

Appendix II  
**Resolution A.868(20)**  
*Adopted on 27 November 1997*  
*(Agenda item 11)*

**GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST  
WATER TO MINIMIZE THE TRANSFER OF HARMFUL AQUATIC ORGANISMS AND  
PATHOGENS**

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 concerning prevention and control of marine pollution from ships,

RECALLING ALSO resolution A.774(18) by which it recognized that the uncontrolled discharge of ballast water and sediment from ships has led to the transfer of harmful aquatic organisms and pathogens, causing injury to public health and damage to property and the environment, and accordingly adopted Guidelines for preventing the introduction of unwanted aquatic organisms and pathogens from ships' ballast water and sediment discharges, and further that the Marine Environment Protection Committee (MEPC) and the Maritime Safety Committee (MSC) shall keep the ballast water issue and the application of the Guidelines under review with a view to further developing the Guidelines as a basis for a new Annex to MARPOL 73/78,

RECALLING FURTHER that the 1992 United Nations Conference on Environment and Development (UNCED), in its Agenda 21, requests IMO to consider the adoption of appropriate rules on ballast water discharge to prevent the spread of non-indigenous organisms, and further proclaims in its Declaration on Environment and Development that States shall widely apply the precautionary approach according to their capabilities,

BEARING IN MIND that MEPC/Circ.288 recognized that the existing Guidelines do not provide a complete solution towards the total prevention of the introduction of harmful aquatic organisms and pathogens, but urged that focus should be directed on measures aimed at minimizing the risks, emphasizing further that in applying the existing Guidelines, the ship's safety was of paramount importance,

NOTING the objectives of the Convention on Biological Diversity, 1992, and that the transfer and introduction of alien aquatic species with ballast water threatens the conservation and sustainable use of biological diversity,

NOTING FURTHER the status of work carried out by MEPC as requested by resolution A.774(18) concerning the development of legally binding provisions on ballast water management together with guidelines for their effective implementation, as well as the Guidance on safety aspects of ballast water exchange at sea prepared by the Sub-Committee on Ship Design and Equipment, and distributed as MEPC/Circ.329 and MSC/Circ.806, both of 30 June 1997,

RECOGNIZING that several States have taken unilateral action by adopting legally binding provisions for local, regional or national application with a view to minimizing the risks of introducing harmful aquatic organisms and pathogens through ships entering their ports, and also that this issue, being of worldwide concern, demands action based on globally applicable regulation together with guidelines for their effective implementation and uniform interpretation,

HAVING CONSIDERED the recommendation of the MEPC at its fortieth session on this issue,

1. ADOPTS the Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens set out in the annex to the present resolution;

2. REQUESTS Governments to take urgent action in applying these Guidelines, including the dissemination thereof to the shipping industry, to use them as a basis for any measures they adopt with a view to minimizing the risks of introducing harmful aquatic organisms and pathogens, and to report to the MEPC on any experience gained in their implementation;
3. REQUESTS ALSO the MEPC to work towards completion of legally binding provisions on ballast water management in the form of a new Annex to MARPOL 73/78, together with guidelines for their uniform and effective implementation with a view to their consideration and adoption in the year 2000;
4. REQUESTS FURTHER the MSC to include in its work plan the evaluation of information received from interested parties, particularly that relevant to 12.2 of the Guidelines adopted herewith, with a view to determining the hazards and potential consequences for various existing ship types and operations. The MSC is also requested to consider any other relevant issues concerning ballast water management as well as design objectives for new ships, with a view to minimizing to the extent possible risks of introducing harmful aquatic organisms and pathogens with ships' ballast water and sediments;
5. REVOKES resolution A.774(18).

