et al. (2000).

References for further reading

APPENDIX 10

GUIDANCE FOR PRACTICAL APPLICATION AND REVIEW PROCESS OF FSA

Introduction

1. The guidance provides information on the following subjects:

   .1 project management issues to be considered for an FSA study;

   .2 application of FSA by a Member State or an organization having a consultative status with the IMO (hereinafter called Member), when proposing amendments to maritime safety and pollution prevention instruments, to support or analyse the implications of such proposals;

   .3 application of FSA by a Committee or instructed subsidiary body, to provide a balanced view of a framework of regulations, so as to identify priorities and areas of concern, and to analyse the benefits and implications of proposed changes;

   .4 consideration of the expertise for the team carrying out an FSA study and qualifications for those experts; and

   .5 review of an FSA study.

2. Recommendations resulting from an FSA study should aim to be used by decision makers at all levels and in a variety of contexts at the IMO, without a requirement of specialist expertise. For this purpose, an FSA study should be open and transparent for review by all interested Member States and non-governmental organizations which have not participated in the conduct of the FSA study.

3. FSA studies submitted to the Organization in accordance with the Guidelines for formal safety assessment (FSA), for use in IMO rule-making process for consideration, when introducing or amending IMO instruments should be considered as one source but not the only source of valuable information to support IMO decision-making.

Practice/Conduct of FSA Study

Project management

4. Any activity that uses resources to transform inputs to outputs can be considered a process, and this definition also fits FSA. Quality management in FSA can be applied by identifying each FSA step as a sub-process involving a number of interrelated activities, and by establishing means to facilitate, monitor and control these activities to achieve the desired objectives.

5. In principle, critical issues, controls and controlling measurements to monitor the quality of the process should be defined for each FSA step. Moreover, several issues should be identified up front, before the study initiation and periodically reviewed during the study:

   .1 basic reasons to undertake the study;

   .2 responsibilities and skills of the team in the various stages of the study;
.3 clear authority chart;

.4 extent of the coverage of the study (in particular, how many of the FSA steps are required, which tools are expected to be used);

.5 a project plan including the time scale of the study;

.6 potentially critical areas and key measures of quality assurance; and

.7 risk evaluation criteria.

Application of FSA by a Member

6 A Member State or an organization having a consultative status with IMO, or a pool of Members, may decide to carry out an FSA and submit its results for consideration by a Committee or instructed subsidiary body. The scope of the FSA definition of the problem and its boundaries should be decided by the Member(s) conducting the study, in the context of the submitted proposal. The costs involved in carrying out the study should be covered by the Member(s) conducting the study, who will also coordinate and keep responsibility for the work of subcontractors, if any.

7 The Member(s) carrying out the FSA study should make its/their best efforts to ensure that the report is presented in accordance with the Standard Format for Reporting FSA Applications, given in appendix 8 of the FSA Guidelines. It is important that the FSA report includes the names and credentials of the experts who have carried out or have been involved in the FSA.

Application of FSA by a Committee or an instructed sub-committee

8 The Committee may decide to carry out an FSA study following:

.1 a proposal by a Member;

.2 a proposal from a subsidiary body; or

.3 discussion in the Committee of an agenda item.

9 There are different options which may be followed by the Committee for undertaking the FSA study. In some circumstances, for instance when a proposal has far reaching implications and requires a balanced view between all relevant issues, the Committee may decide that the FSA study should be carried out by an instructed sub-committee, as described in paragraphs 15 to 24 below.

10 Further options for undertaking an FSA study may also be appropriate, one of which could be to invite a Member, or a pool of Members, to carry out the FSA study and report its results for consideration by the Committee. The Member(s) accepting this proposal could proceed according to the steps given in paragraphs 4 to 9 above.

11 In cases where the Committee decides that the study should be carried out by instructed sub-committee(s), the FSA study may be conducted in accordance with the flow chart shown in figure 1, as described below.
12 The Committee may decide to establish a working group, instructed to:

.1 develop the terms of reference for undertaking FSA;
.2 propose a list of required competencies;
.3 develop and execute a project management plan;
.4 coordinate the conduct of FSA;
.5 validate FSA, when necessary; and
.6 report the results of FSA to the Committee, for information and approval.

13 The terms of reference of FSA may include, inter alia:

.1 the definition of the problem under consideration and its boundaries (chapter 4 of these guidelines);
characterization of the problem under consideration, for example in terms or features, characteristics and attributes which are relevant to the problem concerned (section 4.2 of the guidelines);

the organization and tasks proposed for carrying out the five steps of the FSA process, including instructions to the relevant subsidiary bodies; and

the list of competencies required for carrying out each step of FSA.

The Committee should examine the draft terms of reference developed by the working group, including in particular the necessary competencies, for approval. On the basis of the approved terms of reference, the Committee will:

1. instruct the sub-committee(s) to undertake FSA (for instance a sub-committee or several sub-committees);

2. endorse the list of competencies for carrying out each step of FSA; and

3. invite Members willing to participate in the conduct of the FSA study to provide persons with the required competencies.

Members interested in participating in FSA should provide the Committee with a list of persons proposed to participate in the sub-committees instructed to carry out the FSA study, together with details of their relevant competencies. The working group should determine that such a list, when completed, covers the competencies deemed necessary for carrying out each step of the FSA study, and report to the Committee to decide as appropriate.

Each instructed subsidiary body should carry out the parts of the FSA study assigned to them. Any progress reports that the Committee may require, and, on completion of the FSA study, the final report should be submitted to the Committee. This final report should be in accordance with the Standard Reporting Format, given in annex 2 of the FSA Guidelines.

Interim reports may be submitted to the working group for the purposes of providing inputs to other parts of the process and enabling the working group to facilitate and monitor progress according to the project plan. The working group should review these reports and inform the Committee whether the FSA study proceeds in accordance with the approved project management plan. The working group should also propose necessary corrective actions, if any.

In addition to the final report submitted to the Committee by the sub-committees undertaking the FSA study, the working group should, at the completion of the FSA study, present to the Committee a summary report, which may include, inter alia:

1. an evaluation that the methodology applied is in accordance with the interim guidelines;

2. any proposals for improvement of the interim guidelines;

3. deviations, if any, from the terms of reference approved by the Committee, and reasons therefor; and

4. a list of recommendations resulting from the FSA study for a decision by the Committee.
19 The Committee should receive the recommendations made by the working group and decide as appropriate.

**Participation of experts in an FSA study**

20 The participation of experts in the various fields is an essential part for the success of an FSA application. The team carrying out the FSA study should be selected in accordance with the area of interest of the study and related problems. A number of other experts should be involved to gather expert views and judgements throughout the five steps of the FSA process.

21 The team carrying out an FSA study should cover the fields of expertise necessary to progress within the five steps of the FSA process. The composition of the team depends on the type of problem and level of detail of the assessment. For instance, the team might include:

- 1. experts in risk assessment techniques;
- 2. experts in statistical data gathering and analysing;
- 3. experts involved in casualty investigations;
- 4. experts in the human element;
- 5. experts in the applicable rules and regulations;
- 6. experts from the technical, operational and organizational field, (e.g. designers, builders and operators);
- 7. experts in consequence assessment (e.g. SAR, salvage and environment protection); and
- 8. experts in cost-benefit assessment.

22 The team carrying out an FSA study may involve other experts in order to provide additional expert views, technical evaluations and/or judgements. All the experts involved in FSA study should have, as far as possible, a basic knowledge and understanding of the FSA methodology, as set out in the FSA Guidelines.

23 The experts to be involved should cover the widest possible range of knowledge, qualifications and competence relevant to the problem under consideration, including, for instance:

- 1. organizational and managerial aspects, e.g. pertinent to shipping companies;
- 2. technical aspects, e.g. design, construction, operation and maintenance;
- 3. legal, finance and insurance matters; and
- 4. matters of concern to flag Administrations and port State controls.

24 The names and expertise of the members of the team carrying out an FSA study and other experts involved should be included in an annex to the report containing the results of the study.
25 Other experts in various fields may be involved when reviewing and discussing the results of the FSA study.

**Review of FSA study**

**Review process**

26 The Committee or an instructed subsidiary body should consider the submission of an FSA study and decide, on a case by case basis, the most appropriate course of action. When the subject is sufficiently clear, the Committee can form an opinion about the FSA study and its relevant proposals, and decide accordingly. In other circumstances, the Committee may decide that a review is necessary to validate the FSA study and its findings.

27 The review process should be carried out within the Organization, by a group of experts established by the Committee for that purpose following the flow chart shown in figure 2 below.

![Flow chart for FSA review process](image)

*Questions limited to clarifications only.*

**Figure 2**

Flow chart for FSA review process
Terms of reference of the Experts Group

28 The terms of reference of such a review should be established by the Committee, based on the matter under consideration. The terms of reference should be to review the FSA studies submitted, in particular to:

.1 check:
   .1 the adequacy of scope of the FSA; and definition of the problem;
   .2 the validity of the input data (transparency, comprehensiveness, availability, etc.);
   .3 the adequacy of expertise of participants in the FSA; identified hazards and their ranking; and the reasonableness of assumptions; and
   .4 the adequacy of accident scenarios, risk models and calculated risks; identified RCMs and RCOs; selection of RCOs for Cost-Benefit Analysis (CBA); and CBA results;

.2 check methodologies used and relevance of methods and tools for:
   .1 decision in the group(s) in the FSA;
   .2 HAZID;
   .3 Calculation of risk;
   .4 Cost-Benefit Analysis (CBA); and
   .5 Sensitivity and uncertainty analysis;

.3 if any deficiency was identified in the items above, consider whether they affect the results;

.4 consider whether the FSA was conducted in accordance with the guidelines;

.5 check whether the recommendations in the FSA ask to take any immediate action or propose any changes to IMO instruments;

.6 consider whether the results and the recommendations in the FSA are credible and advise the decision makers (e.g. Committees of the Organization) accordingly; and

.7 consider whether it is necessary to improve the FSA Guidelines, and, if so, the proposal for the improvement.

Establishment of, and report from, the Experts Group

29 When the Committee decides to establish a group of experts for a specific project, it should determine the number of meetings necessary to meet the target completion date.
30 The Members, having carried out the FSA study, should provide timely and open access to relevant supporting documents, and any reasonable opportunity to take into consideration the comments received.

31 The results of the review by the group of experts should be presented to the Committee or instructed subsidiary body, as appropriate. The group of experts should, as a goal, try to reach consensus on its conclusions for the review of the FSA study, but where there are strong conflicting views, these should be indicated in the report.

Structure of the Experts Group

32 Participation in a group of experts will be voluntary and is open to all Member States and international organizations.

33 A Chairman and a Vice-Chairman should be selected by the Committee when it decides an FSA study should be reviewed by a group of experts.

34 When nominating experts, Member States and international organizations should nominate experts who have suitable qualifications in the field of formal safety assessment, as described in paragraph 37, and inform the Organization of particulars of the expert (e.g. name, expertise and contact details) with a short CV.

35 Participants in the group of experts should:

1. have not been involved in the FSA study to be reviewed; and
2. be capable of acting scientifically independent (i.e. acting in an individual capacity).

36 The review work should be conducted concisely in order to give timely conclusion(s) to the Committee(s) and, in order to do so, the review work can be conducted by holding meetings of the group (without interpretation) as well as by correspondence.

Qualifications of the experts

37 Members participating in a group of experts should, as a minimum, have knowledge/training in the application of the FSA Guidelines, and should have, at least, one of the following qualifications:

1. risk assessment experience;
2. a maritime background; or
3. relevant knowledge or any unique concerns related to the FSA (e.g. human element).

Report of the Experts Group

38 Experts Groups' reports should only include the names of the experts but not of the nominating Member States or organizations.

