

Key Ballast Water Management Regulations With a View on Ballast Water Management Systems Type Approval Process

Ključni propisi o upravljanju balastnim vodama s osvrtom na postupak odobravanja Sustava za tretiranje balastnih voda

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DOI 10.17818/NM/2019/2.5

UDK 341.225:347.79

Review / Pregledni rad

Paper accepted / Rukopis primljen: 14. 3. 2019.

Summary

Over the last few decades, the spread of invasive aquatic organisms via ships' ballast water became one of the global environmental issues of most concern. The Ballast Water Management Convention is the main instrument of the International Maritime Organization through which a number of regulations and standards have been developed and implemented to manage and control the discharge of ballast water from ships internationally. Since the United States is not a signatory to the The Ballast Water Management Convention, all ships operating in United States waters must comply with United States Ballast Water Management federal regulations. The paper highlights the essential The Ballast Water Management Convention and United States national Ballast Water Management regime topics to be recognised by the stakeholders of the shipping industry, predominantly ship operators and shipowners. Particular attention is given to the Ballast Water Management Systems type approval process where United States testing protocol and requirements are considered to be more rigorous and comprehensive compared to the International maritime Organization's type approval protocol. Although the Ballast Water Management regulations are considered to be matured they are still "living" provisions, and further regulatory enhancements are likely to be expected in the future. Therefore, it would be beneficial for all Ballast Water Management stakeholders to harmonize the Ballast Water Management Systems type approval requirements.

Sažetak

Tijekom posljednjih nekoliko desetljeća, širenje invazivnih vodenih organizama putem balastnih voda na brodovima postalo je jedno od globalnih ekoloških pitanja od najveće važnosti. Konvencija o upravljanju balastnim vodama je glavni instrument Međunarodne pomorske organizacije putem kojega su razvijeni i implementirani brojni propisi i standardi za upravljanje i kontrolu ispuštanja balastnih voda s brodova na međunarodnoj razini. Budući da Sjedinjene Američke Države nisu potpisnice konvencije o upravljanju balastnim vodama, svi brodovi koji rade u vodama Sjedinjenih Država moraju udovoljavati saveznom propisima o upravljanju balastnim vodama. U radu se ističu bitne teme Konvencije o upravljanju balastnim vodama i nacionalnog režima upravljanja balastnim vodama Sjedinjenih Država, koje će prepoznati dionici pomorske industrije, uglavnom broderska poduzeća i brodovlasnici. Posebna pozornost posvećena je postupku odobravanja tipa Sustava za tretiranje balastnih voda u kojem se protokol i zahtjevi za testiranje u SAD-u smatraju strožima i opsežnijima u odnosu prema protokolu odobravanja Međunarodne pomorske organizacije. Iako se smatra da su propisi o upravljanju balastnim vodama sazreli, oni su i dalje „živi“ propisi, a daljnja regulatorna poboljšanja vjerojatno će se očekivati u budućnosti. Zato bi bilo korisno za sve dionike upravljanja balastnim vodama uskladiti zahtjeve za odobravanje tipa Sustava za tretiranje balastnih voda.

KEY WORDS

Ballast Water Management (BWM) regulations
Ballast Water Management System (BWMS) type approval
performance standard

KLJUČNE RIJEČI

propisi o upravljanju balastnim vodama
odobrenje tipa Sustava za tretiranje balastnih voda
standard za ispuštanje balastnih voda

1. INTRODUCTION / Uvod

Ballast water operation is considered as one of the most crucial and essential components for the safe and efficient operation of modern ships which nowadays participate in over 90% of international trade (600 million gross metric tons)

[1]. Ballast generally provides the ship's stability throughout a voyage, improves manoeuvrability and propulsion, reduces and compensates for stress on the hull construction caused by adverse sea conditions, cargo loading/unloading operations as

well as fuel and water consumption [2, 3]. Therefore, water with its suspended matter, predominantly sea water as most prominent media used for this purpose, is called ballast water (BW).

However, whilst BW is being taken on board during the off load of cargo at one port and discharged whilst cargo is loaded at another port, thousands of various aquatic organisms and pathogens are introduced into a new marine environment as non-native invasive organisms [4]. This issue was identified by many studies and therefore in 2002, during a World Summit on Sustainable Development held in Johannesburg, it was recognized by the global community as one of the four greatest threats¹ to the bio diversity of the marine ecosystems, to public health and the economy in the host coastal environments, since some of them may survive and rapidly reproduce to become pests thus becoming invasive and suppressing native organisms [5, 6]. They are also called bio invaders, alien species, nonindigenous or exotic species and include various bacteria, microbes, small invertebrates, eggs, larvae and cysts [2, 7].

