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Responsibilities of flag state in monitoring ships for the implementation of BWM Convention

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RESPONSIBILITIES OF FLAG STATE IN MONITORING SHIPS FOR THE IMPLEMENTATION OF BWM CONVENTION

By

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University

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ABSTRACT

Title: Responsibilities of Flag State in monitoring ships for the implementation of BWM Convention

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International shipping has been identified as one of the key pathways for the movement of aquatic species between differing ecosystems. The translocation of harmful organisms and pathogens via ballast water and sediments inside ballast water tanks had significant economic and ecological impact on marine biodiversity in many regions. They can also pose a threat to human health from the spread of diseases and species harmful to humans. Currently great efforts have been put in preventing the transfer of species in ballast water.

This dissertation focuses on responsibilities of flag state in monitoring ships and implementing the BWM Convention, and uncertainties and difficulties in the process. Further, countermeasures to improve the management of Flag state and compensation for these problems are suggested in this paper.

The BWM Convention is getting close to entry into force, and flag states should get their international ships prepared for ballast water management in accordance with the BWM Convention and Guidelines. There is no doubt that challenges and difficulties will exist during the procedure. To study the Convention in advance, identify risks and come up with countermeasures will help a good enforcement and implementation, and enable ships and shipping companies comply with the Convention.

Keywords: Ballast water, flag state, BWMS, BWM

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LIST OF ABBREVIATIONS

AMS	Alternate Management System
BWE	Ballast Water Exchange
BWE	Ballast Water Exchange
BWM	Ballast Water Management
BWMP	Ballast Water Management Plan
BWMS	Ballast Water Management System
BWT	Ballast Water Treatment
BWTS	Ballast Water Treatment System
BWTT	Ballast Water Treatment Technologies
BWWG	Ballast Water Working Group on Active Substances
DMU	Dalian Maritime University
EEZ	Exclusive Economic Zone
EMSA	European Maritime Safety Agency
EPA	Environmental Protection Agency
ETV	Environmental Technology Verification
FSC	Flag State Control
GESAMP	The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
HAOP	Harmful Aquatic Organisms and Pathogens
IMO	International Maritime Organization
MEPC	Marine Environment Protection Committee (of IMO)

NANPCA	the Non-indigenous Aquatic Nuisance Prevention and Control Act
NIS	the National Invasive Species Act
PSC	Port State Control
RO	Recognized Organization
STO	Standard Test Organism
UNCLOS	United Nations Convention on the Law of the Sea
USCG	The United State Coast Guard

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 Ballast water

Shipping is an important chain of global logistics and is the most cost-effective means of transportation. More than 90% of international trade is done by the sea with some 50,000 merchant ships sailing in the oceans (Globallast Program, 2016a). In order to operate the ships effectively and safely when travelling partially laden or without cargo, ships must take ballast water on board to control trim, list, draught, stability or stresses of the ship. The Ballast water needed are normally taken from the surrounding ocean and kept in ballast tanks. Double bottom tank, wing tank, unloaded cargo hold, forepeak or afterpeak tank are usually used as ballast tank. It is estimated that there are 3-5 billion tonnes of ballast water transferred annually around the world, the capacity of ballast water carried by each ship varies from several hundred liters to more than 130,000 tonnes depending on the size and type of the ship (Nicholas et al, 2003).

Table 1.1-Ballast water capacities for different types of ships

Vessel Type	DWT	Normal (tonnes)	% of DWT	Heavy (tonnes)	% of DWT
Bulk Carrier	250,000	75,000	30	113,000	45
Bulk Carrier	150,000	45,000	30	67,000	45
Bulk Carrier	70,000	25,000	36	40,000	57
Bulk Carrier	35,000	10,000	30	17,000	49

Tanker	100,000	40,000	40	45,000	45
Tanker	40,000	12,000	30	15,000	38
General Cargo	17,000	6,000	35	n/a	
General Cargo	8,000	3,000	38	n/a	
Passenger/RORO	3,000	1,000	33	n/a	

Source: Globallast Program. (2016a). *Ballast water as a vector*. Retried May 16, 2016 from the World Wide Web: http://globallast.imo.org/ballast-water-as-a-vector/

Ballast sediments are another problem associated closely with ballast water. When ships take on ballast water, material contained in the water are also taken especially in turbid or shallow waters, including mud, sand and various biological bodies. These suspended matter settles out of ballast water and forms the ballast sediments, which is defined as "matter settled out of ballast water within a ship" in the BWM Convention. This material provides a favorable substrate for all kinds of marine species, once it settles in the bottom of ballast tank as 'sediment'.

Therefore, ballast water is recognized as one of the primary vectors of potentially invasive alien species.

1.1.2 Invasive aquatic species

However, when ballast water is taken on board by sea chests with ballast pumps in the port of departure or coastal waters, local aquatic organisms can be taken up through the pumps. It is estimated that one cubic metre of ballast water may contain up to 50,000 zooplankton specimens and/or 10 million phytoplankton cells (Globallast Program, 2016b). This includes bacteria and other microbes, small invertebrates and the eggs, cysts and larvae of various species. Even though there is a hostile environment without food and light in the ballast tank, some organisms will survive and be discharged to waters of destination port together with the ballast water at the end of the voyage, as shown in Figure 1.1.

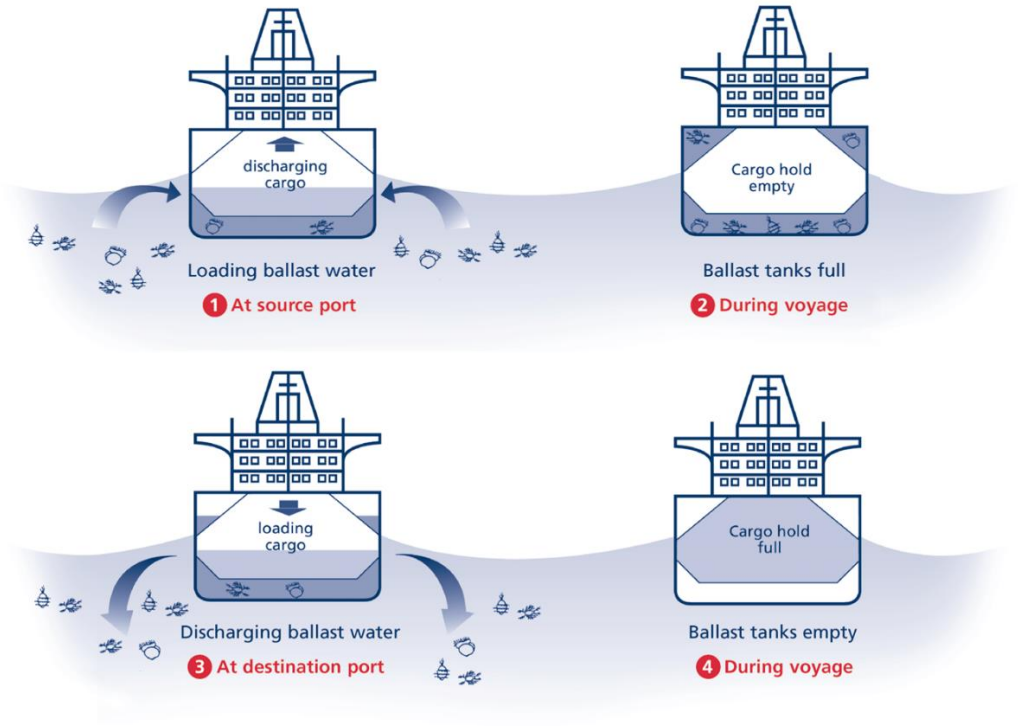

Figure 1.1 -Ballast Water Stowaways

Source: Globallast Program. (2016). Awareness materials. Retrieved May 20 2016 from http://globallast.imo.org/resources/awareness-materials/

From an environmental point of view, natural barriers among distinct biogeographic regions in the world are crossed due to the shipping. If the environmental conditions in new geographic area are suitable, then the alien species may not only survive, but also reproduce and spread rapidly, eventually become established in the new area. These alien organisms may out-compete native aquatic species, transmit diseases to native species, or contaminate the genome of native species through inter-breeding. If untreated ballast water presenting pathogens such as E. Coli is discharged to coastal waters, this provides a vector for disease transmission to human populations from one port to the next (Firestone & Corbett, 2006). Consequently, these invasive species impacts the diversity of marine creatures and the coastal ecosystems, and finally endangers the local environment, economy, and human health. The BWM Convention introduces the term as "Harmful Aquatic Organisms and Pathogens" (HAOP). That means aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into fresh water courses, may create hazards to the environment, human

health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas (IMO, 2004).