***
## ANNEX 34

### BIENNIAL STATUS REPORTS OF THE SUB-COMMITTEES

<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ(s)</th>
<th>Coordinating organ(s)</th>
<th>Status of output for Year 1</th>
<th>Status of output for Year 2</th>
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<td>III/PPR/CCC/SDC/SSE/NCSR</td>
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<td></td>
<td>MSC 78/26, paragraph 22.12; CCC 3/15, section 10; and MSC 97/22, paragraphs 10.9 and 10.10</td>
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</table>

Notes: The Assembly, at its twenty-eighth session, had expanded the output to include all proposed unified interpretations to provisions of IMO safety, security, and environment-related Conventions.

| 2.0.1.5       | Amendments to SOLAS regulations II-2/20.2 and II-2/20-1 to clarify the fire safety requirements for cargo spaces containing vehicles with fuel in their tanks for their own propulsion | 2017                   | MSC             | SSE                 | CCC                   | Completed                   |                            | MSC 96/25, paragraph 23.6; and MSC 98/23, paragraphs 3.14 to 3.17, 3.59 and 3.61 to 3.63 |

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1 The number of the outputs will be replaced after C 118, to adapt the numeration to the new strategic directions agreed by C 117.
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<th>Associated organ(s)</th>
<th>Coordinating organ(s)</th>
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<th>Status of output for Year 2</th>
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<td>5.2.1.2</td>
<td>Amendments to the IGF Code and development of guidelines for low-flashpoint fuels</td>
<td>2016</td>
<td>MSC</td>
<td>HTW/PPR/SDC/SSE</td>
<td>CCC</td>
<td>Extended</td>
<td></td>
<td>MSC 94/21, paragraphs 18.5 and 18.6; and MSC 96/25, paragraphs 10.1 to 10.3</td>
</tr>
<tr>
<td>Notes:</td>
<td>MSC 97 approved the request of CCC 3 to extend the target completion year to 2017 (MSC 97/22, paragraph 19.2). MSC 98 granted a further extension until 2019 taking into account that, based on the relevant submissions to CCC 4, the Sub-Committee was unlikely to complete the output by 2017 (MSC 98/23, annex 38).</td>
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<td>5.2.1.9</td>
<td>Safety requirements for carriage of liquefied hydrogen in bulk</td>
<td>2016</td>
<td>MSC</td>
<td>CCC</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 94/21, paragraph 18.3; and MSC 97/22, paragraph 10.2</td>
</tr>
<tr>
<td>5.2.1.26</td>
<td>Suitability of high manganese austenitic steel for cryogenic service and development of any necessary amendments to the IGC Code and IGF Code</td>
<td>2017</td>
<td>MSC</td>
<td>CCC</td>
<td></td>
<td>In progress</td>
<td></td>
<td>MSC 96/25 paragraph 23.4; and CCC 3/15, section 8</td>
</tr>
<tr>
<td>Notes:</td>
<td>MSC 98 extended the target completion year to 2019 taking into account that, based on the relevant submissions to CCC 4, it was considered possible that the Sub-Committee would be unable to complete the output by 2017 (MSC 98/23, annex 38).</td>
<td></td>
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<tr>
<td>5.2.3.3</td>
<td>Amendments to the IMSBC Code and supplements</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>CCC</td>
<td></td>
<td>Ongoing</td>
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<td>MSC 86/26, paragraph 7.2; and MSC 98/23, paragraph 3.72 to 3.78</td>
</tr>
<tr>
<td>Output number</td>
<td>Description</td>
<td>Target completion year</td>
<td>Parent organ(s)</td>
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<tr>
<td>5.2.3.4</td>
<td>Amendments to the IMDG Code and supplements</td>
<td>Continuous</td>
<td>MSC</td>
<td>CCC</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td>MSC 75/24, paragraph 7.36; and CCC 3/15, section 6</td>
</tr>
<tr>
<td>5.2.3 (New)²</td>
<td>Amendments to the CSS Code with regard to weather-dependent lashing</td>
<td>2019</td>
<td>MSC</td>
<td>CCC</td>
<td></td>
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<td>MSC 98/23, paragraph 20.7</td>
</tr>
</tbody>
</table>

Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for CCC 5.

7.1.1.1 Mandatory requirements for classification and declaration of solid bulk cargoes as harmful to the marine environment 2017 MEPC CCC Completed MEPC 68/21, paragraphs 12.35, 17.16 and 17.17; MSC 95/22, paragraph 19.1; MEPC 69/21, paragraphs 13.13 to 13.21; MSC 96/25, paragraphs 10.14 and 10.15; MEPC 70/18, paragraph 3.31; MSC 97/22, paragraph 10.6; and MSC 98/23, paragraphs 3.72 to 3.78

² New output approved by MSC 98. Number of the output to be assigned by C 118.
<table>
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<tr>
<th>Output number</th>
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<th>Parent organ(s)</th>
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<th>Status of output for Year 1</th>
<th>Status of output for Year 2</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.3.1.1</td>
<td>Consideration of reports of incidents involving dangerous goods or marine pollutants in packaged form on board ships or in port areas</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td>CCC</td>
<td>Completed</td>
<td></td>
<td>MSC 79/23, paragraph 12.7; and CCC 3/15, section 11</td>
</tr>
<tr>
<td>14.0.1.1</td>
<td>Analysis and consideration of recommendations to reduce administrative burdens in IMO instruments including those identified by the SG-RAR</td>
<td>2017</td>
<td>Council</td>
<td>III/HTW/PPR/CCC/SDC/SSE/NCSR</td>
<td>MSC/MEPC/FAL/LEG</td>
<td>No work requested</td>
<td></td>
<td>MSC 96/25, paragraphs 19.4.5, 19.4.9 and 19.4.10</td>
</tr>
<tr>
<td>Output number</td>
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<tr>
<td>5.1.1.6</td>
<td>Amendments to SOLAS chapter II-1 and associated guidelines on damage control drills for passenger ships</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>SDC</td>
<td>Completed</td>
<td></td>
<td>MSC 93/22, paragraphs 6.28.4, 20.5 and 20.14; MSC 97/22, paragraphs 3.11 and 3.23; and MSC 98/23, paragraph 3.62</td>
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<td>5.2.1.14</td>
<td>Review of the MODU Code, LSA Code and MSC.1/Circ.1206/Rev.1</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>SSE</td>
<td>Completed</td>
<td></td>
<td>MSC 93/22, paragraph 20.17; MSC 98/23, paragraph 12.24; and HTW 3/19, paragraph 15.9</td>
</tr>
</tbody>
</table>

Notes: Target completion year extended to 2017 (MSC 96/25, paragraph 23.34).

| 5.2.1.29      | Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships (2019) | 2017 | MSC | HTW/SDC | SSE | | | MSC 97/22, paragraph 19.19 |

Notes: Pending endorsement by C 118
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>5.2.2.1</td>
<td>Guidance for the implementation of the 2010 Manila Amendments</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td>In progress</td>
<td>Extended</td>
<td>HTW 3/19, section 5; HTW 4/16, paragraph 5.26; and MSC 98/23, paragraph 9.2</td>
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</tr>
<tr>
<td>Notes:</td>
<td>MSC 98 (MSC 98/23, paragraph 9.2) renamed the output as &quot;Guidance for STCW Code, section B-1/2&quot; and extended the TCY to 2018.</td>
<td></td>
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<tr>
<td>5.2.2.2</td>
<td>Review of STCW passenger-ship-specific safety training</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 12.5</td>
<td></td>
<td></td>
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<tr>
<td>5.2.2.3</td>
<td>Validated model training courses</td>
<td>Continuous</td>
<td>MSC</td>
<td>HTW</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>HTW 3/19, section 3; and HTW 4/16, section 3</td>
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<tr>
<td>5.2.2.4</td>
<td>Reports on unlawful practices associated with certificates of competency</td>
<td>Annual</td>
<td>MSC</td>
<td>HTW</td>
<td>Completed</td>
<td>Completed</td>
<td>HTW 3/19, paragraphs 4.1 and 4.2; and HTW 4/16, paragraphs 4.1 to 4.4</td>
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<tr>
<td>5.2.5.2</td>
<td>Completion of the detailed review of the Global Maritime Distress and Safety System (GMDSS)</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>NCSR</td>
<td>Completed</td>
<td>MSC 90/28, paragraph 25.18; MSC 96/25, paragraph 14.9</td>
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<tr>
<td>Output number</td>
<td>Description</td>
<td>Target completion year</td>
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</tr>
<tr>
<td>5.2.5.3</td>
<td>Draft Modernization Plan of the Global Maritime Distress and Safety System (GMDSS) (2018)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td>NCSR</td>
<td>No work requested</td>
<td>Completed</td>
<td>MSC 90/28; MSC 96/25; MSC 98/23, paragraph 11.21</td>
</tr>
<tr>
<td></td>
<td>Notes: Having completed this output a year earlier than the target completion year of 2018, results in deletion of item 38 from the Committee's post-biennial agenda.</td>
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<tr>
<td>5.2.5 (New)³</td>
<td>Revision of SOLAS chapters III and IV for Modernization of the GMDSS, including related and consequential amendments to other existing instruments (2021)</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td>HTW/SSE</td>
<td>No work requested</td>
<td>No work requested</td>
<td>MSC 98/23, paragraph 20.27</td>
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<tr>
<td></td>
<td>Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for NCSR 5.</td>
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<tr>
<td>5.4.1.1</td>
<td>Comprehensive review of the 1995 STCW-F Convention (2018)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 95/22; HTW 3/19; HTW 4/16, section 6</td>
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</table>

³ New output approved by MSC 98. Number of the output to be assigned by C 118
<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
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<tr>
<td>5.4.1.2</td>
<td>Revision of the Guidelines on Fatigue</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 95/22, paragraph 19.18; MSC 98/23, paragraph 9.8; HTW 3/19, paragraphs 8.13 and 8.14; and HTW 4/16, paragraph 8.11</td>
</tr>
<tr>
<td>12.2.1.1</td>
<td>Revised Guidelines on the Implementation of the ISM Code by Administrations (resolution A.1071(28)) on training audits</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 95/22, paragraph 19.5; and MSC 96/25, paragraph 12.4</td>
</tr>
<tr>
<td>Output number</td>
<td>Description</td>
<td>Target completion year</td>
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</tr>
<tr>
<td>1.1.2.3</td>
<td>Unified interpretation of provisions of IMO safety, security, and environment-related Conventions</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>III/PPR/CCC/SDC/SSE/NCSR</td>
<td></td>
<td>Ongoing</td>
<td></td>
<td>MSC 78/26, paragraph 22.12</td>
</tr>
</tbody>
</table>

Notes: The Assembly, at its twenty-eighth session, had expanded the output to include all proposed unified interpretations to provisions of IMO safety, security, and environment-related Conventions.

| 2.0.1.2     | Revised guidance on ballast water sampling and analysis                        | 2017                   | MEPC            | PPR                 | III                    | No work requested           |                             | MEPC 68/21, paragraphs 7.14 and 17.26 |

| 2.0.1.6     | Review the Model Agreement for the authorization of recognized organizations acting on behalf of the Administration (2018) | 2017                   | MSC             | III                 |                         |                             |                             | MSC 97/22, paragraph 19.7 |

Notes: Pending endorsement by C 118.

| 2.0.2.1     | Analysis of consolidated audit summary reports                               | Annual                 | Assembly         | MSC/MEPC/LEG/TCC/III | Council                 | Completed                   |                             |                         |

| 5.1.2.2     | Measures to protect the safety of persons rescued at sea                      | 2017                   | MSC/FAL          | III                 | NCSR                    | No work requested           |                             | MSC 98/23, paragraph 11.1 |

Notes: Recognizing that the humanitarian crisis in the Mediterranean is far from being resolved, that this continues to impact merchant shipping and that proposals might be submitted, NCSR 4 invited the Committee to extend the target completion year for this output to 2019. FAL 41 agreed to include this output in the post-biennial agenda with the intention to revisit this decision during FAL 42 (FAL 41/17, paragraph 6.4).
### Output

<table>
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<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
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<tr>
<td>5.2.1.17</td>
<td>Updated Survey Guidelines under the Harmonized System of Survey and Certification (HSSC)</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
<td>Completed</td>
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<td>MEPC 68/21, paragraphs 14.5 and 14.6</td>
</tr>
<tr>
<td>5.2.1.20</td>
<td>Non-exhaustive list of obligations under instruments relevant to the IMO Instruments Implementation Code (III Code)</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MEPC 64/23, paragraph 11.49; MSC 91/22, paragraph 10.30; and MEPC 52/24, paragraph 10.15</td>
</tr>
<tr>
<td>5.3.1.1</td>
<td>Measures to harmonize port State control (PSC) activities and procedures worldwide</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>HTW/PPR/ NCSR</td>
<td>III</td>
<td>Ongoing</td>
<td></td>
<td>MEPC 66/21, paragraph 18.8; MSC 94/21, paragraph 18.2.1; MEPC 68/21, paragraph 17.3; MEPC 70/18, paragraph 15.20; and MSC 97/22, paragraph 19.8</td>
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</table>

**Notes:** MEPC 70 and MSC 97 agreed to amend the output to reflect the coordinating role of III and to add PPR, NCSR and HTW as associated organs.
## SUB-COMMITTEE ON IMPLEMENTATION OF IMO INSTRUMENTS (III)

<table>
<thead>
<tr>
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<th>Target completion year</th>
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</tr>
</thead>
<tbody>
<tr>
<td>5.2.1</td>
<td>Development of guidelines for cold ironing of ships and of amendments to SOLAS chapters II-1 and II-2, if necessary (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SDC/III</td>
<td>SSE</td>
<td></td>
<td></td>
<td>MSC 98/23, paragraph 20.36</td>
</tr>
<tr>
<td>7.1.3.1</td>
<td>Consideration and analysis of reports on alleged inadequacy of port reception facilities</td>
<td>Annual</td>
<td>MEPC</td>
<td>III</td>
<td></td>
<td>Completed</td>
<td></td>
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</tr>
<tr>
<td>8.0.3.1</td>
<td>Requirements for access to, or electronic versions of, certificates and documents, including record books required to be carried on ships</td>
<td>2017</td>
<td>FAL</td>
<td>MSC/LEG/III/MEPC</td>
<td></td>
<td>No work requested</td>
<td>FAL.5/Circ.39/Rev.2; FAL 40/19, paragraphs 6.18 to 6.21; and MEPC 68/21, paragraphs 13.2 and 17.26</td>
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</tr>
<tr>
<td>12.1.2.1</td>
<td>Lessons learned and safety issues identified from the analysis of marine safety investigation reports</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
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<td>Completed</td>
<td>MSC 92/26, paragraph 22.29</td>
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<tr>
<td>12.1.2.2</td>
<td>Identified issues relating to the implementation of IMO instruments from the analysis of PSC data</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
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Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for SSE 5.