The first scientific acknowledgment of transfer invasive aquatic species by ships' BW was revealed by C.H. Ostenfeld in 1903, when a large amount of Asian phytoplankton algae *Odontella* was observed in the North Sea [8]. The scientific community and global maritime industry started to pay an appropriate amount of attention to this issue in 1988, just after Canada and Australia first reported on invasive aquatic organisms present in BW and, over the following years, effective BW management has been prioritised as a topic of discussion amongst shipping industry stakeholders [9, 10].

The International Maritime Organization² (IMO), particularly via the Marine Environment Protection Committee³ (MEPC), first initiated and developed a number of international measures to aid and assist IMO member states to prevent the spread of harmful aquatic species and pathogens via ships' BW and sediments contained therein discharge [11, 12]. Resolution MEPC50(31), *Guidelines for preventing the introduction of unwanted organisms and pathogens from ships' ballast waters and sediment discharges* adopted by MEPC in 1991 contained the first applicable voluntary guidelines. Following the United Nations Conference on the Environment and Development (UNCED), these guidelines were revised and adopted as IMO Assembly Resolution A.774(18) in 1993. The adoption of the more comprehensive Resolution A.868(20), *Guidelines for the control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens*, which superseded all previous IMO regulations, followed in 1997.

In 1994, MEPC established the Ballast Water Working Group which in 1999 gradually started to prepare the foundations for an independent Convention on the management of ships' BW and sediments [5, 6]. These efforts to consistently develop and improve standards finally resulted in the adoption of the *International convention for the control and management of ship's ballast water and sediments (Ballast Water Management*

Convention – BWMC) on 13 February 2004. The BWMC stipulated the date of enforcement to be 12 months after its ratification by a minimum of 30 States, representing at least 35% of the world's merchant shipping tonnage. These stipulations were achieved on 8 September 2016 when the world's total merchant shipping tonnage reached 35.14% with Finland as the 52nd contracting country that ratified the agreement. Therefore, from 8 September 2017 all internationally trading ships are obligated to manage their BW by complying with the standards set out in the BWMC [4, 9, 6, 13].

This paper provides an overview of the major IMO regulations, emphasising those of most importance for ship operators and shipowners. Along with IMO Ballast Water Management (BWM) provisions designed for international implementation by parties to the BWMC, the United States of America (US) BWM regime, applicable to ships operating in US waters, is also well recognized as significant influential legislation affecting BWM operational practices on international level. Particular attention is given to the Ballast Water Management Systems (BWMS) type approval process where US testing protocol and requirements are considered to be more rigorous and comprehensive comparing to the IMO's type approval protocol.

2. BWMC KEY REGULATIONS AND BWMS TYPE APPROVAL PROCESS - INTERNATIONALLY RECOGNISED APPROACH / Ključni propisi i postupak odobrenja tipa Sustava za tretiranje balastnih voda međunarodne konvencije o upravljanju balastnim vodama – međunarodno priznati pristup

Since the control and management of ships' BW has become a major environmental challenge for the IMO and the global shipping industry, the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BWMC) was established to minimize, prevent and ultimately eliminate the risks to the environment, human health and natural resources arising from the transfer of harmful aquatic organisms contained in BW, while maintaining the safe operation of ships [14, 15, 16]. It came into force 13 years after it was adopted at the diplomatic conference held at the IMO Headquarters in London and to date it has been ratified by 79 signatory countries representing 80.94% of world's merchant tonnage [17].

The BWMC consists of 22 Articles, an Annex containing 24 regulations divided into five sections (A, B, C, D and E) and two Appendices⁴ to the Annex [5]. While Articles provide provisions related to the development, ratification, enforcement and implementation of the BWMC, Annex regulations (Table 1) specify the technical standards and regulations that must be followed to meet the goals of the BWMC.

¹ Bio invasion is one of the four biggest threats facing the world's oceans today, alongside land based sources of marine pollution, the overexploitation of living marine resources and the physical alteration and destruction of marine habitats.

² International Maritime Organization (IMO) is the United Nations specialized agency responsible for the safety and security of shipping and the prevention of marine pollution by ships.

³ Marine Environment Protection Committee (MEPC) consists of all IMO member states and is empowered to consider any matter within the scope of the IMO concerned with prevention and control of pollution from ships. In particular it is concerned with the adoption and amendment of conventions and other regulations and measures to ensure their enforcement.

⁴ Two Appendices to the Annex: form of *International Ballast Water Management Certificate* (IBWMC) and form of *Ballast Water Record Book* (BWRB).