Figure 1.2- GloBallast poster [5]

Source: Globallast Program. (2016) Awareness materials. Retrieved May 20 2016 from: http://globallast.imo.org/resources/awareness-materials/.

In recent years, the ballast water and sediments issues have attracted great attention of the global scientific and professional public. Since international shipping has increased greatly with the globalization of trade, the number, size and speed of ships increase too. In consequence, both the volume of ballast water transported and the exchange times have increased, which aggravate the invasion of alien species caused by ballast water. In addition, it is different from pollution of toxic and harmful substances such as oil spill, which can be cleaned up and will degrade in the environment over time, once the alien species are introduced, the influence will accumulate or even exponential increase, as well as the cost of cleaning and recover.

There are an estimated 7,000 and 10,000 different species of marine microbes, plants and animals globally transferred by ships' ballast water each day**.** In marine and coastal environments, the introduction of non-indigenous or invasive species have been considered as one of the four greatest threats to the world's oceans, along with land-based sources of marine pollution; over-exploitation of living marine resources; physical alteration/destruction of marine habitats (Globallast Program, 2016b).

1.1.3 The importance of Flag States in implementing the BWM Convention

The Flag state is the state that the ship is registered. United Nations Convention on the Law of the Sea (UNCLOS) together with lots of other international conventions of the International Maritime Organization (IMO) sets up the legal framework of maritime safety and environment protection. The flag state gives the right to ships flying its flag, and the flag state has the authority and responsibility to enforce regulations over ships registered under its flag in order to ensure compliance with the IMO conventions. By this way, the "Genuine link" between ships and the flag state can be achieved.

However, it is impossible for the shipping companies to implement the BWM Convention initiatively since it will add the costs of operation. Therefore, the Flag states have obligations to develop mandatory legislation and necessary procedures to enforce ships to manage the ballast water and meet the requirements of international convention. Moreover, Flag state control (FSC) over ships' ballast water is the first defence line to prevent the invasion of alien aquatic species, and protect the human health, economic development and marine environment (Li & Chen, 2012).

1.2 Objectives of the research

BWM convention nearly enters into force now, and flag states need to manage ballast water in accordance with the BWM Convention and Guidelines, specifically in the following aspects: the type approval of Ballast Water Management System (BWMS), approval of prototype Ballast Water Treatment Technology Program (BWTT),

approval of Ballast Water Management Plan (BWMP), Survey and certification. In these procedures, it is definitely that difficulties and risks will be encountered. This paper reviews critical aspects of the BWM Convention and selected guidelines from the perspective of Flag State, identifies obligations of flag states in monitoring ships and associated difficulties, then proposes recommendations to flag states to prepare for implementation BWM Convention and Guidelines in advance.

1.3 Methodologies

Firstly, relevant literature has been widely reviewed, including IMO Conventions, guidelines, circulars, articles from contemporary journals, papers, books and information from websites. Furthermore, the information and view in the relevant literature have been sorted out and summarized. In order to identify risks and difficulties clearly and comprehensively, risk identification tools have been applied. The publications relating to flag states' obligation in monitoring ships are also referred to abstract the common suggestions for implementation in practice.

1.4 Structure of the dissertation

This dissertation consists of five chapters. Chapter 1 introduces the background about ballast water and invasive aquatic species, indicates the serious impacts of the issue and emphasizes the importance of Flag state in preventing the introduction of alien species, then presents the objective and methodologies of this study. Chapter 2 describes the development of legislations on ballast water, international as well as regional or national legislation of some developing countries in BWM. Chapter 3 analyses detailed requirements in the BWM Convention and Guidelines that flag state should comply with, and further, points out the risks and difficulties of standards and procedures flag state may encounter in implementation. Chapter 4 presents the relative suggestions for flag state to improve the management of ballast water. The last chapter discourses the overall summaries and conclusions.

CHAPTER 2

LEGISLATION ON BALLAST WATER MANAGEMENT

2.1 International convention

In the 1970s, IMO has noted the negative impacts of non-indigenous organisms transported via unmanaged ballast water, and listed this issue in the agenda of the Marine Environment Protection Committee (MEPC) with the aim to minimize the invasions of alien aquatic organisms (Gollasch et al., 2007).

As the first effort, *the International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships Ballast Water and Sediments Discharges*" was adopted at the 31 Session of MEPC in July 1991. In 1993, the IMO Assembly adopted these guidelines by Resolution A. 774(18). And in 1997, *the Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens* were adopted by Resolution A. 868(20), which provides recommendations and good practice in ballast water management, like non-release of ballast, ballast water exchange, ballast water management practices and the use of shore water exchange, further, urges the Governmental to implement the Guidelines through national legislation (Globallast Program, 2016c.).

Given the limitation of the IMO Guidelines in a voluntary basis, the occurrence of several devastating introductions of HAOP in many countries, it was recommended that IMO works towards a mandatory, legally-binding international instrument to address this problem. As a result, the International Convention for the Control and

Management of Ships Ballast Water and Sediments, hereafter called the BWM Convention, was adopted by consensus at a Diplomatic Conference at IMO in London on 13 February 2004, which is believed the most-highly complex and multi-disciplinary convention in the IMO history due to the scientific and technological challenges present. The convention aims to prevent, minimize and ultimately eliminate the transfer and subsequent harmful impact of aquatic organisms in the ballast water and sediment of ships.

The BWM Convention is divided into Articles and an Annex which includes technical standards and requirements in the Regulations for the control and management of ships' ballast water and sediments. To help with the implementation of the Convention, IMO adopted over 15 sets of guidelines and other documents contained in MEPC resolutions and circulars (Globallast Program, 2016d).

By March, 2016, 49 States have ratified the Convention representing 34.79% of world tonnage (IMO, 2016), which means the BWM convention now nearly meets the requirements for entry into force.

According to the BWM Convention, the definitions of Ballast Water and Ballast Water Management respectively are as follows:

- Ballast Water means water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship;
- Ballast Water Management 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 (IMO, 2004).

It is a big challenge for all nations to take effective control over the discharge of ballast water to prevent or minimize the transference of non-indigenous aquatic species and the related invasive risks. However, IMO regulations only provide

minimum standards on ballast water management, a country can always require better and higher standards for vessels flying its flag, raise and adopt an integrated approach to control and eliminate the introduction of invasive aquatic organism. By now, great efforts at local, national and global levels have been made to control introduction of non-indigenous species via ships' ballast water. Such as Australia, Canada, New Zealand, United Kingdom, the United States and various individual States within the US, a number of counties and regions all developed their own legislation for the management of ballast water, including reporting, recordkeeping, establishing a ballast water discharge standard, designating ballast water exchange areas, BWMP and sediments management. These measures may be more stringent than the IMO regulations in order to protect the marine ecosystems of their countries and regions (Liu, Chang & Chou, 2014).

2.2 BWM in United States of America

The United States of America was one of the first countries concerning the issue of invasive species transported by ships' ballast water. In 1990, the Non-indigenous Aquatic Nuisance Prevention and Control Act (NANPCA) was adopted by the Congress, which is made by the Environmental Protection Agency (EPA) and performed by US Coast Guard (USCG) in Eastern and Western Coast and the Great Lakes. In 1996 the National Invasive Species Act, 1996 (NIS) was passed, which amended the NANPCA and established a ballast water management program administered by the USCG. This Act continued the requirements of the Great Lakes and extended the scope of guidelines to vessels "with ballast tanks", it also directed the USCG to develop voluntary guidelines which requires all ships arriving from beyond the US or Canadian Exclusive Economic Zone (EEZ) which may carry alien species for report on ballast water. It further stipulated the approval of certain alternative BWM methods if those alternative methods are at least as effective as Ballast Water Exchange (BWE) in preventing and controlling infestation of aquatic species. The NIS also sets up a research program, a Clearinghouse mechanism, as

well as education and technology development programs (Zhang& Tu, 2008).

