

The Impact of the Revised Ballast Water Management Convention on Ship Compliance Management

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Abstract

With the growing global awareness of marine ecological protection and the rapid development of the shipping industry, the issue of invasive species caused by ship ballast water has attracted increasing attention. The original Ballast Water Management Convention has become inadequate in meeting practical needs regarding ecological control standards and the compatibility of technical specifications, prompting its revision. Against this backdrop, this paper systematically examines the specific impacts of the revised convention on the validity of ship certificates, the adaptability of ballast water management plans, standards for equipment maintenance and operational procedures, the standardization of crew operational records, and the shore-based support systems of shipowners. On this basis, targeted countermeasures are proposed from four dimensions: convention interpretation, system adjustment, equipment training, and shore-based evaluation. The study aims to provide both theoretical insights and practical guidance for shipping enterprises to meet the new regulatory requirements and enhance their compliance management standards.

Keywords

Ballast Water Management; Convention Revision; Ship Compliance; Impact; Countermeasures.

1. Introduction

Ballast water is a critical means for ships to adjust draft, stability, and hull stress, with its proper management being directly linked to the safety of navigation. However, the loading and discharge of ballast water across different marine regions lead to the transboundary transfer of aquatic organisms. Lacking natural predators in new environments, these organisms can proliferate rapidly, disrupt local ecological balances, and even pose threats to fishery resources and human health. The International Maritime Organization (IMO) established the Ballast Water Management Convention to provide unified global standards for controlling ship ballast water. At present, with the continued expansion of the global shipping network and the strengthening of environmental regulation, certain provisions of the original convention have revealed limitations in terms of technical requirements and implementation standards. In this context, studying the impact of the revised convention on ship compliance management can help the shipping industry clarify its compliance direction, enabling vessels to ensure navigational safety while fulfilling their ecological protection responsibilities.

2. Background of the Convention Revision

2.1. Ecological Protection Perspective

The marine ecosystem constitutes a vital component of the Earth's ecological system, playing an irreplaceable role in regulating the global climate and maintaining biodiversity. With the increasing frequency of global trade, ship ballast water has become a primary conduit for the spread of invasive species. When these organisms enter new marine environments, the absence

of natural predators allows them to reproduce and spread rapidly. They not only compete with native species for essential resources, leading to significant population declines or even local extinctions, but may also alter the structure of marine food chains, disrupt existing ecological balances, and, in some cases, secrete harmful substances that pollute seawater. Such disruptions negatively affect fisheries and tourism industries along coastal regions. In response to the growing ecological threats posed by invasive species, international standards for the environmental regulation of ballast water discharge have become increasingly stringent[1-2]. However, the provisions of the original Ballast Water Management Convention regarding harmful organism detection and treatment efficiency no longer meet the practical demands of modern ecological protection. To strengthen the control of harmful organisms within ballast water and mitigate the risks of biological invasions, revising the convention has become imperative.

2.2. Shipping Development Perspective

The accelerated process of global economic integration has spurred robust growth in the shipping industry, with the number of vessels steadily increasing and shipping routes expanding from traditional coastal lines to more remote marine regions. The water quality in these regions varies significantly-some areas contain extremely high levels of sediment, others exhibit high degrees of eutrophication, and some harbor unique microbial communities. Consequently, ships face increasingly complex challenges in ballast water treatment. Many of the treatment standards and operational guidelines prescribed in the original Ballast Water Management Convention were designed for a relatively uniform maritime environment of earlier times and can no longer accommodate the diversified demands of contemporary navigation. Meanwhile, new ballast water treatment technologies have been continuously developed and implemented, offering marked improvements in treatment efficiency and applicability compared with traditional methods[3-4]. Yet the original convention did not clearly define standards for the adoption, inspection, and certification of these technologies, creating a lack of unified guidance for their deployment. To ensure the sustainable and regulated development of the shipping industry and to align ballast water management practices more closely with the practical requirements of modern maritime operations, revising the convention to incorporate these new technological standards and adapt to diverse navigation scenarios has become an intrinsic demand of the industry.