Table 1 *BWMC Annex regulations sections* [5]
 Tablica 1. *Odjeljci pravila priloga Konvencije o upravljanju balastnim vodama*

Section A regulations – General provisions	
Reg. A-1	<i>Definitions</i>
Reg. A-2	<i>General Applicability</i>
Reg. A-3	<i>Exceptions</i>
Reg. A-4	<i>Exemptions</i>
Reg. A-5	<i>Equivalent compliance</i>
Section B regulations – Management and control requirements for ships	
Reg. B-1	<i>Ballast Water Management Plan</i>
Reg. B-2	<i>Ballast Water Record Book</i>
Reg. B-3	<i>Ballast Water Management for Ships</i>
Reg. B-4	<i>Ballast Water Exchange</i>
Reg. B-5	<i>Sediment Management for Ships</i>
Reg. B-6	<i>Duties of Officers and Crew</i>
Section C regulations – Special requirements in certain areas	
Reg. C-1	<i>Additional Measures</i>
Reg. C-2	<i>Warnings Concerning Ballast Water Uptake in Certain Areas and Related Flag State Measures</i>
Reg. C-3	<i>Communication of Information</i>
Section D regulations – Standards for Ballast Water Management	
Reg. D-1	<i>Ballast Water Exchange Standard</i>
Reg. D-2	<i>Ballast Water Performance Standard</i>
Reg. D-3	<i>Approval requirements for Ballast Water Management systems</i>
Reg. D-4	<i>Prototype Ballast Water Treatment Technologies</i>
Reg. D-5	<i>Review of Standards by the Organization</i>
Section E regulations – Survey and certification requirements for Ballast Water Management	
Reg. E-1	<i>Surveys</i>
Reg. E-2	<i>Issuance or Endorsement of a Certificate</i>
Reg. E-3	<i>Issuance or Endorsement of a Certificate by Another Party</i>
Reg. E-4	<i>Form of the Certificate</i>
Reg. E-5	<i>Duration and Validity of the Certificate</i>

Presently, BWMC also sets out 16 guidelines with the aim of achieving uniform implementation of its standards by all signatory states (Table 2). Over time, the guidelines have been revised, updated and new ones added through MEPC resolutions as a result

of the emergence of new knowledge and additional technologies becoming available [5, 14]. The BWMC contain obligations to be met by all stakeholders: ships, IMO and Administrations in their capacity as a Flag State and Port State [14, 18].

Table 2 *BWMC guidelines* [14, 19]
 Tablica 2. *Smjernice Konvencije o upravljanju balastnim vodama*

G1	Guidelines for sediment reception facilities
G2	Guidelines for ballast water sampling
G3	Guidelines for ballast water management equivalent compliance
G4	Guidelines for ballast water management and development of ballast water management plans
G5	Guidelines for ballast water reception facilities
G6	2017 Guidelines for ballast water exchange
G7	2017 Guidelines for risk assessment under regulation A-4 of the BWMC
G8	Guidelines for approval of ballast water management systems
G8 ⁵	2016 Guidelines for approval of ballast water management systems
G9	Procedure for approval of ballast water management systems that make use of active substances
G10	Guidelines for approval and oversight of prototype ballast water treatment technology programmes
G11	Guidelines for ballast water exchange design and construction standards
G12	2012 Guidelines on design and construction to facilitate sediment control on ships
G13	Guidelines for additional measures regarding ballast water management including emergency situations
G14	Guidelines on designation of areas for ballast water exchange
--	Guidelines for port State control under the BWMC
--	Guidelines for ballast water exchange in the Antarctic treaty area

⁵ Flag administrations should apply new G8, 2016 Guidelines (MEPC.279(70)) as soon as possible when approving Ballast Water Management Systems already installed on board ships but not later than 28 October 2018. Same guidelines should be applied for approval of the Systems installed on broad ships on or after 28 October 2020. In October 2019, these guidelines will be superseded by the BWMS Code (resolution.300(72)).

Apart from a few exceptions⁶, the BWMC applies to all internationally traded ships and offshore installations⁷, irrespective of size, that carry BW and are registered in States that are Parties to the BWMC or operate in the waters of such member States. [15, 20].

Substantial provisions of the BWMC stipulate that, upon its entry into force, all previously defined vessels are required to have on board as follows:

Ballast Water Management Plan (BWMP) is documentation specifically developed for each ship that provides guidance for the crew and operators. It details the actions and procedures to be taken to implement the BWMC requirements and supplemental BWM practices such as elaborated resources, crew training, familiarization and responsibilities, as well as the timings of the actions in terms of ballasting, sediment management and contingency procedures. The BWMP has to be approved by the Flag State Administration or recognized organization, such as the classification society, on its behalf and is used as the main reference in the PSC surveys to comply with BWMC [15,21, 22, 23].

