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**GUIDELINES FOR
IMPLEMENTATION OF THE
BALLAST WATER MANAGEMENT
CONVENTION**

2024

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PREFACE

Harmful aquatic organisms and pathogens pose a major threat to marine ecosystems, and the shipping sector has been identified as an important route for introducing species to new environment. Especially in the past few decades, with the expansion of global seaborne trade, the global impact of the introduction of non-native species by ship ballast water has been substantial. The uncontrolled discharge of ballast water and sediment from ships leads to the transfer of harmful aquatic organisms and pathogens, causing injury or damage to the ecological environment, human health, property and resources. In February 2004, the International Maritime Organization (IMO) adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (hereinafter referred to as the "BWM Convention"), in order to prevent, reduce and ultimately eliminate hazards to the environment, human health, property and resources caused by the transfer of harmful aquatic organisms and pathogens through the establishment of standards and procedures for the management and control of ships' ballast water and sediments. The BWM Convention entered into force on 8 September 2017 and officially entered into force for China on 22 January 2019. As one of the important conventions developed by the International Maritime Organization in the field of environmental protection, its implementation will have a far-reaching impact on the development of China's shipbuilding industry and shipping industry and the government's implementation of the convention.

In order to facilitate and promote the entry into force and effective implementation of the BWM Convention, IMO has established an Experience Building Phase (EBP) to collect and analyze the problems and challenges faced by ships in meeting the BWM Convention, especially the D-2 standard, in order to comprehensively review the Convention and related guidelines and develop a package of solutions. The original EBP period was five years after the entry into force of the Convention (i.e. 2022). However, with the gradual emergence of many problems in the process of ship implementation, it is difficult to complete the relevant work within the predetermined EBP deadline. At MEPC78 in June 2022, the Committee agreed in principle to extend the EBP and consider the development of the Convention Review Plan (CRP) as the next step of the EBP.

In order to assist relevant industries and units in China to successfully implement the requirements of the BWM Convention, the Guidelines describes the basic requirements of the Convention and related guidelines and other documents, and analyzes the rights and obligations of the parties involved in the implementation of the Convention. In particular, it provides relevant information on typical ballast water treatment technologies and the working principles of related ballast water management systems. It provides technical guidance on ship design, arrangement, selection and installation of ballast water management systems for ships meeting the requirements of the Convention, and provides guidance on product development and type approval for ballast water management system manufacturers.

The purpose of the Guidelines is to provide information reference for the implementation of the

Convention by the industry, and is not intended as a basis for enforcement of the Convention. In case of any inconsistency with national laws and regulations, rules of competent authorities and other legal documents, the latter shall prevail. Specific technical requirements are to be referred to IMO conventions and relevant guidelines, and the relevant ballast water guidelines issued by CCS.

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Chapter 1 Basic Requirements of the Ballast Water Management Convention

1.1 General

The Ballast Water Management Convention aims to control the aquatic organisms and pathogens within the ballast water discharged by ships engaged on international voyages. More generally, the control is to be taken when the ballast water taken onboard within the waters under the jurisdiction of one country is carried to the waters under the jurisdiction of another country and discharged, so as to prevent the invasion of alien species and the transfer of harmful aquatic organisms and pathogens. From this point of view, the BWM Convention applies, regardless of ship type and tonnage, to ships engaged on international voyages fitted with ballast tanks or other tanks for carriage of ballast water. According to the international practice, any warship, naval auxiliary or other ship owned by a State and used only on government non-commercial service are not bound by the BWM Convention. In some emergency or exceptional cases, relevant requirements of the BWM Convention may be exempted. For some special ship type or operational characteristic, equivalent measures may also be taken.

According to the provisions of the BWM Convention, all ships within the scope of application of the Convention are to comply with ballast water management requirements. Furthermore, according to no more favourable treatment principle of IMO, the BWM Convention not only applies to ships of Parties to the Convention, but also applies to ships flying the flag of a non-Party but operating in the waters under the jurisdiction of a Party.

1.2 Definitions

The following definitions apply, in addition to those specified in the BWM Convention and other relevant Guidelines:

- (1) Ballast Water means water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship.
- (2) Sediments mean matter settled out of Ballast Water within a ship.
- (3) Ballast Water Management (BWM) means mechanical, physical, chemical, and biological processes, either singularly or in combination, to remove, render harmless, or avoid the uptake or discharge of harmful aquatic organisms and pathogens within ballast water and sediments.
- (4) Ballast water management system (BWMS) means any system which processes ballast water such that it meets or exceeds the ballast water performance standard in regulation D-2. The BWMS includes ballast water treatment equipment, all associated control equipment, piping arrangements as specified by the manufacturer, control and monitoring equipment and sampling facilities. BWMS does not include the ship's ballast water fittings, which may include piping, valves, pumps, etc., that would be required if the BWMS was not fitted.

(5) Ballast water management plan (BWMP) means the plan referred to in regulation B-1 of the Convention describing the ballast water management process and procedures implemented on board individual ships.

(6) Ballast Water Capacity means the total volumetric capacity of any tanks, spaces or compartments on a ship used for carrying, uptake or discharging Ballast Water, including any multi-use tank, space or compartment designed to allow carriage of Ballast Water.

(7) Harmful Aquatic Organisms and Pathogens mean aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into freshwater courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas.

(8) Ship means a vessel of any type whatsoever operating in the aquatic environment and includes submersibles, floating craft, floating platforms, FSUs and FPSOs.

(9) Major conversion^① means a conversion of a ship:

- .1 which changes its ballast water carrying capacity (which means the capacity of ballast water tanks) by 15 percent or greater; or
- .2 which changes the ship type. A change of ship type is to be considered to refer to a conversion that substantially alters the dimensions or carrying capacity of the ship; or changes the type of cargo carried through a major alteration of the ship; or
- .3 which, in the opinion of the Administrations, is projected to prolong its life by ten years or more; or
- .4 which results in modifications to its ballast water system other than same component replacement-in-kind. Conversion of a ship to meet the provisions of Regulation D-1 is not to be deemed to constitute a major conversion;
- .5 new installation of BWMS in order to meet the provisions of Regulation D-2 is not to be treated as a major conversion.

(10) Constructed in respect of a ship means a stage of construction where:

- .1 the keel is laid; or
- .2 construction identifiable with the specific ship begins; or
- .3 assembly of the ship has commenced comprising at least 50 tonnes or 1 percent of the estimated mass of all structural material, whichever is less; or
- .4 the ship undergoes a major conversion.

(11) Active Substance means a substance or organism, including a virus or a fungus, that has a general or specific action on or against harmful aquatic organisms and pathogens.

(12) System Design Limitations (SDL) of a BWMS means the water quality and operational parameters, determined in addition to the required type approval testing parameters, that are important to its operation, and, for each such parameter, a low and/or a high value for which the BWMS is designed to achieve the performance standard of regulation D-2. The SDL should be

① Refer to IMO Clarification of “Major Conversion” as Defined in Regulation A-1.5 of the BWM Convention (BWM.2/Circ.45)

specific to the processes being employed by the BWMS and should not be limited to parameters otherwise assessed as part of the type approval process.

(13) Control and monitoring equipment means the equipment installed for the effective operation and control of the BWMS and the assessment of its effective operation.

(14) Major components means those components that directly affect the ability of the system to meet the ballast water performance standard described in regulation D-2 of the Convention.

(15) Sampling facilities refers to the means provided for sampling treated or untreated ballast water as specified in Guidelines for ballast water sampling (G2) developed by IMO.

(16) Shipboard testing means a full-scale test of a complete BWMS carried out on board a ship according to Chapter 9 of CCS Guidelines for Type Approval of Ship's Ballast Water Management System, to confirm that the system meets the standards set by regulation D-2 of the Convention.

(17) Land-based testing means a test of the BWMS carried out in a laboratory, equipment factory or pilot plant including a moored test barge or test ship, according to Chapter 7 of CCS Guidelines for Type Approval of Ship's Ballast Water Management System, to confirm that the BWMS meets the ballast water performance standard described in regulation D-2 of the Convention.

(18) Treatment Rated Capacity (TRC) means the maximum continuous capacity expressed in cubic metres per hour for which the BWMS is type approved. It states the amount of ballast water that can be treated per unit time by the BWMS to meet the standard in regulation D-2 of the BWM Convention. The TRC is to be measured at the inlet of the BWMS.

(19) Viable organisms mean organisms that have the ability to successfully generate new individuals in order to reproduce the species.

(20) Basic Approval means the approval of Active Substances or Preparations used in prototype tests or Type Approval tests in accordance with their usage. Basic Approval is to confirm that the available information does not indicate possible unacceptable adverse effects or a potential for unreasonable risk to environment, human health, property or resources. This is to include consideration of potential risks during full-scale tests on commercial ships when possible.

(21) Final Approval means the approval of a ballast water management system using an Active Substance or Preparation to comply with the BWM Convention and includes a review of the Type Approval tests in accordance with the Code for approval of ballast water management systems (BWMS Code). The Final Approval is to confirm that previous evaluations of risks to ship, crew and the environment including storage, handling and application of Active Substances or Preparations remain valid and the concerns expressed during the Basic Approval process have been addressed, as well as that the residual toxicity of the discharge conforms to the evaluation undertaken for Basic Approval. The risk evaluation at Final Approval is to take qualitatively into account cumulative effects that may occur due to the nature of shipping and port operations. The uncertainties involved in the application for approval is to be considered during the Final Approval process, and advice on how these uncertainties can be dealt with is to be provided as appropriate.

(22) Representative sampling means sampling that reflects the relative concentrations (chemicals) and numbers and composition of the populations (organisms) in the volume of interest. Samples

shall be taken in a time-integrated manner and the sampling facility shall be installed, taking into account annex to Part 1 of Guidelines for ballast water sampling (G2).

(23) Administration means the Government of the State under whose authority the ship is operating. With respect to a ship entitled to fly a flag of any State, the Administration is the Government of that State. With respect to floating platforms engaged in exploration and exploitation of the seabed and subsoil thereof adjacent to the coast over which the coastal State exercises sovereign rights for the purposes of exploration and exploitation of its natural resources, including Floating Storage Units (FSUs) and Floating Production Storage and Offloading Units (FPSOs), the Administration is the Government of the coastal State concerned.

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

1.3 Scope of application of the BWM Convention

1.3.1 Scope of application

(1) The BWM Convention applies to ships meeting the following conditions:

- ① ships of a Party to the BWM Convention or ships of non-Parties to this Convention which operate in waters under the jurisdiction of that Party, and
- ② fitted with ballast tanks or other compartments intended to carry ballast water and engaged in international voyage.

(2) The BWM Convention is not to apply to:

- ① ships not designed or constructed to carry ballast water;
- ② ships of a Party which only operate in waters under the jurisdiction of that Party;
- ③ ships of a Party which only operate in waters under the jurisdiction of another Party, subject to the authorization of the latter Party for such exclusion;
- ④ ships which only operate in waters under the jurisdiction of one Party and on the high seas;
- ⑤ any warship, naval auxiliary or other ship owned or operated by a State and used, for the time being, only on government non-commercial service;
- ⑥ permanent ballast water in sealed tanks on ships that is not subject to discharge.

(3) Furthermore, the BWM Convention will not apply in other cases, mainly considering the water are not the ballast water as defined in the BWM Convention, such as:

- ① The water in the hopper area of hopper dredgers not used for the purpose of controlling ship's trim, list, draught, stability and stresses, so such water is not considered as ballast water.
- ② When the cargo tank of live fish carrier is filled with water to carry live fish, this condition is cargo carriage condition and the water within the tank is not for the control of trim, list, draught, stability and stresses of the ship, therefore, the water is not to be considered as ballast water.

1.3.2 Exception under the BWM Convention

Although some ships are within the scope of application of the BWM Convention, in any one of the

following cases, exceptions exist and relevant clauses of the BWM Convention do not apply.

- (1) Necessary uptake or discharging of ballast water and sediment for ship safety and rescue of life at sea in emergency;
- (2) Accidental discharge of ballast water and sediment or flooding due to damage of the ship or equipment;
- (3) Uptake and discharging of ballast water to avoid or reduce pollution incidents of ship;
- (4) The discharging of the same ballast water or sediment which is previously loaded on the high seas;
- (5) Discharging of the ballast water and sediment at the same place where the ballast water and sediment was initially loaded and the discharged ballast water and sediment are not mixed with ballast water loaded in other area;
- (6) According to 18.3.2 of MARPOL Annex I, the ballast water of oil tanker is loaded in oil tank in exceptional cases.

It is to be particularly noted that if the above measures are taken by the ship, the reasonability of the exceptional case is to be fully elaborated in the Ballast Water Record Book.

1.3.3 Exemption and equivalent measures of relevant requirements of the BWM Convention

(1) Exemption

According to the provisions of Regulation A-4 in the BWM Convention, the BWM Convention permits the flag State Administration to grant the ship exemption for the ballast water management requirements under a certain specific situation, such as ships on a voyage or voyages between specified ports or locations or ships which operates exclusively between specified ports or locations, that do not mix Ballast Water or Sediments other than between the specified ports or locations, and the Administration may grant exemption of ballast water management requirements for the ship according to the guidelines for risk assessment^① developed by IMO.

The flag State Administration granting the exemption of ballast water management requirements is to engage in the dealing with the inquiry put forward by port State authority based on the request of the port State authority, such as updating of the ballast water management plan. Only when all the states which may possibly be subject to the effects of exemption achieved unanimous agreement that the risk assessment proves that the risks introduced by the exemption on environment, human health, property and resources are acceptable, the exemption may be granted.

The exemption granted for some ships is not to exceed 5 years. The exemption is to be subject to intermediate review. If the risk assessment shows that the actual risk caused by navigation increases, the exemption may be withdrawn. The Administration must report the information on the granted exemption to IMO.

It is to be particularly noted that the exemption only applies to the D-1 or D-2 standard specified by regulation B-3 of the Convention or additional measures taken by other states specified by regulation

① Refer to the 2017 Guidelines for risk assessment under regulation A-4 of the BWM Convention (G7) adopted by IMO by resolution MEPC.289(71).

C-1. For ships granted with exemption, the ballast water management plan and ballast water record book are still to be provided and the International Ballast Water Management Certificate is to be kept onboard.

(2) Equivalent measures

According to regulation A-5 of the BWM Convention, for pleasure craft used solely for recreation or competition or craft used primarily for search and rescue, less than 50 metres in length overall, and with a maximum Ballast Water capacity of 8 cubic metres, equivalent measures may be implemented according to G3^① developed by IMO.

It is to be particularly noted that the ballast water management plan and ballast water record book may still be kept onboard the ships taking equivalent measures, referring to the requirements of the flag State Administration for management.

1.4 Ballast water management method and discharge standard

1.4.1 General

In order to prevent the invasion of alien species through ballast water so as to achieve the purpose of the BWM Convention, measures for the control of ballast water of ships engage on international voyages are categorized into two types, namely prevention and management. Preventive measures are to minimize or prevent the transfer of alien aquatic organisms during uptake and discharging of ballast water. Management measures are to deal with and control the ballast water loaded onboard the ship.

1.4.2 Preventive measures

Preventive measures include two routes:

(1) Avoid unnecessary discharge of ballast water

If it is necessary to load and discharge ballast water at a same port, unnecessary discharge of the ballast water loaded at other port is to be avoided.

The mix of the treated ballast water with the untreated ballast water is to be avoided as far as possible.

(2) Minimize the intake of harmful aquatic organisms and pathogens and sediment

The intake of potential harmful aquatic organisms and pathogens, and sediment which possibly contain such species, is to be avoided as far as possible during the uptake of ballast water. The uptake of ballast water is to be minimized or avoided in the following areas and conditions:

- 1) water areas proposed by the port State;
- 2) darkness where aquatic organisms may rise up in the water column;
- 3) phytoplankton accumulation area (algae, e.g.: red tide);
- 4) shallow waters;
- 5) where propellers may stir up sediments;
- 6) where dredging is or recently has been carried out;

① Refer to the Guidelines for ballast water management equivalent compliance (G3) adopted by IMO by resolution MEPC.123(53).

7) close to the sewage outlet, etc..

Furthermore, the mix of the untreated ballast water is to be avoided as far as possible, if so, the managed ballast water will not meet the requirements of standard D-2 of the BWM Convention.

1.4.3 Ballast water management measures

There are two ballast water management methods, including ballast water exchange and ballast water treatment.

(1) D-1 standard - basic requirements for ballast water exchange

Ballast water exchange management measures are not only required to be implemented within specified waters, the exchange standards corresponding with the adopted method are to be met. The exchange method must be subject to IMO assessment and acceptance^①. Requirements for exchange waters are indicated in Table 1.4.3(1).

Requirements for Exchange Waters		Table 1.4.3(1)
	Exchange area requirements	Remarks
Plan 1	From the nearest land $\geq 200\text{nm}$ and water depth $\geq 200\text{m}$	When Plan 1 is not feasible, plan 2 is adopted; For Plan 1 and Plan 2, the ship is not to be required to deviate from the intended route
Plan 2	From the nearest land $\geq 50\text{nm}$ and water depth $\geq 200\text{m}$	
Plan 3	Area designated by the port State	When neither Plan 1 nor Plan 2 is feasible

The following three methods of ballast water exchange have been evaluated and accepted by IMO:

- 1) Sequential method: refilled with replacement ballast water to achieve at least a 95 per cent volumetric exchange.
- 2) Flow-through method: at least three times the volume of each filled ballast water tank is to be required.
- 3) Dilution method: at least three times the volume of each filled ballast water tank is to be achieved.

Sequential method, also referred to as empty-refill method, a process by which one or more ballast tank intended for the carriage of ballast water is first emptied and then refilled with replacement ballast water. Flow-through method and dilution method, also referred to as pump-through method, a process by which replacement ballast water is pumped into a ballast tank, while allowing water to flow through manhole, air pipe or other overflow arrangements (flow-through method) or pumping out the ballast water at the same flow rate (dilution method). Ballast water exchange operation may pose threat to the safety of ship. Therefore, suitable exchange method is to be selected based on the

① Refer to 2017 Guidelines for ballast water exchange (G6) adopted by IMO by resolution MEPC.288(71), as amended by resolution MEPC.371(80).

design features and operation conditions of the ship and whether to implement exchange operation is to be determined according to the sea conditions during the actual operation process.

It is to be noted that for ships intended to discharge ballast water in Antarctic water area, the ballast water is to be exchanged taking into account the Guidelines for Ballast Water Exchange in the Antarctic Treaty Area (MEPC.163(56)) as developed by IMO.

(2) D-2 standard - ballast water performance standard

Ballast water performance standard is the acceptable maximum limit to prevent or minimize the transfer of harmful aquatic organisms and pathogens due to discharge of ballast water. The performance standards for ballast water discharge as specified by the BWM Convention are indicated in Table 1.4.3(2):

Ballast Water Performance Standard (D-2 standard)		Table 1.4.3(2)
Index	Amount/allowable concentration	
viable organisms ($\geq 50\mu\text{m}$)	<10/m ³	
viable organisms ($\geq 10\mu\text{m}$ but $< 50\mu\text{m}$)	<10/ml	
Toxicogenic <i>Vibrio cholerae</i> (O1 and O139)	<1 cfu/100ml or <1 cfu/g zooplankton samples (wet weight)	
<i>Escherichia coli</i>	<250 cfu/100ml	
Intestinal <i>Enterococci</i>	<100 cfu/100ml	

In order to achieve the above mentioned performance standards, the ballast water management system^① as type approved by the Administration is normally to be adopted.

Ballast water treatment means the treatment of the aquatic organisms in the ballast water on board before it is discharged to another waters so as to keep the survival rate of the organisms in the ballast water meet the limit as specified in Table 1.4.3(2) and not to cause adverse effect on the waters receiving the ballast water.

(3) Timetable for implementation of D-1/D-2 standard

Ballast water exchange (D-1 standard) is a transitional measure for ballast water management and D-2 standard is the final target. The BWM Convention specifies that before the mandatory implementation of D-2 standard, the discharge of ballast water is at least to meet the D-1 standard. Regulation B-3 of the BWM Convention specifies the timetable for the implementation of D-2 standard, as indicated in Table 1.4.3(3):

① Refer to the Guidelines for approval of ballast water management systems (G8) adopted by IMO by resolution MEPC.174(58) or resolution MEPC.279(70) or Code for Approval of Ballast Water Management Systems (BWMS code) adopted by resolution MEPC.300(72).

Timetable for implementation of D-2 standard**Table 1.4.3(3)**

Categories of Ships		Date of mandatory implementation of D-2 standard
New ships	Constructed on or after 8 September 2017	At the delivery of the ship
Existing ships (constructed before 8 September 2017)	(1) The IOPP certificate renewal survey is completed on or after 8 September 2014 but prior to 8 September 2017	At the first IOPP certificate renewal survey on or after 8 September 2017
	(2) The first IOPP certificate renewal survey is completed on or after 8 September 2017 but prior to 8 September 2019 (excluding the ships described in (1))	At the second IOPP certificate renewal survey on or after 8 September 2017
	(3) The first IOPP certificate renewal survey is completed on or after 8 September 2019 (excluding the ships described in (1))	At the first IOPP certificate renewal survey on or after 8 September 2019
	(4) Ships constructed prior to 8 September 2017 to which the IOPP certificate renewal survey does not apply	At the date determined by the Administrations but no later than 8 September 2024

It is particularly to be noted that after the mandatory implementation of D-2 standard, it does not mean the ballast water exchange operation will be prohibited, which may still be taken as an emergency measure. However, the ballast water exchange may not substitute D-2 standard, unless the ballast water exchanged meets D-2 standard subject to sufficient test and verification. Furthermore, for ships occasionally engage on one international voyage such as platform, FPSOs/FSUs, MOUs etc., the Administration may possibly agree to replace D-2 standard with ballast water exchange method based on risk assessment for such ships. By far, ballast water exchange is considered as a feasible emergency measure when D-2 standard can not be met by the ship. The uptaking of ballast water at a port with challenging water quality may lead to the failure of the ballast water management system and D-2 standard will not be met. In this case, ballast water exchange combined with ballast water treatment (BWE+BWT) will be jointly taken. Therefore, for some ships, it is very important that the ship is still capable of ballast water exchange after the mandatory implementation of D-2 standard.