Annex

**GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER TO MINIMIZE THE TRANSFER OF HARMFUL AQUATIC ORGANISMS AND PATHOGENS**

Contents

Chapter 1	Introduction
Chapter 2	Definitions
Chapter 3	Application
Chapter 4	Guideline objectives and background
Chapter 5	Dissemination of information
Chapter 6	Training and education
Chapter 7	Procedures for ships and port States
	7.1 Procedures for ships
	7.2 Procedures for port States
Chapter 8	Recording and reporting procedures
	8.1 Procedures for ships
	8.2 Procedures for port States
Chapter 9	Ships' operational procedures
	9.1 Precautionary practices
	.1 Minimizing uptake of harmful aquatic organisms, pathogens and sediments
	.2 Removing ballast sediment on a timely basis
	.3 Avoiding unnecessary discharge of ballast water
	9.2 Ballast water management options

## Appendix II

	.1	Ballast water exchange
	.2	Non-release or minimal release of ballast water
	.3	Discharge to reception facilities
	.4	Emergent and new technologies and treatments
Chapter 10		Port State considerations
	10.1	Highly disparate conditions between uptake and discharge ports
	10.2	Ballast water age
	10.3	Presence of target organisms
Chapter 11		Enforcement and monitoring by port States
Chapter 12		Future considerations in relation to ballast water exchange
	12.1	Research needs
	12.2	Long-term evaluation of safety aspects in relation to ballast water exchange
Chapter 13		Ballast system design
Appendix 1		Ballast water reporting form
Appendix 2		Guidance on safety aspects of ballast water exchange at sea

## I INTRODUCTION

**1.1** Studies carried out in several countries have shown that many species of bacteria, plants, and animals can survive in a viable form in the ballast water and sediment carried in ships, even after journeys of several months' duration. Subsequent discharge of ballast water or sediment into the waters of port States may result in the establishment of harmful aquatic organisms and pathogens which may pose threats to indigenous human, animal and plant life, and the marine environment. Although other media have been identified as being responsible for transferring organisms between geographically separated water bodies, ballast water discharge from ships appears to have been among the most prominent.

**1.2** The potential for ballast water discharge to cause harm has been recognized not only by the International Maritime Organization but also by the World Health Organization, which is concerned about the role of ballast water as a medium for the spreading of epidemic disease bacteria.

**1.3** These Guidelines are not to be regarded as a certain solution to the problem. Rather, each part of them should be viewed as a tool which, if correctly applied, will help to minimize the risks associated with ballast water discharge. As scientific and technological advances are made, the Guidelines will be refined to enable the risk to be more adequately addressed. In the interim, port States, flag States and other parties that can assist in mitigating this problem should exercise due care and diligence in an effort to conform to the maximum extent possible with the Guidelines.

**1.4** The selection of appropriate methods of risk minimization will depend upon several factors, including the type or types of organisms being targeted, the level of risk involved, its environmental acceptability, the economic and ecological costs involved and the safety of ships.

## 2 DEFINITIONS

For the purposes of these Guidelines, the following definitions apply:

*Administration* means the Government of the State under whose authority the ship is operating.

*Convention* means MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 related thereto).

*Member States* means States that are Members of the International Maritime Organization.

*Organization* means the International Maritime Organization (IMO).

*Port State authority* means any official or organization authorized by the Government of a port State to administer guidelines or enforce standards and regulations relevant to the implementation of national and international shipping control measures.

*Treatment* means a process or mechanical, physical, chemical or biological method to kill, remove or render infertile harmful or potentially harmful organisms within ballast water

### **3 APPLICATION**

The Guidelines are directed to Member States and can apply to all ships; however, a port State authority shall determine the extent to which they do apply.

### **4 GUIDELINE OBJECTIVES AND BACKGROUND**

**4.1** The objectives of these Guidelines, developed under technical and scientific guidance, are to assist Governments and appropriate authorities, ship masters, operators and owners, and port authorities, as well as other interested parties, in minimizing the risk of introducing harmful aquatic organisms and pathogens from ships' ballast water and associated sediments while protecting ships' safety.