In addition to the federal legislation, a number of States, such as Washington, Oregon, Michigan, and California also have adopted or are in the process of adopting regulations on ballast water. These subnational requirements almost refer to the federal act and regulations of USCG, which stipulate agencies involved, requirements of reporting and BWM, exemptions, and legal responsibilities. This responds public concerns about the ecological impact of invasive species and completes the blank of federal legislation, further promotes the implementation (US EPA, 2016).

2.2.1 Ballast water discharge standards of United States of America

USCG enacted guidelines of ballast water and discharge standards (as specified in Table 2.1) in August 2009, which divided into two phases to perform the BWM.

Table 2.1 Timeline of the discharge standards for ships using BWMS approved by USCG

Ships	Ballast tank capacity (m^3)	Date of built	Implementation date
New-build ships	All capacity	After 2013.12.1	At the time of delivery
Existing ships	<1500	Before2013.12.1	First survey after 2016.1.1
	1500-5000	Before2013.12.1	First survey after 2014.1.1
	>5000	Before2013.12.1	First survey after 2016.1.1

Source: National Invasive Species Act, 1996.

The 1972 Clean Water Act allows the states develop independent requirements in accordance with the capacity of environment, for example, California and New York states have formulated strict ballast water discharge standard which is 100 to 1000 times stricter than that of IMO due to their vulnerable environment and large amount

of ships entering and leaving their ports (The comparison seen in Table 2.2).

Table 2.2 - Comparison of Ballast water discharge standards between IMO and the US

Organisms/size	IMO	California	New York	USCG Phase 1	USCG Phase 2
		2010(interim standard)	2020	2012	2013
		New ships	All ships*	All ships	All ships
>50µm	<10/m³	0*	0	<0.1/ m³	0
50µm/ m³	<10/m³	0	0	<0.1/ m³	0
10µm <Organisms<50µm	<10/ml	<0.01/ml	0	<0.1/ml	<0.01/ml
10µm	<10/ml	<0.01/ml	0	<0.1/ml	<0.01/ml
<10µm	N/A*	<103 Bacteria/100ml <104 Viruses/100ml	0	N/A	N/A
Toxicogenic Vibrio Cholera(O1&O19)	<1cfu*/100ml or <1cfu/g Zooplankton samples	<1cfu/100ml or <1cfu/g Zooplankton samples	0	<1cfu/100ml	<1cfu/100ml
Escherichia coli	<250 cfu/100ml	<126cfu/100ml	0	<126cfu/100ml	<126cfu/100ml
Intestinal Enterococci	<100 cfu/100ml	<33cfu/100ml	0	<33cfu/100ml	<33cfu/100ml
Bacteria	N/A	N/A	N/A	N/A	<103 Bacteria/100ml
Viruses	N/A	N/A	N/A	N/A	<104 Viruses/100ml
***: "0": No Organism shall be detected; "N/A": Not applicable or no requirements; "All ships": New ships and existing ships; cfu: colony forming unit.**					

Source: CCS, 2011.

2.2.2 Requirements on type approval of BWMS

In 2010, USCG published the *Proposal of Environmental Technology Verification* (ETV) which is an essential guideline to perform tests in type approval of BWMS. However, the standards are too stringent for the tests and to obtain the approval from USCG within a limited time. As an alternate measure, USCG permitted that these

BWMSs approved by Administration or Recognized Organization (RO) can apply for 5 years interim approval which called alternate management system (AMS). According to AMS, BWMS with Type Approval Certificate does not need to carry out tests again, but present the Type Approval Certificate issued by the Administration or RO, together with the documents and plans of BWMS, testing report. Then, USCG will confirm whether the BWMS has met the standards and requirements set by regulations of the US. If that is satisfied, AMS will be certificated. Ships equipped with BWMS with AMS will pass through the US unimpeded during the validity period of the Certificate. However, the formal Type Approval Certificate should also be applied for, because the AMS is just a temporary certificate. In addition, the testing should be carried out by Independent Laboratory recognized by USCG in according to ETV standards (Luo, et al, 2012).

2.2.3 BWMP

Different from the BWM Convention, it is voluntary to have and implement the BWMP on board ships in American acts. However, ballast water operation must be recorded in the Ballast Water Record Book. The US recommends each ship to equip a BWMP particular to its specific situation, but the details and requirements of BWMP are not mentioned.

2.3 BWM in Australia

Australia is generally regarded as a leading country in the field of research and management on ballast water. As an island country, Australia depends greatly upon the international shipping. It has a small amount of ships flying its flag and relies mostly on foreign ships for its trade. However, the marine ecosystem around Australia is very fragile because of important coral reefs and rare species. So Australia is vulnerable to invasive aquatic species. It is estimated that more than 200 alien species has been introduced by ships carrying ballast water to coastal waters of Australia, and triggered negative impacts on the ecosystem of Australia. As a result, extensive

research efforts and significant resources have been devoted to the issue.

In 1991, after MEPC adopted *the International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships Ballast Water and Sediments Discharges*, Australian Quarantine and Inspection Service (AQIS) produced the Australian Ballast Water Management Guidelines in order to reduce and eliminate risks of introducing invasive aquatic organisms by international ships through unmanaged ballast water. Subsequently, Australia adopted a coordinated national approach to the issue in 1994, including support for research into management techniques. In 1 July 2001, Australia enacted mandatory Ballast Water Management Requirements authorized by the Quarantine Act of 1908 (AQIS, 2008). In February 2004, the BWM Convention was adopted at a Diplomatic Conference at IMO, and Australia has signed and ratified the Convention immediately. Once the BWM Convention comes into force, ships arrived at Australia must comply with the requirements of the Convention.

On 16 June 2016, a new Biosecurity Act entered into force in Australia, replacing the Quarantine Act of 1908. The main legislative change, in relation to the operation of vessels, is alignment of Australian ballast water management requirements with those in the IMO's BWM Convention (GREEN4SEA, 2016).

Specially, Victoria, one of seven states of Australia, adopted additional requirements for the management of domestic ballast water in July 1, 2004, which are enforced by the Environment Protection Authority (EPA Victoria) under the framework of the 1908 Quarantine Act. EPA Victoria requires all ships planning to visit a Victorian port to submit a ballast water report form and record the source of all ballast water on board in detail. The discharge of domestic ballast water is forbidden in waters of Victorian unless EPA has approved in written form. (EPA Victoria, 2016). Under this policy, those ballast water with high risks originating outside of port and coastal waters of Victoria are impossible to enter into Victoria.

2.4 BWM in the European Union

Within the European Union, more than 90% of foreign and about 40% of domestic trade are completed through waterborne traffic (EU Commission, 2007). Once an invasive organism was introduced in a European country, it would spread rapidly in the EU. However, the EU has neither established a common EU ballast water policy nor formulated legal mandatory requirements. Existing legislation emphasizes parts of the issue, however, it is neither unified nor consistent with neighboring countries and region, which lack an effective enforcement. The European Maritime Safety Agency (EMSA) is responsible for matters of maritime safety and environmental management.

In the EU, there are a series of policies relating to the BWM, for example, marine strategy framework directive, marine equipment directive, biocide directive, port state control directive, port waste reception facilities directive, and habitat directive. Since the BWM Convention has not entered into force yet, the management of ballast water was not taken under the umbrella of the BWM Convention. But the EU has strongly suggested its member states to ratify and implement the Convention. The EMSA and the European Parliament also address that there is an urgent need to establish a common marine strategy, as well as an effective early warning system and emergency mechanism on the BWM issue under the framework of the new EU Maritime Policy and the EU Marine Strategy (David& Gollasch, 2008).

2.5 Analysis and summary

Above counties are almost developed capitalist countries with advanced shipping industry and broader shipping network, and are more probable to suffer from invasive species transferred by ballast water. Besides, the ecosystems of those countries are fragile and vulnerable to invasive species from the geographic conditions. The direct cause of legislation on ballast water is that they have suffered great loss due to

invasive species, the most infamous example is the zebra mussels introduced from the Black Sea into the Great Lakes costing millions of dollars in the mid-1980s (Kuang, 2010). Therefore, they put more scientific and legislative resources on the issue, have developed their own BWM laws and regulation in ballast water. Some of them adopt unilateral policies of ballast water which is more rigorous requirements than the IMO, such as California of the US. Those various requirement between different jurisdictions lead to chaos and difficulties in practice, which may form a shipping green barrier.