International Ballast Water Management Certificate (IBWMC) is issued by or on behalf of the Flag State Administration to ships of 400 GT and above. It confirms that the ship's BWM practices are in accordance with the BWMC and specifies which BWM standard the ship is complying with. A Certificate of Compliance (CoC) is issued instead of an IBWMC for the ships if their Flag State has not yet ratified the convention [15, 21].

Ballast Water Record Book (BWRB) is a document, either a paper or electronic record book, which can be part of the BWMP and into which all on board BWM activities have to be recorded. It includes the discharge of the BW to a reception facility as well as possible accidental or other exceptional discharges. BWRB has to be readily available for inspection at all times and kept for a minimum of two years from the time of writing [3, 9, 21].

All member states have an obligation to directly verify the compliance of all ships calling their ports with the BWMC regulations by conducting BWRB inspections, certification verification as well as sampling BW in accordance with the associated guidelines [9, 24].

At the core of effective BWM compliance are two BWMC regulations practices known as the BW exchange standard (D-1 standard) and BW performance standard (D-2 standard), which provide the foundation for developing the ship specific BWMP [21].

D-1 standard requires ships to exchange costal with open ocean water with a volumetric BW exchange efficiency of at least 95%, typically 200 nautical miles from the nearest land and in waters at least 200 meters deep⁸. The acceptable exchange methods for achieving this regulation are [5, 9]:

- *Sequential method*: first emptying and then refilling ballast tanks with replacement BW.
- *Flow-through method*: pumping through and overflowing replacement BW into ballast tanks three times the volume of each BW tank. Pumping through less than three times the

volume may be accepted provided the ship can demonstrate that at least 95% volumetric exchange is met [25, 26].

- *Dilution method*: filling replacement BW at least three times the tank volume is through the top of the ballast tanks and maintaining a constant level throughout operation with simultaneous discharge from the bottom at the same flow rate.

D-2 standard defines the permissible concentration of viable organisms and specified indicator microbes harmful to human health in the discharged BW (Table 3). This represents a large reduction in the concentration of biota delivered via BW with the aim of reducing the establishment of new invasions where BW is discharged [27, 28]. In another words, this regulation impersonate the BW treatment standard which sets BW biological discharge limits after being processed through certificated BWMSs⁹, also referred as Ballast Water Treatment Systems¹⁰ (BWTS), the ultimate method for compliance with BWMC specifically designed for this purpose [28, 29].

Table 3 BWMC D-2 performance standard [30, 31]

Tablica 3. D-2 Standard za ispuštanje balastnih voda Konvencije u upravljanju balastnim vodama

ORGANISM SIZE INDICATOR MICROBES	IMO D-2 REGULATION BW performance standard
Size ≥ 50 µm in min. dimension	< 10 viable organisms/m ³ of BW
10 ≤ Size < 50 µm in min. dimension	< 10 viable organisms/mL of BW
Toxicogenic <i>Vibrio cholera</i> (O1 and O139)	< 1 cfu* /100 mL, or < 1 cfu /g (wet weight) zooplankton samples
<i>Escherichia coli</i>	< 250 cfu /100 mL
<i>Intestinal enterococci</i>	< 100 cfu /100 mL

* cfu – colony forming unit

It has been determined that BW exchange method is not sufficiently effective to prevent the spread of invasive aquatic organisms via BW [9]. However, it presents an acceptable interim measure to comply with BWMC until the majority of IMO defined ships eventually install certificated type approved BWMS in accordance with the IMO amended B-3 regulation implementation schedule. This was approved during the MEPC 71 session in July 2017 and circulated after the BWMC came into force with final adoption at MEPC 72 session in April 2018 [9, 27, 32]. The amendments will enter into force on 13 October 2019 [33].

The International Oil Pollution Prevention (IOPP) certificate renewal date is the main mechanism used to define deadlines for BWMS installation for existing ships, i.e. constructed prior to the BWMC coming into force. A new ships, i.e. constructed/keel laid on or after 8 September 2017, must have BWMS installed upon delivery, while existing ships which are not required to have an IOPP certificate must have it installed on board no later than 8 September 2024 [34, 35].

Current BWTS technologies and methods in utilisation are

⁶Ships not regulated by BWMC: ships not carrying BW, ships with sealed or permanent BW tanks, war ships, naval auxiliary and other government ships operating only within the territorial waters of their Flag State.