1.4.4 Sediment management

Since harmful aquatic organisms and pathogens will also exist in sediment of ships, especially some larva and sporocyst of animal and plant, these sediment are not to be randomly discharged. According to regulation B-5 of the BWM Convention, all ships shall remove and dispose of Sediments from spaces designated to carry Ballast Water in accordance with the provisions of the ship's Ballast Water Management plan. The removal of sediment is normally carried out on high sea, in the port, repairing yard or dry dock. For example, the bottom and surface of ballast tank may be cleaned in the ballast water exchange area specified by the BWM Convention. When the cleaning is carried out in a port, repairing yard or dry dock, it is to be subject to control and monitoring and it would be better that the sediment is discharged to a reception facility. When the cleaned sediment is to be disposed at sea, it is to be disposed in area 200 nm from the nearest land and with water depth greater than 200 m. The frequency and timing for the removal of sediment depends on the entrapment of sediment, ship's operational mode, whether there is reception facility, working load of crew and safety issues.

The ship is to be designed and constructed with a view to minimize the uptake and undesirable entrapment of sediments, facilitate removal of sediments and provide safe access to allow for sediment removal and sampling^①.

1.4.5 Ballast Water Management Plan (BWMP) and Ballast Water Record Book (BWRB)

(1) Ballast Water Management Plan (BWMP)

Ship's Ballast Water Management Plan is a key document for management of ballast water. According to regulation B-1 of the BWM Convention, each ship to which the BWM Convention applies shall have on board and implement a Ballast Water Management Plan. Such a plan shall be approved by the Administration and developed according to the provisions and format of the Guidelines for ballast water management plans developed by IMO^②. The Ballast Water Management Plan shall at least:

- 1) detail safety procedures for the ship and the crew associated with Ballast Water Management as required by this Convention;
- 2) provide a detailed description of the actions to be taken to implement the Ballast Water Management requirements and supplemental Ballast Water Management practices as set forth in this Convention;
- 3) detail the procedures for the disposal of Sediments at sea and to shore;
- 4) include the procedures for coordinating shipboard Ballast Water Management that involves discharge to the sea with the authorities of the State into whose waters such discharge will take place;
- 5) designate the officer on board in charge of ensuring that the plan is properly implemented;
- 6) contain the reporting requirements for ships provided for under this Convention.

Before the issue of the BWM Convention, the Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens was adopted by IMO by resolution A.868(20) for implementation by the Industry on a voluntary basis. Some ships have developed BWMP according to resolution A.868(20) and the BWMP has been approved by the Administration. Therefore, such BWMP is still valid after 8 September 2017, unless BWMS is installed and the BWMP is to be amended and re-approved. The amendment and re-approval of the BWMP are to be carried out according to resolution MEPC.127(53) (as amended by resolution MEPC.306(73) and MEPC.370(80)). It is to be noted that the BWMP is to contain ship's emergency measures and applicable ships of less than 400 GT are also to be provided with BWMP.

(2) Ballast Water Record Book (BWRB)

According to regulation B-2 of the BWM Convention, each ship to which the Convention applies shall have on board a Ballast Water record book that may be an electronic record system, or that may be integrated into another record book or system. Each operation concerning Ballast Water shall be

① Refer to Guidelines on design and construction to facilitate sediment control on ships (G12) adopted by IMO by resolution MEPC.150(55).

② Refer to Guidelines for ballast water management and development of ballast water management plans (G4) adopted by IMO by resolution MEPC.127(53), as amended by MEPC.306(73) and MEPC.370(80).

fully recorded without delay in the Ballast Water record book. Each entry shall be signed by the officer in charge of the operation concerned and each completed page shall be signed by the master. The entries in the Ballast Water record book shall be in a working language of the ship. If that language is not English, French or Spanish the entries shall contain a translation into one of those languages. The BWRB is at least to contain the information as required in appendix II of the BWM Convention, mainly involving the following ballast water operation:

- 1) When Ballast Water is taken on board;
- 2) Whenever Ballast Water is circulated or treated for Ballast Water Management purposes;
- 3) When Ballast Water is discharged into the sea;
- 4) When Ballast Water is discharged to a reception facility;
- 5) Accidental or other exceptional uptake or discharges of Ballast Water;
- 6) Additional operational procedure and general remarks;
- 7) Exemption;
- 8) Exception (including contingency procedures).

All above operations are at least to include date, time, place, port or reception facility, volume of ballast water uptake or discharged etc. Ballast Water record book entries shall be maintained on board the ship for a minimum period of two years after the last entry has been made and thereafter in the Company's control for a minimum period of three years. The BWRB is to be readily available for inspection by port State control or inspection by other Administration.

It is to be noted that BWRB is also to be kept onboard the applicable ships of less than 400 GT.

1.4.6 Additional measures for some areas

According to regulation 2.3 of the BWM Convention, nothing in this Convention shall be interpreted as preventing a Party from taking, individually or jointly with other Parties, more stringent measures consistent with international law. The Convention also specifies that special requirements may be taken for some area to prevent, reduce or eliminate the transfer of harmful aquatic organisms and pathogens, if necessary. Section C of the BWM Convention specifies special requirements in certain areas which are the supplementary requirements to the regular measures as specified in PART B of the Convention.

For ships applicable to the additional measures in certain states or areas, the additional measures must be observed and the warning issued by the Party is to be implemented. Considering that these additional measures and warning may be issued, changed and invalid as appropriate, ship operator and master are advised to inquire relevant information periodically through flag State Administration or the port State where the ship is about to call.

1.5 Requirements for survey and certification

According to regulation E-1 and E-2 of the BWM Convention, applicable ships of 400 GT and above but not including floating platform, FSUs/FPSOs are to subject to surveys according to the requirements of the BWM Convention. For ships not covered above (ships less than 400 GT, floating platform, FSUs/FPSOs), the Administration is to develop measures to ensure the compliance of the ships with the requirements of the Convention.

According to the interpretation of the Application of the BWM Convention to Mobile Offshore Units issued by IMO by BWM.2/Circ.46, although specified as above, the mobile offshore units are to comply with the relevant requirements of the BWM Convention and subject to survey and certification as required by the Convention.

The surveys of ballast water management of ships include initial survey, annual survey, intermediate survey, renewal survey and additional survey. Except that the additional survey is to be carried out

after a change, replacement, or significant repair of the structure, other surveys are to be carried out as scheduled.

After the satisfactory completion of the initial survey, the Administration or the person or recognized organization (RO) authorized by the Administration is to issue an International Ballast Water Management Certificate (IBWMC). The validity of the certificate is not to exceed 5 years.

After each annual or intermediate survey is completed, the certificates are to be endorsed and the certificate is to be renewed after the renewal survey. The certificate is to be drawn up, in the forms specified in Appendix 1 of the BWM Convention, in the official language of the issuing country. If the language used is neither English, French nor Spanish, a translation into one of these languages is to be included.

At the request by the flag State Administration, another Party may carry out surveys and issue certificates. Such certificate shall have the same force and receive the same recognition as a Certificate issued by the Administration.

1.6 Port State Control(PSC)requirements

1.6.1 General

Port State Control (PSC) means the inspection carried out by the port State authority of a Party for the foreign ships at its port so as to confirm that the condition of the ship and its equipment are in compliance with national and/or international regulations and the ship is manned and operated according to these regulations.

According to article 9 of the BWM Convention, ships to which the Convention applies may be subject to PSC inspection for the purpose of determining whether the ship is in compliance with the Convention. In order to assist the port State authority in the PSC inspection, IMO developed the Guidelines for port State control under the BWM Convention (PSC Guidelines) (MEPC.252(67)).

1.6.2 Basic requirements for PSC

PSC may be considered as a four-stage inspection:

(1) the first stage, the "initial inspection", should focus on documentation (e.g., IBWMC, BWMP, BWRB and other related documents) and ensuring that an officer has been nominated for ballast water management on board the ship and to be responsible for the BWMS, and that the officer has been trained and knows how to operate it;

(2) the second stage – the "more detailed inspection" where the operation of the BWMS is checked and the PSCO clarifies whether the BWMS has been operated adequately according to the BWMP and the self-monitored operational indicators verified during type approval procedures. Where a ship does not carry a valid Certificate or there are clear grounds for believing that: the condition of the ship or its equipment does not correspond substantially with the particulars of the Certificate; or the master or the crew are not familiar with essential shipboard procedures relating to Ballast Water Management, or have not implemented such procedures, a detailed inspection may be carried out;

(3) the third stage – sampling is envisaged to occur during this stage of PSC which relies on indicative analysis, to identify whether the ship is meeting the ballast water management performance standard described in regulation D-2, or whether detailed analysis is necessary to ascertain compliance;

(4) the fourth stage, when the result of indicative analysis exceeds the corresponding threshold or if necessary, incorporates detailed analysis to verify compliance with the D-2 standard .

Indicative sampling and detailed sampling may be carried out according to the Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2) (BWM.2/Circ.42/Rev.2) developed by IMO.

When the result of sampling analysis shows that the ship is not in compliance with the ballast water management requirements, PSCO may take steps to warn, detain or exclude the ship or grant such a

ship permission to leave to discharge ballast water elsewhere or seek repairs. The PSCO should use professional judgment to determine whether to detain the ship until any noted deficiencies are corrected, or to permit a ship to sail with deficiencies that do not pose an unreasonable threat of harm to the marine environment.

1.7 Right and obligation of parties under the framework of BWM Convention

1.7.1 General

Effective implementation of the BWM Convention involves multiple responsible bodies. On one hand, the BWM Convention clarifies the jurisdiction of relevant states, on the other hand specifies the obligations to be fulfilled by parties. Most contents are technical and operational provisions of ships, mainly the duties of the ship and shipowner or ship company. However, the Convention involves the survey and certification of ships, monitoring, cooperation among states, exchange between states and IMO etc., the responsible subject involves the Flag State Administration and the recognized organization authorized by the Flag State Administration, Port State authority and coastal State government.

1.7.2 Flag State

The flag State is the core to ensure the implementation of the BWM Convention by ships flying its flag. The flag State must ensure the ships comply with the international regulations and provisions, including the undertaking of the surveys and certification and appropriate law enforcement action in the case of violation by the ship. If the ship enters the water of a port State or coastal State, the Flag State may have both the jurisdiction of the port State or coastal State. Ships on the high sea are only subject to the jurisdiction of the flag State.

The flag State Administration is responsible for providing suggestion for law department and government of the nation and providing suggestion for the shipping industry and port State authority, on the other hand, responsible for the approval of BWMS, approval of BWMP and survey and certification requirements.

1.7.3 Port State

The BWM Convention requires the Party to prohibit the violation of the Convention by the ship and impose sanction on the violation within its jurisdiction (including the port). The port State is the subject to excise the law enforcement to ships calling at its port through Port State Control (PSC). The jurisdiction of the port State may include the examination of certificates, violation inspection, detention of the violating ships etc.

The port State authority may be required to provide sufficient sediment reception facilities and ballast water reception facilities. The port State may effectively implement the compliance by joining the regional agreement.

1.7.4 Coastal State

According to the BWM Convention, the Party is to prohibit the violation within its jurisdiction and establish sanction mechanism. According to the international law, the coastal State enjoys the sovereignty and right to apply its national law in the territorial waters. In exclusive economic zone (EEZ), the coastal State also has the jurisdiction for protection of marine environment. The

implementation of the jurisdiction of the coastal State varies based on different sea areas (refer to UNCLOS).

1.7.5 Shipowner and ship operator

The shipowner and ship operator (collectively referred to as shipowner) are the direct responsible party to ensure the ship satisfies the requirements of the BWM Convention. The shipowner is to select and provide proper equipment for the ship and get the crew well trained. The shipowner is to ensure the ship is provided with the approved BWMP which is actually implemented so as to ensure that the ship satisfies the relevant requirements of the Convention, especially D-1 or D-2 standard, and requirements for management of sediment at any time. In order to ensure the correct implementation of BWMP, a specific officer is to be designated for each ship to implement relevant duties.

1.7.6 Other parties concerned

(1) Ports and terminals where cleaning and repair of ballast tanks occurs

According to the BWM Convention, the port State authority may be required to provide adequate facilities for the reception of sediments in ports and terminals where cleaning or repair of ballast tanks occurs.

(2) Testing organization

The testing organization carrying out sampling analysis test under the BWM Convention is to be furnished with the qualification and testing capabilities accepted by the Administration or its authorized organization, e.g.: approval, certification and audit by an independent certification organization or to have a strict quality control/quality guarantee plan accepted by the Administration. The testing organization carrying out BWMS type approval test and commissioning test is to be independent of the manufacturer or supplier of the equipment or major parts of the equipment.

(3) Ports or terminals for the reception of ballast water from ships engaged on international voyage
Ports or terminals for the reception of ballast water from ships engaged on international voyage are to be provided with ballast water reception capability or measures in emergency as far as possible.

1.8 Relevant documents of IMO on the implementation of the BWM Convention

In order to achieve the uniform implementation of the Ballast Water Management Convention, IMO developed and adopted 15 guidelines successively after the adoption of the Convention and developed dozens of other related resolutions and circulars which, on one hand, provide the technical and operational guidance for the implementation of the BWM Convention, and on the other hand, provide the unified interpretation for relevant clauses of the Convention. In 2017, IMO published Ballast Water Management -How to Do It, which provided practical information and guidance for Parties of the Convention, flag State Administrations, port State authorities, shipowners, testing organizations, equipment manufacturers, classification societies and other stakeholders.

For easy inquiry of relevant documents, the text of the BWM Convention, list of guidelines and related resolutions and circulars are set out in appendix 1 of the Guidelines.

Chapter 2 Ballast Water Management System

2.1 Technical characteristics of ballast water treatment technologies

2.1.1 Overview

Ballast Water Treatment means physical or chemical treatment of aquatic organisms and pathogens in the ballast water loaded on board before discharge into foreign waters, so that the survival rate of aquatic organisms and pathogens in the ballast water complies with the ballast water performance standards stipulated in regulation D-2 of the BWM Convention and will no longer adversely affect the receiving waters.

The basic treatment methods and technologies used by existing BWMSs can be divided into:

- (1) Mechanical treatment methods (filtration or separation)
- (2) Physical treatment methods (ultraviolet irradiation, cavitation, deoxidation, etc.)
- (3) Chemical treatment methods (antimicrobial agents and chemicals, electrolytic chlorination, advanced oxidation, etc.)

Each technology has its own characteristics that affect its applicability to a particular ship. Most BWMS treatment units take a combination of the above technologies to overcome the shortcomings of one technology.

Typical marine ballast water treatment technologies are shown in Figure 2.1.1.

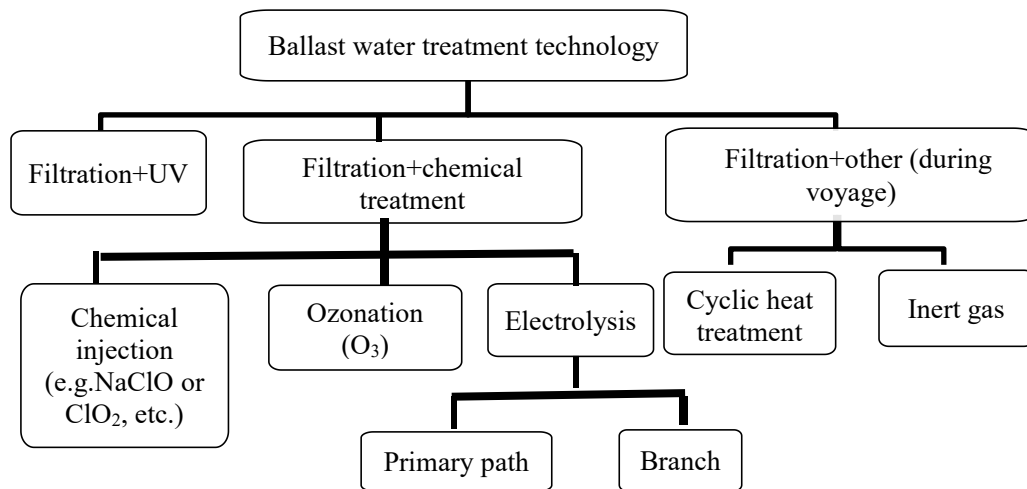


Figure 2.1.1 Typical marine ballast water treatment technologies

2.1.2 Mechanical treatment methods

The mechanical treatment method is to filter all ballast water through a filter or filter membrane, a separator or other forms of separator in the ballast water uptake or discharging process to filter out impurities and organisms above 50 microns or smaller scales to achieve solid-liquid separation. The filtered material will be returned to the ocean (if treated during ballasting) or stored in separate tanks (if treated during voyage). It is characterized as very effective against microorganisms within a certain size range, but it is usually prone to problems such as blocking of the filter, residual storage space and disposal of collected residues on board, and increased discharge resistance of the ballast pump (head). These methods are ineffective against small pathogens and have limited overall treatment capacity, so they are generally only used as an auxiliary means of ballast water treatment

systems, and are commonly adopted as the first treatment process during ballast water uptake.

At present, the typical mechanical treatment equipment mainly includes backwashing filter, rotary flow filter (or rotary separator) and filter membrane. Figure 2.1.2 shows the ballast water filtration (a) and hydrocyclone (b) processes.

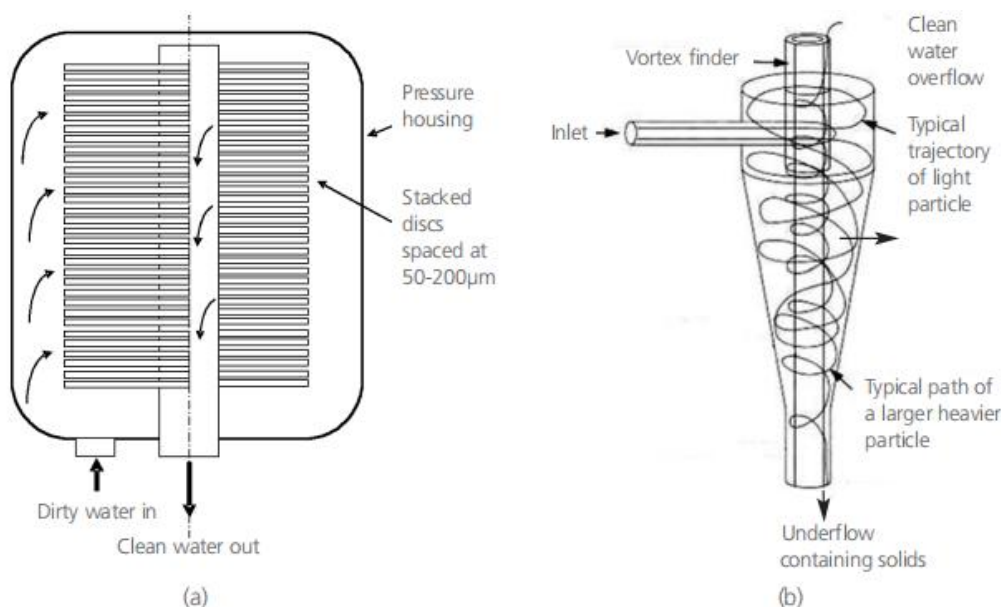


Figure 2.1.2 Filtration (a) and hydrocyclone (b) processes

2.1.3 Physical treatment methods

Typical physical treatment methods are ultraviolet (UV) irradiation, deoxidation (inerting), ultrasonic treatment or heating.

The physical treatment method is to destroy or inhibit the survival conditions of microorganisms and bacteria through processes such as ultraviolet irradiation, ultrasonic treatment, deoxidation or heating to achieve the purpose of killing. It is characterized by being very effective against microorganisms that can be treated and is not harmful to the environment. However, some microorganisms may not be affected by this method and may require additional piping. For heating methods, there may be adverse effects on the cargo carried on board and on pumps and piping used for a long time.

(1) Ultraviolet (UV) irradiation method

Ultraviolet (UV) irradiation method is one of the most widely used physical treatment methods. It uses mercury lamps placed in quartz tubes to produce ultraviolet light of different intensities and wavelengths, which can treat microorganisms of different sizes. UV systems are easy to install and modify, have few safety hazards and can operate in different salinities and temperatures. UV treatment is usually carried out during loading and discharging of ballast water, and its effectiveness is affected by the turbidity of the water, which affects the penetration of UV light. In theory, the UV system is suitable for any ship, but because the power consumption and volume of the UV system increase linearly with the processing capacity, it is mainly suitable for small and medium-sized ships.

that do not need too much ballast water and the ballast pump flow of which is small. Figure 2.1.3 is a schematic diagram of a UV tube.