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4 New output approved by MSC 98. Number of the output to be assigned by C 118.
<table>
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<tr>
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<tbody>
<tr>
<td>12.3.1.1</td>
<td>Consideration of reports of incidents involving dangerous goods or marine pollutants in packaged form on board ships or in port areas</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td>CCC</td>
<td>No work requested</td>
<td></td>
<td>MSC 79/23, paragraph 12.7</td>
</tr>
<tr>
<td>14.0.1.1</td>
<td>Analysis and consideration of recommendations to reduce administrative burdens in IMO instruments including those identified by the SG-RAR</td>
<td>2017</td>
<td>Council</td>
<td>III/HTW/PPR/CCC/SDC/SSE/NCSR</td>
<td>MSC/MEPC/ FAL/LEG</td>
<td>No work requested</td>
<td></td>
<td>MSC 96/25, paragraphs 19.4.5, 19.4.9 and 19.4.10</td>
</tr>
</tbody>
</table>
**SUB-COMMITTEE ON NAVIGATION, COMMUNICATIONS AND SEARCH AND RESCUE (NCSR)**

<table>
<thead>
<tr>
<th>Output number</th>
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<th>References</th>
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<tbody>
<tr>
<td>1.1.2.2</td>
<td>Response to matters related to the Radiocommunication ITU R Study Group and ITU World Radiocommunication Conference</td>
<td>Annual</td>
<td>MSC</td>
<td>NCSR</td>
<td>Completed</td>
<td>Completed</td>
<td>MSC 97/22, paragraph 7.6</td>
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</tr>
<tr>
<td>1.1.2.3</td>
<td>Unified interpretation of provisions of IMO safety, security, and environment-related Conventions</td>
<td>Continuous</td>
<td>MSC / MEPC</td>
<td>III / PPR / CCC / SDC / SSE / NCSR</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 78/26, paragraph 22.12;</td>
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</tr>
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</table>

Notes: The Assembly, at its twenty-eighth session, had expanded the output to include all proposed unified interpretations to provisions of IMO safety, security, and environment-related Conventions.

<table>
<thead>
<tr>
<th>1.3.4.1</th>
<th>Amendments to the IAMSAR Manual</th>
<th>Continuous</th>
<th>MSC</th>
<th>NCSR</th>
<th>Ongoing</th>
<th>Ongoing</th>
</tr>
</thead>
</table>

| 2.0.3.1       | Further development of the provision of global maritime SAR services | 2017 | MSC | NCSR | In progress | Extended |

Notes: Recognizing that it was very important to consider the further development of the Global SAR Plan and that proposals might be submitted, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2019.

| 2.0.3.2       | Guidelines on harmonized aeronautical and maritime search and rescue procedures, including SAR training matters | 2017 | MSC | NCSR | In progress | Extended |

Notes: Recognizing that it was very important to further consider Guidelines on harmonized aeronautical and maritime search and rescue procedures, including SAR training matters and that proposals are expected be submitted, in particular by the ICAO/IMO Joint Working Group, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2019.
<table>
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<tr>
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<tbody>
<tr>
<td>2.0.3.3</td>
<td>Revised guidelines for preparing plans for cooperation between search and rescue services and passenger ships (MSC.1/Circ.1079)</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td>In progress</td>
<td>Completed</td>
<td></td>
<td>MSC 95/22, paragraph 19.11; and MSC 98/23, paragraph 11.34</td>
</tr>
<tr>
<td>5.1.2.2</td>
<td>Measures to protect the safety of persons rescued at sea</td>
<td>2017</td>
<td>MSC / FAL</td>
<td>III</td>
<td>In progress</td>
<td>Extended</td>
<td></td>
<td>MSC 98/23, paragraph 11.1</td>
</tr>
</tbody>
</table>

Notes: Recognizing that the humanitarian crisis in the Mediterranean is far from being resolved, that this continues to impact merchant shipping and that proposals might be submitted, NCSR 4 invited the Committee to extend the target completion year for this output to 2019. FAL 41 agreed to include this output in the post-biennial agenda with the intention to revisit this decision during FAL 42 (FAL 41/17, paragraph 6.4).

| 5.2.1.15     | Consequential work related to the new Code for ships operating in polar waters | 2017          | MSC / MEPC      | NCSR / PPR / SSE | SDC                  | No work requested          | Extended                  | MSC 93/22, paragraphs 10.44, 10.50 and 20.12; MSC 96/25, paragraph 3.77; MSC 97/22, paragraphs 8.32 and 19.25; and MSC 98/23, annex 38 |

Notes: Noting that this output is urgent and of utmost importance, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2018. MSC 98 granted an extension until 2019 for the SSE Sub-Committee (MSC 98/23, annex 38).

<p>| 5.2.4.1      | Routeing measures and mandatory ship reporting systems | Continuous   | MSC             | NCSR              | Ongoing              | Ongoing                    |                          | MSC 96/25, paragraphs 14.2 to 14.5 |</p>
<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
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<th>Status of output for Year 1</th>
<th>Status of output for Year 2</th>
<th>References</th>
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<tbody>
<tr>
<td>5.2.4.2</td>
<td>Updates to the LRIT system</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 97/22, paragraph 7.3</td>
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<tr>
<td>5.2.4.3</td>
<td>Amendment to the General Provisions on Ships' Routeing (resolution A.572(14)) on establishing multiple structures at sea</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
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<td>Completed</td>
<td></td>
<td>Resolution MSC.419(97)</td>
</tr>
<tr>
<td>5.2.4.4</td>
<td>Interconnection of NAVTEX and Inmarsat SafetyNET receivers and their display on Integrated Navigation Display Systems</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 23.22; and MSC 98/23, paragraphs 11.7 to 11.11</td>
</tr>
<tr>
<td>5.2.4.5</td>
<td>Guidelines associated with multi-system shipborne radionavigation receivers dealing with the harmonized provision of PNT data and integrity information</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 98/23, paragraphs 11.12 and 11.13</td>
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<tr>
<td>5.2.4.6</td>
<td>Recognition of Galileo as a component of the WWRNS</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 96/25, paragraph 14.6</td>
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<tr>
<td>5.2.5.1</td>
<td>Updating of the GMDSS Master Plan and guidelines on MSI (maritime safety information)</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 97/22, paragraphs 7.4 and 7.5</td>
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</table>
### SUB-COMMITTEE ON NAVIGATION, COMMUNICATIONS AND SEARCH AND RESCUE (NCSR)

<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ(s)</th>
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<th>Status of output for Year 1</th>
<th>Status of output for Year 2</th>
<th>References</th>
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<tbody>
<tr>
<td>5.2.5.2</td>
<td>Completion of the detailed review of the Global Maritime Distress and Safety System (GMDSS)</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>NCSR</td>
<td>Completed</td>
<td></td>
<td>MSC 90/28, paragraph 25.18; MSC 96/25, paragraph 14.9</td>
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<tr>
<td>5.2.5.3</td>
<td>Draft Modernization Plan of the Global Maritime Distress and Safety System (GMDSS) (2018)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td>NCSR</td>
<td>No work requested</td>
<td>Completed</td>
<td>MSC 90/28, paragraph 25.18; MSC 96/25, paragraph 14.9; and MSC 98/23, paragraph 11.21</td>
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</tbody>
</table>

**Notes:** Having completed this output a year earlier than the target completion year of 2018, results in deletion of item 38 from the Committee's post-biennial agenda.

| 5.2.5.4       | Developments in GMDSS satellite services | Continuous | MSC | NCSR | Ongoing | Ongoing | MSC 96/25, paragraph 14.17; and MSC 98/23, paragraphs 11.30 to 11.32 |

**Notes:** Description changed from "Analysis of information on developments in Inmarsat and Cospas-Sarsat" to "Developments in GMDSS satellite services".

| 5.2.5.5       | Revised Performance Standards for EPIRBs operating on 406 MHz (resolution A.810(19)) to include Cospas-Sarsat MEOSAR and second-generation beacons | 2017 | MSC | NCSR | In progress | Extended | | |

**Notes:** Recognizing that the work on the revision of those Performance Standards has not been completed and that further work is required, the Sub-Committee invited the Committee to extend the target completion year for this output to 2018.
<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
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<th>Status of output for Year 2</th>
<th>References</th>
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</thead>
<tbody>
<tr>
<td>5.2.5.6</td>
<td>Performance Standards for ship-borne GMDSS equipment to accommodate additional providers of GMDSS satellite services</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 14.8; and MSC 98/23, paragraphs 11.16 to 11.20</td>
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<tr>
<td>5.2.5.7</td>
<td>Analysis of developments in maritime radiocommunication systems and technology</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 14.7</td>
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</tr>
<tr>
<td>5.2.5.8</td>
<td>Review SOLAS chapter IV and appendix (Certificates: Forms P, R and C) to accommodate additional mobile satellite systems</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td>No work requested</td>
<td>Completed</td>
<td>MSC 96/25 paragraph 23.18; and MSC 98/23, paragraphs 11.22 to 11.29</td>
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<tr>
<td>5.2.5 (New)</td>
<td>Revision of SOLAS chapters III and IV for Modernization of the GMDSS, including related and consequential amendments to other existing instruments (2021)</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td>HTW/SSE</td>
<td></td>
<td>MSC 98/23, paragraph 20.27</td>
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</tbody>
</table>

Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for NCSR 5.
### SUB-COMMITTEE ON NAVIGATION, COMMUNICATIONS AND SEARCH AND RESCUE (NCSR)

<table>
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<tr>
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<th>Parent organ(s)</th>
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<tbody>
<tr>
<td>5.2.6.1</td>
<td>Additional modules to the Revised Performance Standards for Integrated Navigation Systems (INS) (resolution MSC.252(83)) relating to the harmonization of bridge design and display of information</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 98/23, paragraphs 11.8 and 11.9</td>
</tr>
<tr>
<td>5.2.6.2</td>
<td>Guidelines for the harmonized display of navigation information received via communications equipment</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td></td>
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<tr>
<td>5.2.6.3</td>
<td>Revised Guidelines and criteria for ship reporting systems (resolution MSC.43(64))</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 98/23, paragraph 11.14</td>
</tr>
</tbody>
</table>

**Notes:**
- The Committee agreed to keep this output in the post-biennial agenda of the Committee, in order to be further considered, in principle, at NCSR 6 in 2019.
- Recognizing that the work on those Guidelines has not been completed and that further work is required, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2018.
### Output number | Description | Target completion year | Parent organ(s) | Associated organ(s) | Coordinating organ(s) | Status of output for Year 1 | Status of output for Year 2 | References |
---|---|---|---|---|---|---|---|---|
1.1.2.3 | Unified interpretation of provisions of IMO safety, security, and environment-related Conventions | Continuous | MSC/MEPC | III/PPR/CCC/SDC/SSE/NCSR | | Ongoing | Ongoing | MSC 78/26, paragraph 22.12; and SDC 4/16, section 10 |

**Notes:** The Assembly, at its twenty-eighth session, had expanded the output to include all proposed unified interpretations to provisions of IMO safety, security, and environment-related Conventions.

2.0.1.1 | Amendments to the ESP Code | Continuous | MSC | SDC | | Ongoing | Ongoing | MSC 91/22, paragraph 19.24; and SDC 4/16, section 9 |

5.1.1.1 | Guidelines on safe return to port for passenger ships | 2016 | MSC | SDC | | Completed | | MSC 81/25, paragraph 23.54; and MSC 96/25, paragraph 11.10 |

5.1.1.3 | Amendments to SOLAS and FSS Code to make evacuation analysis mandatory for new passenger ships and review of the Recommendation on evacuation analysis for new and existing passenger ships | 2016 | MSC | SDC | | Extended | Completed | MSC 83/28, paragraph 25.25; MSC 93/22, paragraph 20.11; MSC 96/25, paragraph 11.13; MSC 96/25, paragraph 11.15; and MSC 98/23, paragraph 10.12 |

**Notes:** Target completion year extended to 2017 (MSC 96/25, paragraph 23.25).
<table>
<thead>
<tr>
<th>Output number</th>
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<th>Status of output for Year 2</th>
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</tr>
</thead>
<tbody>
<tr>
<td>5.1.1.6</td>
<td>Amendments to SOLAS chapter II-1 and associated guidelines on damage control drills for passenger ships</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>SDC</td>
<td>Completed</td>
<td></td>
<td>MSC 93/22, paragraphs 6.28.4, 20.5 and 20.14; MSC 97/22, paragraphs 3.11 and 3.23; and MSC 98/23, paragraph 3.62</td>
</tr>
<tr>
<td>5.2.1.1</td>
<td>Revised SOLAS regulation II-1/3-8 and associated guidelines (MSC.1/Circ.1175) and new guidelines for safe mooring operations for all ships</td>
<td>2017</td>
<td>MSC</td>
<td>HTW/SSE</td>
<td>SDC</td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 95/22, paragraph 19.22; and SDC 4/16, section 11</td>
</tr>
</tbody>
</table>

Notes: Target completion year extended to 2019 (MSC 98/23, paragraph 10.20).

| 5.2.1.4       | Mandatory instrument and/or provisions addressing safety standards for the carriage of more than 12 industrial personnel on board vessels engaged on international voyages (2020) | 2017                   | MSC             | SDC                 | In progress                  | Postponed                    | MSC 95/22, paragraphs 10.13 and 19.25; MSC 96/25, paragraphs 7.10 and 7.12; MSC 97/22, paragraphs 6.22 to 6.25; and SDC 4/16, section 8 |