⁷ Submersibles, floating crafts and platforms, Floating Storage Units (FSO) and Floating Production, Storage and Offloading Units (FPSO).

⁸ If ship is unable to perform BW exchange as described, then it can be conducted as far from the nearest land as possible but at least 50 nautical miles from nearest land and in waters at least 200 meters in depth. In cases where distance from nearest land or the depth cannot be met, adjacent port States may consult each other and designate such BW exchange areas as appropriate.

⁹ Ballast Water Management System (BWMS) means any system which processes BW such that it meets or exceeds the BW discharge performance standard in Regulation D-2 of the *Convention*. The BWMS includes BW treatment equipment, all associated control equipment, monitoring equipment and sampling facilities.

¹⁰ Ballast Water Treatment System (BWTS) refers to equipment which mechanically, physically, chemically or biologically processes BW, either singularly or in combination, to remove, render harmless or avoid the uptake or discharge of harmful aquatic organisms and pathogens within the BW and associated sediments. BW treatment equipment may operate at the uptake or discharge of BW, during the voyage, or at a combination of the events.

Table 4 BW treatment technologies and methods [15, 29, 36, 37]
 Tablica 4. Tehnologije i metode tretiranja balastnih voda

MECHANICAL	PHYSICAL	CHEMICAL
<ul style="list-style-type: none"> – Filtration – Cyclonic separation (Hydrocyclone) – Magnetic separation 	<ul style="list-style-type: none"> – Ultraviolet (UV) irradiation – Ultrasound – Thermal (heat) – Cavitation – Deoxygenation (inertization) – Gas injection – Vacuum – Coagulation/Flocculation (pre-treatment/chemical enhancement prior to mechanical treatment) 	<p><u>Oxidising biocides:</u></p> <ul style="list-style-type: none"> – Chlorination – Electro-chlorination/electrolysis – Chlorine dioxide – Chlorine hypochlorite – Ozonation – Electro-catalysis – Advanced oxidation – Peraclean® (peroxyacetic acid, peracetic acid, hydrogen peroxide) <p><u>Non-oxidising biocides:</u></p> <ul style="list-style-type: none"> – Seakleen® (Menadione, vitamin K)

generally grouped within three broad categories pertaining to the primary mechanism which renders the organisms inactive, as presented in Table 4. Presently developed BWTs combine various technological methodologies as one alone is not sufficient to meet the D-2 standard. Most systems use a two stage approach which involves mechanical separation at the first stage, followed by physical/chemical treatment at the second stage. Some systems use a combination of more than two treatment methods [9, 36].

The BWMC does not require specific treatment methodology to be used. However, BWMSs must be tested against the comprehensive IMO evaluation procedure to obtain a *Type Approval Certificate* (TAC) issued by the Flag State Administration or a recognised organization. Therefore, all systems are required to be tested in accordance with BWMC D-3 approval requirements regulation, further clarified in the *Guidelines for Approval of Ballast Water Management Systems* (G8 guidelines), while those employing *active substances*¹¹ are subject to the additional *Procedure for Approval of Ballast Water Management Systems that make use of Active Substances* (G9 guidelines) [9, 29]. These guidelines are designed to ensure that the treatment technologies used in BWMSs meet the D2 standard, are sufficiently robust, have a minimal adverse environmental impact and are safe and suitable for use in the specific shipboard environment [37].

A BWMSs type approval process, as outlined in Figure 1, consists of land based testing, to confirm that D-2 discharge standards are met and shipboard testing, to confirm that the system works satisfactorily in service [26, 37, 38]. As an addition to the G8 guidelines, the G9 guidelines consist of a basic and final approval process to ensure that treated and discharged BW does not pose an unreasonable risk to the environment, human health, property or resources [39]. These two-tier approvals are conducted and reviewed by GESAMP¹² Ballast Water Working Group (BWWG)¹³, the committee operating under the auspices of MEPC [7, 39, 40]. Once final G9 approval for the systems using

active substances has been granted by the MEPC under the advice of GESAMP BWWG, the Flag State Administration follows up and issues the TAC in accordance with the G8 guidelines [37]. The process of achieving a type approval is time consuming and for the BWMSs using active substances may last for up to two years [37]. Once a type approved BWMS is installed on board, an installation survey of the system must be conducted to confirm that it has been installed in accordance with its design, its readiness for operation and compliance to the TAC. After the installation survey is completed, an IBWMC may be issued [37]. As per the latest IMO update on BWMS approval status in January 2019, there are 59 and 43 systems which have received basic and final approval, respectively, from the IMO, while 76 BWMSs have received type approval certification from their respective Administrations [41].

