

A study on the development of ballast water management-related familiarization training pursuant to the STCW convention

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Abstract: The International Convention for the Control and Management of Ships' Ballast Water and Sediments (hereafter "BWM Convention") will be enforced beginning on September 8, 2017. Even though the STCW Convention (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers) and other international instruments require all ship personnel be qualified under certain competencies and standards, the International Maritime Organization (hereafter "IMO") has no unified requirements for training ship personnel on ballast water management. When the BWM Convention enters into force, all officers and crew on board ships should be intimately familiar with the guidelines and procedures outlined by the BWM Convention, regarding, among other topics, proper record keeping techniques and measures, the layout of the ballast control system, methods of ballast water exchange, and inspections by the port state control. To ensure that officers and crew members are adequately familiar, this paper proposes new competency requirements for ballast water management training and education to be added to the STCW Code. To support the introduction of these new competency requirements, this paper explores the evolution of the BWM Convention and examines how international regulations will be used to implement it.

Keywords: Ballast water, International maritime organization, STCW convention, Seafarers, Competence

1. Introduction

With Finland's ratification to the International Convention for the Control and Management of Ships' Ballast Water and Sediments of 2004 (hereinafter "BWM convention") on September 8, 2016, the percentage of the world's fleet tonnage surpassed the 35% minimum tonnage threshold required to enforce the BWM Convention, thus, prompting the BWM Convention entry into force on September 8, 2017 [1]. By adopting enforcement of the BWM Convention, member states must prepare to install ship ballast water treatment facilities, maintain ship ballast water plans, and carry international certificates for ballast water management (hereinafter "BWM") on their ships. In addition, the BWM facilities must be equipped before renewal of the IOPP (International Oil Pollution Prevention) certificate [2]. Also, unlike the treatment approved by the IMO, United States Coast Guard (hereinafter "USCG") has their own regulation regarding approval of the facilities. Hence, ships arriving at port in the United States must equip the ship ballast water treatment facility approved by the USCG. With the impending enforcement date, it is imperative

that IMO (International Maritime Organization) member states prepare their BWM systems [3].

As part of this preparation, employers shall inform workers of the hazards associated with exposure to workplace chemicals; teach the workers how to obtain and use the information provided on labels and chemical safety data sheets; use the chemical safety data sheets to prepare proper handling instructions to workers, which should be written if appropriate; and train workers on a continuing basis in the practices and procedures for the safe use of workplace chemicals (ILO, 1990) [4].

Authorities recommend that ship companies and ship masters ensure that ship personnel are appropriately familiar with the potential dangers of ballast water treatment. Specifically, ship personnel should be familiar with the potential hazards and dangerous products generated in the process of the ballast water treatment [5].

Also, with respect to BWM, the IMO imposes standards upon entry into enclosed spaces as well as standards regarding the health and safety of ballast sampling through the G2 Guidelines [6].

Several studies on BWM mention the need to establish a

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proper training and education course prior to the BWM Convention’s entry into force.

Li Ohlsson’s 2012 study on the legalities surrounding BWM emphasizes the importance of establishing a training and education course informed by the guidelines. Ohlsson’s research states that masters and ship personnel should be subject to appropriate training that should teach personnel about the application of BWM as well as the procedures required for ballast water treatment. Ohlsson’s study also suggests that maritime administrations are obligated to know about and fulfill the duties to control both marine pollution and the population of harmful aquatic organisms [7].

A 2011 study by Lawal focuses on efforts to combat the unintentional discharge of invasive harmful organisms and states that flag states of the IMO should be responsible for these efforts. Lawal’s research suggests that seafarers must be trained and educated such that they are familiar with ballast water exchange and safety precautions for the ships. When ballast water exchange operations and pumping plans are concerned, training and education for officers should cover the maintenance of the BWM record book and logs as well as treatment procedures for ballast water and its sediment [8].