However, these national or regional legislations should work as a supplement of the BWM Convention in ballast water management, particularly when the Convention doesn't come into force in some special areas. Both international legislation and unilateral policies could supplement and promote mutually, which will help with the development of unified world-wide standards of ballast water and coordination of ballast water management.

CHAPTER 3

RESPONSIBILITIES OF FLAG STATES

3.1 General obligations of Flag State

3.1.1 Ensure ships flying its flag compliance with the Convention

Article 2 of the BWM convention requires that Parties undertake to give full and complete effect to the provisions of the Convention and the Annex, and encourage its ships to control and manage ballast water and sediments in order to prevent, minimize and ultimately eliminate the transfer of Harmful Aquatic Organisms and Pathogens.

It is regulated in Article 4 that Parties shall require that ships flying its flag and applying to the Convention comply with the requirements set forth in this Convention, meanwhile, they shall take effective measures to ensure that those ships comply with those applicable standards and requirements. Article 4.2 introduces the selective BWM approach which requests a party state to develop its own BWM policies, strategies or programs regarding to its particular conditions and capabilities. Because there are differences between countries in geography, environment socio-economy, organization, politics and other conditions. On the basis of Regulation A-4, these can be given exemptions. While based on Regulation C-1, additional measures may be introduced (Hebei MSA, 2015).

3.1.2 Legislation and enforcement

Flag States are required to develop laws to prohibit violation of the Convention and provide sanctions adequate in severity to discourage violations (Article 8).

3.1.3 Ballast Water Management Plan and relative documents

As in Regulation B-1, each ship shall have on board and implement a BWMP which shall be approved by the Administration taking into account the Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (G4) developed by IMO. Basically, an officer must be designated to be in charge of ballast operation complying with the BWMP and reporting to port authorities before entering. In addition, each ship must carry a Ballast Water Management Record Book for 2 years onboard and a further 3 years in company, which contains information about the ballast water operations. In accordance with Regulation B-2, these records must be written in the crew's language and translated into English, French or Spanish and available to authorities on the basis of a request consistent with international law (IMO, 2004).

3.1.4 Crew Competence

Regulation B-6 stipulates that 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 (IMO, 2004). Therefore, related crew members must be trained in implementing the BWMP and the procedures specific to that ship, namely both the generic training and the specific training.

3.1.5 International Ballast Water Management Certificate

As specified in Article 7, Each Party shall ensure that ships flying its flag or operating under its authority and subject to survey and certification are so surveyed and certified in accordance with the regulations in the Annex (IMO, 2004).

According to Regulation E-1, a specific initial survey and interim surveys must be carried out by the Administration of the Flag State or recognized organization

(normally, the classification society) to ensure that the vessel is in compliance with the requirements of the BWM Convention for vessels of 400 and above gross tonnage. For other vessels less than 400 gross tonnage, flag states need to develop appropriate supplementary procedures. After these surveys and inspections, an International Ballast Water Management Certificate will be issued by the flag State. The certificate will be valid for up to 5 years which is subject to the periodic survey. It will also be recognized by other States.

3.1.6 Ballast Tank Sediments

Regulation B-5 presents that tank sediments must also be managed, again with a variation in expectations depending on the construction date of the ship relative to the Convention coming into force.

Except for above fundamental obligations, specific duties of Flag State include the following four aspects: type approval of BWMS; Prototype ballast water treatment technology; approval of BWMP; survey and certificate.

3.2 Type approval of Ballast Water Management Systems

Basic approval requirements for BWMS are presented in Regulation D-3 which must be approved by the Administration taking into account the Guidelines for approval of ballast water management systems (G8), and those systems making use of active substances should be approved by the IMO according to the Procedure for approval of ballast water management systems that make use of Active Substances (G9) developed by IMO. For ships participating in a program approved by the Administration to test and evaluate promising ballast water treatment technologies (BWTT), regulation D-4 allows those ships delay to comply with such standard, meanwhile, when establishing and carrying out any program to test and evaluate promising BWTT, Parties should take into account the Guidelines for approval and oversight of prototype ballast water treatment technology programmes (G10)

developed by IMO.

The procedure of type approval of BWMSs is different for systems using active substances and not using active substances which are specified in 3.2.1 and 3.2.2 respectively (shown in the Figure 3.1).

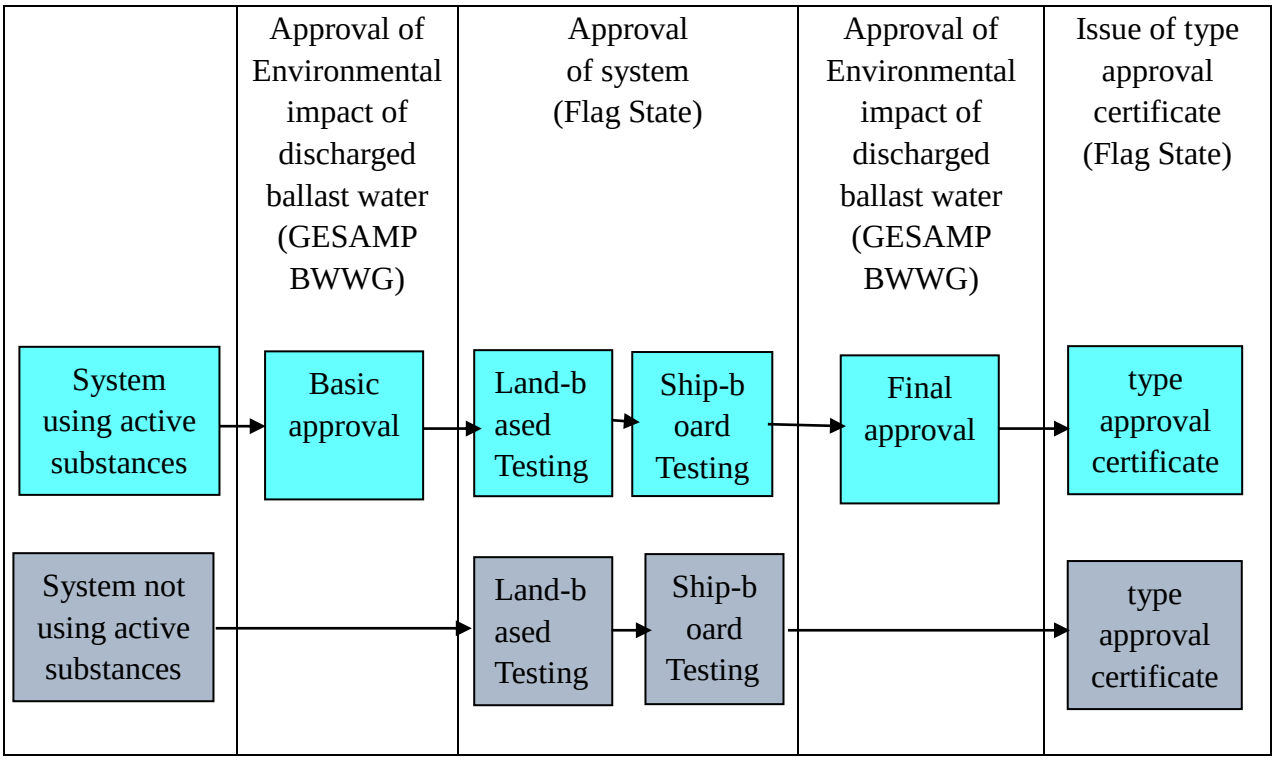

Figure 3.1- Procedure of a Type Approval of a BWMS

Source: Magnus, B. (2010). *Guidelines for selection of a ship ballast water treatment system. Master thesis*, Norwegian University of Science and technology, Trondheim, Norway.

3.2.1 BWMS (not using active substances)

To ensure the uniform and proper implementation of the Convention, G8 provides methods for the Administration and manufactures to assess whether BWMS meet the performance standards as set out in Regulation D-2(As shown in Table 3.1), including general requirements concerning appropriate design, construction, operational parameters, technical procedures for evaluation, as well as the procedure for issuance

of the Type Approval Certificate of the BWMS.

Table 3.1- Ballast Water Performance Standard

Organism category	Regulation
Plankton, >50μm in minimum dimensions	<10 cells/m^3
Plankton, 10-50μm	<10 cells/ml
Toxicogenic Vibrio cholera(O1 and O19)	<1 cfu/100ml or less than 1 cfu/g(wet weight)
Escherichia coli	<250 cfu/100ml
Intestinal Enterococci	<100 cfu/100ml

Source: Lloyd's Register Group. (2015). Understanding ballast water management.