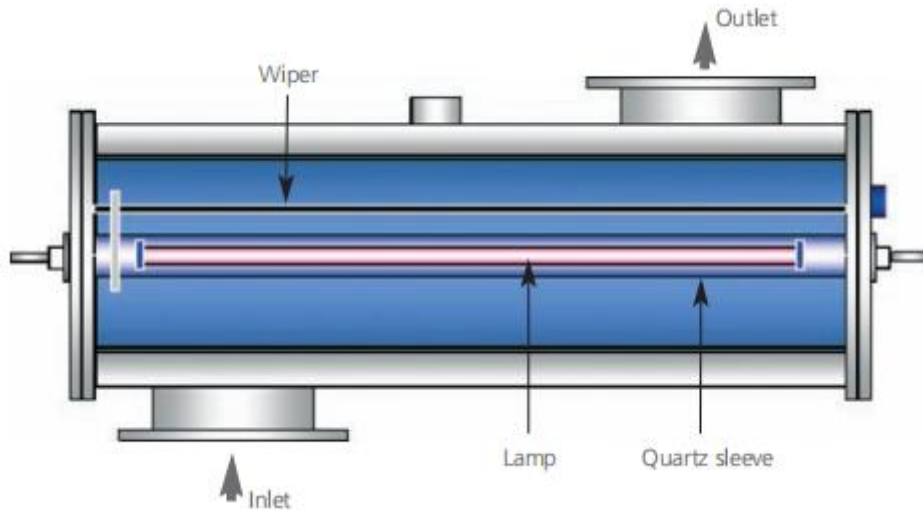


Figure 2.1.3 Schematic diagram of a UV tube

(2) Deoxidation method

Deoxidation treatment is to inject inert gases such as nitrogen into the ballast water to reduce the oxygen content of the ballast water, so that microorganisms suffocate. The deoxidation method may require a certain holding time (such as more than 24 hours) to ensure the killing rate of water organisms. In addition, the ballast tank must have a closed ventilation system to ensure the inerting effect.

(3) Ultrasound or cavitation method

This method acts on the surface of microorganisms, destroys the cell wall through the rupture of cavitation, and achieves the inactivation effect. The effectiveness of ultrasound alone has not been well demonstrated, and chemical methods have been used in some systems to achieve biological inactivation effect.

(4) Heating method

Usually when the temperature is controlled in the range of 38-50 °C, and the ballast water is heated continuously for 2-4 hours, most of the organisms can be killed. However, if the organisms exist in the form of dormant sporocysts, they may not be killed, and may be regenerated under appropriate conditions. Heating a large amount of ballast water consumes a lot of energy, and high temperatures can cause other negative effects such as accelerated corrosion of bulkheads and equipment damage.

2.1.4 Chemical treatment methods

Typical chemical treatment methods include electrolysis (electrochlorination, electrocatalytic oxidation) and chemical injection.

The technical ways of electrolytic chlorine treatment system are mainly divided into two kinds: "electrolysis + neutralization" and "filtration + electrolysis + neutralization". Many electrolytic systems use filtration for pre-treatment. Installation modes include main electrolysis and branch

electrolysis. Electrolytic treatment systems work by electrifying either the branch (1-2% of the total ballast water flow) or the main (all ballast water) of seawater, chemically reacting to produce a hypochlorite active fungicide, which is then injected into the ballast water to kill organisms. Electrolytic system is more suitable for large and medium-sized ships with large ballast water capacity. Electrolysis based treatment systems for the electrolytic operation of ballast water only need to be carried out during ballasting, and appropriate neutralization may be required during deballasting.

Figure 2.1.4(1) shows the schematic diagram of a filter + branch electrolytic system. The system is capable of sterilizing the ship and providing in-tank circulation treatment during the voyage. The by-product hydrogen will be produced in the electrolytic reaction, which needs to be included in the scope of safety considerations and corresponding safety measures are to be in place. The use of electrolytic systems in low-salinity and low-temperature environments has certain limitations, so it is necessary to consider the corresponding measures such as salt adding devices or reserving seawater, and taking heating measures for seawater or brine for electrolysis. The branch electrolytic system requires small amount of electrolytic water, small volume of electrolytic unit and high electrolytic efficiency, so it can easily solve the problems of fresh water ballast and low temperature electrolysis.

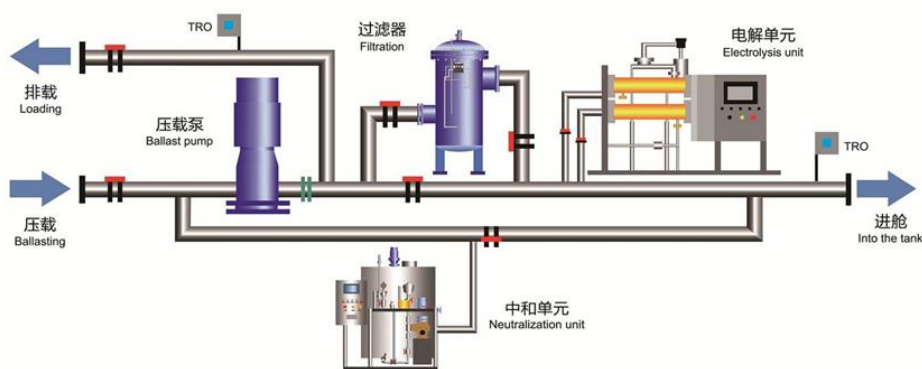


Figure 2.1.4(1) Schematic diagram of a filter + branch electrolytic system

The dosage of the chemical treatment injection system is to be appropriate, usually within a few hours to achieve the killing rate of aquatic organisms, but the ballast water may still contain excessive drug when being discharged, so it is usually necessary to neutralize the drug in the water to ensure that it is harmless to the discharge environment. In addition, if the concentration of drugs in the ballast tank is too high, the risk of corrosion of the ballast bulkheads needs to be assessed.

The electrocatalytic oxidation treatment method mainly uses active oxidizing substances such as hydroxyl free radicals generated by the catalytic reaction to directly contact with the ballast water entering the catalytic reactor to kill microorganisms efficiently and quickly. During deballasting, if

the concentration of active oxidizing substances in the ballast water exceeds the set value, neutralization is required. The electrocatalytic method generally adopts the primary path installation, so as to achieve the direct action of the active oxidizing substance and the organisms in the water, and also to reduce the consumption of the active oxidizing substance in the transmission process. The electrocatalytic system has a wide range of application and can be used on large, medium and small ships. Electrocatalytic system in normal use does not produce by-product hydrogen, so it is relatively safe.

The electrocatalytic system only needs to turn on the electrocatalytic reactor during ballasting, and the neutralization reaction needs to be turned on if the TRO concentration is too high during deballasting. Figure 2.1.4(2) below is a schematic diagram of the ballast principle of a typical filtration + electrocatalysis system. During ballasting, water enters the ballast tank after passing through the filter and the electrocatalytic reactor (EUT). Monitoring device is used for on-line monitoring of oxidizing substance level in water. The process of producing active oxidizing substances is the process of electron transfer, so the electrocatalytic system is limited in a low-salinity environment, and corresponding measures need to be considered to increase the salinity of the water entering the electrocatalytic reactor; adding salt or seawater are both feasible. The electrocatalytic system has no limit on the water temperature and does not require a heating device.

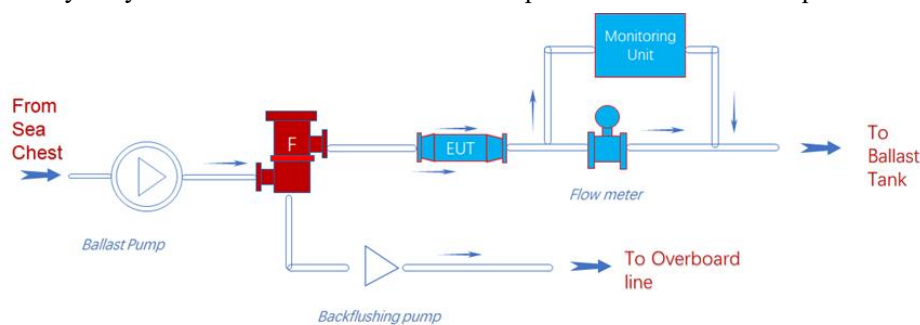


Figure 2.1.4(2) Schematic diagram of the ballast principle of a filtration + electrocatalysis system

2.2 IMO type approval requirements for BWMSs

2.2.1 Overview

Regulation D-3 of the BWM Convention specifies the approval requirements for BWMSs. All BWMSs for compliance with the requirements of the standard of regulation D-2 must be approved by the Administrations of ships in accordance with G8 or the BWMS Code developed by IMO. In addition, BWMSs using active substances require additional approvals from MEPC in accordance with the IMO Procedure for Approval of Ballast Water Management Systems that make use of Active Substances (G9). Type approval is the approval of the performance requirements of the ballast water management system (i.e. the standard of regulation D-2). IMO approval is the approval of environmental acceptability requirements.

2.2.2 Type approval basis for BWMSs

(1) Guidelines for Approval of Ballast Water Management Systems (G8)

In line with the implementation of regulation D-3 of the Convention, IMO has developed the

Guidelines for Approval of Ballast Water Management Systems (G8), which have been published in three versions to date, as shown in Table 2.2.2.

Versions of G8			Table 2.2.2
Resolution No.	Document name	Date of adoption	Remarks
MEPC.125(53)	Guidelines for Approval of Ballast Water Management Systems (G8)	22 July 2005	Revoked by resolution MEPC.174(58)
MEPC.174(58)	Guidelines for Approval of Ballast Water Management Systems (G8)	10 October 2008	Superseded by resolution MEPC.279(70)
MEPC.279(70)	2016 Guidelines for Approval of Ballast Water Management Systems (2016 G8)	28 October 2016	Revoked by the BWMS Code after 13 October 2019

The 2016 Guidelines (G8) adopted by resolution MEPC.279(70) is a comprehensive revision of the Guidelines (G8) adopted by resolution MEPC.174(58); the main differences are as follows:

1) Adding requirements for effective test temperature range

A ballast water temperature range of 0°C to 40°C (2°C to 40°C for fresh water) and a mid-range temperature of 10°C to 20°C is required to assess the effective performance of BWMS. Testing in the above temperature range may be carried out during land-based, shipboard, laboratory or bench-scale testing.

2) Adding the concept of System Design Limitation (SDL) and relevant requirements

During system design, the BWMS manufacturer is required to identify all known water quality and operational parameters that are sensitive to the system design as system design limitations for the BWMS, which are not to be limited to the parameters evaluated in the type approval test and are to be verified by the Administration or RO.

3) Shipboard testing conditions and land-based testing conditions

- ① The requirement for control tank onboard is deleted. Modification has been made to the sampling quantity and methods for shipboard testing. It is specified that the satisfactory evaluation of the ship-board testing is based on three consecutive test cycles in compliance with regulation D-2 in a period of not less than six months. The six-month shipboard test period starts and ends with the completion of a successful test cycle or invalid test cycle that complies with the standard of regulation D-2.
- ② For land-based testing, testing in two salinity ranges has been changed to testing in all three salinity ranges and the salinity ranges also has been changed. Modification has been made to the sampling quantity and methods for land-based testing. The requirement that the treated ballast water is retained for at least five days is deleted. It is up to the BWMS manufacture to specify the minimum retention period.
- ③ In accordance with G9, for BWMS testing processes involving identification of Relevant Chemicals and toxicity testing, the treated ballast water are required to be reserved for at least one test cycle per salinity.

4) Adding requirements for the evaluation of the regrowth of organisms

The evaluation of the regrowth of organisms is required to be undertaken in land-based and/or shipboard testing in at least two test cycles in each salinity.

5) Adding “Self-monitoring” requirements in the Annex

The minimum requirements for self-monitoring parameters are given in detail, including the data to be recorded by all systems and the self-monitoring parameters used, as well as the requirements for data storage and acquisition.

(2) IMO Code for approval of ballast water management systems (the BWMS Code)

On 13 April 2018, IMO adopted the Code for Approval of Ballast Water Management Systems (the BWMS Code) by resolution MEPC.300(72). Resolution MEPC.300(72) made the 2016 Guidelines (G8) adopted by resolution MEPC.279(70) mandatory. The BWMS Code took effect on 13 October 2019. After the BWMS Code took effect, the 2016 Guidelines (G8) adopted by resolution MEPC.279(70) was revoked.

According to the provisions of the BWMS Code, BWMSs installed onboard on or after 28 October 2020 are to be approved according to the BWMS Code while BWMS installed onboard prior to that date are to be approved according to G8 adopted by resolution MEPC.125(53), MEPC.174(58) or MEPC.279(70). Resolution MEPC.300(72) specified that prior to the BWMS Code taking effect, references to the Guidelines (G8) and 2016 Guidelines (G8) in existing IMO instruments should be read to mean references to the BWMS Code. As a result, BWMSs approved taking into account resolution MEPC.279(70) are deemed to be in accordance with the BWMS Code.

2.2.3 Type approval requirements for ballast water management systems (BWMSs)

G8 or the BWMS Code is developed to assist the Administration or its recognized organization (RO) (e.g. classification societies) in evaluating whether a BWMS complies with the standard of regulation D-2, and the approval of a BWMS is to screen out those BWMSs that may not comply with the standard of regulation D-2. However, the approval of the system is not a guarantee that the approved system will work on all ships or in all situations. To be in compliance with the Convention, ballast water discharges must comply with the standard of regulation D-2 throughout the ship's life cycle.

The BWM Convention requires that a BWMS in compliance with the standard of regulation D-2 must be safe for the ship, equipment and crew. In addition, G8 or the BWMS Code contain many technical provisions that a BWMS should comply with to obtain type approval, including general principles such as that a BWMS is to effectively meet the standard of regulation D-2 and be environmentally safe. The design of the BWMS is to account for the fact that, regardless of the BWMS technology employed, viable organisms remaining after treatment may reproduce in the interval between treatment and discharge. The technical provisions also address matters such as design and construction reliability, safety factors and risk reduction measures, maintenance arrangements, calibration and monitoring arrangements (including a self-monitoring system to verify the correct operation of the system).

The type approval of the ballast water management system is divided into two stages: "land-based testing" and "shipboard testing". IMO approval consists of two stages: basic approval and final approval. For ballast water management systems (BWMSs) using active substances, there is a time-node sequence between the type approval of the Administration or RO and IMO approval. The basic process for type approval and IMO approval of ballast water treatment systems is detailed in Figure 2.2.3.

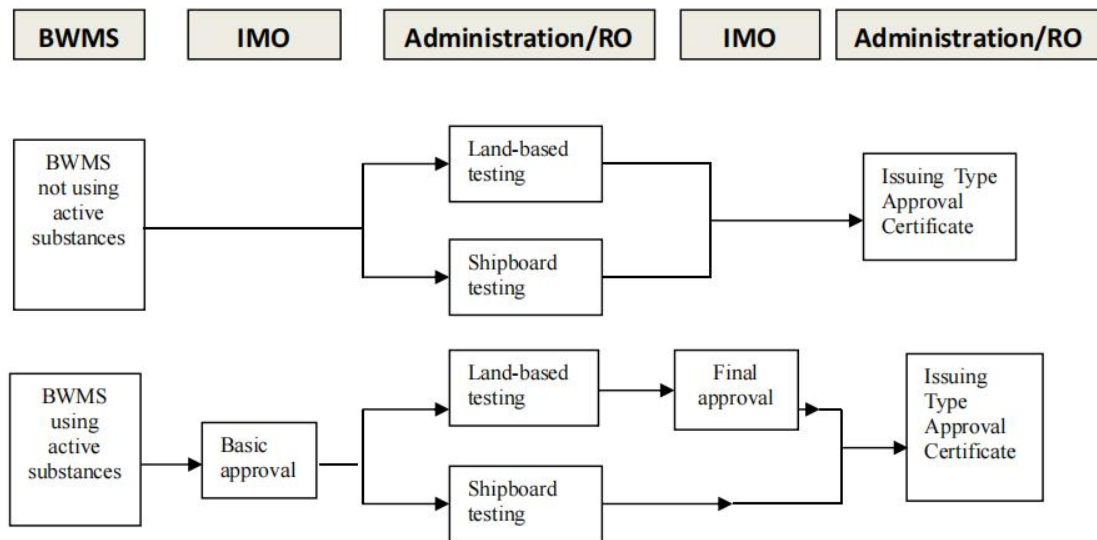


Figure 2.2.3 Flowchart for approval for ballast water management system

For detailed requirements for type approval of BWMSs, refer to CCS Guidelines for Type Approval of Ship's Ballast Water Management Systems (2022).

2.2.4 Identification of System Design Limitations (SDL)

System Design Limitations (SDL) means the water quality and operational parameters, determined in addition to the required type approval testing parameters, that are important to its operation, and, for each such parameter, a low and/or a high value for which the BWMS is designed to achieve the performance standard of regulation D-2. SDL refers to the physical and/or operational limitations inherent in the design of the BWMS itself, and the manufacturer integrates the SDLs into the self-monitoring system of the BWMS where appropriate and practical.

SDLs are the BWMS-specific water quality parameters (environmental factors) and/or operational parameters (arising from the BWMS design). SDLs are to be relevant to the operation of ships, and may be displayed, monitored, recorded and alarmed by the BWMS self-monitoring system. For BWMSs of different working principles, their SDLs also vary greatly. Table 2.2.4 is the List of potential System Design Limitations and related self-monitoring parameters.

List of potential System Design Limitations and related self-monitoring parameters

Table 2.2.4

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements/related information
		Environmental/water quality parameters	Technical/operational parameters		
Filtration	- Removal of particles and organisms greater than the filter mesh size (disk, basket, candle, etc.) - Automatic cleaning	- Suspended solids (size, quality, quantity) - Salinity and temperature	- Maximum flow rate - Minimum backwash pressure	- Flow rate - Inlet/outlet pressure or differential pressure(dP) - Minimum backwash pressure	- Mesh size or retention threshold (nominal or absolute) - Filtration capacity (flow rate) - Cleaning capacity (backflush) - Number or

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements/related information
		Environmental/water quality parameters	Technical/operational parameters		
					frequency of backwashes or cleaning cycles
Hydrocyclone	- Gravitational separation of particles by centrifugal force (removal of organisms)	- Suspended solids (specific gravity, quantity) - Salinity and temperature	- Minimum and maximum flow rate	- Flow rate - Inlet/outlet pressure	- Capacity - Separation percentage
Ultraviolet (UV) irradiation	- UV irradiation (low pressure / medium pressure) damages cells	- UVT - Salinity and temperature	- UVI - Minimum and maximum flow rate - Minimum holding time	- UVI, UVT, and/or UV dose - Power, or current and voltage - Minimum and maximum flow rate	- UV dose high/low value - irradiation time
Electro-chlorination	- Generation of Active Substance through electrolysis of seawater (electric current)	Salinity and temperature, or conductivity, of the electrolytic feedwater and/or the ambient water to be treated	- Active Substance dose (quantity or concentration) - Maximum flow rate - Minimum holding time	- Power, or current and voltage - Active Substance dose, TRO, and/or ORP - Feedwater (side stream, or full flow) conductivity, or salinity and temperature - Flow rate - Holding time	- Active Substance production rate - Active Substance concentration
	- Neutralizing agent may be used (as per Procedure (G9) requirements)	- Salinity and temperature	- Neutralization dose - Maximum flow rate	- Neutralizing agent flow rate or quantity - Flow rate - Active Substance concentration at discharge	- Neutralizing agent storage quantity and dosing rate
Chemical injection (e.g. ozone, sodium hypochlorite, ClO ₂ , etc.)	- Storage or generation of Active Substance and injection of	- Salinity and temperature	- Active Substance dose (quantity or concentration) - Maximum flow rate - Minimum holding	- Power, or current and voltage - Temperature of ozone	- Active substance production rate, storage quantity, and/or dosing rate

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements/related information
		Environmental/water quality parameters	Technical/operational parameters		
	the created biocide in ballast water		time	generator - Active Substance dose - Salinity and/or water conductivity - Water temperature - Flow rate - Holding time	
	- Neutralizing agent may be used (as per Procedure (G9) requirements)	- Salinity and temperature	- Neutralization dose - Maximum flow rate	- Neutralization agent flow rate or quantity - Flow rate - Active Substance concentration at discharge	- Neutralizing agent storage quantity and dosing rate
Heat	- Disruption of chemical bonds, denaturing of enzymes and structures through heat energy	- Salinity and temperature	- Temperature range and minimum holding time - Maximum flow rate	- Temperature and holding time - Flow rate	- Heating capacity
Cavitation	- Cell membrane is damaged by shear forces	- Salinity and temperature	- Minimum differential pressure - Inlet and outlet pressure - Maximum flow rate	- Differential pressure - Flow rate	- Available differential pressure
Ultrasound	- Ultrasound waves generate cavitation bubbles in water resulting in intense shear forces and high stress to cell membranes	- Salinity and temperature	- Minimum ultrasound power - Maximum flow rate - Minimum exposure time	- Power, or current and voltage - Flow rate	- Frequency, amplitude and exposure time of ultrasound delivery
Deoxygenation	- Inert gas injection or creation (e.g. CO ₂ or N ₂) to reduce the available	- Salinity and temperature	- Minimum inert gas purity (in %) - Minimum injection rate - Minimum holding time	- Dissolved oxygen content - Inert gas purity (%) - Injection rate	- Inert gas production rate and purity - Rate of gas injection and mixing

Technology	Principles	Potential SDL		Control and monitoring parameters seen in BWMS	Design elements/related information
		Environmental/water quality parameters	Technical/operational parameters		
	oxygen for organisms in water			- Holding time	
In tank treatment systems – chemicals	- Application of Active Substance into ballast water tanks	- Salinity and temperature - As appropriate for the Active Substance in use	-Minimum uniformity of tank mixing -Minimum holding time per tank	- Active Substance dose or concentration in tank - Holding time	- Mixing device placement - Circulation flow rate/volume - Holding time
	- Neutralizing agent may be used (as per Procedure (G9) requirements)	- Salinity and temperature	- Neutralization dose	-Neutralizing agent flow rate or quantity - Active Substance Concentration in ballast tank	-Neutralizer storage quantity and dosing rate
In tank treatment systems – non-chemicals	- Application of mechanism into ballast water tanks	- Salinity and temperature -As appropriate for the treatment mechanism in use	- Fraction of the tank water being circulated - Minimum uniformity of mechanism application - Minimum holding time per tank	- Measurement of mechanism to the ballast tank or in the ballast tank - Holding time	-Mixing device placement - Circulation flow rate/volume - Holding time

The determination of the specific value of each parameter of SDL requires a large number of tests, and after obtaining the approximate range of values, they are verified by land-based testing and shipboard testing, including the use of existing data and/or models. Appropriate verification methods are to be adopted for SDLs of BWMSs with different treatment technologies.