Kim, from World Maritime University, stresses the necessity to educate flag states in his 2013 study on the implications of the BWM Convention. Kim suggests that governments develop domestic provisions for the implementation of BWM, especially focusing on the issuance of certificates, Type Approval of BWM systems, survey procedures, approval of BWM plans, and training of the crew [9].

The 2010 Guidelines for National Ballast Water Status Assessments states that GloBallast Partnerships (hereafter “GBP”) made an e-learning course to provide for the legal implementation of the BWM Convention at the domestic level [10].

This paper reviews how the BWM evolved and considers both the technical and legal aspects of creating an adequate training program by examining the STCW Convention (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers), the BWM Convention, and their relevant resolutions and circulars. This paper thoroughly examines the need for a proper training and education course on BWM in order to implement it globally. Following these examinations, this paper proposes new provisions on ballast management to be added to the STCW Convention on the international level.

2. Evolution of BWM

The BWM Convention has been deliberated with respect to Article 196(1) of the 1982 United Nations Convention on the

Law of the Sea (UNCLOS). The UNCLOS advises member states to take all possible measures to prevent, mitigate, and control marine environment pollution with technologies [11].

After introducing ballast water into a ship, the water is operated to stabilize the ship throughout its voyage according to weight fluctuations of various cargo loads. The ballast water reduces stress on the ship’s construction. It leads to improved ship movement and maneuverability. Although this process is beneficial to naval transportation, it unfortunately transfers sea species through the ballast water from one port into another, creating environmental problems arising from the influx and reproduction of these invasive species.

The first time researchers realized an alien species had been introduced was in 1903, when the *biddulphia sinensis* was found in the North Sea. However, after that initial realization, no one researched the issue in detail until the 1970s. In the late 1980s, the Marine Environment Protection Committee (hereafter “MEPC”) of IMO reviewed the invasive species problem at the request of Canada and Australia. The concern of invasive species transference through ballast water on board ship has dramatically increased due to the growth in international trade over recent decades. IMO recognizes the ecological and economic threats carried by invasive species. Some studies mention that such species can cause enormous irreversible damage to marine ecological systems. Furthermore, serious invasions can even affect human health. After recognizing invasive alien species in other countries’ ports, member states of IMO spent 14 years discussing and reviewing the issue, and, as a result, the BWM Convention was adopted at the diplomatic conference of IMO on February 13, 2004. The BWM Convention describes contents of the BWM plan to be implemented on all ships. This plan includes the requirement that all ships maintain a ballast water record book and that all ships properly execute BWM procedures. Some provisions of the BWM Convention deal with guidelines developed by the IMO [12].

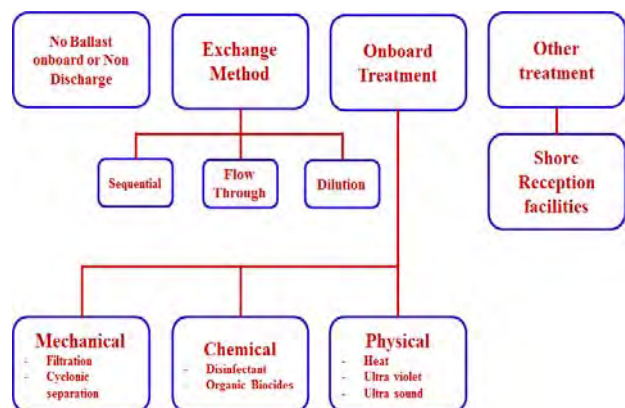


Figure 1: Overview of treatment on BWM [10]

As soon as practicable, these developed guidelines should be dealt with as a matter of urgency with a view to facilitating a unified implementation of the provisions.

The MEPC of IMO, in April 2004, approved guidelines and procedures to implement the BWM Convention. At the 53rd session in July 2005, MEPC developed and adopted 14 sets of guidelines. Resolution MEPC.173(58) was adopted in October 2008. While discussing the BWM Convention and other relevant instruments, many efforts by member states have been made to develop proper ballast water exchange standards and performance criteria to meet requirements of numbers of organisms per unit of volume. The technical experts under the GESAMP (Group of Experts on the Scientific Aspects of Marine Environmental Protection) reviewed technologies of BWM systems for approval. The GBP introduced an overview of BWM as shown in **Figure 1** [10].