Notes: Progressed as planned. The actual target completion year is 2020.
<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
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</thead>
<tbody>
<tr>
<td>5.2.1.6</td>
<td>Revision of section 3 of the Guidelines for damage control plans and information to the master (MSC.1/Circ.1245) for passenger ships</td>
<td>2017</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 93/22, paragraphs 6.28 and 20.15; and MSC 98/23, paragraph 10.13</td>
</tr>
<tr>
<td>5.2.1.7</td>
<td>Computerized stability support for the master in case of flooding for existing passenger ships</td>
<td>2016</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
<td>Extended</td>
<td>Extended</td>
<td>MSC 94/21, paragraph 18.20; and SDC 4/16, section 4</td>
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<td>Notes: Target completion year extended to 2018 (MSC 98/23, paragraph 10.11).</td>
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<tr>
<td>5.2.1.12</td>
<td>Finalization of second generation intact stability criteria (2019)</td>
<td>2017</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
<td>In progress</td>
<td>Postponed</td>
<td>MSC 85/26, paragraphs 12.7 and 23.42; and SDC 4/16, section 5</td>
</tr>
<tr>
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<td>Notes: Progressed as planned. The actual target completion year is 2019.</td>
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<tr>
<td>5.2.1.13</td>
<td>Amendments to SOLAS regulations II-1/6 and II-1/8-1</td>
<td>2017</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 85/26, paragraph 23.35; MSC 97/22, paragraph 3.11; and SDC 4/16, section 3</td>
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<td>Notes: Target completion year extended to 2019 and the existing description replaced with &quot;Amendments to SOLAS regulation II-1/8-1 on the availability of passenger ships’ electrical power supply in cases of flooding from side raking damage&quot; (MSC 98/23, paragraph 10.3).</td>
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### SUB-COMMITTEE ON SHIP DESIGN AND CONSTRUCTION (SDC)

<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ(s)</th>
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<th>Status of output for Year 1</th>
<th>Status of output for Year 2</th>
<th>References</th>
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<tr>
<td>5.2.1.21</td>
<td>Guidelines for use of Fibre Reinforced Plastics (FRP) within ship structures</td>
<td>2017</td>
<td>MSC</td>
<td>SDC</td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 95/22, paragraph 10.16; and MSC 98/23, paragraph 10.21</td>
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<tr>
<td>Notes: This output moved to the post-biennial agenda (MSC 98/23, paragraph 10.22).</td>
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<tr>
<td>5.2.1.24</td>
<td>Amendments to Part B of the 2008 IS Code on towing, lifting and anchor handling operations</td>
<td>2016</td>
<td>MSC</td>
<td>SDC</td>
<td>Completed</td>
<td></td>
<td>MSC 88/26, paragraph 23.36; MSC 97/22, paragraphs 3.88 and 3.89</td>
<td></td>
</tr>
<tr>
<td>5.2.1 (New)⁶</td>
<td>Development of guidelines for cold ironing of ships and of amendments to SOLAS chapters II-1 and II-2, if necessary (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SDC/III</td>
<td>SSE</td>
<td>No work requested</td>
<td>MSC 98/23, paragraph 20.36</td>
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<td>Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for SSE 5.</td>
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</table>

⁶ New output approved by MSC 98. Number of the output to be assigned by C 118.
### SUB-COMMITTEE ON SHIP SYSTEMS AND EQUIPMENT (SSE)

<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
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<th>Parent organ(s)</th>
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<th>Status of output for Year 2</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1.1.2.3</td>
<td>Unified interpretation of provisions of IMO safety, security, and environment-related Conventions</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>III/PPR/CCC/SDC/SSE/NCSR</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 78/26, paragraph 22.12; and SSE 4/19, section 12</td>
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<td>Notes: The Assembly, at its twenty-eighth session, had expanded the output to include all proposed unified interpretations to provisions of IMO safety, security, and environment-related Conventions.</td>
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<tr>
<td>2.0.1 (New)</td>
<td>Amendments to chapter 9 of the FSS Code for fault isolation requirements for cargo ships and passenger ship cabin balconies fitted with individually identifiable fire detector systems (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SSE</td>
<td>MSC 98/23, paragraph 20.34</td>
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<tr>
<td>5.1.1.2</td>
<td>Clarification of the requirements in SOLAS chapter II-2 for fire integrity of windows on passenger ships carrying not more than 36 passengers and special purpose ships with more than 60 (but no more than 240) persons on board</td>
<td>2017</td>
<td>MSC</td>
<td>SSE</td>
<td>Completed</td>
<td>MSC 95/22, paragraph 19.30; and MSC 97/22, paragraphs 8.6 and 8.7</td>
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7 New output approved by MSC 98. Number of the output to be assigned by C 118.
<table>
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<th>References</th>
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<tr>
<td>5.1.1.4</td>
<td>Development of life safety performance criteria for alternative design and arrangements for fire safety (MSC.1/Circ.1002)</td>
<td>2016</td>
<td>MSC</td>
<td>SSE</td>
<td>Completed</td>
<td>MSC 90/28, paragraph 25.12; and MSC 97/22, paragraph 8.2</td>
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<tr>
<td>5.1.2.1</td>
<td>Making the provisions of MSC.1/Circ.1206/Rev.1 mandatory</td>
<td>2016</td>
<td>MSC</td>
<td>SSE</td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 95/22, paragraphs 12.36 and 19.29; MSC 96/25, paragraphs 3.82, 3.86 and 8.15; and MSC 98/23, paragraphs 12.19 and 12.20</td>
<td></td>
</tr>
<tr>
<td>5.1.2.4</td>
<td>Revision of requirements for escape route signs and equipment location markings in SOLAS and related instruments</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>SSE</td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 94/21, paragraph 18.24; and MSC 98/23, paragraph 12.31 and annex 24</td>
</tr>
<tr>
<td>5.1.2.5</td>
<td>Develop new requirements for ventilation of survival crafts (2018)</td>
<td>2017</td>
<td>MSC</td>
<td>SSE</td>
<td>No work requested</td>
<td>Postponed</td>
<td>MSC 97/22, paragraph 19.22; and SSE 4/19, section 14</td>
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Notes: Target completion year extended to 2017.
<table>
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<th>Output number</th>
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</thead>
<tbody>
<tr>
<td>5.2.1.5</td>
<td>Revised SOLAS regulations II-1/13 and II-1/13-1 and other related regulations for new ships</td>
<td>2017</td>
<td>MSC</td>
<td>SDC</td>
<td>SSE</td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 95/22, paragraphs 19.20 and 19.32; and MSC 98/23, annex 38</td>
</tr>
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<td>Notes: Target completion year extended to 2019.</td>
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<td>5.2.1.10</td>
<td>Safety objectives and functional requirements of the Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III</td>
<td>2017</td>
<td>MSC</td>
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<td>MSC 82/24, paragraph 3.92; and MSC 98/23, annex 38</td>
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<td>5.2.1.11</td>
<td>Amendments to the Guidelines for vessels with dynamic positioning (DP) systems (MSC/Circ.645)</td>
<td>2016</td>
<td>MSC</td>
<td>SSE</td>
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<td>MSC 90/28, paragraph 25.35; and MSC 98/23, paragraph 12.30</td>
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<td>Notes: Target completion year extended to 2017.</td>
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<td>5.2.1.14</td>
<td>Review of the MODU Code, LSA Code and MSC.1/Circ.1206/Rev.1</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>SSE</td>
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<td>MSC 93/22, paragraph 20.17; and MSC 98/23, paragraph 12.24</td>
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<td>5.2.1.15</td>
<td>Consequential work related to the new Code for ships operating in polar waters</td>
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<td>SDC</td>
<td>No work requested</td>
<td>Extended</td>
<td>MSC 93/22, paragraphs 10.44, 10.50 and 20.12; MSC 96/25, paragraph 3.77; MSC 97/22, paragraphs 8.32 and 19.25; and MSC 98/23, annex 38</td>
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<tr>
<td>5.2.1.22</td>
<td>Requirements for onboard lifting appliances and winches</td>
<td>2017</td>
<td>MSC</td>
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<td>In progress</td>
<td>Extended</td>
<td>MSC 89/25, paragraph 22.26; and MSC 98/23, annex 38</td>
<td>Based on the scope of the draft SOLAS regulation, the Committee has approved the change of the existing title of the output to &quot;Requirements for onboard lifting appliances and anchor handling winches&quot;. In addition, the target completion year has been extended to 2019.</td>
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<td>5.2.1.27</td>
<td>Amendments to the FSS Code for CO2 pipelines in under-deck passageways</td>
<td>2017</td>
<td>MSC</td>
<td>SSE</td>
<td>No work requested</td>
<td>Extended</td>
<td>MSC 96/25, paragraph 23.26; and MSC 98/23, annex 38</td>
<td>Target completion year extended to 2018.</td>
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Notes: Noting that this output is urgent and of utmost importance, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2018. MSC 98 granted an extension until 2019 for the SSE Sub-Committee (MSC 98/23, annex 38).
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<tr>
<th>Output number</th>
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<tr>
<td>5.2.1.28</td>
<td>Uniform implementation of paragraph 6.1.1.3 of the LSA Code</td>
<td>2017</td>
<td>MSC</td>
<td>SSE</td>
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<td>No work requested</td>
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<td>MSC 96/25, paragraph 23.28; and MSC 98/23, paragraph 12.23</td>
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<td>Notes: MSC 98 agreed to instruct SSE 5 to further consider the draft amendment to paragraph 6.1.1.3 of the LSA Code and approved an extension of the target completion year until 2018.</td>
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<tr>
<td>5.2.1.29</td>
<td>Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships (2019)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW/SDC</td>
<td>SSE</td>
<td>No work requested</td>
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<td>MSC 97/22, paragraph 19.19; and SSE 4/19, section 13</td>
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<td>5.2.1 (New)</td>
<td>Development of guidelines for cold ironing of ships and of amendments to SOLAS chapters II-1 and II-2, if necessary (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SDC/III</td>
<td>SSE</td>
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<td>MSC 98/23, paragraph 20.36</td>
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8 New output approved by MSC 98. Number of the output to be assigned by C 118.
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<td>Amendments to MSC.1/Circ.1315</td>
<td>2019</td>
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<td>5.2.5</td>
<td>Revision of SOLAS chapters III and IV for Modernization of the GMDSS, including related and consequential amendments to other existing instruments (2021)</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td>HTW/SSE</td>
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<td>MSC 98/23, paragraph 20.27</td>
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9 New output approved by MSC 98. Number of the output to be assigned by C 118.

10 New output approved by MSC 98. Number of the output to be assigned by C 118.
ANNEX 35

PROVISIONAL AGENDAS FOR THE SUB-COMMITTEES

PROVISIONAL AGENDA FOR CCC 4

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Amendments to the IGF Code and development of guidelines for low-flashpoint fuels (5.2.1.2)

4 Suitability of high manganese austenitic steel for cryogenic service and development of any necessary amendments to the IGC Code and IGF Code (5.2.1.26)

5 Amendments to the IMSBC Code and supplements (5.2.3.3)

6 Amendments to the IMDG Code and supplements (5.2.3.4)

7 Unified interpretation of provisions of IMO safety, security and environment-related conventions (1.1.2.3)

8 Consideration of reports of incidents involving dangerous goods or marine pollutants in packaged form on board ships or in port areas (12.3.1.1)

9 Biennial status report and provisional agenda for CCC 5

10 Election of Chair and Vice-Chair for 2018

11 Any other business

12 Report to the Committees

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1 The number of the outputs included in the provisional agendas of the sub-committees will be replaced after C 118, to adapt the numeration to the new strategic directions agreed by C 117.
PROVISIONAL AGENDA FOR HTW 5

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Validated model training courses (5.2.2.3)

4 Reports on unlawful practices associated with certificates of competency (5.2.2.4)

5 Guidance for STCW Code, section B-1/2 (5.2.2.1)

6 Comprehensive review of the 1995 STCW-F Convention (5.4.1.1)

7 Role of the Human Element

8 Revision of the Guidelines on Fatigue (5.4.1.2)

9 Review of SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships (5.2.1.29)

10 Amendments to the IGF Code and development of guidelines for low-flashpoint fuels (5.2.1.2)

11 Revised SOLAS regulation II-1/3-8 and associated guidelines (MSC.1/Circ.1175) and new Guidelines for safe mooring operations for all ships (5.2.1.1)

12 Measures to harmonize port State control (PSC) activities and procedures worldwide (5.3.1.1)

13 Biennial agenda and provisional agenda for HTW 6

14 Election of Chair and Vice-Chair for 2019

15 Any other business

16 Report to the Maritime Safety Committee
PROVISIONAL AGENDA FOR III 4

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Consideration and analysis of reports on alleged inadequacy of port reception facilities (7.1.3.1)

4 Lessons learned and safety issues identified from the analysis of marine safety investigation reports (12.1.2.1)

5 Measures to harmonize port State control (PSC) activities and procedures worldwide (5.3.1.1)

6 Identified issues relating to the implementation of IMO instruments from the analysis of PSC data (12.1.2.2)

7 Analysis of consolidated audit summary reports (2.0.2.1)

8 Updated Survey Guidelines under the Harmonized System of Survey and Certification (HSSC) (5.2.1.17)

9 Non-exhaustive list of obligations under instruments relevant to the IMO Instruments Implementation Code (III Code) (5.2.1.20)

10 Unified interpretation of provisions of IMO safety, security, and environment related Conventions (1.1.2.3)

11 Review the Model Agreement for the authorization of recognized organizations acting on behalf of the Administration (2.0.1.6);