2.2.5 BWMS product transformation and upgrading type approval

For existing BWMS products approved according to the Guidelines (G8), after upgrading and applying for type approval according to the BWMS Code, the following requirements are to be paid attention to:

- (1) Analyzing and identifying the differences between the type approval requirements when the existing products were previously certificated and the BWMS Code (resolution MEPC.300(72));
- (2) Identifying major components of existing products that need to be updated, major components meaning those components that directly affect the ability of the system to meet the ballast water performance standards described in regulation D-2 of the BWM Convention;
- (3) Based on the above difference analysis and the sorting out of major components, developing a test plan, which is to cover all major components that need to be updated. After the major components are changed, the land-based testing and shipboard testing are to be re-conducted;
- (4) For the existing components that have not been replaced, the manufacturer's inspection test records are to be provided;
- (5) Allowing replacement of non-major components of the same specifications (independently approved according to recognized or equivalent operational standards). Replacement of non-major components are to be reported.

In view of the previous type approval tests of the existing products, additional type approval tests are

carried out as per the test plan according to the BWMS Code, and the previous valid test data can continue to be used without repeated tests. Applicants may submit only additional test reports and related documents.

2.3 Type approval requirements of USCG for BWMSs

2.3.1 Overview

On 23 March 2012, the United States Coast Guard (USCG) issued the final rule for the Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters (CFR 33 Part 151 and CFR 46 Part 162). Its discharging standards are identical to IMO standard of regulation D-2. For ships that install BWMSs for ballast water treatment before discharge to meet 33 CFR part 151, such BWMSs are to be type approved by the USCG in accordance with 46 CFR Part 162.

For details of the USCG ballast water discharge rules and the type approval of BWMSs, see "Federal Register 33 CFR Part 151 / 46 CFR Part 162". Website: <http://www.gpo.gov/fdsys/pkg/FR-2012-03-23/pdf/2012-6579.pdf>.

2.3.2 Differences between USCG and IMO on type approval of BWMS

There are differences on the type approval requirements of BWMSs between the Guidelines (G8) and the BWMS Code of IMO and the type approval requirements of the USCG. In general, the biggest difference lies in the "biological treatment effectiveness evaluation method". IMO defines biological viability as "having the ability to reproduce". The USCG uses "dead/live" as a criterion, leading to differences in acceptable test methods. The ETV protocol used by USCG specifies the test methods permitted for various tests; the 2016 Guidelines (G8) (resolution MEPC.279(70) of IMO does not specify test methods. In the 2016 Guidelines (G8)/BWMS Code, "Guidance on Methodologies that may be used for enumerating viable organisms for type approval of ballast water management systems" (BWM.2/Circ.61/Rev.1) is supplemented. The overall comparison is shown in Table 2.3.2:

**Main differences between USCG BWMS approval requirements
and IMO BWMS approval requirements**

Table 2.3.2

	IMO requirements (G8)	IMO requirements(the revised G8/the BWMS Code)	USCG requirements
BWMS type approval	Administration or RO	Administration or RO	USCG
Type approval standard	G8(MEPC.174(58))	G8(MEPC.279(70))/BWMS Code	46 CFR.162.060
Test laboratory	Any competent laboratories	Independent laboratories	Approved independent laboratories
Test operator	BWMS manufacturers	Independent laboratories	Independent laboratories
Reporting of test results	Manufacturers or laboratories	Independent laboratories	Reported to the USCG by independent laboratories
Determination on the biological treatment efficacy(viable)	Reproductive	Reproductive	Dead/live
UV technical analysis (for analysis of organism of 10-50um)	MPN(Most Probable Number) is accepted	BWM.2/Circ.61/Rev.1	MPN is not accepted
Impact of temperature on the operation effectiveness of BWMS equipment	No mandatory requirements	Testing is carried out in the temperature range of 0°C to 40°C to evaluate the effectiveness of BWMS	Testing is carried out in the temperature range of 4°C to 35°C
Requirement for System Design Limitation (SDL)	No mandatory requirements	Adding the evaluation requirements for SDL	SDL is not specified in 46CFR162.060; however, TRC and operational limitations are specified in the certificate

	IMO requirements (G8)	IMO requirements(the revised G8/the BWMS Code)	USCG requirements
Requirement for environmental testing	Environmental test items complying with IACS UR E10	Adding other environmental test items complying with IACS UR E10	According to the test sequence specified in 46CFR162.060-30
Requirement for shipboard testing	Five consecutive successful test cycles in a period of not less than six months	Three consecutive successful test cycles in a period of not less than six months	Five consecutive successful test cycles in a period of not less than six months; all ballast water needs to be treated before being discharged
Minimum retention period for land-based testing	5 days	Less than 5 days is allowed as per the BWMS manufacturer	≥ 24 hours
Evaluation of biological reproduction capability	No mandatory requirements	Evaluation of biological reproduction capability is required	No mandatory requirements

2.4 BWMS product certification at home and abroad

According to the latest information published on the IMO website, as of July 2023 (MEPC 80), there are a total of 63 BWMS worldwide that have received IMO basic approval for the use of active substances, of which 51 have received IMO final approval. There are 55 BWMS products approved under the 2016 Guidelines (G8) (resolution MEPC.279(70)) or the BWMS Code (resolution MEPC.300(72)), and 78 BWMS products approved under the Guidelines (G8) (resolution MEPC.125(53) or resolution MEPC.174(58)).

As of 31 December 2023, there are 14 domestic BWMSs approved by CCS on behalf of the Chinese Administration, and 52 domestic and foreign BWMSs approved by the USCG, of which 7 are manufactured by Chinese product manufacturers. A summary of information on Chinese BWMS products approved by CCS, global products approved by the USCG and BWMS products approved by various Administrations worldwide in accordance with the BWMS Codes or the 2016 Guidelines (G8) is set out in Appendix 2.

Chapter 3 Selection and Installation of BWMS

3.1 Selection of BWMS

3.1.1 Overview

The selection and use of BWMS involves various aspects. For any specific ship, the selection of BWMS is directly or indirectly related to factors such as the operating characteristics of the ship, treatment requirements for ballast water, compartment spaces for treatment equipment, total capacity of ballast tank, capacity of ballast pump, power supply, and requirements for coordination and operation with other ship systems. Each ballast water treatment technology has its own limitations. For example, the electrolysis of sea water has certain requirements for the salinity of ballast water. The treatment by ultraviolet light would be impacted by the turbidity of water. Some treatment systems are too huge in volume. Some treatment systems are too power-consuming. For some chemical methods and deoxidization methods, the ballast water needs to be preserved in the tank for certain duration to achieve the predicted killing rate.

Based on the above reasons, there is no obvious experience that proves a certain type of BWMS can apply to all ship types. Many BWMS treatment technologies are a combination of two or more technologies so as to give full play to the advantages of various ballast water treatment technologies and avoid their limitations. In fact, the selection and installation of BWMS is a comprehensive project, which is constrained by factors including ship features, treatment technology and system treatment capacity.

The following factors are to be considered in a comprehensive manner for selection of BWMS:

- (1) ship features;
- (2) BWMS features;
- (3) arrangement and maintenance;
- (4) others.

3.1.2 Ship features

(1) Ship type and its ballast demands

In most cases, ship type is the determinant for selection of an appropriate BWMS. Different ship types differ in their ballast capacity and ballast water pump flow. The total ballast capacity of ships and requirements for ballast water discharge and uptake capacity at different ports are also different. The dependence on ballast water for some ship types such as oil tankers and bulk carriers is high while that for ships such as container ships is low. For ships with a high dependence on ballast water, full ballast navigation is generally required when ships are empty loaded (without cargo). Their ballast water pumps are designed to uptake or discharge all ballast water within a certain period of time to adapt to the quick port turnover cycle. Ships with a lower dependence on ballast usually have smaller ballast capacity and barely engage in full ballast navigation (without cargo). Their ballast water operations are very limited to the transfer from one compartment to another or adjustment of trim and list. Ballast water uptake or discharge within certain period of time is not needed.

Some ships may be provided with two or more ballast systems. For instance, some oil tankers are fitted with two ballast systems, one in the cargo spaces (hazardous area) and one in the engine room (safety area). Some ships also use eductors to discharge the residual ballast water. For the ballast water management system in hazardous areas, considerations are to be given to the hazardous level of the space in which it is located, and fire and explosion protection are generally required. BWMS demanding aftertreatment may not be applicable to ships discharging the residual ballast water by eductors. BWMS demanding aftertreatment, in general, are not applicable to ships discharging the ballast water by gravity.

(2) Ship route

Ship route is also another factor to consider for selection of BWMS. At present, some countries or regions have adopted unilateral actions other than IMO standards for ballast water management, such as the United States. Relevant requirements are to be considered for ships that may moor

alongside ports with unilateral discharge requirements. Avoiding ballast water discharge through ballast water management methods or using onshore reception facilities may be economically efficient for some small ships or ships with small discharge.

The turbidity, salinity and sediment content of water have a certain impact on the effect or maintenance of some treatment technologies. For example, the impact of turbidity and sediment content of water is to be considered when selecting BWMS for ships often mooring alongside ports with high sediment contents in water. The impact of salinity is to be considered when selecting BWMS for ships often mooring alongside inland ports or ports of low salinity.

The impact of sediments within the ballast tank is also to be considered. The sludge containing invasive species may contaminate the uptake of ballast water, which requires treatment of ballast water during the uptake or discharge of ballast water. Therefore, regular removal of sediments is of crucial importance.

3.1.3 Features of BWMS

As is described in Chapter 2 above, ballast water treatment technologies are various in number with their own features. The ballast water treatment technologies may be verified to meet D-2 standard subject to type approval, but this does not guarantee that all BWMSs can work normally and meet D-2 standard onboard all ships or under all circumstances. Therefore, the BWMS is to be selected considering specific factors such as the ship design, operating characteristics and route. The following aspects are to be considered for selection of BWMS:

(1) Size of BWMS

In general, the treatment capacity of BWMS is to be equal to or slightly larger than the maximum flow rate of the ballast water pump to ensure that the operation of BWMS will not exceed its Treatment Rated Capacity (TRC). The size of BWMS is directly determined by the treatment capacity of BWMS. Different BWMSs differ in the shape and size. Some BWMSs require the fitting of branch piping from ballast piping, whose impact may be more significant than installation of BWMS. The space arrangement of BWMS may be taken into comprehensive consideration during design stage for newbuildings. The installation of BWMS on existing ships may be a challenge due to limited space. BWMS manufacturers may be consulted for spatial sizes of different BWMS.

In addition, considerations are to be given to appropriate maintenance access to the BWMS installed, including ladder, platform, illumination, crane runway, lifting eye and spaces for cleaning internal parts and storing and disposing consumables (this space may also be outside the engine room), as well as the fire protection system and ventilation system needed by the spaces.

(2) Treatment capacity of BWMS

The selected BWMS is to ensure the capacity for treatment of the maximum flow rate of ballast water. However, for ships not in need of treatment of huge quantity of ballast water such as semi-submerged ships, BWMS with relatively smaller treatment capacity may be selected to reduce the purchase, operation and maintenance costs of BWMS.

(3) Pressure drop of BWMS

The installation of some BWMS may result in drops in flow rate and pressure of ballast water. The removal of filtered materials by some automatic washable filters or hydrocyclones may result in about 10% loss in pressure head and flow rate. For BWMS adopting full circulation treatment of ballast water, the backpressure will usually increase with an impact on the flow rate of ballast water pump, which will result in prolonged time in ballast operation and consumption of more power. Therefore, for selection of BWMS, considerations are to be given to the possible pressure drop during the operation of the system.

(4) Power of BWMS

Power consumption of the system is to be considered for selection of BWMS. For existing ships in particular, additional power requirement is a huge constraint for selection of BWMS. Some existing ships may not withstand an excess of additional power consumption. Therefore, the power margin of ship power station is to be estimated in advance for selection of BWMS to confirm that existing power generation equipment can meet the additional power requirements.

(5) IP grade and explosion protection of BWMS

The IP grade and fire rating of BWMS and its materials are to comply with the classification society's requirements. Special attention is to be paid to the explosion protection of BWMS installed in hazardous spaces. For example, the equipment installed in the cargo pump room must be certified safe type electrical apparatus. However, there is no explosion protection requirement for equipment installed in engine room.

According to 1.3.2.2, Chapter 1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships, the type of protective enclosures selected for electrical equipment supporting BWMS is to be appropriate to the condition of the location at which such equipment is installed. Attention is to be paid to relevant explosion protection requirements during installation of BWMS on oil tankers, tankers and other ships carrying dangerous goods. Appropriate explosion protection types of electrical equipment are to be adopted when BWMS is installed in hazardous areas.

3.1.4 Arrangement and maintenance

The arrangement and maintenance of BWMS onboard the ship is another key factor for selection of BWMS, especially for existing ships. Therefore, smooth installation of BWMS onboard the ship is to be ensured and follow-up maintenance is also to be considered for selection of BWMS. The following factors are generally to be considered:

(1) Ship information

Spatial position suitable for installation of BWMS onboard the ship (e.g. the arrangement plans for engine room, pump room and whole ship) and the provision of the ship's ballast water system (e.g. ballast water piping plan) are to be available to evaluate the installation position for BWMS onboard the ship. Relevant information from the above-mentioned plans may directly influence the installation positions of equipment and configuration requirements of the system for smooth installation.

(2) Application of existing ballast system

Existing ballast system onboard the ship is to be given into full play for selection and arrangement of BWMS on existing ship, so that BWMS can work perfectly with existing ballast water system with simplified conversion of BWMS and convenient maintenance in the future.

(3) Sampling

The installation of sampling unit is to be considered in advance for BWMS arrangement to serve purposes including inspections by authorized officers from port States or Administrations. The locations for sampling and the arrangement of sampling unit are to comply with relevant requirements in IMO Guidelines for ballast water sampling (G2) and BWM.2/Circ.42 /Rev.2 or PSC sampling analysis and inspection.

(4) Control and monitoring

A main control panel is provided near equipment for most BWMS to facilitate operations near the equipment and monitoring of the system. The shipowner may require a combination of the main control panel, alarm system and monitoring system for better management. The control and monitoring equipment of BWMS are to comply with requirements in resolution MEPC.279(70) or resolution MEPC.300(72).

(5) Maintenance

The maintenance requirements such as the replacement frequency of relevant parts and the convenience of operations in the future are to be considered for selection of BWMS. The reliability of complicated BWMS is relatively impacted. The system with a high reliability and low maintenance requirements can both relieve the burden of maintenance on the crew and reduce the cost of system maintenance.

3.1.5 Miscellaneous

(1) Corrosion of ballast tank and piping

Some ballast water treatment technologies may change the chemical components in ballast water or atmospheric compositions in ballast tank. Incorrect design and operations of these technologies may destroy the ballast tank coatings and accelerate the corrosion of ballast tank and piping. Therefore,

this factor is to be considered for selection of treatment system.

(2) Storage of dangerous chemicals

The active substances used by BWMS include chemicals such as ozone, hydrogen peroxide, chlorine dioxide and peracetic acid, which have increased the risks to both the health and safety of the crew and the environment. Different port authorities may have different requirements for the concentration of active substances in the ballast water discharged. This factor is to be considered, especially for ships often navigating in sensitive areas. The training on the crew's skills and safety risk treatment capabilities is also to be considered for selection of this type of BWMS.

(3) System purchase and maintenance cost

The operating cost is also to be considered apart from the purchase cost. The operating cost covers energy consumption, consumption of stored chemicals (active substances), spare parts consumption, training, etc.

3.2 Installation and commission of BWMS onboard the ship

3.2.1 Installation of BWMS

Correct installation of BWMS onboard the ship is the premise to ensure that the ballast water after treatment by BWMS meets the D-2 standard. In addition, the installation of BWMS is not to bring any safety risk to the ship, crew or environment. Basic requirements for installation of BWMS onboard the ship following type approval are provided in 2016 Guidelines for Approval of Ballast Water Management Systems (G8) and the updated BWMS Code as follows:

- (1) Treatment Rated Capacity (TRC) of BWMS is to match with the rated capacity of the ballast pump serving BWMS, to ensure that the flow rate of ballast water does not exceed the TRC of BWMS;
 - (2) The monitoring and alarm of BWMS are to comply with relevant requirements;
 - (3) BWMS is to provide sampling facilities as required;
 - (4) The location BWMS is to be easily accessible for inspection and maintenance with enough space for cleaning and renewal of components;
 - (5) Suitable bypasses or overrides to protect the safety of the ship and personnel are to be installed and used in the event of an emergency and any bypass or override of the BWMS is to activate an alarm. The bypass or override event is to be recorded by the control and monitoring equipment.
- These requirements are all closely connected with the factors to consider for selection of BWMS mentioned above.

International Association of Classification Societies (IACS) have also developed unified requirements for installation of BWMS in UR M74 with two amendments, among which UR M74 (Rev.2) came into force on 1 July 2022. In addition, UR F45 on requirements of additional fire safety measures for BWMS was also developed by IACS to avoid any possible safety risk caused by installation of BWMS on the ship. Requirements of IACS UR M74 (Rev.2) and UR F45 have been incorporated into Chapter 26, PART EIGHT of CCS Rules for Classification of Sea-going Steel Ships.

3.2.2 Matters needing attention for installation of electrolytic BWMS on tanker

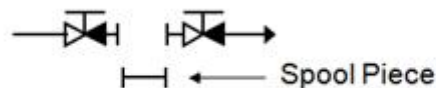
Given the classification of hazardous areas of tankers carrying cargo oil or chemicals having a flash point not exceeding 60 °C, special considerations are to be given to the safety level, safety risk, location of installation on the ship and piping arrangement of the BWMS to be installed on this type of tanker.

The electrochlorination process of BWMS will produce the hazardous gas of hydrogen (H₂). Therefore, the following aspects are to be considered for the installation location of BWMS on the tanker:

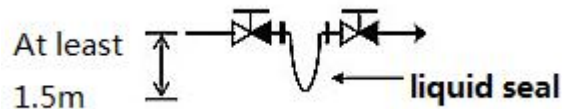
- (1) Where the BWMS with electrochlorination process is installed within safety area, forced mechanical ventilation system of sufficient capacity is to be fitted in spaces within the safety area. Where it is installed in hazardous area, the ventilation system in the area is to comply with corresponding requirements such as IEC 60092-502, IBC Code and IGC Code.

(2) A gas detector with audible and visual alarm is to be fitted in the spaces where BWMS is installed. A monitoring and measuring device with independent shutdown is to be fitted where a gas removal unit or device is used. This shutdown function demands a system unit, which is an independent control and alarm system and the same equipment. An independent shutdown function is required so that the system will be shut down by the independent shutdown function (with independent sensor, cable, controller or relay) once hazardous gas is detected apart from the control and monitoring system (main PLC). This independent shutdown may be based on the relay connected to the circuit, triggered by signals from an independent sensor. This shutdown function is not to be influenced by the malfunctions of BWT control and tested in functional test.

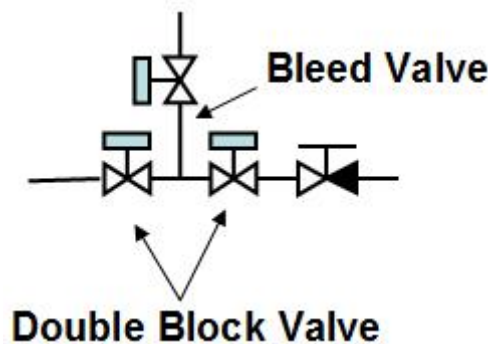
(3) Where appropriate isolation arrangements are fitted in interconnections between the ballast piping in hazardous area and ballast piping in safety zone of the tanker, only one BWMS may be acceptable for treatment of the ballast water from the hazardous area and safety zone. The isolation arrangements are to comply with the requirements of IACS UR M74 (Rev.2) or requirements for BWMS installation in Chapter 26, PART EIGHT of CCS Rules for Classification of Sea-going Steel Ships. Aforementioned suitable isolation arrangements are to be provided on the weather deck in cargo area and the arrangements in the following three figures are acceptable:



① Two non-return valves with positive means of closing in series with a spool piece, or



② Two non-return valves with positive means of closing in series with a liquid seal at least 1.5 m in depth, or



③ Automatic double block and bleed valves and a non-return valve with positive means of closing.. Figure 3.2.2 is a sketch map for arrangement of BWMS shared by safety and hazardous areas in tankers (take BWMS of electrolytic process as an example).