3. Analysis of Current Education and Training Program

3.1 Norway - Seagull

Seagull established an e-learning module on BWM in response to the IMO Convention A.868(20) of 2004, which requires that all ship personnel involved in BWM receive proper training to minimize the transfer of harmful aquatic organisms and pathogens. The education program requires the development and implementation of a BWM plan that maintains all ballast operations as shown in **Table 1** [13].

Table 1: Contents of training and education on BWM in Norway – Seagull [13]

Step	Contents
1	Background
2	Environmental threats
3	BWM plan
4	BWM record book
5	BWM techniques
6	Training required for officers and crew
7	Regional requirements
8	Assessment

3.2 SQE Academy

To provide training and high quality information on the current status of regulations and technical solutions in regard to the BWM Convention, a textbook, which discusses the following regulatory references, is necessary: the BWM Convention, Resolution A.868(20), Resolution MEPC.127(53), Resolution MEPC.124(53), and additional domestic laws. A textbook has already been developed for shore staff in shipping companies who will be in charge of planning how to apply and imple-

ment the BWM legislation and the plan. The SQE Academy BWM course is developed as shown in **Table 2** [14].

Table 2: Contents of training and education on BWM in SQE Academy [14]

Step	Contents
1	BWM Convention and the USCG law
2	Requirements complying with BWM legislation
3	Operational limitations on technologies of the various ballast water treatment
4	Ship types and trades suited to other alternative compliance options
5	Comparison of ballast water treatment systems for use on board a specific ship with a defined operational profile
6	Matters associated with retrofit of ballast water treatment systems
7	Port state control approach to compliance with the BWM Convention
8	Ballast Management plan and Logbook

3.3 UK – Warsash Maritime Academy

With the imminent enforcement of the BWM Convention, the shipping industry must take environmentally responsible measures to avoid pollution through the transfer of non-indigenous species from one area of the world to another in the ship’s water ballast. The Warsash Maritime Academy offers a new two-day course to provide industry professionals with an appreciation of the requirements and challenges associated with BWM. The course covers the well-publicized core issues of the concern of transporting harmful aquatic organisms in ballast water of ships. The course will ensure that company and organizations officials are better prepared to implement and monitor the BWM Convention. This course takes delegates through the BWM Convention requirements in hopes of streamlining the planning required to implement and monitor these requirements. The course also provides an outline of the main principles and pitfalls of the treatment technologies available for installation and use, as well as the issues of installation and retrofitting. In addition, the course provides an overview of the key monitoring and compliance checks that will be conducted by enforcement authorities to make sure that vessels are in compliance with BWM Convention requirements. Foreign and regional regulations are also likely to be in force alongside the BWM Convention requirements; thus, the course covers the main foreign legislation and the key differences. The course is designed for people who are working as superintendents or ship managers for shipping companies; seafarers including deck officers and engineers; flag state or port state control officers and ship surveyors and inspectors in maritime administrations; legal aid or maritime law professionals; operators and managers at enforcement agencies and terminals; and students studying environmental protection [15].

3.4 USA and Singapore – Maritime Training Service

Improper ballast water discharge influences the spread of invasive and harmful species around the world and leads to significant health risks, environmental damage, and economic costs. The Singapore educational program focuses on ways to comply with the current regulations by implementing procedures of approved ballast water treatment. Seafarers and relevant personnel should take action to implement provisions of the BWM Convention, otherwise, improper implementation could lead to detention of ships by port state control, invalidated certificates, and fines [16].