**4.2** The Guidelines allow port States to exempt ships within the area under their jurisdiction from part or all of the relevant provisions. Notwithstanding, any Administration wishing to apply restrictions to ballast water operations should still follow these Guidelines when developing legislation or procedures.

**4.3** In order that the Guidelines may be implemented in a standard and uniform manner, all Member State Governments, ship operators, other appropriate authorities and interested parties are requested to apply these Guidelines.

### **5 DISSEMINATION OF INFORMATION**

**5.1** Administrations are encouraged to maintain and exchange information relevant to these Guidelines through the Organization. Accordingly, Administrations are encouraged to provide the Organization with the following:

- .1** information on severe outbreaks or infestations of harmful aquatic organisms which may pose a risk;
- .2** copies of current domestic laws and regulations;
- .3** technical and research information;
- .4** education materials (such as audio and video tapes) and printed materials; and

- .5 location and terms of use of alternative exchange zones, contingency strategies, availability of shore reception facilities, fees, etc.

5.2 Member States, applying ballast water and sediment discharge procedures, should notify the Organization of specific requirements and provide to the Organization, for the information of other Member States and non-governmental organizations, copies of any regulations, standards, exemptions or guidelines being applied. Verification and detailed information concerning port State requirements should be obtained by the ship prior to arrival.

5.3 Port State authorities should provide the widest possible distribution of information on ballast water and sediment management and treatment requirements that are being applied to shipping. Failure to do so may lead to unnecessary delays for ships seeking entry to port States.

5.4 Shipping organizations and ships' managers should be familiar with the requirements of port State authorities with respect to ballast water and sediment management and treatment procedures, including information that will be needed to obtain entry clearance.

5.5 Member States are invited to provide the Organization with details of any research and development studies that they carry out with respect to the impact and control of harmful aquatic organisms and pathogens in ships' ballast water and sediment.

5.6 Member States should provide to the Organization details of records describing reasons why existing requirements could not be complied with, e.g. *force majeure*, heavy weather, failure of equipment, or lack of information concerning port State requirements.

## 6 TRAINING AND EDUCATION

6.1 Training for ships' masters and crews as appropriate should include instructions on the application of ballast water and sediment management and treatment procedures, based upon the information contained in these Guidelines. Instruction should also be provided on the maintenance of appropriate records and logs. Governments should ensure that their marine training organizations include this in the contents of their syllabus.

6.2 The application of processes and procedures concerning ballast water management is currently at the core of the solution to minimize the introduction of harmful aquatic organisms and pathogens.

6.3 Governments are encouraged to include knowledge of duties regarding the control of pollution of the sea by harmful aquatic organisms and pathogens in their training requirements for certificates.

## 7 PROCEDURES FOR SHIPS AND PORT STATES

### 7.1 Procedures for ships

7.1.1 Every ship that carries ballast water should be provided with a ballast water management plan to assist in the minimization of transfer of harmful aquatic organisms and pathogens. The intent of the plan should be to provide safe and effective procedures for ballast water management

7.1.2 The ballast water management plan should be specific to each ship.

7.1.3 The ballast water management plan should be included in the ship's operational documentation. Such a plan should address, *inter alia*:

- relevant parts of these Guidelines;
- approval documentation relevant to treatment equipment;
- an indication of records required; and
- the location of possible sampling points.

## **7.2 Procedures for port States**

**7.2.1** Reception and treatment facilities should be made available for the environmentally safe disposal of ballast tank sediments.

**7.2.2** Discharge of ship's ballast water into port reception and/or treatment facilities may provide an acceptable means of control. Port State authorities wishing to utilize this strategy should ensure that the facilities are adequate.

## **8 RECORDING AND REPORTING PROCEDURES**

### **8.1 Procedures for ships**

**8.1.1** Where a port State authority requires that specific ballast water procedures and/or treatment option(s) be undertaken, and due to weather, sea conditions or operational impracticability such action cannot be taken, the master should report this fact to the port State authority as soon as possible and, where appropriate, prior to entering seas under its jurisdiction.