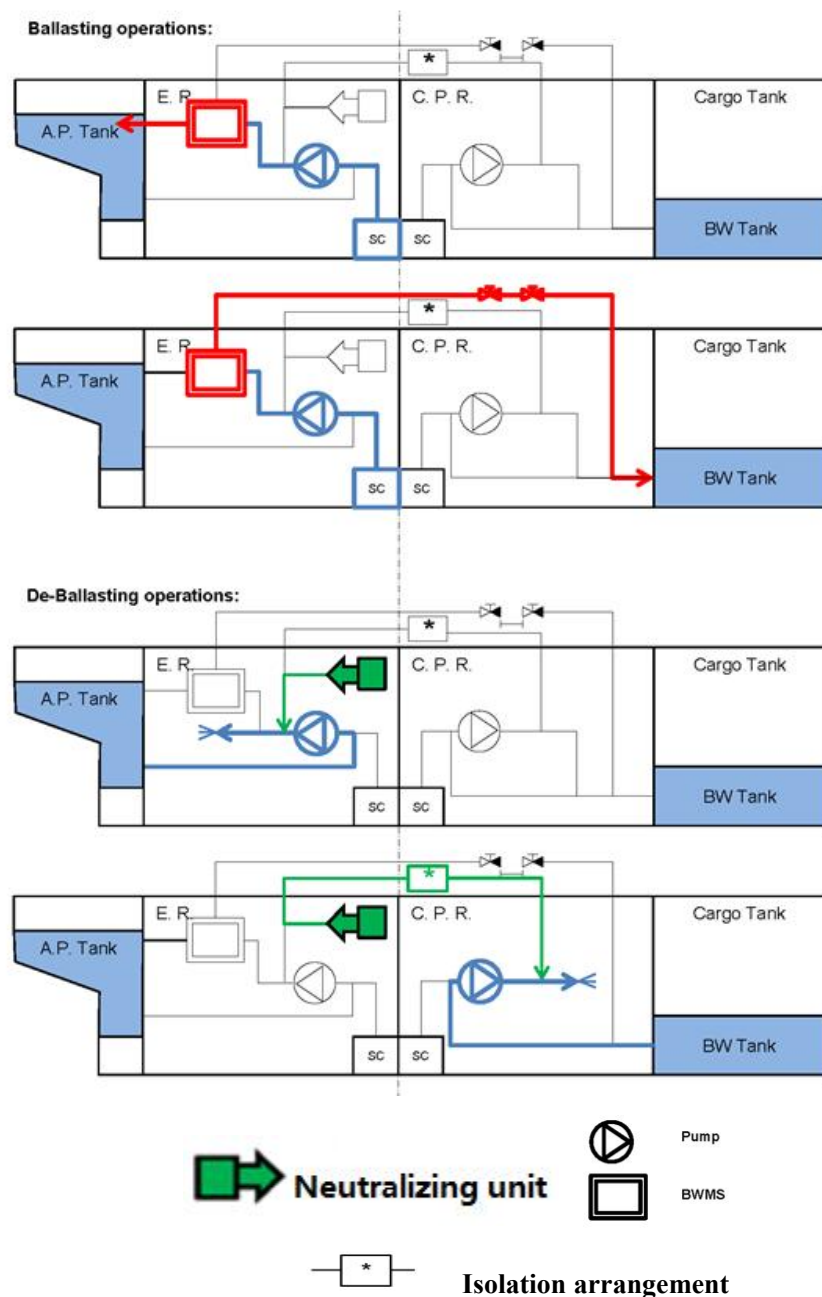


Figure 3.2.2 Sketch map for arrangement of BWMS (electrolytic process) shared by safety and hazardous areas in tankers in the engine room

3.2.3 Commissioning of BWMS

Sufficient testing of BWMS is to be carried out after installation to ensure normal and steady operation of BWMS. The BWMS commissioning procedure is to be carried out in accordance with the specification or technical manual provided by the BWMS manufacturer. Different BWMS may demand different commissioning procedures. The commissioning of BWMS (electrolytic process) mainly includes commissioning preparation, inspection of equipment installation and wiring status, system wiring check, electrification for the first time, instrument initialization setting, alarm

elimination and failure treatment, functional test of equipment, system signal check, dock test and sea trial test, onsite data recording and judgment of qualified commissioning:

- (1) Commissioning preparation: prepare the project plan procedure before the commissioning of the project and bring debugging tools;
- (2) Inspection of equipment installation and wiring status: board the ship to check the installation and appearance of the equipment and check the integrity of system piping and wiring;
- (3) System wiring check: check the system wiring in accordance with the electrical systematic drawing and electrical wiring drawing to ensure correct wiring;
- (4) Electrification for the first time: ask the crew for power transmission after wiring check, confirm the power supply and electrify in the control box in turn;
- (5) Commissioning of manual interface: initialize the instrument after power on, eliminate alarms and process failures and confirm whether each part of the equipment functions normally;
- (6) System signal check: confirm whether control, feedback and status signals of the system are accurate and check peripheral signals of GPS and ballast pump;
- (7) Manual water connection test: carry out manual water connection test, check whether there is water leakage and confirm the normal function of each part of the system;
- (8) Automatic operation test: the automatic ballast/deballast mode test of the system ensures normal operation of the system, normal data and no triggering of equipment alarm. Check whether the logic of control actions of each system part is normal. During this process, the indicative sampling analytical method is to be adopted to verify that the ballast water after BWMS treatment meets the D-2 standard;
- (9) Test of alarm point: check whether the system alarm point can be triggered normally and carry out the test to trigger key alarm points;
- (10) System data record: check and file the system operation data.

The onsite installation and commissioning procedure for BWMS equipment (electrolytic process) is shown in Figure 3.2.3 below.

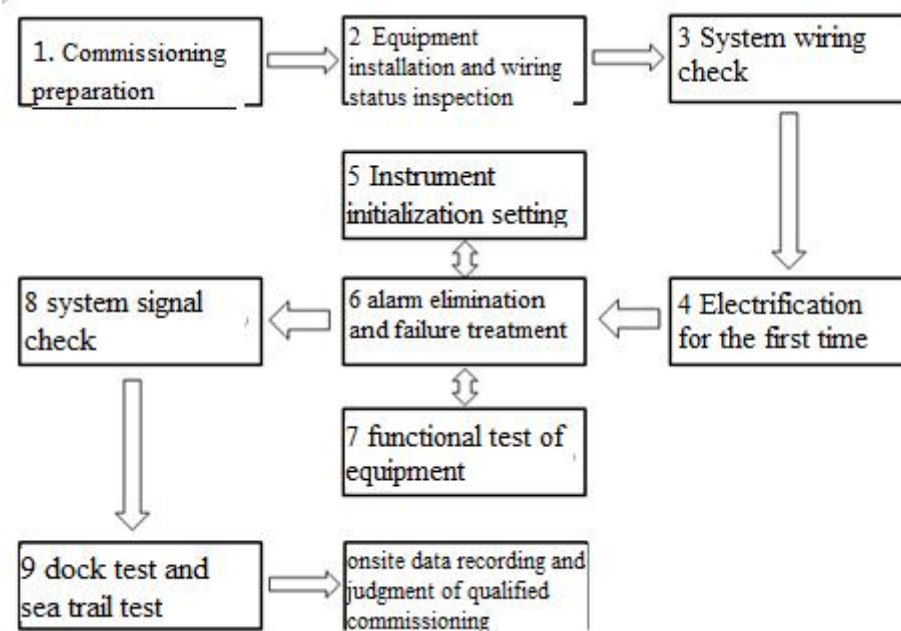


Figure 3.2.3 Onsite installation and commissioning procedure for BWMS equipment (electrolytic process)

3.2.4 Requirements for BWMS commissioning test

According to regulation E-1 of Amendments to International Convention for the Control and Management of Ships' Ballast Water and Sediments (resolution MEPC.325(75)), the indicative sampling analysis is to be carried out to ballast water treated by BWMS under normal operating conditions to verify the conformity with the D-2 standard. The whole installation and commissioning process can only be successfully completed with the conformity with the D-2 standard and other satisfactory commissioning data. This commissioning test procedure is to be carried out in accordance with the 2020 Guidance for the commissioning testing of ballast water management systems (IMO circular BW.M.2/Circ.70/Rev.1) and the relevant requirements are as follows:

(1) Local ambient water should be used for testing regardless of the level of challenge it poses to the BWMS. In the case that the ambient water is not appropriate for the commissioning testing (e.g. salinity of ambient water is outside the system design limitations of the BWMS), testing should be evaluated to the satisfaction of the Administration.

(2) A sample may be collected during ballast water uptake, and an indicative analysis may be undertaken to characterize the ambient water, by any means practical (e.g. in-line sample port or direct harbour sample).

(3) A representative sample should be collected during the corresponding ballast water discharge after the full treatment has been applied. Samples should be collected from the sampling point as described in the Guidelines on ballast water sampling (G2). The total sample volume should be at least 1 m³. If a smaller volume is validated to ensure representative sampling of organisms, it may be used.

(4) The representative samples should be analysed for the two size classes of organisms, namely $\geq 50 \mu\text{m}$ and $\geq 10 \mu\text{m}$ to $< 50 \mu\text{m}$, as specified in the D-2 standard, using indicative analysis methods listed in BW.M.2/Circ.42/Rev.2, as may be amended.

(5) The applicable self-monitoring parameters (e.g. flow rate, pressure, TRO concentration, UV transmittance/intensity, etc.) of the BWMS should also be assessed, taking into account the system design limitations of the BWMS, and the correct operation of all sensors and related equipment

should be confirmed.

(6) Indicative analysis equipment used should be to the satisfaction of the Administration. The commissioning test is successful if the indicative analysis indicates that the discharge samples do not exceed the D-2 standard for the size classes analysed in (4) above and the self-monitoring equipment indicates correct operation.

(7) The collection and analysis of the representative samples should be independent of the BWMS manufacturer or supplier and to the satisfaction of the Administration.

CCS Guidelines for Management of Approval of Suppliers and Personnel Qualification^① (2022) may be referred to for suppliers providing ballast water commissioning test to ships surveyed by CCS. Detailed requirements for the commissioning test and judgment of results are to be determined by the Administration of flag State.

3.3 Installation of BWMS on existing ships

3.3.1 Basic procedure for installation of BWMS on existing ships

In general, the basic procedure for installation of BWMS on existing ships includes investigation of the ship, detailed design, production design, plan approval, onsite installation and commissioning, and test and delivery. Each process may demand certain time, which may vary for different BWMSs. BWMS manufacturers provide the above procedures and services in general. Taking BWMS (electrolytic chlorine process) as an example, the basic procedure and time estimation of installation of BWMS on existing ships are listed.

(1) Investigation of the ship in service

In general, the measuring time onboard is 10 to 20 hours. All relevant plans are to be collected during the mapping of the ship to facilitate plan submission and design in the future. The relevant plans are to include but not limited to:

- 1) Plan of ship's ballast system;
- 2) Plan of ship's venting system;
- 3) Plan of ship's fresh water, steam, condensate water, compressed air, control air system;
- 4) Plan of ship's ventilation system;
- 5) Plan of ship's equipment arrangement;
- 6) Plan of main distribution board arrangement and wiring;
- 7) Plan of valve remote control system wiring;
- 8) Ship power load calculations;
- 9) Light weight calculations;
- 10) Ballast water management plan;
- 11) Ship property list.

At least the following information is to be confirmed during the mapping onboard:

- 1) Ballast pump flow rate and header information for selection of BWMS;
- 2) The locations, pipings, cables and maintenance space for all equipment, and interface locations to all relevant auxiliary systems such as steam, condensate water, compressed air, control air and fresh water are to be confirmed;
- 3) Discharge location of hazardous gases and locations of outboard piping;
- 4) The methods to obtain all the necessary signals including valve, pump and fan.

(2) Production design

After completion of mapping onboard, the investigation report is to be submitted to the shipowner for review. The conversion design including reverse modeling and production design is to begin after approval by the shipowner:

- 1) The scanned data are to be accurate and clear;
- 2) The reverse modeling is to be accurate and consistent with the site with reversed reference substances in the neighborhood as many as possible;

① The access to the Guidelines is <https://www.ccs.org.cn/ccswz/specialDetail?id=202206170959554730>.

3) Detailed design covers systems required by the rules, such as ballast system drawing, BWMP and power load calculation. Some projects may need light weight calculation and short-circuit calculation;

4) Production design requirements cover all details of BWMS, such as chemical dosing node, water intake node, sampling node and node for fitting hydrogen sensors.

(3) Detailed design

1) A detailed schematic drawing is prepared for plan submission;

2) After completion of detailed design, all the plans are to be sent to the shipowner for assistance with plan submission for approval;

3) The plans are suggested to be submitted for approval at least three months before the ship arrives at the shipyard, which may be adjusted according to practical needs.

(4) Review of plans

For any modification or conversion involving classed hull, machinery installations and electrical installations, the drawings and documents related to such modification are to be submitted to the classification society for approval or for information. Reference may be made to CCS Guidelines on Survey and Certification for Ballast Water Management of Ships(2022).

(5) On-site installation, guidance, commissioning test and delivery

1) Open-package inspection is to be carried out to BWMS devices to ensure no deficiency or damage with the devices and consistency with the certificate;

2) The shipowner and shipyard are to be assisted to complete the onsite conversion project in accordance with the design plans;

3) Attention is to be paid to installation requirements for each device, such as vertical installation of air filter, installation of upward piping of flowmeter, interval requirement for water intake, requirement for installation position of hydrogen ventilation cap, water seal requirement for deck piping and requirement for cable hold;

4) In general, the commissioning program is to be sent to the surveyor for confirmation in advance;

5) The shipowner is to be assisted to apply for the survey of the system.

The flow chart for installation of BWMS on existing ships is shown in Figure 3.3.1(1) below.

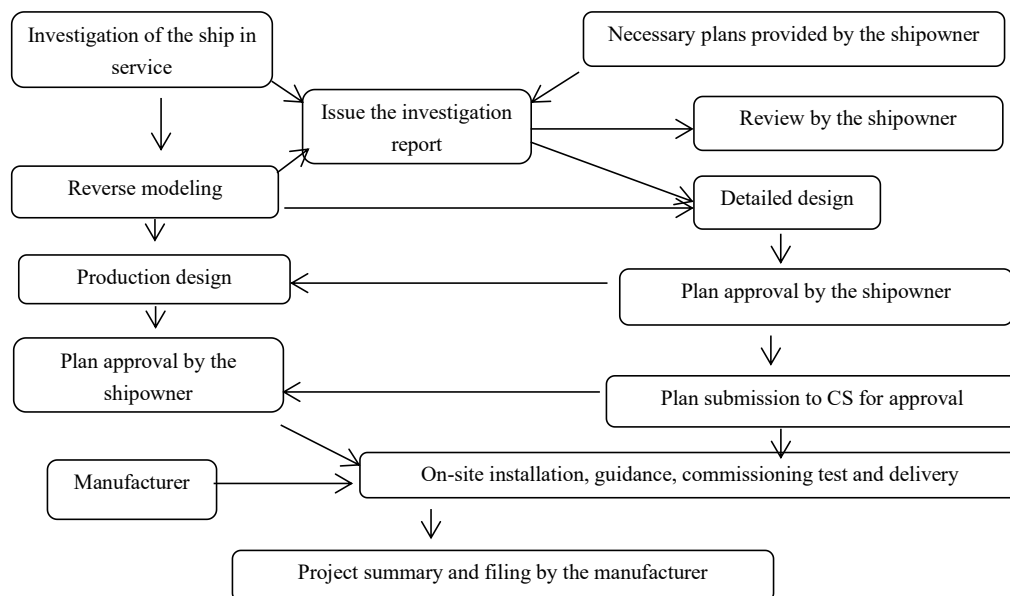


Figure 3.3.1(1) Flow chart for installation of BWMS on existing ships

The installation of BWMS on existing ships demands about 30 weeks, which may vary due to different treatment methods and ship types. The estimated time for each step is listed in Figure 3.3.1(2).

It is to be specially noted that since test verification process is added to the stage of installation and commissioning, a certain period of holding time may be needed for the ballast water management system demanding in-tank treatment to ensure full treatment of ballast water. Therefore, the whole installation and commissioning process may take more time.

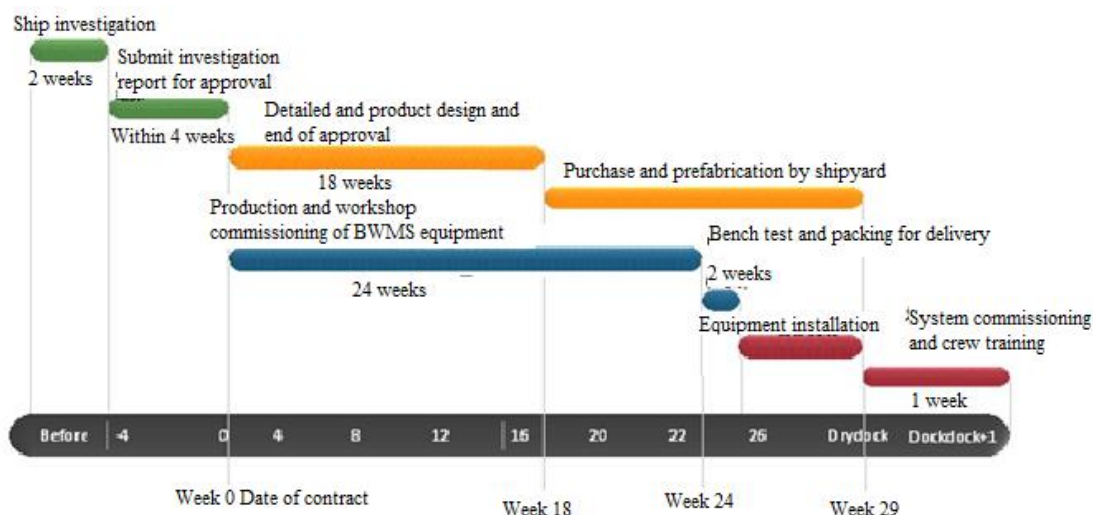


Figure 3.3.1(2) Influence factors for installation of BWMS on existing ships

3.3.2 Factors having impact on the installation of BWMS on existing ships

Various factors may have certain impact on the installation of BWMS on existing ships. Special attention is to be paid to the following factors:

- (1) Sufficient space is to be available to ensure proper arrangement of all devices and pipelines;
- (2) Explosion-proof equipment with relevant certificates and compliance with requirements of rules are to be used in explosion-proof areas;
- (3) The pressure heads of ballast pumps are to be ensured within a reasonable range;
- (4) The original electric power on the ship is to comply with the requirements for the use of BWMS. Otherwise, consideration is to be given to increasing the electric power;
- (5) The directly interconnected ballast piping between the engine room and pump room is to be connected through areas on open deck with appropriate isolation arrangements in the deck area (applicable to oil or chemical tankers carrying cargoes having a flash point not exceeding 60°C)
- (6) A sufficient installation and commissioning duration is to be considered for the ship's docking period, usually 15 to 25 days based on the ship type;
- (7) The size of hanging holes on the ship is to be verified to ensure smooth hoisting of electrolytic unit, ballast filter, etc.;
- (8) The impact of equipment installation on the ship's weight and gravity is to be considered and light weight calculation is to be carried out again when necessary;
- (9) The impact on the loading and unloading rate of the ship is to be considered. The ballast tank with deballasting by gravity may be converted into one with displacement by ballast pump if necessary.

3.4 Considerations for selection of BWMS for special ship types

Due to limits such as its own or navigational operating features and spatial or power load, some special types of ships cannot be fitted with BWMS with a treatment capacity matching the rated capacity of ballast pump. For some ships not demanding high rates of ballast uptake and deballasting, the shipowner may choose the BWMS of a smaller treatment capacity from the perspective of economical efficiency of cost and maintenance. Semi-submerged ships and mobile platforms are taken as an example below to explain the feasible plans for BWMS selection and arrangement.

3.4.1 Semi-submersible vessels

Semi-submersible vessels have many ballast tanks with a huge capacity of ballast pumps. They are usually fitted with two ballast bilge pumps with a smaller capacity for ballast adjustment among internal ballast tanks and port and starboard. Ballast water uptake or deballasting for loading and unloading of cargoes or operations is usually carried out on site. According to the BWM Convention, ballast water discharged to a different place is to meet D-2 standard but the method to reach the goal is not limited (e.g. online treatment of ballast water, in-tank treatment or out-tank treatment). Therefore, due to ballast uptake or deballasting features of semi-submersible vessels, ballast tanks engaged in onsite semi-submersible operations (deemed as working tanks) have no access to the ballast water management system while other ballast tanks have access to the system. BWMS with a smaller treatment capacity matching ballast bilge pump or circulating pump with small capacity is to be installed. Three or more circulations of ballast water within the tank are to be carried out through BWMS during the navigation of the semi-submersible vessel. This method is called circulation method. With many ballast tanks for semi-submersible vessels, ballast water after treatment by BWMS in one tank may be transferred to another void tank to ensure that all the ballast water is discharged after treatment and meeting D-2 standard. This treatment method is called tank transfer method.

3.4.2 Mobile offshore unit

For self-elevating units or column stabilized units, the sea water and sediments in pre-loaded ballast tank or operating ballast tank may be discharged without treatment at the same location as long as they are not mixed with untreated water in other areas. Where the ballast water needs to be transferred to other areas, the ballast water retained in the pre-loaded ballast tank or operating ballast tank may be treated by internal circulation method during the voyage. The shipowner may choose the BWMS with a relatively smaller treatment capacity as needed.

In conclusion, the treatment of ballast water within the ballast tanks by internal circulation method via the installed BWMS may be accepted for various special purpose ships to meet the D-2 standard.

Chapter 4 Requirements for Ballast Water Management Plan

4.1 Development and approval basis of ballast water management plan

4.1.1 General basis

According to the requirements of the BWM Convention, each ship shall have on board a Ballast Water Management Plan approved by the Administration and carry out ballast water management accordance with the plan. In addition to the relevant requirements of the BWM Convention, the ballast water management plan is to be developed taking into special consideration the following IMO documents:

- (1) Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (G4) (MEPC.127(53), as amended by MEPC.306(73) and MEPC.370(80));
- (2) 2017 Guidelines for Ballast Water Exchange (MEPC.288(71), as amended by MEPC.371(80));
- (3) Guidance on Contingency Measures under the BWM Convention (BWM.2/Circ.62);
- (4) Issuance of Ballast Water Management Certificates Prior to Entry Into Force of the BWM Convention and Ballast Water Management Plans Approved According to Resolution A.868(20) (BWM.2/Circ.40).

Reference can be made to CCS Guidelines for Development of Ship's Ballast Water Management Plan (2022). The Guidelines have integrated the requirements of the above documents and have been supplemented with more detailed instructions and requirements.