Table 3: Contents of training and education on BWM in Warsash Maritime Academy [15]

Step	Contents
1	Background
2	Ballast water exchange and hazards
3	GloBallast
4	Summary of treatment technologies
5	Key principles of BWM convention
6	Treatment technology approvals
7	Individual nation’s response
8	Implementation schedules
9	Administration of BWM
10	Active substances
11	Filtration
12	Port state control of BWM
13	Installation, retrofitting and surveys
14	Sampling and monitoring
15	Non-active substances
16	Ballast water risk assessment

Table 4: Contents of training and education on BWM in Maritime Training Service [16]

Step	Contents
1	Important precautions to take follow
2	Requirements for proper ballast water exchange
3	Ways on to properly implement the BWM plan and record book
4	Ways in preparing and responding to an inspection
5	Video clip on an actual inspection of BWM

3.5 DNV-GL

This training program on the BWM Convention is designed to inform trainees about the current status of regulations and technical solutions regarding BWM. Trainees should be superintendents, nautical officers, engineers of shipping companies, design managers, engineers (naval architects), production managers, engineers in yard, and material engineers. The program will provide trainees with current information regarding tech-

nologies, provisions, and industry practices with regard to BWM. This education program will provide practical knowledge for every ship to make decisions on a case-by-case basis [17].

3.6 GEF/UNDP/IMO

The Global BWM project, established by IMO, is also the called GEF-UNDP-IMO GBP Programme (2008-2016). The project intends to solve the ballast water concerns and to collaborate through global cooperation referred to as GBP. GBP will support developing countries with BWM Convention implementation to mitigate the marine aquatic risks from ballast water and its sediments. Based on prior experiences of the GMP project, the project intends to enhance capacity building of governments and enhance port management. In addition, the project will assist in developing maritime law, policy, and related institutional reformation at a national level. The project intends to provide technical solutions, knowledge, and competence on global BWM. GBP provides training and education programs for BWM as shown in Table 5 [18].

Table 5: Contents of training and education on BWM in GEF/UNDP/IMO [18]

Step	Contents
1	Background to BWM
2	BWM Onboard Ships
3	Standards for BWM
4	Operational Aspects on Ship-board BWM
5	BWM by Port/Coastal State
6	Compliance Monitoring and Enforcement
7	Incursion Management
8	Development of a National Strategic Framework to BWM
9	Technical Assistance and Regional Co-operation

4. Analysis of relevant Provisions on Training and Education of BWM

4.1 Analysis on STCW convention

4.1.1 Deck officers and ratings

In Table A-II/1 of the BWM Convention, navigational officers at the operational level on ships of 500 gross tonnage or more must be qualified with respect to 1) Prevention of pollution of the marine environment and anti-pollution procedures; 2) Knowledge of the precautions to be taken to prevent pollution of the marine environment; 3) Anti-pollution procedures and all associated equipment; and the 4) Importance of proactive measures to protect the marine environment in order to comply with the “Controlling the operation of the ship and care for persons on board at the operational level” provision. To be competent to “monitor compliance with legislative requirements,” the provisions require basic working knowledge of the relevant IMO pro-

visions concerning safety of life at sea and protection of the marine environment referred to as Knowledge, Understanding, and Proficiency (hereafter “KUP”) [19].

In Table A-II/2 of the BWM Convention, masters and chief mates on ships of 500 gross tonnage or more must be qualified with respect to 1) Methods and aids to prevent pollution of the marine environment by ships and 2) National legislation for implementing international agreements and conventions to control the operation of the ship and care for persons on board. In addition, with respect to cargo handling and stowage, navigational officers at the management level must have KUP in order to keep hull stress within acceptable limits by using “stability and trim diagrams and stress-calculating equipment, including automatic data-based (ADB) equipment [as well as] knowledge of loading cargoes and ballasting with the intent of planning and ensuring “safe loading, stowage, securing [of cargo] during the voyage and unloading of cargo” at port [20].