In order to obtain the type approval of the Administration, manufactures of BWMS submit applications and sufficient information to prove that the BWMS gets prepared for testing. After the pre-test evaluation of the Administration (or Classification Society) of the submitted plans and technical documents, the approval testing includes land-based testing, shipboard testing, environmental testing of electrical and electronic systems are carried out, according to Part 2-Test and performance specification for approval of BWMS and Part 3-Specification for environmental testing for approval of BWMS of G8 respectively. For every BWMS which fulfills the requirements of G8, the Administration issues a Type Approval Certificate, which specifies the main particulars of the system (e.g. specific operation capacities, flow rates, salinity and temperature conditions) and any other limiting conditions or circumstances on its usage in accordance with specific format. The Administration can also issue a Type Approval Certificate of BWMS based on a Type Approval Certificate previously issued by another Administration. It is essential to make sure that both the land-based testing and the ship-board testing on the BWMS were conducted by the Administration before the issuance, and the results of tests should be attached to the Type Approval Certificate of BWMS (IMO, 2008b).

3.2.2 BWMS using active substances

Active substances are defined as 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 in the guideline G9 (IMO, 2008c). For the sake of ship safety, human health and the aquatic environment, BWMSs that make use of active substances shall be approved by IMO in accordance with G9 in order to ensure environmental acceptability of the system and the compliance with the BWM Convention. The approval procedure of G9 considers a variety of elements, such as persistency, bioaccumulation and toxicity, etc. However, such an approved BWMS still does not mean that it could be used world-widely because there may need additional national approval on active substance generators in some national or regional.

The approval of BWMS using active substances by IMO is divided into a two-step process. Firstly, after a detailed consideration of the active substance, the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection -Ballast Water Working Group (namely the GESAMP- BWWG) provides recommendations to IMO whether or not an active substance should receive basic approval, after that, the basic approval is given to the BWMS by IMO. Subsequently, shipboard testing and land-based testing are carried out after obtaining basic approval from IMO, and the active substance may be used in these testing. Once the G8 tests are completed, a final approval of IMO should be applied for, at the same time, data of toxicity tests of discharged water after being treated by land-based testing equipment in type approval are to be submitted to IMO. Finally, the final approval from IMO is obtained, further, a Type Approval Certificate of BWMS is issued (IMO, 2008c).

3.2.3 Ballast Water Treatment

The BWMS includes ballast water treatment equipment which is the core component, and associated control equipment, sampling facilities as well as monitoring

equipment.

Generally, the ballast water treatment technologies can be classified into four types: mechanical, physical, chemical methods and their combination method. Mechanical method utilizes the gravity and the centrifugal force of organisms and uses surface filtration or hydrocyclone to separate the heavier and larger parts from ballast water. Physical disinfection makes use of ultraviolet (UV) irradiation, deoxygenation, cavitation, heat treatment, etc. in order to kill aquatic organisms in ballast water. Chemical disinfection normally uses the technologies like chlorination, electrochlorination, ozonation, chlorine dioxide, peracetic acid, hydrogen peroxide, menadione/vitamin K, etc. (Feng, et al, 2010).

Above technologies used in BWMS should be capable of handling different kinds of aquatic organisms ranging from viruses and microorganism to plankton, fish and shellfish. In operation, BWMS must work even under difficult operational conditions such as high flow-rates of ballast water pumps, large water volumes and variable retention times. The BWMS should also be effective under a wide variety of challenging environmental conditions including various temperature, salinity, nutrients and suspended solids. (Abu-Khader, et al, 2011). Normally, certain type of BWMS applies to certain type of vessel due to the diversity of voyage, ballast water volume, existing systems arrangement, etc. Therefore, it is significantly important to choose a BWMS adaptive.

3.2.4 Risks, difficulties and uncertainties in type approval of BWMS

3.2.4.1 Applicability and reliability of a BWMS

As Article 1.5 of General Provisions in G8 points out, approval of a BWMS does not ensure that the given system will work on all vessels or in all situations (IMO, 2010). That means, a type-approved BWM System, used on different sizes and types of ships,

different sea and weather conditions, are likely to influence the operation effectiveness and environmental acceptability of ballast water treatment. Some regional regulation is different from global convention, for example, standards in US is higher than the BWM Convention, those ships equipped with BWMS approved also could not operate in waters of the US (Fei, 2015).

3.2.4.2 Sampling phase

Ballast water sampling is also a challenge which will affect the result of testing and the reliability of BWMS. However, considering there is currently no complete detailed and consistent unified sampling guidelines which can be referred in Type Approval and PSC, there may be risks that type-approved systems were not compliant with the Convention when the discharged ballast water is tested by PSC, even though they are operated entirely according to their manufacturer's specifications (HIS Maritime, 2014). Besides, there were no standard measurement procedures in G8 and G9 in 2004/2005 for the type approval. Organism counting may not be accurate because of the water movements resulting from the ship movement. The testing measures could be different from each other (Gollasch, 2010). There still exist uncertainties regarding the number of samples, volumes, where (tank or discharge line) and when to take them (in the beginning, middle or final a discharge and/or at fixed time intervals). Besides, concerns are also related to who is going to be the authorized personnel to conduct those procedures (David and Perkovic, 2004. IMO, 2008a).

3.2.4.3 Testing phase

Test procedure of type approval is very comprehensive which requires a great amount of resources involving man power, time and money. Testing should be performed using fresh, brackish and marine waters across those temperature ranges, a test duration including both land-based and ship-board tests last at least 6 months.

Standard Test Organisms (STOs): There is no clear understanding of how STOs might be used in laboratory-scale evaluations during type approval testing. It may be

impractical, no more robust and a potential risk to use STOs for testing. It is highly unlikely that specific validated organisms would be native to all test locations and that it would therefore be difficult for all test facilities to use the same organisms. A requirement to culture non-indigenous organisms in large numbers and then to use them in industrial scale treatment operations may increase the risk of the introduction of non-indigenous species into the local environment (Dang, 2016).

Discharge of treated ballast water: Many Administrations are not allowing the discharge of treated ballast water from ships during the shipboard testing period prior to the entry into force of the BWM Convention and this affects the manner in which shipboard testing can be conducted.

Major Components and Non-major Components: The evaluation of the test proposal should identify the Major Components of the BWMS. Major components are considered to be those components that directly affect the ability of the system to meet the BWM Convention D-2 standard. Upgrades or changes to major components should not take place during type approval testing. A change to a major component should require a new submission of the test proposal and should involve a new evaluation and repeating of the land-based and shipboard tests. The Administration may allow replacement like consumable components, during type approval testing and all replacements should be reported. (Dang, 2016)

Other uncertainties: there are other debates on whether safety considerations, risk assessments, PPE requirements, required for the safe operation of BWMS should be part of the type approval; whether the location for suitable fitment of electronic and electrical equipment should be specified in the approval etc (Zhang & Zhang, 2016).

3.2.4.4 Professional personnel demand

As to the type approval of a BWMS using active substance, the flag states are mainly

responsible for the approval of application documents and submit them to IMO. Those documents involve various technical content, which requires a professional expert team familiar with G9 and follow a set of developed methods and procedures to review the integrity and effectiveness of the application files submitted.

The type approval process of BWMS is very transparent, which will reveal provide he capabilities and limitations of the BWMS and the operating conditions to the ship owners (Resolution MEPC.228.(65)).

In addition, there is no basis in the Convention or the guidelines that a basic approval under G9 is a precondition for start-up of the ship-board tests under G8. However, basic approval is a necessary qualification before further tests can be carried out using only one or a few ships in the ship-board testing under G8.

3.3 Approval of Prototype ballast water treatment technology program

3.3.1 General requirements

The Guidelines for approval and oversight of prototype ballast water treatment technology program (G10) offers guidance to approve or reject such program for the Administration, and regulates responsibilities of supervision on such program.