The Ballast Water Management Plan is to be specific to each ship and therefore attention is to be paid to other relevant provisions of the flag State Administration and port State authority when preparing the Ballast Water Management Plan for a specific ship.

4.1.2 Special requirements for navigating in waters under the jurisdiction of the United States

For the ships navigating in the waters under the jurisdiction of the United States, attention is to be paid to that the requirements and procedures of the biofouling management are to be included in the Ballast Water Management Plan. The biofouling management content may be integrated as a part of the Ballast Water Management Plan or may be a stand-alone Biofouling Management Plan. The Biofouling Management Plan does not need to be approved and may be regarded as meeting the requirements if it conforms to the biofouling management plan format and management measures in 2011 Guidelines for the Control and Management of Ships' Biofouling developed by IMO.

4.2 Considerations for preparing and submitting ballast water management plan

4.2.1 Language requirements

- (1) The BWM Convention stipulates that the Ballast Water Management Plan shall be written in the working language of the ship. If the language used is not English, French or Spanish, a translation into one of these languages shall be included.
- (2) If the flag State Administration designates the working language of the ship to be one other than English, French or Spanish, the ship's Ballast Water Management Plan is to be provided with a version of the designated working language.

4.2.2 Submission requirements of ballast water management plan

(1) When a ship fitted with a ballast water management system (BWMS), the ship's existing Ballast Water Management Plan needs to be revised and resubmitted for approval. If the previously approved Ballast Water Management Plan was prepared in accordance with the requirements of the Convention and only meets the D-1 standards, an updated Ballast Water Management Plan or a supplement to the existing Ballast Water Management Plan may be submitted. If the ship's existing Ballast Water Management Plan has been approved in accordance with Resolution A.868(20), the Ballast Water Management Plan is to be updated in accordance with the requirements of BWM.2/Circ.40 and may not be submitted as a supplement.

(2) For the ships navigating in the waters under the jurisdiction of the United States, where the Biofouling Management Plan is prepared in separate volume, only the ship's Ballast Water Management Plan is to be submitted for approval. If the biofouling management plan content is an integral part of the Ballast Water Management Plan, only the ballast water part of the complete Ballast Water Management Plan submitted for approval is to be approved. If the ship already has a previously approved Ballast Water Management Plan, the revised Ballast Water Management Plan is to be resubmitted for approval only if the biofouling management plan content is incorporated as an integral part of the previously approved Ballast Water Management Plan, and only the ballast water part of the Ballast Water Management Plan is to be approved.

For specific requirements, refer to CCS Technical Information "Notice on the Latest Requirements of the United States Authorities for the Ship's Ballast Water Management Plan" ((2012) Technical Information No. 9 General No. 9).

(3) When the working language of the ship is not English, French or Spanish but another language, it is to be noted that the language in which the ship's Ballast Water Management Plan is prepared for approval is to include the version of working language and one of the translations.

4.2.3 Ballast water management plan requirements for special ships

In general, the Ballast Water Management Plan is required only for the ships to which the BWM Convention applies. However, for some ships designed and constructed to carry ballast water, even if the BWM Convention does not apply, consideration is to be given to having a Ballast Water Management Plan on board, indicating the specific ballast water management method of the ship to demonstrate that it is not subject to the BWM Convention. Examples are as follows:

(1) Some engineering ships, which operate basically only in waters under the jurisdiction of a Party, conduct their international voyages by means of barges when they occasionally shift in transboundary waters. Ships navigating in the waters under the jurisdiction of different states may be regarded as cargoes and are therefore not subject to the BWM Convention.

(2) A ship that circulates the ballast water only within the ship and does not discharge it externally or discharges it only in place where it is loaded, is to demonstrate to the port State authority that the ballast water management of the ship does not violate the requirements of the BWM Convention, although the ship may not be applicable to the BWM Convention or is an exception according to the application of the BWM Convention.

4.3 Selection of contingency measures in Ballast Water Management Plan

4.3.1 Basic options for contingency measures

In accordance with the Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (G4) (as amended by resolution MEPC.306(73) and resolution MEPC.370(80)), a ship's Ballast Water Management Plan is to include contingency measures. For specific contingency measures, refer to Guidance on Contingency Measures under the BWM Convention (BWM.2/Circ.62). In the case of a ship unable to manage ballast water in accordance with its approved Ballast Water Management Plan to meet the D-1 or D-2 standard, the ship is to communicate with the port State to determine appropriate contingency measures. Possible contingency measures include:

- (1) actions predetermined in the Ballast Water Management Plan of the ship;
- (2) discharging ballast water to another ship or to an appropriate shipboard or land-based reception facility, if available;
- (3) managing the ballast water in accordance with a method acceptable to the port State;
- (4) ballast water exchange carried out to an approved plan in accordance with regulation B-4 of the BWM Convention to meet the standard in regulation D-1 of the BWM Convention; or
- (5) operational actions, such as modifying sailing or ballast water discharge schedules, internal transfer of ballast water or the retention of ballast water on board the ship.

4.3.2 Considerations for contingency measures

Among the above contingency measures, the item (4) of ballast water exchange measure is relatively more feasible and operable. Therefore, after the enforcement of the D-2 standards on ships, ships are still to have a ballast water exchange method conforming to the D-1 standards as a contingency measure. In addition, some countries, such as the United States and Brazil, require mandatory exchange in designated areas when ships enter waters under their jurisdiction, so it is recommended to retain the ballast water exchange capacity of ships.

If item (2) is selected as a contingency measure for a ship, the feasibility of discharging ballast water to another ship or to an appropriate shipboard or land-based reception facility is to be duly taken into account.

Chapter 5 Requirements for Survey and Certification of Ballast Water Management of Ships

5.1 Application of survey and certification

Although the application of the BWM Convention is as described in 1.3.1, the application of ship survey and certification is different from that. As set out in 1.5 of the Guidelines, unless otherwise specified by the flag State Administration, only ships of 400 gross tonnage and above, excluding floating platforms, floating storage units (FSUs) and floating production storage and offloading (FPSOs), are to be subject to surveys in accordance with the BWM Convention. For ships not covered above (including ships of less than 400 gross tonnage, floating platforms, FSUs/FPSOs), the Administration is to develop appropriate measures to ensure that these ships comply with the requirements of the BWM Convention. However, in accordance with the interpretation of BWM.2/Circ.46 on Application of the BWM Convention to Mobile Offshore Units, Mobile Offshore Units (MOUs) applicable to the BWM Convention are to comply with the provisions of the BWM Convention and are to be surveyed and issued with an International Ballast Water Management Certificate (IBWMC), according to regulations E-1 and E-2 of the BWM Convention.

5.2 Survey types and survey items

5.2.1 Survey types and periods

Ships applicable to survey and certification of the BWM Convention are to be subject to the following applicable surveys: initial survey, renewal survey, intermediate survey, annual survey and additional survey.

(1) Initial survey

An initial survey is to be carried out before the ship is put in service or before the International Ballast Water Management Certificate (IBWMC) is issued for the first time. This survey is a complete inspection and test of the Ballast Water Management Plan (BWMP) and any associated structure, equipment, systems, fitting, arrangements and material or processes to verify that they comply fully with the requirements of the BWM Convention. This survey shall confirm that commissioning test has been conducted to validate the installation of any ballast water management system by demonstrating that its mechanical, physical, chemical and biological processes are working properly, taking into account the guidelines^① developed by IMO.

(2) Annual survey

An annual survey is to be carried out within three months before or after each Anniversary date of the due date of the International Ballast Water Management Certificate (IBWMC). The annual survey includes a general inspection of the structure, any equipment, systems, fittings, arrangements and material or processes associated with the Ballast Water Management Plan (BWMP) to ensure that they have been maintained and remain satisfactory for the service for which the ship is intended. Such annual survey is to be endorsed on the Certificate.

(3) Intermediate survey

An intermediate survey is to be carried out within three months before or after the second Anniversary date or within three months before or after the third Anniversary date of the International Ballast Water Management Certificate (IBWMC), which is to take the place of one of the annual surveys. The intermediate survey is to ensure that the equipment, associated systems and processes for Ballast Water Management fully comply with the applicable requirements of the BWM Convention and are in good working order. Such intermediate survey is to be endorsed on the Certificate.

(4) Renewal survey

^① Refer to the Guidance for Commissioning Testing of Ballast Water Management Systems, 2020 (BWM.2/Circ.70/Rev.1), as may be amended.

A renewal survey is to be carried out for the renewal of the International Ballast Water Management Certificate (IBWMC) when it is expired. The interval of this survey is to be specified by the flag State Administration, but not exceeding five years. This survey is to verify that the Ballast Water Management Plan (BWMP) and any associated structure, equipment, systems, fitting, arrangements and material or processes are fully comply with the applicable requirements of the BWM Convention.

(5) Additional survey

An additional survey is to be carried out after a change, replacement, or significant repair of the structure, equipment, systems, fittings, arrangements and material necessary to achieve full compliance with the requirements of the BWM Convention. Such survey either general or partial, according to the circumstances, is to be carried out to ensure that any such change, replacement, or significant repair has been effectively made, so that the ship complies with the requirements of the BWM Convention. When an additional survey is undertaken for the installation of any ballast water management system onboard the ship, this survey is to confirm that a commissioning test has been conducted to validate the installation of the ballast water management system by demonstrating that its mechanical, physical, chemical and biological processes are working properly, taking into account the guidelines^① developed by IMO.

Survey and certification under the BWM Convention is to comply with Survey Guidelines under the Harmonized System of Survey and Certification, 2021 (resolution A.1156(32)). The survey schedule and survey window period are shown in Table 5.2.1 and Figure 5.2.1 respectively.

Survey Schedule					Table 5.2.1
0 year	1st year	2nd year	3rd year	4th year	5th year
Initial survey	Annual survey	Annual survey or intermediate survey	Annual survey or intermediate survey	Annual survey	Renewal survey

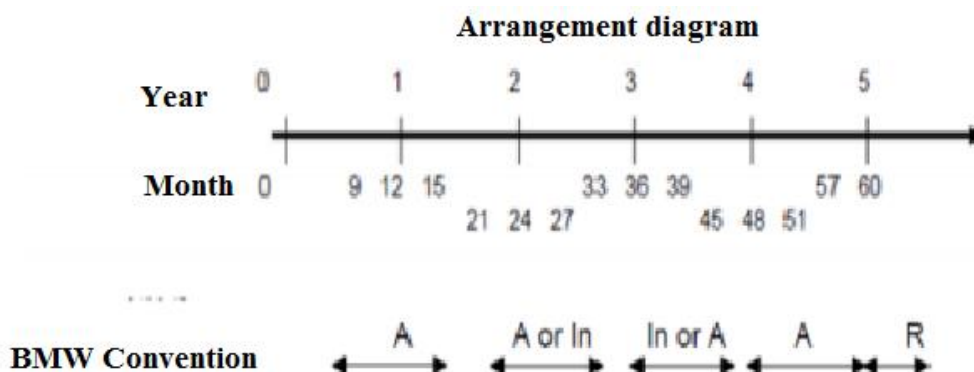


Figure 5.2.1 Diagram of survey window period arrangement

Special attention is to be paid to the fact that if there is an International Ballast Water Management Certificate (IBWMC) for an existing ship, the type of survey is to be additional survey rather than initial survey when applying for installation of the BWMS.

For the purpose of the commissioning test requirements of the ballast water management system in the above additional survey process, if re-type approval has been carried out for the existing BWMS installed on board due to major conversion, the commissioning test is to be conducted for the BWMS.

^① Refer to the Guidance for Commissioning Testing of Ballast Water Management Systems, 2020 (BWM.2/Circ.70/Rev.1), as may be amended.

5.2.2 Survey items

For the survey items of each survey, refer to Sections 2.3 to 2.7 of CCS Guidelines on Survey and Certification for Ballast Water Management of Ships (2022). In general, the items may be classified into the following aspects:

- ① review and confirmation of drawings and documents;
- ② validity of the ship's existing certificate and the crew's certificate of competency;
- ③ confirming the installation and maintenance of the equipment and its related systems;
- ④ confirming the commissioning test of ballast water management system;
- ⑤ issuing or signing an International Ballast Water Management Certificate.

5.3 Certification of International Ballast Water Management Certificate

5.3.1 Certificate types

After the satisfactory survey, certification or certificate endorsement is to be carried out in accordance with the authorization agreement with the flag State. The specific content of authorization and the type of certificate are to refer to the legal documents of the flag State. The International Ballast Water Management Certificate (IBWMC) is only to be issued to ships flying the flag of a Party to the BWM Convention. For a ship flying the flag of a non-Party, according to the IMO principle of no more favourable treatment, when the ship operates in waters under the jurisdiction of a Party to the BWM Convention, it is to comply with the requirements of the BWM Convention. However, the IBWMC cannot be issued for such ship, and the International Ballast Water Management Statement of Compliance (SOC) is to be issued. The form of SOC is to be determined by the flag State Administration.

According to the validity period of IBWMC or SOC, it can be divided into long-term certificate, short-term certificate and conditional certificate.

5.3.2 Filling in ballast water management certificate

Although the types of certificates may be different due to the different authorizations of the flag States, the specific content is consistent. When filling in the ballast water management certificate, attention is to be paid to the following items.

(1) Certificate content

1) Date of Construction

According to the definition of “constructed in respect of a ship” in 1.2 (10) of the Guidelines, the date is to be the time when the keel is last laid or at a similar stage of construction or major conversion time of the ship. If a major conversion has been made to the ship after it holds the International Ballast Water Management Certificate (IBWMC), this date is to be the date of the latest major conversion.

Attention is to be paid to the interpretation of the definition of “major conversion” in A-1.5 of the BWM Convention in accordance with BWM.2/Circ.45:

- ① new installation of ballast water management systems should not be treated as a major conversion;
- ② substantial alteration of the dimensions or carrying capacity of the ship should be treated as a major conversion;
- ③ changing the type of cargo carried through a major alteration of the ship should be treated as a major conversion.

2) Ballast water capacity

In accordance with the definition of “ballast water capacity” in 1.2 (6) of the Guidelines, ballast water capacity means the total volumetric capacity of any tanks, spaces or compartments on a ship used for carrying, uptake or discharging ballast water, including any multi-use tank, space or compartment designed to allow carriage of ballast water. For example, storm ballast tanks, which may generally be found on the capacity plan.

3) Methods of ballast water management used

If the ship uses the D-1 standards, one or more of the sequential/flow-through/dilution methods as described in the Ballast Water Management Manual is to be filled in. In this case, “Date installed” and “Name of manufacturer” are not to be filled in.

If the ship uses the D-2 or D-4 standards, “Methods of ballast water management used”, “Date installed” and “Name of manufacturer” are to be completed. For specific information, refer to the manufacturer's instruction.

4) Date installed

If the ship is fitted with a ballast water management system or prototype technology that meets the D-2 or D-4 standards, this date is the time when commissioning of the device is completed after installation on board, irrespective of whether the equipment is approved in accordance with resolution MEPC.174(58) or resolution MEPC.279(70) or resolution MEPC.300(72).

5) The principal Ballast Water Management method(s) employed on this ship

According to the format of the International Ballast Water Management Certificate, there are four main options for ballast water management methods employed on ships: D-1, D-2, D-4 or other approach. There are a few special cases that need to be explained.

- ① For a ship which is occasionally engaged in an international voyage and is not intending to discharge ballast water back to the original location, having been granted an exemption by its Administration, taking into account BWM.2/Circ.52/Rev.1, on the condition that the ship implements the D-1 standard in lieu of the D-2 standard, the principal ballast water management method(s) employed is:
“other approach in accordance with regulation D-1 (taking into account BWM.2/Circ.52/Rev.1).”
- ② For a ship granted an exemption in accordance with regulation A-4 of the BWM Convention, the principal ballast water management method employed on the ship is:
“other approach in accordance with regulation A-4.”
- ③ For a ship which is fitted with a BWMS on board and is certified in accordance with the D-2 standards, even if the ship will also use other ballast water management methods (such as ballast water exchange) as contingency measures, the principal ballast water management method employed on this ship is:
“in accordance with regulation D-2
(describe)”
- ④ For the “describe” column in ③, it is at least to include the name and model of the installed BWMS and the rated treatment capacity, which is to be consistent with the information of the actual installed BWMS.
- ⑤ For ships that have adopted the alternative measures of regulation A-5 of the BWM Convention, “the principal Ballast Water Management method employed” in the certificate is to be entered as:
“other approach in accordance with regulation A-5.”
- ⑥ For ships that have adopted the relevant measures of regulation B-3.6 of the BWM Convention, “the principal Ballast Water Management method employed” in the certificate is to be entered as:
“other approach in accordance with regulation B-3.6”
- ⑦ For ships that have adopted the relevant measures of regulation B-3.7 of the BWM Convention, “the principal Ballast Water Management method employed” in the certificate is to be entered as:
“other approach in accordance with regulation B-3.7”
- ⑧ For a ship that employs “other approach” in accordance with A-5, B-3.6 or B-3.7 as described in 5.3.2.1 (5) ⑤ to ⑦ above, the Ballast Water Management Plan should describe the other approach that has been approved for the ship.
- ⑨ For ships discharge ballast water to reception facilities under Regulation B-3.6 of the BWM

Convention, documentation of adequate reception facilities at the port where the ballast water is to be discharged is to be provided.

(2) Special instructions

1) If the ship in service has not been fitted with the ballast water management system, that is, the D-2 standards have not been implemented for the time being, and the validity of the existing certificate exceeds the deadline for the implementation of the D-2 required by the BWM Convention. The suggested wording is as follows: “This certificate will be invalid unless the ship has been fitted with a ballast water management system meeting the D-2 standards by the deadline required by the BWM Convention”.

2) Unless otherwise specified by the flag State, the validity period of the Ballast Water Management Certificate and the window period for surveys are to be harmonized with at least one other certificate in the Survey Guidelines under the Harmonized System of Survey and Certification (HSSC), 2021 or classification society certificate.

3) With respect to the “completion date of the survey on which this certificate is based”, as long as the ship holding a valid certificate has not carried out the initial survey or renewal survey described in 5.2.1 above in the Guidelines again, when the ship has carried out any other survey and a renewal of the certificate is required (e.g. the ballast water management system has been newly installed or replaced during this period), the date of the new certificate is to be the date of completion of the last “initial survey” or “renewal survey”.

Chapter 6 Ballast Water Management Requirements in China

6.1 China ballast water management departments and institutions

6.1.1 China Maritime Safety Administration under the Ministry of Transport

China Maritime Safety Administration under the Ministry of Transport is the competent maritime authority for the implementation of the Ballast Water Management Convention in China. It is the Administration for ships flying Chinese national flag and is the port state authority of China. As to the implementation of the Ballast Water Management Convention, the main responsibilities of China MSA include:

- (1) Responsible for organizing formulation of principles, policies, regulations and technical standards for ballast water management;
- (2) Responsible for organizing type approval of ballast water management systems;
- (3) Authorizing classification societies to carry out ballast water inspection and certification, ballast water management system type approval and ballast water management plan approval;
- (4) Responsible for conducting on-site supervision and inspection as well as PSC inspection in accordance the PSC guidelines and ship supervision and inspection regulations for the BWM Convention ;
- (5) Responsible for granting ballast water exemption for ships that meet the exemption conditions;
- (6) Responsible for carrying out administrative investigations on ships that violate the Marine Environmental Protection Law of the People's Republic of China, the Water Pollution Prevention and Control Law of the People's Republic of China, and the Regulation on Prevention and Control of Marine Environmental Pollution from Ships,etc.

6.1.2 Entry-exit Inspection and Quarantine Bureau under the General Administration of Customs

The Entry-Exit Inspection and Quarantine Bureau is subordinate to the General Administration of Customs, responsible for implementation of the Biosecurity Law of the People's Republic of China, the Frontier Health and Quarantine Law of the People's Republic of China, and the Law of People's Republic of China on the Entry and Exit Animal and Plant Quarantine. According to the State health and quarantine law, all ship ballast water from the infected areas as listed by the World Health Organization (WHO) and the government is required to be disinfected before discharge. According to Article 23 of the Biosecurity Law of the People's Republic of China, persons, means of transport, containers, goods, objects, packaging, and ballast water discharges by ships on international voyages entering and leaving China shall meet China's requirements of biosecurity management. According to Article 5 of the Law of People's Republic of China on the Entry and Exit Animal and Plant Quarantine, the State shall prohibit the following objects from entering the country:(1) Pathogenic micro-organisms (including seed cultures of bacteria and viruses) of animals and plants, insect pests and other harmful organisms. Article 18 of the Frontier Health and Quarantine Law of the People's Republic of China provides that frontier health and quarantine offices shall, in accordance with state health standards, exercise health supervision over the sanitary conditions at frontier ports and the sanitary conditions of conveyances on entry or exit at frontier ports: supervise and inspect the disposal of garbage, waste matter, sewage, excrement and ballast water.

6.1.3 Ministry of Natural Resources and Ministry of Ecology and Environment

The Ministry of Natural Resources and the Ministry of Ecology and Environment perform the duties of safety management of invasive alien species in accordance with the relevant requirements of the Measures for the Management of Invasive Alien Species, which mainly include: establishing and improving the emergency response mechanism, organizing to formulate emergency plans for alien species invasion emergency in related areas; according to their division of responsibilities, strengthening dynamic tracking and risk assessment of alien species that may be introduced into

China through natural channels such as air flow and water flow; releasing the information on occurrence of alien invasive species in the area according to their duties and authority; studying and formulating strategies and measures for prevention and control of invasive alien species in the area, and providing guidance on local prevention and control.

6.1.4 China Classification Society

Entrusted by China Maritime Safety Administration under the Ministry of Transport, China Classification Society conducts type approval of ballast water management systems, inspection and certification of ships, and development and maintenance of statutory survey regulations for ships.