12 Biennial status report and provisional agenda for III 5

13 Election of Chair and Vice-Chair for 2018

14 Any other business

15 Report to the Committees
PROVISIONAL AGENDA FOR NCSR 5

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Routeing measures and mandatory ship reporting systems (5.2.4.1)

4 Updates to the LRIT system (5.2.4.2)

5 Application of the “Indian Regional Navigation Satellite System (IRNSS)” in the maritime field and development of performance standards for shipborne IRNSS receiver equipment*

6 Guidelines for the harmonized display of navigation information received via communications equipment (5.2.6.2)

7 Guidelines on standardized modes of operation, S-mode*

8 Develop guidance on definition and harmonization of the format and structure of Maritime Service Portfolios (MSPs)

9 Updating of the GMDSS master plan and guidelines on MSI (maritime safety information) provisions (5.2.5.1)

10 Consequential work related to the new Polar Code (5.2.1.15)

11 Revision of SOLAS chapters III and IV for Modernization of the Global Maritime Distress and Safety System (GMDSS), including related and consequential amendments to other existing instruments*

12 Response to matters related to the Radiocommunication ITU-R Study Group and ITU World Radiocommunication Conference (1.1.2.2)

13 Measures to protect the safety of persons rescued at sea (5.1.2.2)

14 Developments in GMDSS satellite services (5.2.5.4)

15 Revised Performance Standards for EPIRBs operating on 406 MHz (resolution A.810(19)) to include Cospas-Sarsat MEOSAR and second generation beacons (5.2.5.5)

16 Further development of the provision of global maritime SAR services (2.0.3.1)

17 Guidelines on harmonized aeronautical and maritime search and rescue procedures, including SAR training matters (2.0.3.2)

18 Amendments to the IAMSAR Manual (1.3.4.1)

* Output number to be decided by the Council in due course.
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>19</td>
<td>Unified interpretation of provisions of IMO safety, security, and environment-related conventions (1.1.2.3)</td>
</tr>
<tr>
<td>20</td>
<td>Biennial status report and provisional agenda for NCSR 6</td>
</tr>
<tr>
<td>21</td>
<td>Election of Chair and Vice-Chair for 2019</td>
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<tr>
<td>22</td>
<td>Any other business</td>
</tr>
<tr>
<td>23</td>
<td>Report to the Maritime Safety Committee</td>
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</table>
PROVISIONAL AGENDA FOR SDC 5

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Amendments to SOLAS regulation II-1/8-1 on the availability of passenger ships’ electrical power supply in cases of flooding from side raking damage (5.2.1.13)

4 Computerized stability support for the master in case of flooding for existing passenger ships (5.2.1.7)

5 Review SOLAS chapter II-1, parts B-2 to B-4, to ensure consistency with parts B and B-1 with regard to watertight integrity

6 Finalization of second generation intact stability criteria (5.2.1.12)

7 Mandatory instrument and/or provisions addressing safety standards for the carriage of more than 12 industrial personnel on board vessels engaged on international voyages (5.2.1.4)

8 Amendments to the 2011 ESP Code (2.0.1.1)

9 Unified interpretation to provisions of IMO safety, security, and environment-related Conventions (1.1.2.3)

10 Revised SOLAS regulation II-1/3-8 and associated guidelines (MSC.1/Circ.1175) and new guidelines for safe mooring operations for all ships (5.2.1.1)

11 Guidelines for wing-in-ground craft (5.2.1.23)

12 Biennial status report and provisional agenda for SDC 6

13 Election of Chair and Vice-Chair for 2019

14 Any other business

15 Report to the Maritime Safety Committee

* Output number to be decided by the Council in due course.
PROVISIONAL AGENDA FOR SSE 5

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Safety objectives and functional requirements of the Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III (5.2.1.10)

4 Develop new requirements for ventilation of survival crafts (5.1.2.5)

5 Uniform implementation of paragraph 6.1.1.3 of the LSA Code (5.2.1.28)

6 Consequential work related to the new Code for ships operating in polar waters (5.2.1.15)

7 Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships (5.2.1.29)

8 Amendments to the FSS Code for CO₂ pipelines in under-deck passageways (5.2.1.27)

9 Amendments to MSC.1/Circ.1315*

10 Requirements for onboard lifting appliances and anchor handling winches (5.2.1.22)

11 Revised SOLAS regulations II 1/13 and II-1/13-1 and other related regulations for new ships (5.2.1.5)

12 Unified interpretation of provisions of IMO safety, security, and environment-related conventions (1.1.2.3)

13 Development of guidelines for cold ironing of ships and of amendments to SOLAS chapters II-1 and II-2, if necessary*

14 Biennial status report and provisional agenda for SSE 6

15 Election of Chair and Vice-Chair for 2019

16 Any other business

17 Report to the Maritime Safety Committee

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* Output number to be decided by the Council in due course.
# REPORT ON THE STATUS OF OUTPUTS FOR THE 2016-2017 BIENNIAL

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<td>1.1.1.1</td>
<td>Cooperate with the United Nations on matters of mutual interest, as well as provide relevant input/guidance</td>
<td>2017</td>
<td>Assembly</td>
<td>MSC/MEPC/FAL/LEG/TCC</td>
<td>Council</td>
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<td>MSC 9/22, paragraph 7.6</td>
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<td>1.1.2.1</td>
<td>Cooperate with other international bodies on matters of mutual interest, as well as provide relevant input/guidance</td>
<td>2017</td>
<td>Assembly</td>
<td>MSC/MEPC/FAL/LEG/TCC</td>
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<td>1.1.2.2</td>
<td>Response to matters related to the Radiocommunication ITU R Study Group and ITU World Radiocommunication Conference</td>
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<td>MSC 97/22, paragraph 7.6</td>
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1 The number of the outputs will be replaced after C 118, to adapt the numeration to the new strategic directions agreed by C 117.
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<td>1.1.2.3</td>
<td>Unified interpretation of provisions of IMO safety, security, and environment-related Conventions</td>
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<td>III/PPR/CCC/SDC/SSE/NCSR</td>
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<td>MSC 78/26, paragraph 22.12</td>
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<td>2.0.1.1</td>
<td>Amendments to the ESP Code</td>
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<td>MSC</td>
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<td>Ongoing</td>
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<td>MSC 91/22, paragraph 19.24;</td>
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<tr>
<td>2.0.1.5</td>
<td>Amendments to SOLAS regulations II-20.2 and II-20-1 to clarify the fire safety requirements for cargo spaces containing vehicles with fuel in their tanks for their own propulsion</td>
<td>2017</td>
<td>MSC</td>
<td>SSE</td>
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<td>MSC 96/25, paragraph 23.6; and MSC 98/23, paragraphs 3.14 to 3.17, 3.59 and 3.61 to 3.63</td>
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Notes: The Assembly, at its twenty-eighth session, had expanded the output to include all proposed unified interpretations to provisions of IMO safety, security, and environment-related Conventions.
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<td>2.0.1.6</td>
<td>Review the Model Agreement for the authorization of recognized organizations acting on behalf of the Administration (2018)</td>
<td>2017</td>
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<td>III</td>
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<td>MSC 97/22, paragraph 19.7</td>
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<td>2.0.1² (New)</td>
<td>Amendments to chapter 9 of the FSS Code for fault isolation requirements for cargo ships and passenger ship cabin balconies fitted with individually identifiable fire detector systems (2020)</td>
<td>2019</td>
<td>MSC</td>
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<td>MSC 98/23, paragraph 20.34</td>
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<td>2.0.2.1</td>
<td>Analysis of consolidated audit summary reports</td>
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<td>Council</td>
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<td>2.0.3.1</td>
<td>Further development of the provision of global maritime SAR services</td>
<td>2017</td>
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<td>NCSR</td>
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<td>In progress</td>
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<td>Notes: Recognizing that it was very important to consider the further development of the Global SAR Plan and that proposals might be submitted, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2019.</td>
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² New output approved by MSC 98. Number of the output to be assigned by C 118.
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<td>2.0.3.2</td>
<td>Guidelines on harmonized aeronautical and maritime search and rescue procedures, including SAR training matters</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
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<td>Extended</td>
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</table>

Notes: Recognizing that it was very important to further consider Guidelines on harmonized aeronautical and maritime search and rescue procedures, including SAR training matters and that proposals are expected be submitted, in particular, by the ICAO/IMO Joint Working Group, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2019.

| 2.0.3.3       | Revised guidelines for preparing plans for cooperation between search and rescue services and passenger ships (MSC.1/Circ.1079) | 2017                   | MSC             | NCSR                |                        | In progress                 | Completed                    | MSC 95/22, paragraph 19.11; and MSC 98/23, paragraph 11.34 |

| 3.4.1.1       | Input on identifying emerging needs of developing countries, in particular SIDS and LDCs to be included in the ITCP | Continuous         | TCC             | MSC/MEPC/FAL/LEG    |                        | Ongoing                     | Ongoing                      | MSC 98/23, paragraphs 22.1 to 22.5 |

<p>| 3.5.1.1       | Identify thematic priorities within the area of maritime safety and security, marine environmental protection, facilitation of maritime traffic and maritime legislation | Annual              | TCC             | MSC/MEPC/FAL/LEG    |                        | Postponed                    | Completed                    |            |</p>
<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ(s)</th>
<th>Coordinating organ(s)</th>
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<th>Status of output for Year 2</th>
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<tr>
<td>3.5.1.2</td>
<td>Input to the ITCP on emerging issues relating to sustainable development and</td>
<td>2017</td>
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<td>4.0.1.3</td>
<td>Endorsed proposals for new outputs for the 2016-2017 biennium as accepted by</td>
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<td>Endorsed proposals for the development, maintenance and enhancement of</td>
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<td>information systems and related guidance (GISIS, websites, etc.)</td>
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<td>4.0.3.1</td>
<td>Development of a new strategic framework for the Organization for 2018-2023</td>
<td>2017</td>
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<td>4.0.5.1</td>
<td>Revised guidelines on organization and method of work, as appropriate</td>
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<td>C 116/D, paragraph 4.8; and MSC 98/23, paragraph 18.8</td>
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<td>Guidelines on safe return to port for passenger ships</td>
<td>2016</td>
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<td>MSC 81/25, paragraph 23.54; and MSC 96/25, paragraph 11.10</td>
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<td>5.1.1.2</td>
<td>Clarification of the requirements in SOLAS chapter II-2 for fire integrity of windows on passenger ships carrying not more than 36 passengers and special purpose ships with more than 60 (but no more than 240) persons on board</td>
<td>2017</td>
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<td>MSC 95/22, paragraph 19.30; and MSC 97/22, paragraphs 8.6 and 8.7</td>
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<td>5.1.1.3</td>
<td>Amendments to SOLAS and FSS Code to make evacuation analysis mandatory for new passenger ships and review of the Recommendation on evacuation analysis for new and existing passenger ships</td>
<td>2016</td>
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<td>MSC 83/28, paragraph 25.25; MSC 93/22, paragraph 20.11; MSC 96/25, paragraph 11.13; MSC 96/25, paragraph 11.15; and MSC 98/23, paragraph 10.12</td>
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<td>5.1.1.4</td>
<td>Development of life safety performance criteria for alternative design and arrangements for fire safety (MSC.1/Circ.1002)</td>
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<td>MSC 90/28, paragraph 25.12; and MSC 97/22, paragraph 8.2</td>
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<td>5.1.1.5</td>
<td>Passenger ship safety</td>
<td>2017</td>
<td>MSC</td>
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<td>MSC 96/25, paragraph 6.6</td>
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<td>5.1.1.6</td>
<td>Amendments to SOLAS chapter II-1 and associated guidelines on damage control drills for passenger ships</td>
<td>2016</td>
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<td>HTW</td>
<td>SDC</td>
<td>Extended</td>
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<td>MSC 93/22, paragraphs 6.28.4, 20.5 and 20.14; MSC 97/22, paragraphs 3.11 and 3.23; and MSC 98/23, paragraph 3.62</td>
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Notes: Target completion year extended to 2017 (MSC 96/25, paragraph 23.25).
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<th>Status of output for Year 2</th>
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<td>5.1.2.1</td>
<td>Making the provisions of MSC.1/Circ.1206/Rev.1 mandatory</td>
<td>2016</td>
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<td>MSC 95/22, paragraphs 12.36 and 19.29; MSC 96/25, paragraphs 3.82, 3.86 and 8.15; and MSC 98/23, paragraphs 12.19 and 12.20</td>
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<td>5.1.2.2</td>
<td>Measures to protect the safety of persons rescued at sea</td>
<td>2017</td>
<td>MSC/FAL</td>
<td>III</td>
<td>NCSR</td>
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<td>MSC 98/23, paragraph 11.1</td>
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<td>Notes: Recognizing that the humanitarian crisis in the Mediterranean is far from being resolved, that this continues to impact merchant shipping and that proposals might be submitted, NCSR 4 invited the Committee to extend the target completion year for this output to 2019. FAL 41 agreed to include this output in the post-biennial agenda with the intention to revisit this decision during FAL 42 (FAL 41/17, paragraph 6.4).</td>
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<td>IMO’s contribution to addressing Unsafe Mixed Migration by Sea</td>
<td>2017</td>
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<td>Notes: Target completion year extended to 2018 (FAL 41/17, paragraph 7.15, MSC 98/23, paragraph 16.14).</td>
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<tr>
<td>5.1.2.4</td>
<td>Revision of requirements for escape route signs and equipment location markings in SOLAS and related instruments</td>
<td>2016</td>
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<td>HTW</td>
<td>SSE</td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 94/21, paragraph 18.24; and MSC 98/23, paragraph 12.31 and annex 24</td>
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</tbody>
</table>

Notes: Target completion year extended to 2017.

| 5.1.2.5       | Develop new requirements for ventilation of survival crafts (2018)          | 2017                   | MSC             | SSE                 |                       | Postponed                   |                             | MSC 97/22, paragraph 19.22       |

Notes: Pending endorsement by C 118.

| 5.2.1.1       | Revised SOLAS regulation II-1/3-8 and associated guidelines (MSC.1/Circ.1175) and new guidelines for safe mooring operations for all ships | 2017                   | MSC             | HTW/SSE             | SDC                   | In progress                 | Extended                    | MSC 95/22, paragraph 19.22       |

Notes: Target completion year extended to 2019 (MSC 98/23, paragraph 10.20).
<table>
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<tr>
<td>5.2.1.2</td>
<td>Amendments to the IGF Code and development of guidelines for low-flashpoint fuels</td>
<td>2016</td>
<td>MSC</td>
<td>HTW/PPR/SDC/SSE</td>
<td>CCC</td>
<td>Extended</td>
<td>Extended</td>
<td>MSC 94/21, paragraphs 18.5 and 18.6; and MSC 96/25, paragraphs 10.1 to 10.3</td>
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Notes: MSC 97 approved the request of CCC 3 to extend the target completion year to 2017 (MSC 97/22, paragraph 19.2). MSC 98 granted a further extension until 2019 taking into account that, based on the relevant submissions to CCC 4, the Sub-Committee was unlikely to complete the output by 2017 (MSC 98/23, annex 38).