**8.1.2** To facilitate the administration of ballast water management and treatment procedures on board each ship, a responsible officer should be appointed to maintain appropriate records and to ensure that ballast water management and/or treatment procedures are followed and recorded.

**8.1.3** When taking on or discharging ballast water, as a minimum, the dates, geographical locations, ship's tank(s) and cargo holds, ballast water temperature and salinity as well as the amount of ballast water loaded or discharged should, be recorded. A suitable format is shown in appendix 1. The record should be made available to the port State authority.

**8.1.4** The location and suitable access points for sampling ballast or sediment should be described in the ship's ballast water management plan. This will allow crew members to provide maximum assistance when officers of the port State authority require a sample of the ballast water or sediment.

### **8.2 Procedures for port States**

**8.2.1** Consistent with 5.2 above, port States should provide ships with the following information:

- details of their requirements concerning ballast water management;
- location and terms of use of alternative exchange zones;
- any other port contingency arrangements; and
- the availability, location, capacities of and applicable fees relevant to reception facilities that are being provided for the environmentally safe disposal of ballast water and associated sediment.

**8.2.2** To assist ships in applying the precautionary practices described in 9.1.1 below, port States should inform local agents and/or the ship of areas and situations where the uptake of ballast water should be minimized, such as:

- areas with outbreaks, infestations or known populations of harmful organisms and pathogens;
- areas with current phytoplankton blooms (algal blooms, such as red tides);
- nearby sewage outfalls;
- nearby dredging operations;
- when a tidal stream is known to be the more turbid; and
- areas where tidal flushing is known to be poor.

## **9 SHIPS' OPERATIONAL PROCEDURES**

### **9.1** Precautionary practices

#### **9.1.1** *Minimizing uptake of harmful aquatic organisms, pathogens and sediments*

When loading ballast, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms. The uptake of ballast water should be minimized or, where practicable, avoided in areas and situations such as:

- areas identified by the port State in connection with advice relating to 8.2.2 above;
- in darkness when bottom-dwelling organisms may rise up in the water column;
- in very shallow water; or
- where propellers may stir up sediment.

#### **9.1.2** *Removing ballast sediment on a timely basis*

Where practicable, routine cleaning of the ballast tank to remove sediments should be carried out in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's ballast water management plan.

#### **9.1.3** *Avoiding unnecessary discharge of ballast water*

If it is necessary to take on and discharge ballast water in the same port to facilitate safe cargo operations, care should be taken to avoid unnecessary discharge of ballast water that has been taken up in another port.

### **9.2** **Ballast water management options**

#### **9.2.1** *Ballast water exchange*

Near-coastal (including port and estuarine) organisms released in mid-ocean, and oceanic organisms released in coastal waters, do not generally survive.

When exchanging ballast at sea, guidance on safety aspects of ballast water exchange as set out in appendix 2 should be taken into account. Furthermore, the following practices are recommended:

- where practicable, ships should conduct ballast exchange in deep water, in open ocean and as far as possible from shore. Where this is not possible, requirements developed within regional agreements may be in operation, particularly in areas within 200 nautical miles from shore. Consistent with 9.1.2 above, all of the ballast water should be discharged until suction is lost, and stripping pumps or eductors should be used if possible;
- where the flow-through method is employed in open ocean by pumping ballast water into the tank or hold and allowing the water to overflow, at least three times the tank volume should be pumped through the tank;
- where neither form of open-ocean exchange is practicable, ballast exchange may be accepted by the port State in designated areas; and
- other ballast exchange options approved by the port State.

### **9.2.2** *Non-release or minimal release of ballast water*

In cases where ballast exchange or other treatment options are not possible, ballast water may be retained in tanks or holds. Should this not be possible, the ship should only discharge the minimum essential amount of ballast water in accordance with port States' contingency strategies.