China Classification Society has developed and released related guidance documents including the Guidelines on Survey and Certification for Ballast Water Management of Ships (2017-2022), Guidelines for Development of Ship's Ballast Water Management Plan(2006-2022), and Guidelines for Type Approval of Ship's Ballast Water Management Systems (2012-2022), etc., for survey and certification under BWM convention, type approval of ballast water management system, and other statutory work as authorized by the Administration as well as provide technical services.

For the survey and certification of mobile offshore units (MOUs) flying Chinese national flag, International Ballast Water Management Certificate (IBWMC) may be issued in accordance with the requirements of the BWM Convention.

For floating platforms, floating storage units (FSUs) and floating production, storage and offloading units (FPSOs) operating in waters under the jurisdiction of China, the Ballast Water Management Plan (BWMP) may be approved in accordance with the BWM Convention as requested by shipowners.

6.2 Regulations of China on the management of ships' ballast water and sediments

6.2.1 Overview

At present, China's regulations related to ships' ballast water and sediment management include the Environmental Protection Law of the People's Republic of China, Law of the People's Republic of China on the Prevention and Control of Water Pollution, the Marine Environment Protection Law of the People's Republic of China, the Frontier Health and Quarantine Law of the People's Republic of China, and the Regulations on the Prevention and Control of Marine Environmental Pollution from Ships, etc.

Article 34 of the Environmental Protection Law of the People's Republic of China provides that "The State Council and the people's governments at various levels in coastal areas shall provide better protection for the marine environment. The discharge of pollutants and the dumping of wastes into the seas, and the construction of coastal projects and marine projects shall be conducted in compliance with provisions of laws and regulations and relevant standards, so as to guard against and reduce the pollution and damage of the marine environment."

Article 59 of the Law of the People's Republic of China on the Prevention and Control of Water Pollution provides that "Where vessels navigating on international routes discharge ballast water after entering inland waters within the territory of China, they shall use ballast water treatment devices or take other effective measures to carry out the inactivation treatment of ballast water. It is forbidden to discharge any ballast water that fails to meet the required standards."

Article 62 of Chapter 8 "Prevention and Control of Pollution Damage to the Marine Environment by Shipping and Other Operational Activities" of the Marine Environmental Protection Law of the People's Republic of China provides that "No vessel or related operational activities of any vessel may discharge pollutants, wastes, ballast tank water, vessel garbage and other harmful substances into the sea areas under the jurisdiction of the People's Republic of China in violation of the provisions of this Law."

Article 18 (IV) of Chapter 4 "Health Supervision" of the Frontier Health and Quarantine Law of the People's Republic of China provides: "supervise and inspect the disposal of garbage, waste matter, sewage, excrement and ballast water."

Article 15 of Chapter III “Discharge and Reception of Pollutants from Ships” of the Regulation on Prevention and Control of Marine Environmental Pollution from Ships provides that “The ship garbage, sewage, oily waste water, waste water containing toxic and hazardous substances, waste gas and other pollutants and ballast water discharged by ships into the sea areas under the jurisdiction of the People’s Republic of China shall meet the requirements of laws, administrative regulations, international treaties concluded or acceded to by the People’s Republic of China, and other relevant standards.” “The pollutants which fail to meet the requirements for discharge as prescribed in the preceding paragraph shall be discharged by ships into the receiving facilities in ports or be received by the ship's pollutant receiving unit.”

6.2.2 China's Measures for Supervision and Management of Ships' Ballast Water and Sediments (Trial)

1. Overview

China’s Measures for Supervision and Management of Ships’ Ballast Water and Sediment (Trial) (hereinafter referred to as “the Measures”) provide the requirements for the management of ballast water and sediments from ships navigating, berthing and operating in waters under the jurisdiction of China. China Maritime Safety Administration is responsible for supervision and management of ships’ ballast water and sediments throughout China. The Measures clearly stipulate that the Measures are not applicable to the following ships :

- (I) ships engaged in domestic navigation, including ships navigating between the ports of the Mainland China and Hong Kong, Macao and Taiwan;
- (II) ships designed or constructed without carriage of ballast water;
- (III) fishing vessels, military vessels and public vessels;
- (IV) ships with ballast water sealed in ballast tanks and not discharging;
- (V) fixed and mobile offshore installations.

The measures provide requirements on ship survey and certification, ballast water record book, ballast water management plan, etc., as well as requirements on ballast water and sediment management (including ballast water exchange, ballast water treatment and discharge standards, type approval of ballast water management system, reception of ballast water and sediments, etc.), which are generally consistent with the provisions of the BWM Convention.

2. Exemption from ballast water and sediment management

With regard to the right of exemptions of the Administration granted by the BWM Convention, the Measures provide that:

(1) The following ships may apply to the local maritime authority for exemption from ballast water and sediment management:

- (I) ships navigating only in the waters where mutual exemptions from ballast water management exemption are granted by China and other countries;
- (II) ships navigating only in waters under the jurisdiction of China and in high seas;
- (III) ships only using drinking water as ballast water;
- (IV) unmanned barges;
- (V) Specialized ships only for search, rescue and removal of pollutants from ships.

(2) The information to be submitted by a ship for exemption include:

- (I) copies of the ship's Certificate of Nationality and Certificate of Registry (applicable to a ship of foreign nationality);
 - (II) the description that ballast water management cannot be implemented in accordance with the BWM Convention;
 - (III) the measures that have been taken to minimize the introduction of harmful aquatic organisms and pathogens through ballast water and sediments;
 - (IV) the declaration of the master who undertakes to navigate only in exempted waters.
- (3) For ships that meet the conditions for exemption, the competent maritime authority in charge will issue a Document of Exemption for the ship and grant a maximum exemption period of not more than 5 years. An interim inspection of the ship on exemption will be carried out between the second and third years of the exemption period, .
- (4) The ship shall record the exemption in the Ballast Water Record Book. While conducting ballast water and sediment management, the exempted ship shall ensure that ballast water and sediment outside the exempted waters are not introduced.

3. Supervision and management

The Measures provide that maritime authorities shall supervise and inspect the ballast water and sediment management of ships entering the waters under the jurisdiction of China, and provide clear requirements on ballast water sampling and testing, mainly including the following situations:

- (I) The certificates and documents related to ballast water and sediment management are missing, not valid, or has expired; entries in the certificates and documents related to ballast water and sediment management do not reflect the actual ballast water situation;
- (II) No officer has been designated on board to be responsible for ballast water and sediment management; the master or designated crew is not familiar with their duties or basic operations relating to ballast water and sediment management or such operations have not been carried out;
- (III) the BWMS has not been used in accordance with the Ballast Water Management Plan or its operational instructions, and the accidents or defects affecting the ability of the ship to manage ballast water and sediments are not reported to the maritime authorities ;
- (IV) Ballast water and sediments are not discharged in accordance with the provisions of the Measures, ballast water discharge is not reported to the local maritime authorities, and the Ballast Water Report Form is not submitted to the local maritime authorities;
- (V) The ship is unable to provide evidence that the management of ballast water and sediments on board complies with exceptional or accidental discharges as provided by the BWM Convention;
- (VI) The operation of the ballast water management system exceeds the system designed limitations;
- (VII) Reports or complaints from third parties concerning violation of the provisions of the BWM Convention or the Measures are received.

The Measures also provide that if maritime authorities find noncompliance with the treatment standards of the BWM Convention after rapid sampling and testing, the maritime law enforcement officers will take the samples and send them to a laboratory qualified for ballast water testing for

detailed testing. For maritime authorities that do not have the capability of rapid testing, samples may be directly taken and sent to a laboratory with ballast water testing qualifications.

During the experience accumulation period for the BWM Convention, when maritime authorities and other agencies entrusted by them board a ship to take ballast water or sediment samples for experimental purpose, the testing results shall not be used as a basis for taking measures against the ship.

For ships that have been tested as exceeding the requirements of the BWM Convention, they are allowed to use the port ballast water receiving and treatment facilities for treating ballast water. In ports that do not have the capacity to receive and treat ballast water, ships are allowed to leave the waters under China's jurisdiction to exchange and treat ballast water and re-enter the anchorage or ports in the waters under China's jurisdiction.

6.2.3 Port State Control in China

(1) Overview of Port State Control (PSC) inspection

The purpose of Port State Control(PSC) inspection is to ensure that foreign ships arriving at ports of this country comply with the requirements of international conventions to which this country is a contracting party. As a port State and as a member of the Asian-Pacific Memorandum of Port State Control (Tokyo Memorandum), China currently conducts Port State Control (PSC) inspections at 44 domestic ports for ships of foreign nationalities.

The relevant requirements of the BWM Convention and the guidelines for PSC under the BWM Convention are included in the “Relevant documents” of the Tokyo Memorandum and have become the basis for port State control inspection under the BWM Convention. For maritime law enforcement officers, port State control inspection will be carried out with reference to the Guidelines for Port State Control under the BWM Convention (MEPC.252(67)).

(2) Contents of PSC inspection

1) Check of ship’s certificates and documents

In accordance with Article 9 of the BWM Convention, maritime law enforcement officers will inspect a ship from another country at a Chinese port or terminal for its certificate, ballast water record book, and the ballast water management plan approved by the Administration.

① Ballast water management certificate

Ships of 400 GT or above are required hold a valid International Ballast Water Management Certificate, excluding floating platforms, FSUs and FPSOs. The content of the certificate mainly includes: particulars of ship, details of ballast water management method(s)used, the standards which the ballast water management method complies with(regulation D-1 and D-2), the validity period and the place of issue of the certificate, the signature of authorized official issuing the certificate.

② Ballast water management plan

A ballast water management plan shall be in place for a vessel of any type operating in the aquatic environment, including submersibles, floating crafts and rafts, floating platforms, floating storage units (FSUs) and floating production, storage and offloading units (FPSOs). The plan shall be kept

on board so that it is readily available for inspection by port State control or quarantine officers.

③ Ballast water record book

According to the provisions of Article B-2 of the BWM Convention, each ship shall have on board a ballast water record book that may be an electronic record system, or that may be integrated into another record book or system and, which shall at least contain the information specified in Appendix II. According to the BWM Convention, Ballast water record book entries shall be maintained on board the ship for a minimum period of two years after the last entry has been made and thereafter maintained by the ship company for a minimum period of three years.

2) Sampling and analyzing the ballast water

According to the provisions of Article 9 of the BWM Convention, maritime law enforcement officers will conduct ballast water sampling and analysis of arriving ships in accordance with G2 to determine whether the treated ballast water is in compliance with the standards set out in the BWM Convention. However, the time required to analyze the samples shall not cause the ship to be unduly delayed.

3) Investigation and handling of violations

According to the provisions of Article 9 of the BWM Convention, where a ship does not carry a valid certificate or there are clear grounds for believing that the condition of the ship or its equipment does not correspond substantially comply with the particulars of the certificate, or the personnel on board are not familiar with essential shipboard procedures relating to Ballast Water Management, or have not implemented such procedures, the maritime enforcement officer will carry out a detailed inspection. If a ship is detected to have violated this Convention, the officer may take steps to warn, detain, or exclude the ship. At the same time, the evidence of the violation and the action taken shall be reported to the flag State. However, the maritime enforcement officer may grant such a ship permission to leave the port or offshore terminal for the purpose of exchanging ballast water or proceeding to the nearest appropriate repair yard or reception facility available, provided doing so does not present a threat of harm to the environment, human health, property or resources.

4) Designation of ballast water exchange area

According to the provisions of regulation B-4.2 of the BWM Convention, if the waters through which a ship passes do not meet the sea area conditions of ballast water exchange, China may designate areas, in consultation with adjacent or other States, as appropriate, where a ship may conduct ballast water exchange, taking into account the Guidelines on Designation of Areas for Ballast Water Exchange(G14). Ballast water exchange area will be designated in accordance with rights and obligations under international law. In designating ballast water exchange areas, consideration will be given, as far as possible, to avoid potential adverse impacts on waters protected by national or international law, and other important water resources, including those of economic and ecological importance, as well as to avoid adverse impacts on ships navigation.

5) Risk assessment for exemptions

According to the provisions of regulation A-4 of the BWM Convention, China may, in the waters under its jurisdiction, grant exemptions from the requirements of ballast water management (regulation B-3) or additional measures (regulation C-1) in addition to those exemptions contained elsewhere in the Convention,in accordance with the Guidelines for Risk Assessment under Regulation A-4 of the BWM Convention (G7), but only when requested by ships and the following conditions are met:

- ① ships are on a voyage or voyages between specified ports or locations;
- ② the exemptions are effective for a period of no more than five years subject to intermediate review;
- ③ ships do not mix ballast water from other sources;
- ④ the risk assessment is carried out in accordance with the guidelines for ballast water risk assessment.

Such exemption granted by China to ships will not affect or impair adjacent or other States and shall be recorded in the ballast water record book.

6) Additional measures in case of emergency

According to the provisions of regulation C-1 of the BWM Convention, if China determines that measures in addition to those in Section B are necessary to prevent, reduce, or eliminate the transfer of Harmful Aquatic Organisms and Pathogens through ships' Ballast Water and Sediments in waters under China's jurisdiction, China may, consistent with international law, require additional measures on ships. In taking additional measures, China will follow the principles of the Guidelines for additional measures regarding ballast water management including emergency situations (G13). Additional measures are divided two categories: the additional measures in accordance with international law, for which only a notification to the International Maritime Organization (IMO) is needed; the additional measures not in accordance with international law, which will be reported to the International Maritime Organization (IMO) for approval.

7) Provision of sediment reception facilities

According to the provisions of Article 5 of the BWM Convention, China will provide sediment reception facilities in ports and terminals where cleaning or repair of ballast tanks occurs in accordance with the Guidelines for sediment Reception Facilities (G1). Such reception facilities shall operate without causing undue delay to ships and shall provide for the safe disposal of such sediments that does not impair or damage environment, human health, property or resources. Cases of inadequate facilities will be notified to IMO for transmission to the other Parties concerned. In accordance with regulation B-5 of the BWM Convention, ships are required to remove and dispose of sediments from spaces designated to carry ballast water in accordance with the provisions of the ship's ballast water management Plan.

8) Check of operational requirements for persons on board

According to the provisions of regulation B-6 of the BWM Convention, officers and crew shall be familiar with their duties in the implementation of Ballast Water Management particular to the ship on which they serve and shall, appropriate to their duties, be familiar with the ship's Ballast Water Management plan. Therefore, maritime enforcement officers will check as required whether the relevant persons on board are familiar with the contents of the ballast water management plan and their corresponding duties.

9) For ships of non-Parties to BWM Convention

According to the provisions of Article 3.3 of the BWM Convention, with respect to ships of non-Parties to this Convention, China will carry out PSC inspection under the BWM Convention in

accordance with the IMO principle of no favourable treatment for ships flying the flag of a non-contracting party.

10) Exceptions

Like other conventions related to environmental protection, the BWM Convention also provides for corresponding exemptions. According to the provisions of Regulation A-3 of the Convention, ships are exempted from the ballast water management requirements of Article 2.3 and Section C of the BWM Convention when for the purpose of ensuring the safety of the ship in emergency situations or saving life at sea, for avoiding or minimizing damage to a ship or its equipment, or for avoiding or minimizing pollution incidents from the ship.

6.2.4 Sampling for compliance with the ballast water performance standard (regulation D-2) for port State inspection of ships

The method of ballast water sampling and analysis adopted by China PSC inspection is based on the method and procedures provided in the Guidelines for ballast water sampling (G2) (MEPC.173(58)) and the Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2) (BWM.2/Circ.42/Rev.2).

The objectives of G2 are to provide Parties, including port State control officers, with practical and technical guidance on ballast water sampling and analysis for the purpose of determining whether the ship is in compliance with the Ballast Water Management Convention according to article 9 “Inspection of Ships”. The Guidelines provide general recommendations for sampling for compliance with the ballast water exchange standard (regulation D-1) and sampling for compliance with the ballast water performance standard (regulation D-2).

The purpose of BWM.2/Circ.42/Rev.2 is to provide general recommendations on methodologies and approaches to sampling and analysis to test for compliance with the standards described in regulations D-1 and D-2 of the BWM Convention. The guidance will undergo a trial and BWM convention experience building period after the Convention enters into force, and MEPC will develop a package of solutions based on the results of the trial, including the development of a possible globally harmonized approach to ballast water sampling and analysis.

(1) Principles of sampling - representative sampling

1) G2 recommends that, when sampling for compliance with the ballast water performance standard, samples should be taken from the discharge line, as near to the point of discharge as practicable, during ballast water discharge whenever possible.

2) Sampling via manholes, sounding pipes, or air pipes is not the preferred approach for assessing compliance with regulation D-2. Scientific trials have shown that using these sampling locations may not provide accurate estimates of organism concentrations that would occur in the discharge, i.e. such sampling may provide an under- or over- estimate of the concentration of organisms.

(2) Sampling from the ballast water discharge line

1) The advantage in sampling the biota present in the ballast water discharge line is that this is most likely to accurately represent the concentration of substances and organisms in the actual discharge, which is of primary concern in assessing compliance with the discharge regulations.

2) In order to undertake an accurate measurement on the organism concentration in the ballast water, it is recommended to install an “isokinetic” sampling facility. To achieve isokinetic sampling conditions, a sampler is designed to separate a subsection of the total flow-stream in a manner that does not encourage or discourage water entry other than that which is otherwise in the cross-section of the sampler opening. In other words, flow streams in the main flow of the pipe should not diverge or converge as they approach the opening of the sampler.

3) Technical specifications for design of in-line sampling facilities

Through computational fluid dynamics modelling, it has been shown that the isokinetic diameter calculation can provide guidance for sizing of sample ports for sampling of organisms.

- ① Simulations showed that flow transitions from the main stream were best for sample port diameters between 1.5 and 2.0 times the isokinetic diameter. Ports sized in this range had smooth transitions and pressure profiles that allowed for direct sampling without the need of a pump to induce sample collection. The isokinetic sample port diameter should therefore be determined generally according to the equation:

$$Diso = Dm \sqrt{\frac{Qiso}{Qm}}$$

where: *Diso* and *Dm* are the diameters of the sample port opening and the main flow in the discharge line, respectively;

Qiso and *Qm* represent the respective volumetric flow rates through the two pipes.

It is recommended that sample port size be based on the combination of maximum sample flow rate and minimum ballast flow rate that yields the largest isokinetic diameter.

- ② The opening of the sampling pipe should be chamfered to provide a smooth and gradual transition between the inside and outside pipe diameters.
- ③ The length of the straight sample pipe facing into the flow can vary, but should not usually be less than one diameter of the sampling pipe. The sampling port should be oriented such that the opening is facing upstream and its lead length is parallel to the direction of flow and concentric to the discharge pipe which may require sampling pipes to be “L” shaped with an upstream facing leg if installed along a straight section of discharge pipe.
- ④ The need to be able to service the sample pipe is important and should be considered, taking the safety of ship into consideration. Therefore, the sampling pipe should be retrievable either manually, or mechanically, or it should be in a system which can be isolated. Because of the potential for the opening and interior of the sample pipe to become occluded by biological or inorganic fouling, it is recommended that samplers be designed to be closable at the opening, removed between sampling intervals or be easily cleaned prior to sampling.
- ⑤ The sample pipe and all associated parts of the sampler that come into contact or near proximity with the ballast piping should be constructed of galvanically compatible materials and generally corrosion resistant. Any corrosion of the sampling system will affect sample flow rates and potentially sample representativeness.
- ⑥ If flow control of the sample flow rate is required, ball, gate and butterfly valve types should be avoided as they may cause significant shear forces which may result in organism mortality.

For flow control, it is recommended that diaphragm valves or similar valve types be used to minimize sharp velocity transitions. For flow distribution, ball valves may be utilized in such a manner that they are either fully open or fully closed.

(3) Testing methods

Testing and analysis for compliance with the D-2 standard is based on the number of viable organisms categorized by different sizes and the number of specific types of microorganisms in the D-2 standard of the BWM Convention. It can be determined by means of counting, variable fluorometry, photometry, nucleic acid, ATP, bulk fluorescein diacetate (FDA), chlorophyll a, or by flow cytometry, fluorometric diagnostic kit, fluorescence hybridization, etc.

Although BWM.2/Circ.42/Rev.2 provides generic methods for each indicator of the D-2 standard, they are only recommended currently. There is no globally uniform international standard for ballast water analysis till now, and the confidence level or testing limits of the recommended methods have not been validated. The indicative analysis methods for testing for compliance with the D-2 standard are shown in Table 6.2.4.

D-2 Indicative analysis methods for testing for compliance with the D-2 standard

Table 6.2.4

Indicator	General approach	Notes
Viable organisms $\geq 50 \mu\text{m}$	Visual counts or stereo-microscopy	Can be expensive and time-consuming, needs moderately trained personnel. (Note that OECD Test Guideline for Testing of Chemicals 202, “Daphnia sp. Acute immobilization test and reproduction test” could be used as basis for standard methodology.)
Viable organisms $\geq 50 \mu\text{m}$	Visual inspection	Visual inspection is likely to only register organisms bigger than 1000 micro-metres in minimum dimension.
Viable organisms $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$	Variable fluorometry	Only monitors photosynthetic phytoplankton and thus may significantly underestimate other planktonic organisms in this size fraction
Viable organisms $\geq 50 \mu\text{m}$ and $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$	Photometry, nucleic acid, ATP, bulk fluorescein diacetate (FDA), chlorophyll a	Semi-quantitative results can be obtained. However, some of these organic compounds can survive for various lengths of time in aqueous solution outside the cell, potentially leading to false positives (Welschmeyer and Maurer (2012))
Viable organisms $\geq 50 \mu\text{m}$	Photometry, nucleic	Semi-quantitative results can be obtained. However,

Indicator	General approach	Notes
and $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$	acid, ATP, bulk fluorescein diacetate (FDA), chlorophyll a	some of these organic compounds can survive for various lengths of time in aqueous solution outside the cell, potentially leading to false positives (Welschmeyer and Maurer (2012))
Viable organisms $\geq 50 \mu\text{m}$ and $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$	Flow cytometry	Very expensive
Enterococci	Fluorometric diagnostic kit	Minimum incubation time 6 h. Semi-quantitative results from portable methods
Escherichia coli	Fluorometric diagnostic kit	Minimum incubation time 6 h. Semi-quantitative results from portable methods
Vibrio cholerae (O1 and O139)	Test kits	Relatively rapid indicative test methods are available
Viable organisms $\geq 50 \mu\text{m}$ and $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$	Pulse counting fluoresceindiacetate (FDA)	Sampling kit can be larger than that for bulk fluorescein diacetate

For specific methods of ballast water sample ports and sample collection and handling, reference may be found in ISO 11711-1:2019 Ships and Marine technology - Aquatic nuisance species - Part 1: Ballast water discharge sample port and Ships and marine technology - Aquatic nuisance species - Part 2: Ballast water sample collection and handling.