5.2.1.3 | Revision of requirements for automatic sprinkler systems | 2016 | MSC | | | Completed | | Resolution MSC.403(96) |

5.2.1.4 | Mandatory instrument and/or provisions addressing safety standards for the carriage of more than 12 industrial personnel on board vessels engaged on international voyages (2020) | 2017 | MSC | SDC | | In progress | Postponed | MSC 95/22, paragraphs 10.13 and 19.25; MSC 96/25, paragraphs 7.10 and 7.12; MSC 97/22, paragraphs 6.22 to 6.25 |

Notes: Progressed as planned. The actual target completion year is 2020.

5.2.1.5 | Revised SOLAS regulations II-1/13 and II-1/13-1 and other related regulations for new ships | 2017 | MSC | SDC | SSE | In progress | Extended | MSC 95/22, paragraphs 19.20 and 19.32; and MSC 98/23, annex 38 |

Notes: Target completion year extended to 2019.
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<th>Status of output for Year 2</th>
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<td>5.2.1.6</td>
<td>Revision of section 3 of the Guidelines for damage control plans and information to the master (MSC.1/Circ.1245) for passenger ships</td>
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<td>MSC 93/22, paragraphs 6.28 and 20.15; and MSC 98/23, paragraph 10.13</td>
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<td>5.2.1.7</td>
<td>Computerized stability support for the master in case of flooding for existing passenger ships</td>
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<td>MSC 94/21, paragraph 18.20;</td>
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Notes: Target completion year extended to 2018 (MSC 98/23, paragraph 10.11).

| 5.2.1.8      | Review of flashpoint requirements for oil fuel in SOLAS chapter II-2         | 2016                   | MSC             |                     |                        | Completed                    | MSC 96/25, paragraph 10.2   |                                                                          |
| 5.2.1.9      | Safety requirements for carriage of liquefied hydrogen in bulk               | 2016                   | MSC             | CCC                 |                        | Completed                    | MSC 94/21, paragraph 18.3; and MSC 97/22, paragraph 10.2                 |
| 5.2.1.10     | Safety objectives and functional requirements of the Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III | 2017                   | MSC             | SSE                 |                        | In progress                  | Extended                     | MSC 82/24, paragraph 3.92; and MSC 98/23, annex 38                      |

Notes: Target completion year extended to 2019.
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<td>5.2.1.11</td>
<td>Amendments to the Guidelines for vessels with dynamic positioning (DP) systems (MSC/Circ.645)</td>
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<td>Review of the MODU Code, LSA Code and MSC.1/Circ.1206/Rev.1</td>
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### MARITIME SAFETY COMMITTEE (MSC)

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<tr>
<td>5.2.1.15</td>
<td>Consequential work related to the new Code for ships operating in polar</td>
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<td>Notes: Noting that this output is urgent and of utmost importance, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2018. MSC 98 granted an extension until 2019 for the SSE Sub-Committee (MSC 98/23, annex 38).</td>
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<td>5.2.1.16</td>
<td>Finalization of a non-mandatory instrument on regulations for non-convention</td>
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<td>5.2.1.17</td>
<td>Updated Survey Guidelines under the Harmonized System of Survey and</td>
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<td>III</td>
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<td>5.2.1.20</td>
<td>Non-exhaustive list of obligations under instruments relevant to the IMO Instruments Implementation Code (III Code)</td>
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<td>5.2.1.21</td>
<td>Guidelines for use of Fibre Reinforced Plastics (FRP) within ship structures</td>
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<td>MSC 95/22, paragraph 10.16; and MSC 98/23, paragraph 10.21</td>
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<td>5.2.1.22</td>
<td>Requirements for onboard lifting appliances and winches</td>
<td>2017</td>
<td>MSC</td>
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<td>Notes: Based on the scope of the draft SOLAS regulation, the Committee has approved the change of the existing title of the output to &quot;Requirements for onboard lifting appliances and anchor handling winches&quot;. In addition, the target completion year has been extended to 2019.</td>
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<tr>
<td>5.2.1.24</td>
<td>Amendments to Part B of the 2008 IS Code on towing, lifting and anchor handling operations</td>
<td>2016</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 88/26, paragraph 23.36; and MSC 97/22, paragraphs 3.88 and 3.89</td>
</tr>
</tbody>
</table>
### MARITIME SAFETY COMMITTEE (MSC)

<table>
<thead>
<tr>
<th>Output number</th>
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</thead>
<tbody>
<tr>
<td>5.2.1.25</td>
<td>Amendments to the requirements for foam-type fire extinguishers in SOLAS regulation II-2/10.5</td>
<td>2016</td>
<td>MSC</td>
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<td>Completed</td>
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<tr>
<td>5.2.1.26</td>
<td>Suitability of high manganese austenitic steel for cryogenic service and development of any necessary amendments to the IGC Code and IGF Code</td>
<td>2017</td>
<td>MSC</td>
<td>CCC</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 96/25, paragraph 23.4</td>
</tr>
</tbody>
</table>

**Notes:** MSC 98 extended the target completion year to 2019 taking into account that, based on the relevant submissions to CCC 4, it was considered possible that the Sub-Committee would be unable to complete the output by 2017 (MSC 98/23, annex 38).

| 5.2.1.27      | Amendments to the FSS Code for CO2 pipelines in under-deck passageways     | 2017                    | MSC             | SSE                 |                        | In progress               | Extended                  | MSC 96/25, paragraph 23.26; and MSC 98/23, annex 38 |

**Notes:** Target completion year extended to 2018.

| 5.2.1.28      | Uniform implementation of paragraph 6.1.1.3 of the LSA Code                | 2017                    | MSC             | SSE                 |                        | In progress               | Extended                  | MSC 96/25, paragraph 23.28; and MSC 98/23, paragraph 12.23 |

**Notes:** MSC 98 agreed to instruct SSE 5 to further consider the draft amendment to paragraph 6.1.1.3 of the LSA Code and approved an extension of the target completion year until 2018.
<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>5.2.1.29</td>
<td>Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships (2019)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW/SDC</td>
<td>SSE</td>
<td>In progress</td>
<td>Postponed</td>
<td>MSC 97/22, paragraph 19.19</td>
</tr>
<tr>
<td>5.2.1 (New)²³</td>
<td>Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS) (2020)</td>
<td>2019</td>
<td>MSC</td>
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<td></td>
<td></td>
<td>MSC 98/23, paragraph 20.2.11</td>
</tr>
<tr>
<td>5.2.1 (New)²⁴</td>
<td>Development of guidelines for cold ironing of ships and of amendments to SOLAS chapters II-1 and II-2, if necessary (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SDC/III</td>
<td>SSE</td>
<td></td>
<td></td>
<td>MSC 98/23, paragraph 20.36</td>
</tr>
</tbody>
</table>

Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for MSC 99.

Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for SSE 5.

³ New output approved by MSC 98. Number of the output to be assigned by C 118.

⁴ New output approved by MSC 98. Number of the output to be assigned by C 118.
### MARITIME SAFETY COMMITTEE (MSC)

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</thead>
<tbody>
<tr>
<td>5.2.1</td>
<td>Amendments to MSC.1/Circ.1315</td>
<td>2019</td>
<td>MSC</td>
<td>SSE</td>
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<td>MSC 98/23, paragraph 20.37</td>
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<td>Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for SSE 5.</td>
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<tr>
<td>5.2.2.1</td>
<td>Guidance for the implementation of the 2010 Manila Amendments</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
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<td>In progress</td>
<td>Extended</td>
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<tr>
<td></td>
<td>Notes: MSC 98 (MSC 98/23, paragraph 9.2) renamed the output as &quot;Guidance for STCW Code, section B-1/2” and extended the TCY to 2018.</td>
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<tr>
<td>5.2.2.2</td>
<td>Review of STCW passenger ship-specific safety training</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 96/25, paragraph 12.5</td>
</tr>
<tr>
<td>5.2.2.3</td>
<td>Validated model training courses</td>
<td>Continuous</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
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<tr>
<td>5.2.2.4</td>
<td>Reports on unlawful practices associated with certificates of competency</td>
<td>Annual</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>Completed</td>
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<tr>
<td>5.2.2.5</td>
<td>Reports to the MSC on information communicated by STCW Parties</td>
<td>Annual</td>
<td>MSC</td>
<td></td>
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<td>Completed</td>
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<tr>
<td>5.2.2.6</td>
<td>Guidelines for shipowners and seafarers for implementation of relevant IMO instruments in relation to the carriage of dangerous goods in packed form by sea</td>
<td>2016</td>
<td>MSC</td>
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<td>Completed</td>
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<td>MSC.1/Circ.1520</td>
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5 New output approved by MSC 98. Number of the output to be assigned by C 118.
<table>
<thead>
<tr>
<th>Output number</th>
<th>Description</th>
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<th>Parent organ(s)</th>
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<tbody>
<tr>
<td>5.2.3.1</td>
<td>Amendments to CSC 1972 and associated circulars</td>
<td>2016</td>
<td>MSC</td>
<td></td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 96/25, paragraph 10.8</td>
</tr>
<tr>
<td>5.2.3.2</td>
<td>Revised Guidelines for packing of cargo transport units</td>
<td>2016</td>
<td>MSC</td>
<td></td>
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<td>Completed</td>
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<td>MSC.1/Circ.1442</td>
</tr>
<tr>
<td>5.2.3.3</td>
<td>Amendments to the IMSBC Code and supplements</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>CCC</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 86/26, paragraph 7.2; and MSC 98/23, paragraphs 3.72 to 3.78</td>
</tr>
<tr>
<td>5.2.3.4</td>
<td>Amendments to the IMDG Code and supplements</td>
<td>Continuous</td>
<td>MSC</td>
<td>CCC</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 75/24, paragraph 7.36</td>
</tr>
<tr>
<td>5.2.3 (New)6</td>
<td>Amendments to the CSS Code with regard to weather-dependent lashing</td>
<td>2019</td>
<td>MSC</td>
<td>CCC</td>
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<td>MSC 98/23, paragraph 20.7</td>
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</table>

Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for CCC 5.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>5.2.4.1</td>
<td>Routeing measures and mandatory ship reporting systems</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 96/25, paragraphs 14.2 to 14.5</td>
</tr>
<tr>
<td>5.2.4.2</td>
<td>Updates to the LRIT system</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 97/22, paragraph 7.3</td>
</tr>
</tbody>
</table>

6 New output approved by MSC 98. Number of the output to be assigned by C 118.
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<tr>
<th>Output number</th>
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<tr>
<td>5.2.4.3</td>
<td>Amendment to the General Provisions on Ships' Routeing (resolution A.572(14)) on establishing multiple structures at sea</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Completed</td>
<td></td>
<td>Resolution MSC.419(97)</td>
</tr>
<tr>
<td>5.2.4.4</td>
<td>Interconnection of NAVTEX and Inmarsat SafetyNET receivers and their display on Integrated Navigation Display Systems</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 23.22; MSC 98/23, paragraphs 11.7 to 11.11</td>
</tr>
<tr>
<td>5.2.4.5</td>
<td>Guidelines associated with multi-system shipborne radionavigation receivers dealing with the harmonized provision of PNT data and integrity information</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 98/23, paragraphs 11.12 and 11.13</td>
</tr>
<tr>
<td>5.2.4.6</td>
<td>Recognition of Galileo as a component of the WWRNS</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 96/25, paragraph 14.6</td>
</tr>
<tr>
<td>5.2.5.1</td>
<td>Updating of the GMDSS Master Plan and guidelines on MSI (maritime safety information)</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 97/22, paragraphs 7.4 and 7.5</td>
</tr>
<tr>
<td>Output number</td>
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</tr>
<tr>
<td>5.2.5.2</td>
<td>Completion of the detailed review of the Global Maritime Distress and Safety System (GMDSS)</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td>NCSR</td>
<td>Completed</td>
<td></td>
<td>MSC 90/28, paragraph 25.18; and MSC 96/25, paragraph 14.9</td>
</tr>
<tr>
<td>5.2.5.3</td>
<td>Draft Modernization Plan of the Global Maritime Distress and Safety System (GMDSS) (2018)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td>NCSR</td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 90/28, paragraph 25.18; MSC 96/25, paragraph 14.9; and MSC 98/23, paragraph 11.21</td>
</tr>
</tbody>
</table>