### **9.2.3** *Discharge to reception facilities*

If reception facilities for ballast water and/or sediments are provided by a port State, they should, where appropriate, be utilized.

### **9.2.4** *Emergent and new technologies and treatments*

**9.2.4.1** If suitable new and emergent treatments and technologies prove viable, these may substitute for, or be used in conjunction with, current options. Such treatments could include thermal methods, filtration, disinfection including ultraviolet light, and other such means acceptable to the port State.

**9.2.4.2** Results concerning the application and effectiveness of new ballast water management technologies and associated control equipment should be notified to the Organization with a view to evaluation and incorporation, as appropriate, into these Guidelines.

## **10 PORT STATE CONSIDERATIONS**

The following is provided for the guidance of port State authorities in the implementation of their ballast water management programme, and to assess risks in relation to the ballast water containing harmful aquatic organisms and pathogens.

### **10.1 Highly disparate conditions between uptake and discharge ports**

Significantly different conditions may exist between port(s) of origin and the port in which ballast water is discharged. Examples include freshwater ballast being released into highly saline ports. There may be organisms capable of surviving such extreme transfers; however, there is a lower probability of species establishment under such transport events.

## **10.2 Ballast water age**

The length of time during which ballast water is within an enclosed ballast tank may also be a factor in determining the number of surviving organisms, because of the absence of light, decreasing nutrients and oxygen, changes of salinity and other factors. However, the maximum length of survival of organisms in ballast water varies, and in many cases is not known. Water of an age of 100 days should be considered the minimum for applying this consideration. Ballast water and sediments may contain dinoflagellate cysts and other organisms capable of surviving for a much longer length of time.

## **10.3 Presence of target organisms**

**10.3.1** Under certain circumstances it may be possible to determine if one or more target species are present in the water of a specific port and have been ballasted in a ship. In these circumstances, the receiving port State authority may invoke management measures accordingly. Even if such target species are not present, however, it should be noted that the ship may still be carrying many untargetted species which, if released in new waters, could be potentially harmful.

**10.3.2** Port States are encouraged to carry out biological baseline surveys in their ports and to disseminate the results of their investigations.

# **11 ENFORCEMENT AND MONITORING BY PORT STATES**

**11.1** Consistent with the precautionary approach to environmental protection, these Guidelines can apply to all ships unless specifically exempted by a port State authority within its jurisdiction. In accordance with 5.2 above, port State authorities should inform the Organization on how the Guidelines are being applied.

**11.2** Member States have the right to manage ballast water by national legislation. However, any ballast discharge restrictions should be notified to the Organization.

**11.3** In all cases, a port State authority should consider the overall effect of ballast water and sediment discharge procedures on the safety of ships and those on board. Guidelines will be ineffective if compliance is dependent upon the acceptance of operational measures that put a ship or its crew at risk. Port States should not require any action of the master which imperils the lives of seafarers or the safety of the ship.

**11.4** It is essential that ballast water and sediment management procedures be effective as well as environmentally safe, practicable, designed to minimize costs and delays to the ship, and based upon these Guidelines whenever possible.

**11.5** Any instructions or requirements of a ship should be provided in a timely manner and be clear and concise.

**11.6** Port States should, on request, provide a visiting ship with any requested information relative to ballast water management and its potential effects with respect to harmful aquatic organisms and pathogens.

**11.7** Any enforcement or monitoring activities should be undertaken in a fair, uniform and nationally consistent manner at all ports within the port State. Where there are compelling reasons whereby nationally consistent procedures cannot be followed, then deviations should be reported to the Organization.

**11.8** Compliance monitoring should be undertaken by port State authorities by, for example, taking and analysing ballast water and sediment samples to test for the continued survival of harmful aquatic organisms and pathogens.

**11.9** Where ballast water or sediment sampling for compliance or effectiveness monitoring is being undertaken, port State authorities should minimize delays to ships when taking such samples.