ISO 11711-1:2019 provides requirements for the design and fitting arrangements of ballast water discharge sample ports, including the location of sample ports, the form of ports, specifications for a return port to the ballast line downstream of the sample collection port., etc. which is applicable to ships with a ballast water discharge pipe size of DN 100 or greater. When a ship's ballast water is being sampled, a suitable sample collection probe is installed into the shipboard sample port as needed to collect ballast samples, and the port is sealed with a blind flange at other times. This document standardizes the presentation of the port to accommodate various probe configurations and provides specifications for a return port to the ballast line downstream of the sample collection port, allowing processed sample water to be returned to the ballast pipe.

ISO 11711-2:2002 provides requirements and recommendations to ballast water sampling teams or other concerned parties on the selection and use of sampling apparatus, specifying the design and maintenance of appropriate sample probes for collecting and processing ballast water discharge samples aboard a ship from sample ports installed in accordance with ISO 11711-1 and necessary sample flow control to achieve representative sampling and the handling of samples for subsequent analyse. The measurement uncertainty is minimized in consistence with measurement requirements. Appropriate sample volumes and collection times provide statistical confidence for viable organism counts at the discharge limit. The standard provides sampling approaches for each indicator, including indicative and detailed analysis methods as defined in BWM.2-Circ.42/Rev.2. The ISO 11711 standard does not add any requirements to the BWM Convention or relevant IMO instruments, but only provides supplementary guidance for ballast water sampling.

6.2.4 China-South Korea ballast water exchange exemption

On May 28, 2019, the Maritime Safety Administration under the Ministry of Transport issued the “Notice on Exemption of Ballast Water Exchange Management Requirements for Ships Engaged on International Voyages between China and South Korea” (Maritime Danger Prevention Letter (2019) No. 661). In order to effectively solve the difficulty in ballast water exchange for some ships engaged on international voyages between China and South Korea, after consultation with the competent authorities of South Korea, exemption of ballast water exchange for ships engaged on international voyages between China and South Korea is agreed on as follows:

(1) Exemption time

From June 1st, 2019 to September 7th, 2024.

(2) Object of exemption

Ships engaged on international voyages only between China and South Korea

(3) Exemption conditions

Ships meeting one of the following conditions are exempted from ballast water exchange management in accordance with the Application of the BWM Convention to Ships Operating in Sea Areas where Ballast Water Exchange in accordance with Regulations B-4.1 and D-1 is not Possible(BWM.2/Circ.63) released by IMO:

- ① The water depth of the route is less than 50 meters;
- ② The route is less than 100 nautical miles from the baseline of the territorial sea of the port of destination of China.

For such ships that are unable to carry out ballast water exchange in accordance with the requirements of the BWM Convention, the reasons for not doing so shall be recorded in the Ballast Water Record Book.

It is important to note that this exemption applies to ships engaged on international voyages that comply with the D-1 standard as required by the BWM Convention.

Appendix 1 List of relevant IMO documents on implementation of the BWM Convention

1.1 Codes, Guidance and Guidelines for implementation of the BWM Convention

In order to effectively implement the requirements of the BWM Convention, IMO has formulated 15 codes and guidelines, as follows:

- (1) Code for Approval of Ballast Water Management Systems (BWMS Code (MEPC.300(72), to revoke G8)
- (2) G1—Guidelines for Sediment Reception Facilities (MEPC.152(55))
- (3) G2—Guidelines for Ballast Water Sampling (MEPC.173(58))
- (4) G3—Guidelines for Ballast Water Management Equivalent Compliance (MEPC.123(53))
- (5) G4—Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (MEPC.127(53), as amended by MEPC.306(73) and MEPC.370(80))
- (6) G5—Guidelines for Ballast Water Reception Facilities (MEPC.153(5))
- (7) G6—Guidelines for Ballast Water Exchange (MEPC.288(71), amended by MEPC.371(80))
- (8) G7—Guidelines for Risk Assessment under Regulation A-4 of the BWM Convention (MEPC.289(71), superseding MEPC.162(56))
- (9) G8—Guidelines for Approval of Ballast Water Management Systems (MEPC.279(70), superseding MEPC.174(58))
- (10) G9—Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances (MEPC.169(57))
- (11) G10—Guidelines for Approval and Oversight of Prototype Ballast Water Treatment Technology Programmes (MEPC.140(54))
- (12) G11—Guidelines for Ballast Water Exchange Design and Construction Standards (G11) (MEPC.149(55))
- (13) G12—Guidelines on Design and Construction to Facilitate Sediment Control on Ships (MEPC.150(55))
- (14) G13—Guidelines for Additional Measures regarding Ballast Water Management including Emergency Situations (MEPC.161(56))
- (15) G14—Guidelines on Designation of Areas for Ballast Water Exchange (MEPC.151(55))

1.2 Other guidelines and BWM related circulars

IMO has also developed other relevant guidelines and BWM circulars to further facilitate the smooth implementation of the BWM Convention, including the following:

- (1) Guidelines for Ballast Water Exchange in the Antarctic Treaty Area (MEPC.163(56))
- (2) Procedure for Approving Other Methods of Ballast Water Management in accordance with Regulation B-3.7 of the BWM Convention (MEPC.206(62))
- (3) Information Reporting on Type Approved Ballast Water Management Systems (MEPC.228(65))
- (4) Guidelines for Port State Control under the BWM Convention (MEPC.252(67))
- (5) Implementation of the BWM Convention (MEPC.287(71))

- (6) The Experience-building Phase associated with the BWM Convention (MEPC.290(71))
- (7) Guidelines for the Use of Electronic Record Books under the BWM Convention (MEPC.372(80))
- (8) Survey Guidelines under the Harmonized System of Survey and Certification, 2021 (A.1156(32))
- (9) Harmonized Implementation of the Guidelines for Approval of Ballast Water Management Systems (G8) (BWM.2/Circ.8)
- (10) Methodology for Information Gathering and Conduct of Work of the GESAMP-BWWG (BWM.2/Circ.13/Rev.5)
- (11) Guidance Document on Arrangements for Responding to Emergency Situations involving Ballast Water Operations (BWM.2/Circ.17)
- (12) Guidance to Ensure Safe Handling and Storage of Chemicals and Preparations Used to Treat Ballast Water and the Development of Safety Procedures for Risks to the Ship and Crew Resulting from the Treatment Process (BWM.2/Circ.20)
- (13) Framework for Determining when a Basic Approval Granted to one Ballast Water Management System may be Applied to another System that Uses the same Active Substance or Preparation (BWM.2/Circ.27)
- (14) Applicability of Ballast Water Management Convention to the Water in the Hopper Area of Hopper Dredgers (BWM.2/Circ.32)
- (15) Guidance on Scaling of Ballast Water Management Systems (BWM.2/Circ.33/Rev.1, superseding BWM.2/Circ.33)
- (16) Information that should be Made Available in Proposals for Approval of Ballast Water Management Systems in accordance with the Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances (G9) (BWM.2/Circ.37)
- (17) Issuance of Ballast Water Management Certificates Prior to Entry Into Force of the BWM Convention and Ballast Water Management Plans Approved According to Resolution A.868(20) (BWM.2/Circ.40)
- (18) Guidance on Ballast Water Sampling and Analysis for Trial Use in accordance with the BWM Convention and Guidelines (G2) (BWM.2/Circ.42/Rev.1)
- (19) Amendments to the Guidance for Administrations on the type approval process for ballast water management systems in accordance with Guidelines (G8) (BWM.2/Circ.43/Rev.1)
- (20) Options for Ballast Water Management for Offshore Support Vessels in accordance with the BWM Convention (BWM.2/Circ.44)
- (21) Clarification of “major conversion” as Defined in Regulation A-1.5 of the BWM Convention (BWM.2/Circ.45)
- (22) Application of the BWM Convention to Mobile Offshore Units (MOUs) (BWM.2/Circ.46)
- (23) Guidance on Entry or Re-entry of Ships into Exclusive Operation within Waters under the Jurisdiction of a Single Party (BWM.2/Circ.52/Rev.1)
- (24) Guidance on Methodologies that may be Used for Enumerating Viable Organisms for Type Approval of Ballast Water Management Systems (BWM.2/Circ.61/Rev.1)

- (25) Guidance on Contingency Measures under the BWM Convention (BWM.2/Circ.62)
- (26) Application of the Convention to Ships Operating in Sea Areas where Ballast Water Exchange in accordance with Regulations B-4.1 and D-1 is not Possible (BWM.2/Circ.63)
- (27) Unified Interpretations to the BWM Convention and the BWMS Code (concerning "Date installed" in relation to "Method of ballast water management used")(BWM.2/Circ.66/Rev.5)
- (28) Data Gathering and Analysis Plan for the Experience-building Phase associated with the BWM Convention (BWM.2/Circ.67/Rev.1)
- (29) Guidance for the Commissioning Testing of Ballast Water Management Systems (BWM.2/Circ.70/Rev.1)
- (30) Protocol for the Verification of Ballast Water Compliance Monitoring Devices (CMD)(BWM.2/Circ.78)
- (31) Convention Review Plan for the Experience-building Phase associated with the BWM Convention (CRP) (BWM.2/Circ.79)
- (32) Guidance on Ballast Water Record-keeping and Reporting(BWM.2/Circ.80)

1.3 Other relevant documents

- (1) Manual on Ballast Water Management– How to Do it (MEPC 71/17/Add.2, Annex 11)

Appendix 2 Summary of relevant domestic and overseas BWMS product information

2.1 China's BWMS approval information (in no particular order)

No.	Ballast water management system (BWMS)			Type approval		
	Product manufacturer	BWMS Name/model	Treatment technology	OldG8	2016 G8/BWMS Code	USCG
1	Qingdao SUNRUI Marine Environmental Engineering Co., Ltd.	BalClor	Filtration + electrolysis	✓	✓	✓
2	Headway Technology Group (Qingdao) Co., Ltd.	OceanGuard BWTS	Filtration + electrocatalytic advanced oxidation	✓	✓	✓
3	Cosco Shipbuilding Technology (Weihai) Co., Ltd.	Blue Ocean Shield	Filtration+ UV	✓	✓	✓
4	Shanghai Cyeco Environmental Technology Co., Ltd.	Cyeco BWMS	Filtration+ UV	✓	✓	✓
5	Wuxi blue Sky Electronics Co., Ltd.	BSKY™ BWMS	Hydrocyclone separation + ultrasonic + UV	✓	✓	✓
6	Jiangsu Nanji Machinery Co., Ltd.	NiBallast BWMS	Filtration + Membrane separation + nitrogen and oxygen removal (N2)	✓	✓	✓
7	Elite Automation Technology Co., Ltd.	Seascape® BWMS	Filtration + UV + ultrasound	✓	✓	✓
8	Ahead Ocean Technology (Dalian) CO., Ltd.	AHEAD®-BWMS	Filtration+ UV	✓	✓	
9	Zhejiang YINGPENG Marine Equipment Manufacturing Co., Ltd.	YP-BWMS	Filtration+ UV	✓		
10	Yixing PACT Environmental Protection Technology Co., Ltd.	PACT marine™ BWMS	Filtration+ UV	✓	✓	
11	Jiujiang Precision Test Technology Research Institute	OceanDoctor	Filtration + UV + photocatalysis	✓		
12	Shanghai LEE'S FUDA Electromechanical Science & Technology Co., Ltd.	LeesGreen®	Filtration + UV	✓	✓	
13	Shanghai Jiazhou environmental protection electromechanical equipment Co., Ltd.	Bawaf™ BWMS	Filtration+ UV	✓		
14	Shanghai Hengyuan Marine Equipment Co., Ltd.	HY™-BWMS	Filtration+ UV	✓		

Note: This table is updated to September 2022.

2.2 Information on foreign BWMS products approved by USCG

No.	System name	Treatment technology	Manufacturer (country)
1.	OBS/OBS Ex	Filtration+ UV	Optimarin (Norway)
2.	Pure Ballast 3	Filtration+ UV	Alfa Laval (Sweden)
3.	OceanSaver MK II	Filtration + electrolysis	TeamTec OceanSaver AS (Norway)
4.	Ecochlor BWTS	Filtration + chemical injection	Ecochlor, Inc. (United States)
5.	Erma First FIT	Filtration + electrolysis	Erma First (Greece)
6.	Electro-Cleen System	Electrolysis	Techcross, Inc. (South Korea)
7.	Purimar BWMS	Filtration + electrolytic chlorination	S&SYS Co., Ltd. (South Korea)
8.	BIO-SEA B	Filtration + UV	BIO-UV(France)
9.	Aquarius EC	Filtration + electrolysis	Wartsila Water system, Ltd. (United Kingdom)
10.	HiBallast	Filtration + electrolysis	HHI(South Korea)
11.	BallastAce	Filtration + chemical injection	JFE(Japan)
12.	GloEn-Patrol	Filtration + UV	Panasia (South Korea)
13.	BALPURE	Filtration + electrolysis	De Nora (United States)
14.	InTank BWTS	Electrolysis + chemical injection	SCIENCO/FAST (United States)
15.	CompactClean BWMS	Filtration + UV	DESMI Ocean Guard A/S (Denmark)
16.	Aquarius UV	Filtration + UV	Wartsila Water system, Ltd. (United Kingdom)
17.	PureBallast 3.2	Filtration + UV	Alfa Laval(Sweden)
18.	Evolution	Filtration + UV	Cathelco (United Kingdom)
19.	EcoBallast	Filtration + UV	HHI(South Korea)
20.	HK-(E)C	Filtration + UV	Miura Co., Ltd.(Japan)
21.	EcoGuardian	Filtration + electrolysis	HANLA IMS (South Korea)
22.	HK-S(E)	Filtration + UV	Miura Co., Ltd.(Japan)
23.	BAWAT BWMS Mk2	Heating	BAWAT A/S(Denmark)
24.	GloEn-Patrol 2.0	Filtration + UV	Panasia(South Korea)
25.	NK-O3 BlueBallast II	Ozone	NK Co. Ltd. (South Korea)
26.	NK-O3 BlueBallast II Plus	Ozone	NK Co. Ltd.(South Korea)
27.	Hyde GUARDIAN-US	Filtration + UV	Calgon Carbon UV Technologies LLC,

No.	System name	Treatment technology	Manufacturer (country)
			d/b/a(United States)
28.	HK-(E)R	Filtration + UV	Miura Co., Ltd.(Japan)
29.	ECS-HYCHLOR	Filtration + electrolytic chlorination	Techcross, Inc. (South Korea)
30.	LUV U1	Filtration + UV	Semb-Eco Pte Ltd. (Singapore)
31.	MICROFADE II	Filtration + chemical injection	Kuraray Co., Ltd.(Japan)
32.	oneTank	Chemical injection	oneTank, LLC(United States)
33.	ATPS-BLUEsys	Electrolysis	Panasonic Environmental Systems & Engineering Co., Ltd.(Japan)
34.	KBAL	Pressure vacuum + UV	Knutsen Ballast Water AS(Norway)
35.	PureBallast 2.0	Filtration + UV	Alfa Laval Tumba AB(Sweden)
36.	Senza BWMS	Chemical injection	Teamtec BWMS AS (Norway)
37.	SKF BlueSonic BWMS	Filtration/UV/ultrasound	SKF Marine GmbH (GERMANY)
38.	SeaCURE	Filtration + electrolytic chlorination	Evoqua Water Technologies Limited (United Kingdom)
39.	HiBallast NF	Electrolysis	Hyundai Heavy Industries Co., Ltd. (South Korea)
40.	CleanBallast-Ocean Barrier System (CB-OBS)	Filtration + electrolytic chlorination	RWO GmbH (Germany)
41.	NGT BWMS	Filtration + UV	Norwegian Greentech AS(Norway)
42.	Purestream BWMS	Filtration + UV	Atlantium Technologies Ltd. (Israel)
43.	LanghBW BWMS	Filtration + UV	Langh Tech Oy Ab(Finland)
44.	AquaStar	Electrolysis	AQUASTAR Co., Ltd (South Korea)
45.	ARA Plus+	Filtration + UV	SAMKUN CENTRURY Co., Ltd. (South Korea)

Note: This table is updated to 31 December 2023.

2.3 Information on type approved BWMS worldwide (Approved in accordance with 2016 G8 or the BWMS Code)

No.	Date of approval	System name	Country
1	2017.10.24 (amended on 2017.10.27 and	Ecochlor® Ballast Water Management System	Norway

No.	Date of approval	System name	Country
	2018.09.04)		
2	2018.02.02	PureBallast 3.2 and PureBallast 3.2 Compact Flex ballast water management system	Norway
3	2018.04.06 (amended on 2018.12.20)	BalClor® Ballast Water Management System	Norway
4	2018.09.21 (amended on 2021.07.19)	CompactClean ballast water management system	Denmark
5	2018.12.14	OceanGuard® Ballast Water Management System	Norway
6	2018.12.19	HiBallast™ Ballast Water Management System	Norway
7	2018.12.20	Envirocleanse inTank™ Electrochlorination Ballast Water Treatment System (subsequently changed to inTank WTS Electrochlorination (EC) variation)	Norway
8	2019.05.15	Evolution Mini, Evolution BWMS	United Kingdom
9	2019.06.27	ERMA FIRST BWTS, model FIT 75-3000	Greece
10	2019.07.04	Envirocleanse inTank™ Bulk Chemical Ballast Water Treatment System	Norway
11	2019.07.05	BLUE OCEAN SHIELD BWMS	Norway
12	2019.08.16	GloEn-Patrol 2.0	Norway
13	2019.10.31	Bawat BWMS Mk2	Danmark
14	2020.01.08	PureBallast 3.2 and PureBallast 3.2 Compact Flex ballast water management system	Vietnam
15	2020.01.15	Oceansaver Ballast Water Treatment System MKIIB	Norway
16	2020.01.23	Hyde GUARDIAN -US BWTS	Norway
17	2020.02.10	ECSHYCHLOR™ BWMS	Norway
18	2021.02.25 2020.06.22 2021.01.10	Miura BWMS	Japan
19	2020.03.06	LeesGreen® Ballast Water Management System (LeesGreen® BWMS)	China
20	2020.03.20	Wärtsilä Aquarius UV BWMS	Norway
21	2020.04.06	MICROFADE II BWMS	Netherlands
22	2020.05.15	Seascape BWMS	Norway

No.	Date of approval	System name	Country
23	2020.05.19	NiBallast™ ballast water management system (NiBallast™ BWMS)	China
24	2020.06.12	Wärtsilä Aquarius EC BWMS	Norway
25	2020.06.15	Cyeco Ballast Water Management System	China
26	2020.06.19	KBAL BWMS	Norway
27	2020.07.03	oneTank	Norway
28	2020.08.03	Ecochlor® BWMS	Norway
29	2020.08.05	Semb-Eco BWMS	Singapore
30	2020.09.07	Electro-Cleen™ System (ECS)	South Korea
31	2020.09.07	Purimar™	South Korea
32	2020.09.07	EcoGuardian™ BWMS	South Korea
33	2020.09.10	TLC-BWM	Vietnam
34	2020.10.12	SKF BlueSonic BWMS	Norway
35	2020.10.23	Optimarin Ballast System (OBS) and Optimarin Ballast System Ex (OBS Ex)	Norway
36	2020.11.10	ATPS-BLUEsys BWMS	Norway
37	2020.11.11	inTank BWTS (inTank BWTS Electrochlorination (EC) variation and inTank BWTS Bulk Chemical (BC) variation)	Norway
38	2020.11.25	BALPURE® Ballast Water Management System	United Kingdom
39	2020.12.02	Trojan Marinex BWT™	Norway
40	2020.12.09	NGT BWMS	Norway
41	2020.12.15	JFE BallastAce®	Japan
42	2020.12.21	PACT marine Ballast Water Management System (Pact marine BWMS)	China
43	2020.12.31	BSKY™ Ballast Water Management System	China
44	2021.01.19	KURITA BWMS	Norway
45	2021.03.03	BIO-SEA® BWTS	France
46	2021.04.20	SeaCURE® BWMS and SeaCURE Models SC-F-500 to SC-F-6000	Liberia
47	2021.07.19	Atlantium Purestream™ 100/200/300/500/900/1200/1500	Norway
48	2021.12.30	HiBallast NF™	South Korea

No.	Date of approval	System name	Country
49	2022.01.07	CleanBallast® - Ocean Barrier System	Norway
50	2022.05.12	LanghBW BWMS	Finland
51	2022.05.17	AQUASTAR™	South Korea
52	2022.07.22	ARA Plus+ BWMS	South Korea
53	2022.09.01	ARA Plus+ BWMS	Liberia
54	2023.02.01	One-Pass Mode of the KBAL BWMS	Norway
55	2023.02.22	One-Pass Mode of the KBAL BWMS	United Kingdom

Note: This table is updated to July 2023 (MEPC 80).