Notes: Having completed this output a year earlier than the target completion year of 2018, results in deletion of item 38 from the Committee's post-biennial agenda.

| 5.2.5.4       | Developments in GMDSS satellite services                                      | Continuous             | MSC            | NCSR                |                       | Ongoing                    | Ongoing                    | MSC 96/25, paragraph 14.17; and MSC 98/23, paragraphs 11.30 to 11.32     |

Notes: Description changed from "Analysis of information on developments in Inmarsat and Cospas-Sarsat" to "Developments in GMDSS satellite services".

| 5.2.5.5       | Revised Performance Standards for EPIRBs operating on 406 MHz (resolution A.810(19)) to include Cospas-Sarsat MEOSAR and second-generation beacons | 2017                   | MSC            | NCSR                |                       | In progress                | Extended                   |                                                                                  |

Notes: Recognizing that the work on the revision of those Performance Standards has not been completed and that further work is required, the Sub-Committee invited the Committee to extend the target completion year for this output to 2018.
<table>
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<tr>
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<tbody>
<tr>
<td>5.2.5.6</td>
<td>Performance Standards for ship-borne GMDSS equipment to accommodate additional providers of GMDSS satellite services</td>
<td>2016</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>Extended</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 14.8; and MSC 98/23, paragraphs 11.16 to 11.20</td>
</tr>
<tr>
<td>5.2.5.7</td>
<td>Analysis of developments in maritime radiocommunication systems and technology</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 96/25, paragraph 14.7</td>
</tr>
<tr>
<td>5.2.5.8</td>
<td>Review SOLAS chapter IV and appendix (Certificates: Forms P, R and C) to accommodate additional mobile satellite systems</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td></td>
<td>Completed</td>
<td>MSC 96/25, paragraph 23.18; and MSC 98/23, paragraphs 11.22 to 11.29</td>
</tr>
<tr>
<td>5.2.5 (New)³</td>
<td>Revision of SOLAS chapters III and IV for Modernization of the GMDSS, including related and consequential amendments to other existing instruments (2021)</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td>HTW/SSE</td>
<td></td>
<td>MSC 98/23, paragraph 20.27</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Pending endorsement by C 118. The output has been placed on the 2018-2019 biennial agenda and the provisional agenda for NCSR 5.

³ New output approved by MSC 98. Number of the output to be assigned by C 118.
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<tbody>
<tr>
<td>5.2.6.1</td>
<td>Additional modules to the Revised Performance Standards for Integrated Navigation Systems (INS) (resolution MSC.252(83) relating to the harmonization of bridge design and display of information</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td>MSC 98/23, paragraphs 11.8 and 11.9</td>
</tr>
<tr>
<td>5.2.6.2</td>
<td>Guidelines for the harmonized display of navigation information received via communications equipment</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Extended</td>
<td></td>
</tr>
<tr>
<td>5.2.6.3</td>
<td>Revised Guidelines and criteria for ship reporting systems (resolution MSC.43(64))</td>
<td>2017</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
<td>In progress</td>
<td>Completed</td>
<td>MSC 98/23, paragraph 11.14</td>
</tr>
</tbody>
</table>

Notes: The Committee agreed to keep this output in the post-biennial agenda of the Committee, in order to be further considered, in principle, at NCSR 6 in 2019.

Notes: Recognizing that the work on those Guidelines has not been completed and that further work is required, the NCSR Sub-Committee invited the Committee to extend the target completion year for this output to 2018.
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>5.3.1.1</td>
<td>Measures to harmonize port State control (PSC) activities and procedures worldwide</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>HTW/PPR/NCSR</td>
<td>III</td>
<td>Ongoing</td>
<td></td>
<td>MEPC 66/21, paragraph 18.8; MSC 94/21, paragraph 18.2.1; MEPC 68/21, paragraph 17.3; MEPC 70/18, paragraph 15.20; and MSC 97/22, paragraph 19.8</td>
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<tr>
<td>5.4.1.1</td>
<td>Comprehensive review of the 1995 STCW-F Convention (2018)</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td>In progress</td>
<td>Extended</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.1.2</td>
<td>Revision of the Guidelines on Fatigue</td>
<td>2017</td>
<td>MSC</td>
<td>HTW</td>
<td>In progress</td>
<td>Extended</td>
<td></td>
<td>MEPC 95/22, paragraph 19.18; and MSC 98/23, paragraph 9.8</td>
</tr>
<tr>
<td>6.1.1.1</td>
<td>Guidelines and guidance on the implementation and interpretation of SOLAS chapter XI-2 and the ISPS Code</td>
<td>Annual</td>
<td>MSC</td>
<td></td>
<td>Postponed</td>
<td>Completed</td>
<td></td>
<td>MSC 98/23, paragraphs 5.28 to 5.30</td>
</tr>
</tbody>
</table>

Notes: MEPC 70 and MSC 97 agreed to amend the output to reflect the coordinating role of III and to add PPR, NCSR and HTW as associated organs.

Notes: MSC 98 extended the TCY to 2018.
## MARITIME SAFETY COMMITTEE (MSC)

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</thead>
<tbody>
<tr>
<td>6.2.1.1</td>
<td>Consideration and analysis of reports on piracy and armed robbery against ships</td>
<td>Annual</td>
<td>MSC</td>
<td></td>
<td></td>
<td>Completed</td>
<td>Completed</td>
<td>MSC 97/22, paragraph 14.1; and MSC 98/23, paragraph 15.1</td>
</tr>
<tr>
<td>6.2.1.2</td>
<td>Revised guidance relating to the prevention of piracy and armed robbery to reflect emerging trends and behaviour patterns</td>
<td>Annual</td>
<td>MSC</td>
<td>LEG</td>
<td></td>
<td>Postponed</td>
<td>Completed</td>
<td>MSC 98/23, paragraphs 15.14, 15.27 and 15.32</td>
</tr>
<tr>
<td>7.1.2.3</td>
<td>Code for the transport and handling of limited amounts of hazardous and noxious liquid substances in bulk on offshore support vessels</td>
<td>2017</td>
<td>MSC/MEPC</td>
<td>SDC/SSE</td>
<td>PPR</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>8.0.2.1</td>
<td>Consideration and analysis of reports and information on persons rescued at sea and stowaways</td>
<td>Annual</td>
<td>MSC/FAL</td>
<td></td>
<td></td>
<td>Completed</td>
<td>Completed</td>
<td></td>
</tr>
<tr>
<td>10.0.1.1</td>
<td>Verified goal-based new ship construction standards for tankers and bulk carriers</td>
<td>Continuous</td>
<td>MSC</td>
<td></td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>Output number</td>
<td>Description</td>
<td>Target completion year</td>
<td>Parent organ(s)</td>
<td>Associated organ(s)</td>
<td>Coordinating organ(s)</td>
<td>Status of output for Year 1</td>
<td>Status of output for Year 2</td>
<td>References</td>
</tr>
<tr>
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<td>------------------------------------------------------------------------------</td>
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<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>10.0.1.2</td>
<td>Consideration of development of goal-based ship construction standards for all ship types</td>
<td>2017</td>
<td>MSC/MEPC</td>
<td></td>
<td></td>
<td>In progress</td>
<td>Postponed</td>
<td>MSC 96/25, paragraphs 5.26 and 5.27</td>
</tr>
<tr>
<td>12.1.1.1</td>
<td>Review of FSA studies by the FSA Experts' Group</td>
<td>Continuous</td>
<td>MSC</td>
<td></td>
<td></td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>MSC 97/22, section 13; and MSC 98/23, paragraphs 14.2 and 14.3</td>
</tr>
<tr>
<td>12.1.2.1</td>
<td>Lessons learned and safety issues identified from the analysis of marine safety investigation reports</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 92/26, paragraph 22.29</td>
</tr>
<tr>
<td>12.1.2.2</td>
<td>Identify issues relating to the implementation of IMO instruments from the analysis of PSC data</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.2.1.1</td>
<td>Revised Guidelines on the Implementation of the ISM Code by Administrations (resolution A.1071(28)) on training audits</td>
<td>2016</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
<td>Completed</td>
<td></td>
<td>MSC 95/22, paragraph 19.5; and MSC 96/25, paragraph 12.4</td>
</tr>
<tr>
<td>Output number</td>
<td>Description</td>
<td>Target completion year</td>
<td>Parent organ(s)</td>
<td>Associated organ(s)</td>
<td>Coordinating organ(s)</td>
<td>Status of output for Year 1</td>
<td>Status of output for Year 2</td>
<td>References</td>
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</tr>
<tr>
<td>12.3.1.1</td>
<td>Consideration of reports of incidents involving dangerous goods or marine pollutants in packaged form on board ships or in port areas</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td>CCC</td>
<td>Completed</td>
<td>Postponed</td>
<td>MSC 79/23, paragraph 12.7</td>
</tr>
<tr>
<td>14.0.1.1</td>
<td>Analysis and consideration of recommendations to reduce administrative burdens in IMO instruments including those identified by the SG-RAR</td>
<td>2017</td>
<td>Council</td>
<td>III / HTW / PPR / CCC / SDC / SSE / NCSR</td>
<td>MSC / MEPC / FAL / LEG</td>
<td>In progress</td>
<td>No work requested</td>
<td>MSC 96/25, paragraphs 19.4.5, 19.4.9 and 19.4.10; and MSC 6/25, paragraphs 19.4.5, 19.4.9 and 19.4.10</td>
</tr>
</tbody>
</table>

***
### ANNEX 37

**POST-BIENNIAL AGENDA OF THE MARITIME SAFETY COMMITTEE**

**ALIGNED TO THE NEW STRATEGIC DIRECTIONS AGREED BY C 117**

<table>
<thead>
<tr>
<th>New Strategic Direction</th>
<th>Existing Output Number</th>
<th>Existing description of the Output</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ</th>
<th>Coordinating organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD 2 Integrate new and advancing technologies in the regulatory framework</td>
<td>5.2.1</td>
<td>Revision of SOLAS chapter III and the LSA Code to remove gaps, inconsistencies and ambiguities based on the safety objectives, functional requirements and expected performance for SOLAS chapter III, taking into account the Guidelines for development and application of IMO goal-based standards safety level approach including possible relocation of measures related to the various sequences of evacuation and rescue currently addressed in various chapters of SOLAS to avoid possible overlaps and inconsistencies(^2)</td>
<td>5 sessions</td>
<td>MSC</td>
<td>SSE</td>
<td></td>
</tr>
</tbody>
</table>

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\(^1\) This format, that is different to format 2, annex 2 of resolution A.1099(29), has been used to show the alignment of outputs of the post-biennial agenda with the new strategic directions approved by C 117.

\(^2\) New output approved by MSC 98.
<table>
<thead>
<tr>
<th>New Strategic Direction</th>
<th>Existing Output Number</th>
<th>Existing description of the Output</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ</th>
<th>Coordinating organ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.2.1.21</td>
<td>Guidelines for use of Fibre Reinforced Plastics (FRP) within ship structures</td>
<td>2 sessions</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.3</td>
<td>Amendments to the IMDG Code related to portable tanks with shells made of Fibre Reinforced Plastics (FRP) for multimodal transportation of dangerous goods</td>
<td>2 sessions</td>
<td>MSC</td>
<td>CCC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.6 post biennial</td>
<td>Revised General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids (resolution A.694(17)) relating to Built-in Integrity Testing (BIIT) for navigation equipment</td>
<td>2 sessions</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.6.1</td>
<td>Additional modules to the Revised Performance Standards for Integrated Navigation Systems (INS) (resolution MSC.252(83) relating to the harmonization of bridge design and display of information</td>
<td>2 sessions</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0.1 post biennial</td>
<td>Mandatory application of the Performance standard for protective coatings for void spaces on bulk carriers and oil tankers</td>
<td>2 sessions</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
</tr>
</tbody>
</table>

3 New output approved by MSC 98.
<table>
<thead>
<tr>
<th>New Strategic Direction</th>
<th>Existing Output Number</th>
<th>Existing description of the Output</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ</th>
<th>Coordinating organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other work(^4)</td>
<td>2.0.1 post biennial</td>
<td>Revision of the provisions for helicopter facilities in SOLAS and the MODU Code</td>
<td>2 sessions</td>
<td>MSC</td>
<td>SSE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0.1 post biennial</td>
<td>Performance standard for protective coatings for void spaces on all types of ships</td>
<td>2 sessions</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.1 post biennial</td>
<td>Review of the 2009 Code on Alerts and Indicators</td>
<td>2 sessions</td>
<td>MSC</td>
<td>NCSR</td>
<td>SSE</td>
</tr>
<tr>
<td></td>
<td>5.2.1 post biennial</td>
<td>Application of amendments to SOLAS and related codes and guidelines</td>
<td>2 sessions</td>
<td>MSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.4 post biennial</td>
<td>Recommendations related to navigational sonar on crude oil tankers</td>
<td>1 session</td>
<td>MSC/MEPC(^5)</td>
<td>SDC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.1 post biennial</td>
<td>Amendments to the LSA Code for thermal performance of immersion suits</td>
<td>2 sessions</td>
<td>MSC</td>
<td>SSE</td>
<td></td>
</tr>
</tbody>
</table>

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\(^4\) These outputs are part of the work carried out as part of the mission of the Organization, but they have not been identified as strategic for the 2018-2023 period.