According to regulation 2.1 of G10, "*Prototype Ballast Water Treatment Technology (BWTT) means any integrated system of ballast water treatment equipment as under regulation D-4, participating in a program for testing and evaluation with the potential of meeting or exceeding the ballast water performance standard in regulation D-2 including treatment equipment, all associated control equipment, monitoring equipment and sampling facilities*". Prototype BWTT must be approved by the Administration in order to test and evaluate promising Ballast Water treatment technologies, which is a prototype of BWMS. Before approved by the Administration, on board ship testing must be carried out. In order to provide opportunities for the

development and testing of the promising BWTT, regulation D-4 allows for ships participating in such a program to have a leeway of five years before having to comply with the requirements of Regulation D-2.

Firstly, the applicant submits a detailed plan describing the prototype technology and implementation of the program, as well as evidence on the potential of the prototype technologies meeting or exceeding the performance standard in Regulation D-2. If the prototype BWTT utilizes active substances or prepare to utilize one or more active substances, the substances should have received Basic Approval of IMO in accordance with G9. The Administration evaluates above information and approved the submitted program finally. Further, the installation of the prototype BWTT should be verified by an installation survey. If this survey confirms that the installation was based on the approved program, the Administration may issue a Statement of Compliance under Regulation D-4.

3.3.2 Difficulties and uncertainties

Since the Prototype BWTT is just a prototype or sample of an intact BWMS, it must obtain the type approval of Administration before application. In other words, there is no necessary correlation between the Prototype BWTT and type approval, and the Statement of Compliance issued by the Administration only indicates that the Prototype BWTT complies with the condition set by the program and the Administration after trials of installation.

3. 4 Approval of Ballast Water Management Plan

3.4.1 General requirements

The Ballast Water Management Plan (BWMP) is a document specific to a certain ship describing the process and procedures of ballast water management implemented on board ship in terms of Regulation B-1 of the BWM Convention. It aims to guide

personnel safety on board ship and reasonable operation of the BWMS so as to ensure that BWM is in compliance with management standards specified in the Convention.

The guideline G4 provides general guidance for the flag state to approve BWMP. Actually, the approval responsibility of the Administration is to review whether the BWMP is specific to a certain ship made in accordance with the ship type, ship size, the volume of ballast tank, the capacity of ballast water pump, etc.; whether the BWMP is written in the working language of the ship and covers following essential information and complies with the BWM Convention: plans of BWMS showing arrangement of BWM, such as arrangement of piping and pumping; a detailed description of the actions to be taken to implement the BWM requirements; detail safety procedures for the ship and the crew associated with BWM; operational or safety restrictions; description of procedures for the disposal of sediments; required records; the officer designated for BWM and his duties; training on BWM operational practices' and exemptions granted under Regulation A-4. The BWMP must be realistic, reliable, practical and easy to use; be clearly understood by crew members engaged in ballast water management; evaluated, reviewed, and updated periodically as necessary. In addition, when ships taking up or discharging ballast water, the date, geographical location, ballast water temperature and salinity and the quantity of ballast water loaded or discharged, as well as other related information should be recorded in the standardized form appended to the Guidelines (IMO, 2005a).

When developing a BWMP, at the same time, to approve a BWMP, all appropriate issues must be considered, including but not limited to following issues: the type and size of ship, volume of ballast water carried and total capacity of tanks used for ballast, the capacity of ballast pumping, safety issues relating to ship and crew, ships' typical operational requirements of ship, and ballast water management techniques used on board. Besides, before the execution of a planned operation of ballast water management, vessel stability, stresses and sloshing at every stage of the planned operation, including the 'half full tank' situation, must be calculated previously.

One or more of the following methods may be used for BWM and specific to the BWMP: (a) BWE, the primary management method, including sequential method, flow-through method and dilution method; (b) BWT, including mechanical method, physical method, chemical method, biological method and combination; (c) prototype BWTT; (d) discharge to reception facilities; (e) retention of ballast water on board for future discharging into the areas where the ballast water was loaded. (As shown in Figure3.2)

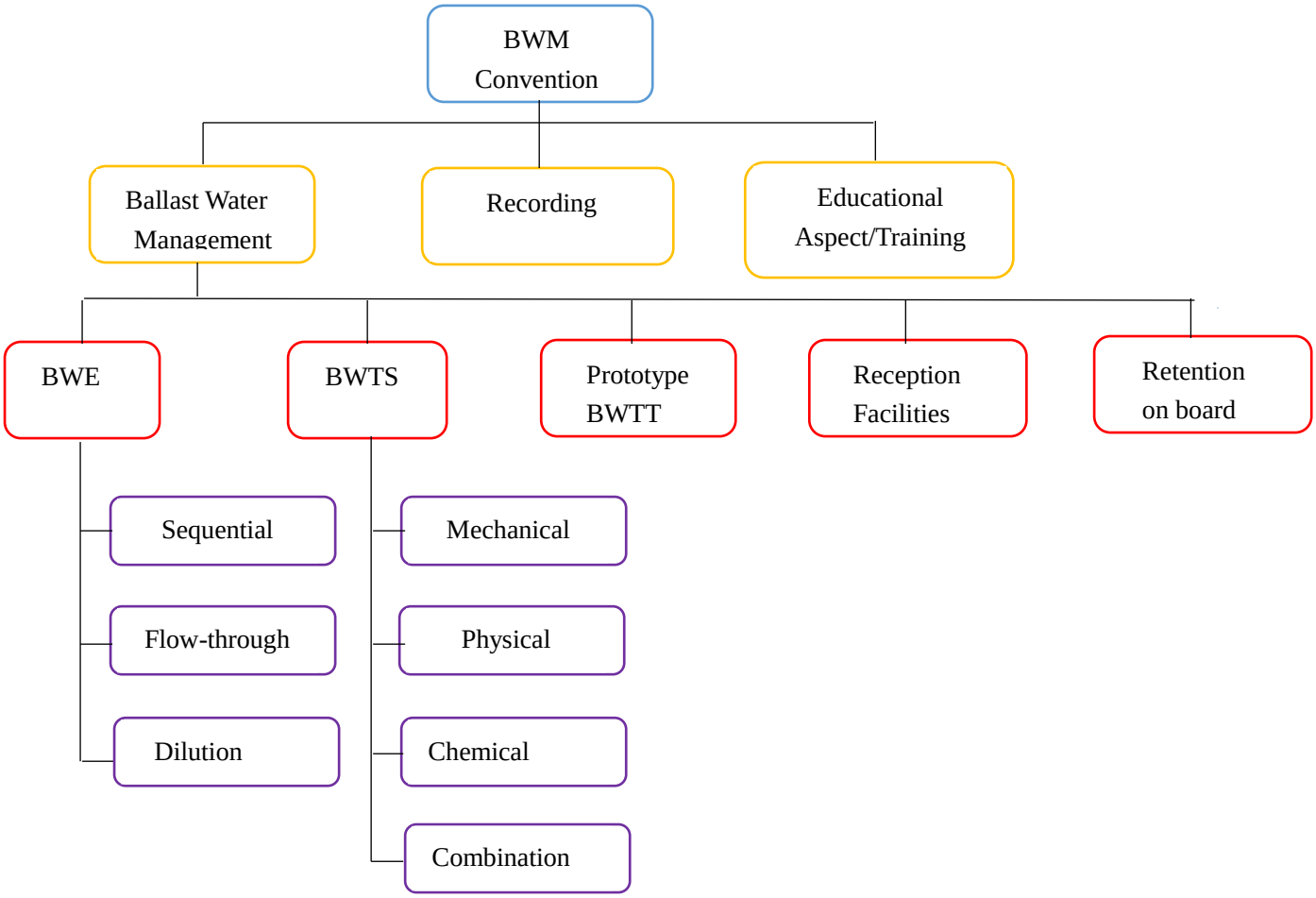

Figure 3.2- Major requirements from the BWM Convention

Source: Compiled by the author.2016.

3.4.2 Risks and difficulties

Limited to the process of IMO in BWM and the research status of BWMS, G4 provides detailed requirements on ballast water exchange methods, however, this is just a general framework.

However, BWE is considered as an interim tool because of its variable efficacy and operational limitations. There are a number of safety conditions to be met when performing BWE, such as weather, sea condition and duration of exchange. The implementation of BWMP directly affects the normal operation of the ship. The most significant risk that brings along BWE is for the existing ships, because those ships don't consider the operation of BWE in phase of design and construction. As a result, when performing BWE, it is difficult for them to meet a number of operational considerations and critical safety conditions required by different conventions, for example, the stability, longitudinal strength, torsion, bridge visibility, slamming, propeller immersion, forward and aft draft etc., for example, slamming and tank sloshing add the risks of causing structural damage to the vessel (Endresen, et al, 2004).