Since BWMC entered into force and the first set of amendments was adopted, there is further focus on its effective implementation, enforcement and on additional improvement. Therefore, the *Experience-Building Phase* (EBP) was established through resolution MEPC.290(71). This mechanism enables all involved stakeholders to gather, prepare and submit data which will provide a systematic and evidence-based review and analysis of the BWMS requirements in order to enhance the further development of the amendments to the Convention as appropriate. Additionally, MEPC 72 approved the *Data Gathering and Analysis Plan* for the EPB which sets out the specific data gathering arrangements, including the principles and organizational arrangements for analyzing the collected data, as well as the timeline for the EPB [33].

During MEPC 73, held in October 2018, there were discussions on whether or not draft amendments to the BWMC could be introduced for consideration at a future MEPC, all based on the analysis of the data gathered and the experience and feedback gained. In addition, it was agreed that *Review of the BWMC based on data gathered in the experience-building phase and Urgent measures emanating from issues identified during the experience-building phase of the BWMC* should be included in its agenda, both with a target completion year of 2023. MEPC also instructed the Sub-committee on Human Element, Training and Watchkeeping to develop appropriate BWMC training tools for seafarers with a target completion year of 2021 [42].

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

¹² Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection is an advisory body established in 1969 which advises the UN bodies on the scientific aspects of marine environmental protection.

¹³ Ballast Water Working Group on Active Substances, GESAMP – BWWG established in November 2005 with purpose to review any proposals submitted to IMO in preparation for the BWMC for BWMSs approval that make use of Active Substances and to report whether such proposals present a potential for environmental and human health risks in accordance with G9 guidelines criteria but does not evaluate the design, operation or effectiveness of a BWTs.

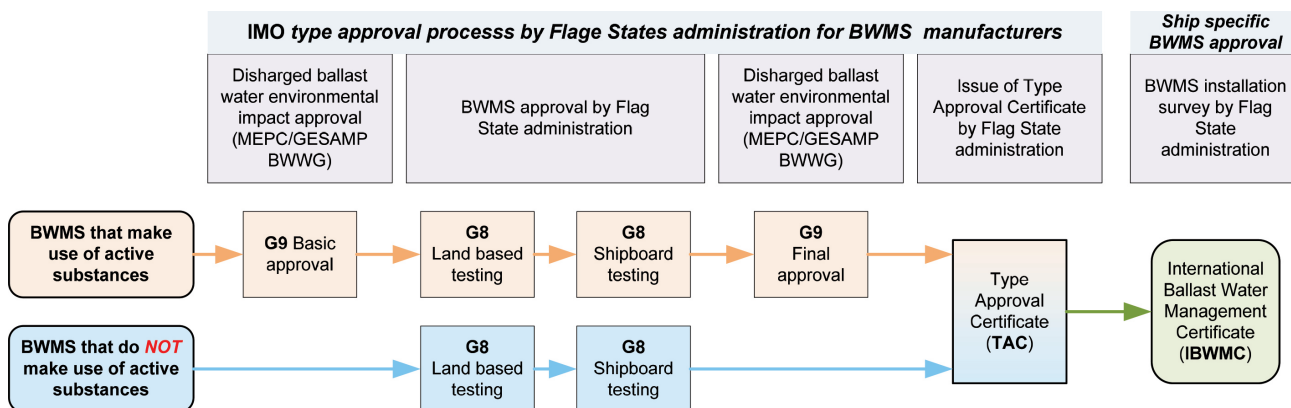


Figure 1 IMO procedure for obtaining BWTS TAC and IBWMC [authors]

Slika 1. IMO postupak odobrenja Sustava za tretiranje balastnih voda i izdavanja Međunarodne svjedodžbe o upravljanju balastnim vodama

3. US BWM KEY REGULATIONS AND BWMS TYPE APPROVAL PROCESS / Ključni propisi i postupak odobrenja tipa Sustava za tretiranje balastnih voda SAD-a

Since the US is not a signatory to the BWMC, all ships operating in US waters must comply with US BWM federal regulations and requirements for the allowable concentration of living organisms in ships' BW discharged into US waters, including specific requirements for type approval of BWMSs. This national legislation is contained in the United States Coast Guard¹⁴ (USCG) Final rule¹⁵ and Environmental Protection Agency's¹⁶ (EPA) Vessel General Permit 2013¹⁷ (VGP 2013) [43, 44, 45, 46]. These authorities signed a Memorandum of Understanding in 2011 which allows them to combine compliance efforts and share information [47].