**11.10** When sampling for research or compliance monitoring, the port State authority should give as much notice as possible to the ship that sampling will occur, to assist in planning staffing and operational resources.

**11.11** The master has a general obligation to provide reasonable assistance for the above monitoring which may include provision of officers or crew, provision of the ship's plans, records pertaining to ballast arrangements and details concerning the location of sampling points.

**11.12** Sampling methods for research and monitoring is the responsibility of the individual port State. The Organization welcomes information on new or innovative methods of sampling and/or analysis, and any relevant information should be provided to it.

**11.13** Port State authorities should indicate to the master or responsible officer the purpose for which a sample is taken (i.e., monitoring, research or enforcement). Results of analyses of samples should be made available to ship's operators on request

**11.14** Port State authorities may sample or require samples to analyze ballast water and sediment, before permitting a ship to proceed to discharge its ballast water in environmentally sensitive locations. In the event that harmful aquatic organisms or pathogens are found to be present in the samples, a port State's contingency strategy may be applied.

## **12 FUTURE CONSIDERATIONS IN RELATION TO BALLAST WATER EXCHANGE**

### **12.1 Research needs**

Operational measures such as ballast water exchange may be appropriate in the short term; however, there is a clear need for further research. These Guidelines should be revised and adjusted in the light of results concerning new ballast water management options.

### **12.2 Longterm evaluation of safety aspects in relation to ballast water exchange**

Recognizing the need to evaluate the hazards and potential consequences for various types of ships and operations, interested parties should carry out detailed studies and provide information relevant to:

- experience gained from carrying out ballast water exchange at sea, including any samples/ model procedures;
- operational precautions and procedures implemented to avoid potential hazards and consequences that may arise during the ballast water exchange at sea;
- an evaluation of the safety margins between the actual metacentric height and stresses versus the allowable seagoing limits specified in the approved trim and stability booklet and loading manual, relevant to different types of ships and loading conditions;
- any hazards which may arise due to human element issues relative to the responsible execution of ballast water exchange at sea in a manner which may not be fully prudent;
- operational procedures carried out prior to initiating the ballast water exchange at sea and checkpoints during the exchange;
- the extent of training and management necessary to ensure that the process of ballast water exchange at sea is effectively monitored and controlled on board;

- plan of action to incorporate any unique procedures should an emergency occur which may affect the exchange of ballast water at sea; and
- the decision-making process, taking into account relevant safety matters, including ship's position, weather conditions, machinery performance, ballast system inspection and maintenance, crew safety and availability.

### **13 BALLAST SYSTEM DESIGN**

Builders, owners and classification societies should take these Guidelines into consideration when designing new ships or modifying existing ships.



## **Guidance on safety aspects of ballast water exchange at sea**

### **1 Introduction**

**1.1** This document is intended to provide guidance on the safety aspects of ballast water exchange at sea. The different types of ships which may be required to undertake ballast water exchange at sea make it presently impractical to provide specific guidelines for each ship type. Shipowners are cautioned that they should consider the many variables that apply to their ships. Some of these variables include type and size of ship, ballast tank configurations and associated pumping systems, trading routes and associated weather conditions, port State requirements and manning.

**1.2** Ballast water exchange at sea procedures contained in relevant management plans should be individually assessed for their effectiveness from the environmental protection point of view as well as from the point of view of their acceptability in terms of structural strength and stability.

**1.3** In the absence of a more scientifically based means of control, exchange of ballast water in deep ocean areas or open seas currently offers a means of limiting the probability that fresh water or coastal aquatic species will be transferred in ballast water. Two methods of carrying out ballast water exchange at sea have been identified:

- .1 the sequential method, in which ballast tanks are pumped out and refilled with clean water; and/or
- .2 the flow-through method, in which ballast tanks are simultaneously filled and discharged by pumping in clean water.