\(^5\) Pending confirmation by MEPC 71.
## ANNEX 38

### OUTPUTS OF THE COMMITTEE FOR THE 2018-2019 BIENNIAL ALIGNED TO THE NEW STRATEGIC DIRECTIONS AGREED BY C 117

<table>
<thead>
<tr>
<th>New Strategic Direction</th>
<th>Existing Output Number</th>
<th>Existing description of the Output</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ</th>
<th>Coordinating organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD 1 Improve implementation</td>
<td>2.0.2.1</td>
<td>Analysis of consolidated audit summary reports</td>
<td>Annual</td>
<td>Assembly</td>
<td>MSC/MEPC /LEG/TCC/ III</td>
<td>Council</td>
</tr>
<tr>
<td></td>
<td>3.4.1.1</td>
<td>Input on identifying emerging needs of developing countries, in particular SIDS and LDCs to be included in the ITCP</td>
<td>Continuous</td>
<td>TCC</td>
<td>MSC/MEPC /FAL/LEG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5.1.1</td>
<td>Identify thematic priorities within the area of maritime safety and security, marine environmental protection, facilitation of maritime traffic and maritime legislation</td>
<td>Annual</td>
<td>TCC</td>
<td>MSC/MEPC /FAL/LEG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.1.20</td>
<td>Non-exhaustive list of obligations under instruments relevant to the IMO Instruments Implementation Code (III Code)</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.1.28</td>
<td>Uniform implementation of paragraph 6.1.1.3 of the LSA Code</td>
<td>2018</td>
<td>MSC</td>
<td>SSE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.2.1</td>
<td>Guidance for STCW Code, section B-I/2</td>
<td>2018</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.2.3</td>
<td>Validated model training courses</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td>HTW</td>
</tr>
<tr>
<td>New Strategic Direction</td>
<td>Existing Output Number</td>
<td>Existing description of the Output</td>
<td>Target completion year</td>
<td>Parent organ(s)</td>
<td>Associated organ</td>
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<tr>
<td>5.4.1.1</td>
<td>5.4.1.1</td>
<td>Comprehensive review of the 1995 STCW-F Convention (2018)</td>
<td>2018</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
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<tr>
<td>5.4.1.2</td>
<td>5.4.1.2</td>
<td>Revision of the Guidelines on Fatigue</td>
<td>2018</td>
<td>MSC</td>
<td>HTW</td>
<td></td>
</tr>
<tr>
<td>6.1.1.1</td>
<td>6.1.1.1</td>
<td>Guidelines and guidance on the implementation and interpretation of SOLAS chapter XI-2 and the ISPS Code</td>
<td>Annual</td>
<td>MSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.1.2</td>
<td>6.2.1.2</td>
<td>Revised guidance relating to the prevention of piracy and armed robbery to reflect emerging trends and behaviour patterns</td>
<td>Annual</td>
<td>MSC</td>
<td>LEG</td>
<td></td>
</tr>
<tr>
<td>1.1.2.2</td>
<td>1.1.2.2</td>
<td>Response to matters related to the Radiocommunication ITU R Study Group and ITU World Radiocommunication Conference</td>
<td>Annual</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td>5.2.1.2</td>
<td>5.2.1.2</td>
<td>Amendments to the IGF Code and development of guidelines for low-flashpoint fuels</td>
<td>2019¹</td>
<td>MSC</td>
<td>HTW/PPR/SDC/SSE</td>
<td>CCC</td>
</tr>
<tr>
<td>5.2.1.4</td>
<td>5.2.1.4</td>
<td>Mandatory instrument and/or provisions addressing safety standards for the carriage of more than 12 industrial personnel on board vessels engaged on international voyages (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
</tr>
<tr>
<td>5.2.1.10</td>
<td>5.2.1.10</td>
<td>Safety objectives and functional requirements of the Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III</td>
<td>2019</td>
<td>MSC</td>
<td>SSE</td>
<td></td>
</tr>
<tr>
<td>5.2.1.12</td>
<td>5.2.1.12</td>
<td>Finalization of second generation intact stability criteria</td>
<td>2019</td>
<td>MSC</td>
<td>SDC</td>
<td></td>
</tr>
<tr>
<td>5.2.1</td>
<td>5.2.1</td>
<td>Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS) (2020)²</td>
<td>2019</td>
<td>MSC</td>
<td></td>
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</table>

¹ CCC 4 is unlikely to complete. Therefore, the completion year has been extended to 2019.

² New output approved by MSC 98. Number of the output to be assigned by C 118.
<table>
<thead>
<tr>
<th>New Strategic Direction</th>
<th>Existing Output Number</th>
<th>Existing description of the Output</th>
<th>Target completion year</th>
<th>Parent organ(s)</th>
<th>Associated organ</th>
<th>Coordinating organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD 2 Integrate new and advancing technologies in the regulatory framework</td>
<td>5.2.1</td>
<td>Development of guidelines for cold ironing of ships and of amendments to SOLAS chapters II-1 and II-2, if necessary (2020)</td>
<td>2019</td>
<td>MSC</td>
<td>SDC/III</td>
<td>SSE</td>
</tr>
<tr>
<td></td>
<td>5.2.4 post biennial</td>
<td>Application of the &quot;Indian Regional Navigation Satellite System (IRNSS)&quot; in the maritime field and development of performance standards for shipborne IRNSS receiver equipment</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.5.5</td>
<td>Revised Performance Standards for EPIRBs operating on 406 MHz (resolution A.810(19)) to include Cospas-Sarsat MEOSAR and second-generation beacons</td>
<td>2018</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.5</td>
<td>Revision of SOLAS chapters III and IV for Modernization of the GMDSS, including related and consequential amendments to other existing instruments (2021)</td>
<td>2019</td>
<td>MSC</td>
<td>HTW/SSE</td>
<td>NCSR</td>
</tr>
<tr>
<td></td>
<td>5.2.6 post biennial</td>
<td>Develop guidance on definition and harmonization of the format and structure of Maritime Service Portfolios (MSPs)</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.6 post biennial</td>
<td>Guidelines on standardized modes of operation, S-mode</td>
<td>2019</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2.6.2</td>
<td>Guidelines for the harmonized display of navigation information received via communications equipment</td>
<td>2018</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.0.1.2</td>
<td>Consideration of development of goal-based ship construction standards for all ship types</td>
<td>2018</td>
<td>MSC/MEPC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3 New output approved by MSC 98. Number of the output to be assigned by C 118.

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<table>
<thead>
<tr>
<th>New Strategic Direction</th>
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<th>Coordinating organ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.5.1.2</td>
<td>Input to the ITCP on emerging issues relating to sustainable development and achievement of the MDGs</td>
<td>2018</td>
<td>TCC</td>
<td>MSC/MEPC/FAL/LEG</td>
<td>TCC</td>
</tr>
<tr>
<td></td>
<td>3.4.1.1</td>
<td>Input on identifying emerging needs of developing countries, in particular SIDS and LDCs to be included in the ITCP</td>
<td>Continuous</td>
<td>TCC</td>
<td>MSC/MEPC/FAL/LEG</td>
<td>TCC</td>
</tr>
<tr>
<td></td>
<td>3.5.1.2</td>
<td>Input to the ITCP on emerging issues relating to sustainable development and achievement of the MDGs</td>
<td>2018</td>
<td>TCC</td>
<td>MSC/MEPC/FAL/LEG</td>
<td>TCC</td>
</tr>
<tr>
<td></td>
<td>7.1.2.2</td>
<td>Designated Special Areas and PSSAs and their associated protective measures</td>
<td>Continuous</td>
<td>MEPC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.1.1.1</td>
<td>Guidelines and guidance on the implementation and interpretation of SOLAS chapter XI-2 and the ISPS Code</td>
<td>Annual</td>
<td>MSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.2.1.1</td>
<td>Consideration and analysis of reports on piracy and armed robbery against ships</td>
<td>Annual</td>
<td>MSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.2.1.2</td>
<td>Revised guidance relating to the prevention of piracy and armed robbery to reflect emerging trends and behaviour patterns</td>
<td>Annual</td>
<td>MSC</td>
<td>LEG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1.2.3</td>
<td>Unified interpretation of provisions of IMO safety, security, and environment-related Conventions</td>
<td>Continuous</td>
<td>MSC/MEPC</td>
<td>III/PPR/CDC/SDC/SSE/NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0.2.1</td>
<td>Analysis of consolidated audit summary reports</td>
<td>Annual</td>
<td>Assembly</td>
<td>MSC/MEPC/LEG/TCC/Council</td>
<td></td>
</tr>
<tr>
<td>New Strategic Direction</td>
<td>Existing Output Number</td>
<td>Existing description of the Output</td>
<td>Target completion year</td>
<td>Parent organ(s)</td>
<td>Associated organ</td>
<td>Coordinating organ</td>
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</tr>
<tr>
<td></td>
<td>5.2.5.4</td>
<td>Developments in GMDSS satellite services</td>
<td>Continuous</td>
<td>MSC</td>
<td>NCSR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.0.2.1</td>
<td>Consideration and analysis of reports and information on persons rescued at sea and stowaways</td>
<td>Annual</td>
<td>MSC/FAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.1.2.1</td>
<td>Lessons learned and safety issues identified from the analysis of marine safety investigation reports</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.1.2.2</td>
<td>Identified issues relating to the implementation of IMO instruments from the analysis of PSC data</td>
<td>Annual</td>
<td>MSC/MEPC</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.0.2.1</td>
<td>Endorsed proposals for the development, maintenance and enhancement of information systems and related guidance (GISIS, websites, etc.)</td>
<td>Continuous</td>
<td>Council</td>
<td></td>
<td>MSC/MEPC/FAL/LEG/TCC</td>
</tr>
<tr>
<td>SD 3 Respond to Climate Change</td>
<td>4.0.5.1</td>
<td>Committee's organization and method of work</td>
<td>2018</td>
<td>Council</td>
<td></td>
<td>MSC/MEPC/FAL/LEG/TCC</td>
</tr>
<tr>
<td></td>
<td>1.1.1.1</td>
<td>Cooperate with the United Nations on matters of mutual interest, as well as provide relevant input/guidance</td>
<td>2018</td>
<td>Assembly</td>
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<td>Cooperate with other international bodies on matters of mutual interest, as well as provide relevant input/guidance</td>
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<sup>5</sup> New output approved by MSC 98. Number of the output to be assigned by C 118.
<table>
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<td>SD 6 Ensure regulatory effectiveness</td>
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<td>Revised SOLAS regulations II-1/13 and II-1/13-1 and other related regulations for new ships</td>
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<td>Amendments to SOLAS regulation II-1/8-1 on the availability of passenger ships’ electrical power supply in cases of flooding from side raking damage</td>
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<td>Consequential work related to the new Code for ships operating in polar waters</td>
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<td>Requirements for on-board lifting appliances, and anchor handling winches</td>
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<td>Guidelines for wing-in-ground craft</td>
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<td>SDC</td>
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<td>5.2.1.26</td>
<td>Suitability of high manganese austenitic steel for cryogenic service and development of any necessary amendments to the IGC Code and IGF Code</td>
<td>2019&lt;sup&gt;6&lt;/sup&gt;</td>
<td>MSC</td>
<td>CCC</td>
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<td>5.2.1.27</td>
<td>Amendments to the FSS Code for CO&lt;sub&gt;2&lt;/sub&gt; pipelines in under deck passageways</td>
<td>2018</td>
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<td>SSE</td>
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<td>5.2.1.29</td>
<td>Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships</td>
<td>2019</td>
<td>MSC</td>
<td>HTW/SDC</td>
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<sup>6</sup> CCC 4 is unlikely to complete. Therefore, the target completion year has been extended to 2019.
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<td>2019</td>
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<td>SD 7 Ensure organizational effectiveness</td>
<td>5.2.1. (from post biennial)</td>
<td>Safety measures for non-SOLAS ships operating in polar waters [(2021)]</td>
<td>2019</td>
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<td>[SDC]</td>
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<td>5.2.1. post biennial</td>
<td>Review SOLAS chapter II-1, parts B-2 to B-4, to ensure consistency with parts B and B-1 with regard to watertight integrity (2020)</td>
<td>2019</td>
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<td>Reports on unlawful practices associated with certificates of competency</td>
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<td>other work&lt;sup&gt;8&lt;/sup&gt;</td>
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<td>Amendments to the CSS Code with regard to weather-dependent lashing&lt;sup&gt;9&lt;/sup&gt;</td>
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<sup>7</sup> New output approved by MSC 98. Number of the output to be assigned by C 118.

<sup>8</sup> These outputs are part of the work carried out as part of the mission of the Organization, but they have not been identified as strategic for the 2018-2023 period.

<sup>9</sup> New output approved by MSC 98. Number of the output to be assigned by C 118.
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<td>HTW/PPR/NCSR</td>
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<td>Consideration of reports of incidents involving dangerous goods or marine pollutants in packaged form on board ships or in port areas</td>
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<td>III</td>
<td>CCC</td>
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