US BWM legislation has a substantial influence on the global shipping industry, especially due to its complexity and stringent protocol to achieve TAC for BWMSs compared to IMO procedure and requirements. Along with currently accepted BWM measures¹⁸, the installation of an adequate type approved BWMS on ships poses the ultimate BWM solution for both regulatory regimes after a ships' compliance date is due [48]. IMO's compliance schedule is linked to the IOPP certificate renewal whilst the USCG schedule depends on a ship's construction date and BW tanks capacity.

¹⁴ United States Coast Guard (USCG) operates under the US Department of Homeland Security which, amongst its other responsibilities, has a maritime law enforcement duty which includes establishment and enforcement of BWM regulations in US waters.

¹⁵ Final rule entitled *Standards for Living Organisms in Ships' Ballast Water Discharged in US Waters* was published by the USCG in March 2012 and became effective on 21 June 2012. It established a standard for the allowable concentration of living organisms in ships' BW discharged into US waters including specific requirements for type approval of BWMSs.

¹⁶ Environmental Protection Agency (EPA) is the US federal government agency given the authority to establish and enforce regulations related to human health and the environment protection purposes.

¹⁷ Vessel general permit 2013 (VGP 2013), issued by the EPA, regulates and specifies best management practices to control and regulate 27 pollutant discharges incidental to ships operations into US waters, as well as BW. It includes numeric BW discharge limits, which are consistent with USCG standards and the IMO D-2 performance standard. The VGP is renewed every 5 years and the newest 3rd edition was expected to come into force on 18 December 2018. However, as newest edition is still not finalized, EPA published an update stating that the existing VGP 2013 will remain in effect until a new permit is issued.

¹⁸ Complete BW exchange beyond 200 nautical miles from a shore for both, IMO and US regimes. USCG Final rule stipulates additional compliance methods for ships calling US waters: US public water as BW, no discharge BW in the US waters and discharge in designated shore side facilities.

Additionally, USCG introduced Alternate Management System¹⁹ (AMS) and Extension of ship's compliance date²⁰ as interim BWM compliance mechanisms, mainly due to an insufficient number of manufactured and US type approved BWMS on the market [44, 49].

The US BWMS type approval process is strictly regulated and must only be carried out in USCG approved Independent Laboratories (IL). Contrary to this, IMO provides recommendatory guidelines (G8, G9) whilst the choice of testing laboratory lies with the Flag Administration and BWMS manufacturer.

The comprehensive steps which must be followed to achieve US TAC, as per testing requirements specified in the Code of Federal Regulations (46 CFR 162.060) and the EPA's Environmental Technology Verification²¹ (ETV) Protocol, are shown in Figure 2 [50, 51, 52, 53]. A rigorous testing and certification process, which may last up to two to three years, starts with the contract between IL and BWMS manufacturer. Prior to starting any of the required tests, the manufacturer must submit a Letter of Intent (LOI) to the USCG expressing its intention to start with the BWMS test. The overall testing program, conducted and supervised by IL, consist of three individual parts: land based test at shore side tank facilities, shipboard test at sea and test at engineering laboratories to verify that BWMS components meets the design and testing requirements. Additionally, if tested BWMS uses an active substance then it requires Federal Insecticide, Fungicide, and Rodenticide Act²² (FIFRA) registration and National Environmental Policy Act²³ (NEPA) risk evaluation as per regulation 46 CFR 162.060-32 [42, 53, 54, 55, 56, 57]. After all tests have been completed, USCG Marine Safety Center receives IL test reports and BWMS manufacturer's type approval application and issues TAC, if the evaluated BWMS is found to be compliant with all requirements [54].

¹⁹ Alternate Management System (AMS) is IMO type approved BWMS accepted by USCG and valid as an alternative for a maximum of five years from a ship's compliance date after which the system needs to obtain US TAC or implement another US approved BWM method.

²⁰ Extension of ship's compliance date is granted by USCG if the shipowner documents prove that the ship is not able to comply with any USCG BWM approved methods, despite of all efforts taken.

²¹ The USCG and the Environmental Protection Agency's Environmental Technology Verification Program worked together to develop a land-based protocol to evaluate full-scale commercial-ready BWTSS.

²² The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is the Federal statute that governs the registration, distribution, sale, and use of pesticides in the US.

²³ The National Environmental Policy Act (NEPA) is a US environmental law that promotes the enhancement of the environment and establishes the President's Council on Environmental Quality (CEQ).