Pursuant to Table A-II/3, chief officers and masters on ships of less than 500 gross tonnage on near-coastal voyages shall be required to have KUP with regard to 1) Prevention of pollution of the marine environment and anti-pollution procedures; 2) Knowledge of the precautions to be taken to prevent pollution of the marine environment and anti-pollution procedures; and 3) Anti-pollution procedures and all associated equipment. Contents of required training on ballast water operation for deck ratings include 1) Prevention of pollution of the marine environment; 2) Knowledge of the precautions to be taken to prevent pollution of the marine environment; 3) Anti-pollution procedures and all associated equipment; and the 4) Importance of proactive measures to protect the marine environment [21].

4.1.2 Marine engineers and ratings

Pursuant to Table A-III/1, marine engineers at the operational level are required to have 1) Basic working knowledge of relevant IMO conventions concerning safety of life at sea and/protection of the marine environment” in order to “monitor compliance with legislative requirements” and 2) Basic working knowledge of the operation of pumping systems to include a) Routine pumping operations and b) Operation of bilge, ballast and cargo pumping systems under operational characteristics of pumps and piping systems, including control systems in order to “operate fuel, lubrication, ballast and other pumping systems and associated control systems” [22].

According to Table A-III/2, chief engineer officers and second engineer officers at the management level on ships powered by main propulsion machinery of 3,000 KW propulsion power or more are required to have KUP regarding the

“[o]peration and maintenance of machinery, including pumps and piping systems” in order to “[m]anage fuel, lubrication, and ballast operations.”

In order to control the operation of the ship and care for persons on board at the management level, seafarers should be qualified to “[m]onitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment.” Also, to fulfill KUP, under the competency provision, the following contents should also be required: “methods and aids to prevent pollution of the environment by ships” and “knowledge of national legislation for implementing international agreements and conventions” [23].

Engine ratings in compliance with Table A-III/5 of STCW Convention should require a BWM course that teaches appropriate “Knowledge [for] the safe function, operation, and maintenance of the bilge and ballast systems,” including training on 1) reporting incidents associated with transfer and operations; 2) the ability to correctly measure and report tank levels. In addition, engine ratings should have KUP with regard to “the precautions to be taken to prevent pollution of the marine environment,” “use and operation of anti-pollution equipment,” and “approved methods for disposal of marine pollutants.” Also, engine ratings must be qualified to “apply precautions and contribute to the prevention of pollution of the marine environment.” Pursuant to Table A-III/5 of the STCW Convention, newly developed electro-technical officers must be qualified in the “[p]revention of pollution of the marine environment” and “[a]nti-pollution procedures and all associated equipment.” In addition, electro-technical officers must be aware “of the precautions to be taken to prevent pollution of the marine environment” and the “[i]mportance of proactive measures to protect the marine environment” [24].

In addition to the above qualifications, in compliance with Table A-III/7 of the STCW Convention, electro-technical ratings must have KUP regarding “the precautions to be taken to prevent pollution of the marine environment,” “use and operation of anti-pollution equipment/agents,” and “approved methods for disposal of marine pollutants” [25].

4.2 Analysis on BWM convention and related resolution and circular

Regulation B-1 of the BWM Convention requires implementation of a BWM plan approved by each member state in consideration of the guidelines developed by the IMO. Also, plans shall be developed for each ship and must include 1) safety procedures for BWM; 2) a detailed procedure of the actions to implement the BWM requirements and practices; 3) guidelines for the disposal of sediments; 4) explanations for BWM in-

cluding discharge guidelines in each state; and 5) a properly designated officer on board to be in charge of BWM [26].

In conformity with regulation B-6, Duties of officers and crew in section B (Management and control requirements for ship), ship personnel shall be familiar with the implementation of BWM to each ship, their duties, and BWM plan [27]. Pursuant to Article 9 (Inspection of ships of the BWM Convention), port state control officers will inspect valid certificates onboard, the ballast water record book, and samplings of the ballast water [28].