In addition, the BWMP has to be revised and renewed regularly as necessary in order to find out and correct all failures and malfunctions of the system in the process of implementation. However, these changes to the provisions relating to BWMP will need the re-approval of the Administration.

In this case, there are at least two difficulties for the Administration. First, the qualification and abilities of personnel in charge of approval may be inadequate; second, there is a consistent standard for specific plans which is difficult to adopt and maintain.

3.5 Survey and Certificate

3.5.1 General requirements on survey and certificate

The Flag State should formulate corresponding procedures for inspection and certification to ensure that the performance of survey and issuance of certificate to ships complied with the Convention, and urge the ships obtained the certificate take necessary measures to meet the requirements. It is a fundamental obligation of Flag State in implementing the BWM Convention. Article 7 and Section E list basic survey and certificate requirements.

Section E gives requirements for initial, renewal, intermediate, annual and additional surveys and certification requirements. Surveys of ships shall be carried out by officers of the Administration, or nominating surveyors or organizations recognized by the Administration. The Administration shall notify the IMO of the specific responsibilities and conditions of the authority delegated to the nominated surveyors or recognized organizations, for circulation to Parties for the information of their officers.

The Administration shall issue the ship (all ships of 400 gross tonnages and above) with the International Ballast Water Management Certificate after it completes the survey conducted in accordance with regulation E-1. As requested by the Administration, another Party can also perform the survey and certificate to ships applied to the Convention, or endorse the Certificate. The period of a Certificate shall not exceed five years, which can be extended under special circumstances.

3.5.2 Difficulties and uncertainties of survey and certificate

Firstly, the enforcement of survey and certificate demands significant resources (including human resources, investments, etc.) and training of personnel depending on the administrative structure in each flag state.

Secondly, there is no transition for the survey and certificate of existing ships built before the Convention enters into force. This means that from the date on which the Convention enters into force, any ship to which the Convention applies must take an approved BWMP and an International Ballast Water Management Certificate on board ship, otherwise, it is possible to be forced out of operation. Undoubtedly, there is a great amount of ships waiting for the installation of BWMS, ships may want to install BWMS and apply for survey in advance due to limited production of manufacturers and installment capacity of shipyards. However, the sampling method of PSC has not been decided yet which may raise concerns on the reliability of BWMS, the operation of BWMS may not meet the requirements of D-2. Therefore, there always are some uncertainties for ships whether survey and certificate in advance or not.

3.6 Supervision on ship retrofitting

3.6.1 General requirements

Nowadays, almost all new ships under construction are equipped with the BWMS to meet the requirement since the BWM Convention is about to enter into force. While existing ships are estimated that have either installed or reserved space for the installation of BWMS are 22.1% for container ships and 23.7% for bulk carriers; new ships under construction that have either planned to install or reserved space for the installation of BWMS are 86% for container ships and 100% for bulk carriers (Liu, Chang, and Chou, 2014). Apparently, the percentages among new ships are higher than existing ships, which mainly result from the relatively high costs and great difficulty of installation in existing ships than in new ships.

3.6.2 Difficulties and risks in existing ships retrofitting

There are many risks bring along with ship retrofitting and BWMS installation. Firstly,

as the BWM Convention has not entered into force yet, shipping companies are still holding a wait-and-see attitude about installing the equipment on existing ships. However, there is no additional time for transition that all vessels need to install BWMS. Once the BWM Convention enters into force, a large number of ships will have to install BWMS concentrated in a time period. And due to the limited space and work ability of shipyard, there will be delay for vessels waiting for the installation of BWMS (He, 2015).

The large dimension of BWMS is one of the most difficult problems due to the limitation of space and existing pipe arrangement, since the vessel didn't consider the space for BWMS in the stage of design and construction. Besides, appropriate maintenance space and facilities should be reserved, including the ladder, platform, light, crane rail, place for cleaning, storage of consumable components, fire system and ventilation system, etc.

The installment of BWMS will also increase the power consumption, and the power supply of vessel's generator may be not sufficient. It is difficult for existing ships to provide additional energy for BWE because there was no requirements of BWE in ships' design and construction stage. Further, the retrofitting will more or less influence the structure and strength of the vessel. These all may lead to incompliance with the new standards, especially the energy efficiency standard.

3.7 Summary

The BWM Convention and its 15 Guidelines provide a uniform standard for ships and clarify the duties and responsibilities of Flag States, namely the type approval of BWMS, approval of prototype BWTT program, approval of BWMP, survey and certification. Being familiar with the requirements in BWM Convention is helpful for Flag State to identify difficulties and risks in the implementation of BWM Convention as analyzed above.

CHAPTER 4

RECOMMENDATIONS

4.1 Domestic legislation

Generally, Flag states implement international conventions by ways of transferring them into domestic laws and regulations, so as to the BWM Convention. So it is important to set up a comprehensive set of BWM legislation in order to ensure the performance of the obligations of the BWM Convention. The flag state has significant influence on the type approval of BWMS, approval of prototype ballast water treatment technology program, research on BWT and BWMS. Therefore, for the sake of providing guidance and services for domestic manufacturers in developing BWMS complying with the Convention, as well as fulfilling the responsibilities of supervision, Flag state should enact laws and regulations on the type approval of BWMS, approval of Prototype BWT technology, approval of BWMP and survey and certificate, and ensure the implementation. Meanwhile, when the Convention comes into force, a perfect domestic legislation in ballast water will lay a foundation for the implementation of the Convention.

The responsibilities of flag states in ballast water management involve different aspects, i.e. technical, organizational, economical, and legal and policy issues. Due to the complexity of this global problem, the most effective solution is to establish a globally standardized approach, which combines the maritime policy and regulations with innovative engineering, biology and economics.

4.2 Closely following the development of the legal and technical standards

The development of BWMS is both the limiting factor in the process of coming into force of the Convention and the premise of the implementation. IMO has developed 15 Guidelines and many technical circulars which is still under development, and some controversial technical guidelines are under discussion and modification. Therefore, Flag states should follow the development of latest relevant documents of IMO closely, which will not only benefit the domestic research institutions and manufactures to obtain the newest information of BWM and promote innovation of BWT technology, but also help to raise proposals for the national interests, further by time for the development of BWMS.

At the same time, relevant institutions should go into details of BWM Convention and Guidelines, comprehensively, systemically and correctly understand the requirements of Convention and Guidelines, grasp the links and interactions between the Convention and Guidelines, clarify the responsibilities and obligations of Administration, and lastly prepare for the implementation when the Convention comes into force.

As described in Chapter 3, there are many risks in the implementation of the BWM Convention and technical guidelines. Consequently, the Flag State need to give voice at IMO conference to appeal for more reasonable and practical regulations favor for their shipping industry.

4.3 Encourage research on the BWMS and BWT

Only based on adequate scientific research, there is a greater understanding of the correlation between ships' ballast water and invasion of marine alien species, further laws and regulations could be enact to regulate the ballast water. Take the US as an example, it is stipulated in the NSNPCA that funds of the Finance must be invest into research on marine ecosystem in each fiscal year, which establishes stable finical

security system for research. Therefore, Flag state should actively promote and foster research on BWMS and BWT by providing preferential policy in order to improve the competitive abilities in the area of BWMS.

In addition, the flag states should actively provide technical information and guidance for both the manufactures and the shipping companies, for example, establishing an information platform to help shipping companies in choosing their appropriate BWMS.

4.4 Training and education

The officers and crews should master and familiarize all relative knowledge and information about the management of ballast water and sediments on board ships in advance (such as the content of the Convention, BWMS, and BWMP, etc.). Therefore, it is crucial for Flag state to select, reserve and train personnel specialized in research, development, management, approval and inspection, since the implementation of most Guidelines demand special professional expertise, such as the approval for the BWMS using active substance in G9.

Flag states and crew supply states should provide training and education for crews on ballast water and sediment management regularly to ensure them be familiar with their obligations under the BWM Convention, including the ballast operation, maintenance of BWMS, record keeping and actions to emergency, etc. Encourage the Maritime Education and Training Institutions to carry out training for crew dealing with safe and effective ballast water management practices, at the same time, to prepare for port state inspections.