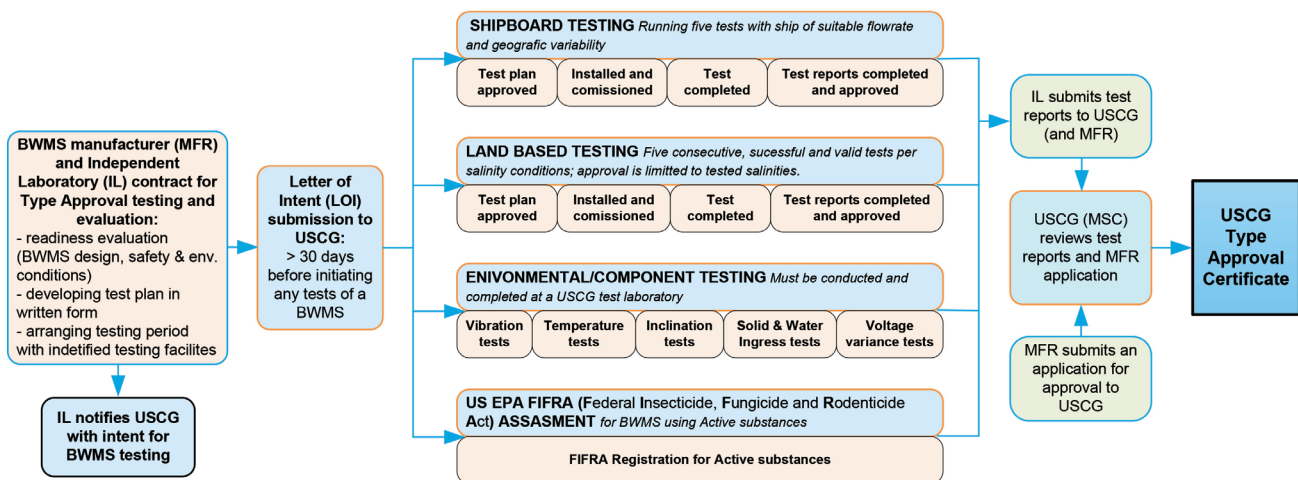


Figure 2 USCG steps for obtaining BWTS Type Approval Certificate [authors]
 Slika 2. Koraci Obalne straže SAD-a u postupku odobrenja Sustava za tretiranje balastnih voda

It is important to note that discharge standards to be proven during type approval process for both regimes are numerically the same. However, BWMC D-2 regulation is phrased in terms of “viable” (able to reproduce) organisms, whilst the USCG discharge standard is written in terms of “living” organisms.

4. CONCLUSION / Zaključak

The spread of invasive aquatic organisms via BW discharges from ships and their establishment in new marine environments as intrusive colonies could have an enormous negative effect on local ecosystems, their bio diversity, health and economy. In response to this issue, globally recognised as one of the potential biggest ecological threats to marine environment, the IMO first took the initiative to establish a number of regulations which aimed to minimise and eliminate the negative consequences of BW discharge.

At present, IMO and US BWM regulations are recognised worldwide as the most significant and influential regulatory provisions within the shipping industry which dictate BWM practices for the shipping industry stakeholders. The BWMC came into the force in September 2017 and obligated all ships which trade internationally to carry a ship specific BWMP, BWRB and IBWMC. IMO revised implementation schedule for the installation of a BWMSs what provides an additional period for many ships to install IMO approved BWMS during their IOPP renewal survey and thus comply with the D-2 standard as the ultimate BWM requirement. Meanwhile, they need to continue to comply with the D-1 BWE standard as transitional measure.

Mainly, due to its stringent type approval protocol, US BWM national legislation contained in *Final rule* and in force from June 2012, is considered as globally influential regime among shipping industry stakeholders. Besides BWE, the AMS and Extension of ship’s compliance date are additional transitional BWM mechanisms established by the US in order to accommodate existing ships until USCG approved BWMSs become sufficiently available to be installed onboard as final BWM compliance solution.

The IMO BWMS type approval process is defined in the BWMC G8 and G9 recommendatory guidelines whilst selection of the most suitable testing laboratory is left to the Flag Administration and BWMS manufacturer. The US BWMS type approval process is more strict and comprehensive than IMO’s

and can be conducted and supervised by USCG approved IL only. Due to quite significant differences in these two protocols, it would be beneficial for all BWM stakeholders to come to an agreement and harmonize BWMS type approval requirements.

Over time, new BWM regulations have been supplemented with new provisions while existing ones have been revised, updated and strengthened due to new knowledge gained from further research and technological advances in the BW treatment. Therefore, although the BWM regulations are considered to have matured they are still “living” provision, and it is realistic to expect further regulatory enhancements in the not so distant future.

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