4.3 Resolution

Guidelines for the control and management of a ship's ballast water to minimize the transfer of invasive harmful species requires instructions for training and education in relation with sediment management and treatment procedures on ballast water. Per the instructions, seafarers should maintain proper records and logs for ballast water. The guidelines request that each administration develop a ballast training program that imparts relevant knowledge and competence with respect to the prevention of marine pollution by harmful sea organisms.

Resolution MEPC.124(53) for ballast water exchange (G6) describes safety issues on "Crew training and familiarization." According to this resolution, ship personnel must be knowledgeable of the arrangement of ballast pump and pipe lines as well as air and measuring pipes; arrangement of relevant tank suction and pipelines; use of the flow by exchange way of ballast water; arrangements for ballast water discharge; methods of measuring pipes and air pipes; the times to undertake the various ballast water exchange operations; the method of ballast water exchange; and the necessity of monitoring ballast water exchange [29].

Regulation D-3 of the BWM Convention requires that BWM systems shall be approved by each government in accordance with guideline 8 [30][31].

BWM systems for type-approval through the member state should be tested on land and on board ships in order to prove and meet the performance standard as set out in regulation D-2 of the BWM Convention [32].

Guideline 8 describes the technical requirement and procedures of the approval and certification to be implemented by the IMO member states. Once a state has fully met the requirements of the guideline (G8), the state can be issued a type-approval certificate for the BWM system on board ship [31].

Guideline 9 (Procedure for approval of BWM systems that make use of active substances,) is made up of a two-tier process that ensures that the BWM facilities do not lead to unreasonable hazard and risk for the environment or human

health [33].

Member states at the 53rd session MEPC of IMO agreed to establish a technical working group to review proposals with additional data and report its results to the IMO. MEPC 53 also agreed that a technical working group under the auspices of GESAMP could study the interest of the marine shipping industry to develop the necessary methodologies and information requirements in accordance with the procedure (G9). Accordingly, the GESAMP published the "Methodology for information gathering and conduct of its work" by the GESAMP-Ballast Water joint working group [33][34].

5. Development on Training and Education of BWM in accordance with STCW

Following this overview of the training and education programs being implemented by current maritime institutes and governments, this paper recognizes knowledge and contents common to these programs including, but not limited to, background on the BWM, introduction to the BWM Convention and relevant resolutions and circulars, and the operation of BWM on board ships.

Chapter VI in A section of STCW Convention deals with standards regarding emergencies, occupational safety, security, medical care, and survival functions. Hence, this paper suggests the following be included in A section VI/7 of STCW Convention in:

1. Before being assigned to shipboard duties, all persons employed or engaged on a seagoing ship shall receive approved BWM-related familiarization training, taking account of the guidance given in relevant instruments, to be able to:
 - 1.1. maintain a BWM plan and BWM record book;
 - 1.2. know the procedures to follow when they recognize a marine invasive threat; and
 - 1.3. take part in BWM-related emergency and contingency procedures.
2. Seafarers with designated BWM duties engaged or employed on a seagoing ship shall, before being assigned such duties, receive BWM-related familiarization training in their assigned duties and responsibilities, taking into account the guidance given in relevant regulations.
3. The BWM-related familiarization training shall be conducted by an equally qualified person.

6. Conclusions

The BWM Convention will be enforced beginning on

September 8, 2017. Although the STCW Convention and other international instruments require all ship personnel be qualified, the IMO has no unified requirements for training ship personnel on ballast water management. When it enters into force, all officers and crew on board ships should be familiar with the guidelines and procedures outlined by the BWM Convention, regarding, among other topics, proper record keeping techniques and measures, the layout of the ballast control system, methods of ballast water exchange, and inspections by the port state control. To ensure that officers and crew members are adequately familiar, this paper proposes new competency requirements for ballast water management training and education to be added to the STCW Code. In order to support the introduction of these new competency requirements, this paper explores the evolution of the BWM Convention and examines how international regulations will be used to implement it. Based on this exploration and examination, this paper suggests certain requirements, provided above, be included in A section VI/7 of the STCW Convention.

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