4.5 FSC

States enforce Flag State Control in order to ensure that their vessels carry and apply a specific BWMP, keep a good record of ballast water operation in the ballast water

record book, well maintained other necessary documentation and have their crew trained to deal with the plan. Meanwhile, FSC helps ships to prepare and provide documentation to designated port authorities using the IMO endorsed ballast water reporting form.

4.6 Other suggestions

International cooperation is essential to address this global issue. States should work together to develop a regionally approach consistent with the future BWM Convention and its Guidelines for the common goals to protect the marine environment. Except for the commercial seagoing ships, flag states should also encourage their non-commercial government ships and warships to perform ballast water management. In addition, encourage the establishment of insurance mechanism for ballast water management, for example, the insurance on the reliability of BWMSs.

CHAPTER 5

CONCLUSIONS

The introduction of invasive aquatic species via ships is now regarded as one of the four greatest threats to the ocean environment resulting in severe damages to human society. In the last ten years, significant progress in ballast water management has been achieved in terms of technology developments, testing methods, surveys and approvals, development of effective monitoring and enforcement tools. It is necessary to enhance the effective implementation of the BWM Convention as soon as possible. Ballast water management is a complex issue which needs the concerns of different parties, such as the flag state, port state, coastal state, shipping companies and manufactures, etc. Flag states take the primary responsibilities to monitor ships to implement the BWM Convention due to the “Genuine link” with ships flying their flags. The BWM Convention and other international regulations take time to enter into force, hence, a series of regional and national regulations were developed to meet with more local demands. Some developed countries and regions, like the United State of America, Australia, and the European Union, which possess advanced shipping industry, broader shipping network, and had suffered from invasive species transferred by ballast water provide good experience for flag states.

According to the BWM Convention, the main responsibilities of flag state cover the following four contents: the type approval of BWMS, approval of prototype BWTT program, approval of BWMP, as well as survey and certificate. There are many difficulties and uncertainties regarding to the ballast water management. However, it is impossible to simulate adequately all conditions and all associated operational and environmental variables that systems will face in voyage. For example, during type approval testing, there still remain important aspects regarding to test conditions,

sampling strategies and endpoint determination. These experience will be benefit for further development and perfection of existing technologies, regulations, standards; moreover, reveal new opportunities and inspire innovation in the area of ballast water management.

The BWM Convention is about to enter into force. Therefore, Flag States should get prepared for the implementation of BWM Convention and 15 Guidelines by domestic legislation, support research of ballast water issues, training and education, etc., in order to reduce the risks of introduction of invasive aquatic species and protect the global marine environment.

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APPENDIX

Abstract of the Alternate management system of the United States of America

§151.2026 Alternate management system

(a) A manufacturer whose ballast water management system (BWMS) has been approved by a foreign administration pursuant to the standards set forth in the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004, may request in writing, for the Coast Guard to make a determination that their BWMS is an alternate management system (AMS). Requests for determinations under this section must include:

(1) The type-approval certificate for the BWMS.

(2) Name, point of contact, address, and phone number of the authority overseeing the program;

(3) Final test results and findings, including the full analytical procedures and methods, results, interpretations of the results, and full description and documentation of the Quality Assurance procedures (i.e., sample chain of custody forms, calibration records, etc.);

(4) A description of any modifications made to the system after completion of the testing for which a determination is requested; and

(5) A type approval application as described under 46 CFR 162.060-12.

(i) Once ballast water management systems are type approved by the Coast Guard and available for a given class, type of vessels, or specific vessel, those vessels will no longer be able to install AMS in lieu of type approved systems.

(ii) [Reserved]

(b) Requests for determinations must be submitted in writing to the Commanding Officer, U.S. Coast Guard Marine Safety Center, 2100 2nd St. SW., Stop 7102, Washington, DC 20593-7102.

(c) If using an AMS that was installed on the vessel prior to the date that the vessel is required to comply with the ballast water discharge standard in accordance with § 151.2035(b), the master, owner, operator, agent, or person in charge of the vessel subject to this subpart may employ such AMS for no longer than 5 years from the date they would otherwise be required to comply with the ballast water discharge standard in accordance with the implementation schedule in § 151.2035 (b) of this subpart. To ensure the safe and effective management and operation of the AMS equipment, the master, owner, operator, agent or person in charge of the vessel must ensure the AMS is maintained and operated in conformity with the system specifications.

(d) An AMS determination issued under this section may be suspended, withdrawn, or terminated in accordance with the procedures contained in 46 CFR 162.060-18.

For more details of AMS, please refer to following link:
http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=7571b33fdb952d2fb75f8e0a7aec694a&n=33y2.0.1.5.21&r=PART&ty=HTML#33:2.0.1.5.21.3

Abstract of Type Approval of the United States of America

§162.060-10 Approval procedures.

(a) Not less than 30 days before initiating any testing of a ballast water management system (BWMS), the results of which are intended for use in an application for type approval, the manufacturer must submit a Letter of Intent (LOI) providing as much of the following information as possible to the Commanding Officer, U.S. Coast Guard Marine Safety Center (MSC), 2100 2nd St. SW., Stop 7102, Washington, DC 20593-7102, or by email to msc@uscg.mil:

(1) Manufacturer's name, address, and point of contact, with telephone number or email address.

(2) Name and location of independent laboratory and associated test facilities and subcontractors, plus expected dates and locations for actual testing.

(3) Model name, model number, and type of BWMS.

(4) Expected date of submission of full application package to the Coast Guard.

(5) Name, type of vessel, and expected geographic locations for shipboard testing.

(b) The manufacturer must ensure evaluation, inspection, and testing of the BWMS is conducted by an independent laboratory, accepted by the Coast Guard, in accordance with §162.060-20 through § 162.060-40 of this subpart. Testing may begin 30 days after submission of the LOI unless otherwise directed by the Coast Guard.

(1) If an evaluation, inspection, or test required by this section is not practicable or applicable, a manufacturer may submit a written request to the Commanding Officer, U.S. Coast Guard MSC, 2100 2nd St. SW., Stop 7102, Washington, DC 20593-7102, or by email to msc@uscg.mil, for approval of alternatives as equivalent to the requirements in this section. The request must include the manufacturer's justification for any proposed changes and contain full descriptions of any proposed alternative tests.

(2) The Coast Guard will notify the manufacturer of its determination under paragraph (b) (1) of this section. Any limitations imposed by the BWMS on testing procedures and all approved deviations from any evaluation, inspection, or testing required by this subpart must be duly noted in the Experimental Design section of the Test Plan.

(c) The manufacturer must submit an application for approval in accordance with § 162.060-14 of this subpart.

(d) Upon receipt of an application completed in compliance with § 162.060-14 of this subpart, the MSC will evaluate the application and either approve, disapprove, or return it to the manufacturer for further revision.

(e) In addition to tests and evaluations required by this subpart, the Coast Guard will

independently conduct environmental analyses of each system in accordance with the National Environmental Policy Act, the Endangered Species Act, and/or other environmental statutes. The Coast Guard advises applicants that applications containing novel processes or active substances may encounter significantly longer reviews during these environmental evaluations.

(f) A BWMS is eligible for approval if-

(1) It meets the design and construction requirements in § 162.060-20 of this subpart;

(2) It is evaluated, inspected, and tested under land-based and shipboard conditions in accordance with §162.060-26 and §162.060-28 of this subpart, respectively, and thereby demonstrates that it consistently meets the ballast water discharge standard in 33 CFR part 151, subparts C and D;

(3) All applicable components of the BWMS meet the component testing requirements of §162.060-30 of this subpart;

(4) The BWMS meets the requirements of § 162.060-32 of this subpart if the BWMS uses an active substance or preparation; and

(5) The ballast water discharge, preparation, active substance, or relevant chemical are not found to be persistent, bioaccumulative, or toxic when discharged.

(g) After evaluation of an application, the Coast Guard will advise the applicant in accordance with 46 CFR 159.005-13 whether the BWMS is approved. If the BWMS is approved, a certification number will be issued and an approval certificate sent to the applicant in accordance with 46 CFR 2.75-5. The approval certificate will list conditions of approval applicable to the BWMS.

Please click following link for more information:

http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=87def066b4363d102529611c0472f86b&n=46y6.0.1.1.4.7&r=SUBPART&ty=HTML#46:6.0.1.1.4.7.1.4