### **2 Safety precautions**

**2.1** Ships engaged in ballast water exchange at sea should be provided with procedures which account for the following, as applicable:

- .1 avoidance of over- and under-pressurization of ballast tanks;
- .2 free surface effects on stability and sloshing loads in tanks that may be slack at any one time;
- .3 admissible weather conditions;
- .4 weather routeing in areas seasonably affected by cyclones, typhoons, hurricanes, or heavy icing conditions;
- .5 maintenance of adequate intact stability in accordance with an approved trim and stability booklet;
- .6 permissible seagoing strength limits of shear forces and bending moments in accordance with an approved loading manual;
- .7 torsional forces, where relevant;

Appendix II

- .8 minimum/maximum forward and aft draughts;
  - .9 wave-induced hull vibration;
  - .10 documented records of ballasting and/or deballasting;
  - .11 contingency procedures for situations which may affect the ballast water exchange at sea, including deteriorating weather conditions, pump failure, loss of power, etc.;
  - .12 time to complete the ballast water exchange or an appropriate sequence thereof, taking into account that the ballast water may represent 50% of the total cargo capacity for some ships; and
  - .13 monitoring and controlling the amount of ballast water.
- 2.2 If the flow-through method is used, caution should be exercised, since:
- .1 air pipes are not designed for continuous ballast water overflow;
  - .2 current research indicates that pumping of at least three full volumes of the tank capacity could be needed to be effective when filling clean water from the bottom and overflowing from the top; and
  - .3 certain watertight and weathertight closures (e.g. manholes) which may be opened during ballast exchange should be re-secured.
- 2.3 Ballast water exchange at sea should be avoided in freezing weather conditions. However, when it is deemed absolutely necessary, particular attention should be paid to the hazards associated with the freezing of overboard discharge arrangements, air pipes, ballast system valves together with their means of control, and the accretion of ice on deck.
- 2.4 Some ships may need the fitting of a loading instrument to perform calculations of shear forces and bending moments induced by ballast water exchange at sea and to compare with the permissible strength limits.
- 2.5 An evaluation should be made of the safety margins for stability and strength contained in allowable seagoing conditions specified in the approved trim and stability booklet and the loading manual, relevant to individual types of ships and loading conditions. In this regard particular account should be taken of the following requirements:
- .1 stability to be maintained at all times to values not less than those recommended by the Organization (or required by the Administration);
  - .2 longitudinal stress values not to exceed those permitted by the ship's classification society with regard to prevailing sea conditions; and
  - .3 exchange of ballast in tanks or holds where significant structural loads may be generated by sloshing action in the partially filled tank or hold to be carried out in favourable sea and swell conditions so that the risk of structural damage is minimized.
- 2.6 The ballast water management plan should include a list of circumstances in which ballast water exchange should not be undertaken. These circumstances may result from

critical situations of an exceptional nature, force *majeure* due to stress of weather, or any other circumstances in which human life or safety of the ship is threatened.

### **3 Crew training and familiarization**

**3.1** The ballast water management plan should include the nomination of key shipboard control personnel undertaking ballast water exchange at sea.

**3.2** Ships' officers and ratings engaged in ballast water exchange at sea should be trained in and familiarized with the following:

- .1** the ship's pumping plan, which should show ballast pumping arrangements, with positions of associated air and sounding pipes, positions of all compartment and tank suction and pipelines connecting them to ship's ballast pumps and, in the case of use of the flow-through method of ballast water exchange, the openings used for release of water from the top of the tank together with overboard discharge arrangements;
- .2** the method of ensuring that sounding pipes are clear, and that air pipes and their non-return devices are in good order;
- .3** the different times required to undertake the various ballast water exchange operations;
- .4** the methods in use for ballast water exchange at sea, if applicable, with particular reference to required safety precautions; and
- .5** the method of on-board ballast water record keeping, reporting and recording of routine soundings.