3. Specific Impacts of the Convention Revision on Ship Compliance Management

3.1. Impact on Certificates and Management Plans

As the shipping industry places increasing emphasis on ecological protection, the revised convention aims to strengthen the standardization of ballast water management. Certificates and management plans, as the fundamental legal credentials of compliance management, are inevitably affected. These documents serve as the statutory references for implementing ballast water management, and their validity directly determines whether a vessel can operate normally. The revision introduces changes to the issuance standards for certificates and the requirements for drafting management plans. Due to the updates, the conditions for the validity of the *International Ballast Water Management Certificate* will be altered, and any content inconsistent with the new standards will render existing certificates invalid. Ships must prepare new application materials in accordance with the revised provisions and submit them to the competent authority for review. Only after approval can new certificates be obtained. Likewise, the ballast water management plan must be updated to incorporate operational procedures stipulated under the revised requirements-for example, specific treatment

processes for particular water quality conditions. After revision, the plan must be approved by the competent authority; until such approval is granted, the outdated plan may not be implemented. Failure to update certificates and plans in time may result in a vessel being deemed non-compliant during port inspections.

3.2. Impact on Equipment Maintenance and Operation

As ballast water treatment technologies evolve, the equipment-related requirements under the original convention can no longer meet current treatment demands, making the revision essential. This directly affects the maintenance and operation of ballast water treatment systems, which are central to ensuring compliant discharge. The compatibility between equipment performance and operational protocols determines whether discharge results meet regulatory standards. The revised convention introduces updated efficiency benchmarks for treatment equipment, leading to changes in maintenance standards and operational procedures[5]. Maintenance cycles must be rescheduled according to the new requirements, with inspection frequencies for core components adjusted to ensure optimal operating conditions. Operational protocols must also be updated to reflect new treatment standards, clarifying equipment parameters for various navigation scenarios. If crew members continue to rely on outdated maintenance and operational practices, the equipment may fail to meet the revised treatment standards, resulting in non-compliant ballast water discharge.

3.3. Impact on Crew Operations and Recordkeeping

During ballast water management, the standardization of crew operations and recordkeeping constitutes a key focus of compliance inspections. To enhance overall compliance quality, the revised convention imposes stricter requirements in this regard. As the direct implementers of ballast water management, crew members’ operational proficiency and recordkeeping accuracy serve as important indicators of compliance performance. The revision will introduce new requirements for crew procedures and documentation (see Table 1). Operational workflows must be adjusted to align with the new management standards, with the execution criteria for each procedural step clearly redefined. The ballast water record book must incorporate additional data elements, and the standards for detail and accuracy in recordkeeping will be further elevated. Crew members will need to undergo retraining to master the updated operational protocols and recordkeeping requirements, ensuring procedures are carried out in strict compliance and records remain complete and error-free. Failure to adapt may lead to operational errors or omissions in records, increasing the risk of non-compliance.

Table 1. Impacts on Crew Operations and Recordkeeping

Impact category	Specific Changes
Operational behavior	The operation process needs to be adjusted in accordance with the new management standards, and the execution standards for each link need to be redefined.
Record work	The filling of the ballast water record book needs to include new elements, and the requirements for detail and accuracy have been raised.
Crew requirements	It is necessary to relearn the new operation norms and record requirements to ensure compliance in operation and record-keeping.

3.4. Impact on Shipowner Management and Shore-Based Support

As the primary managers of vessels, shipowners’ capacity to provide managerial and operational support directly determines overall compliance performance. To ensure the effective operation of the compliance framework, the revised convention introduces new requirements for shipowners’ support systems. Shipowner management structures and their support capabilities are indispensable to achieving compliance. After the revision, shipowners

will need to make corresponding adjustments to their Safety Management Systems (SMS) to align with the new regulatory standards[6-7]. Elements related to ballast water management-such as the delineation of responsibilities and the structuring of operational workflows-must be re-evaluated and refined to ensure consistency with the revised convention. Shipowners must also reassess suppliers, selecting those capable of providing equipment and services that meet the new conditions. Shore-based support protocols must be updated to deliver updated technical guidance and compliance-related advice to vessels. Failure to promptly improve management and support systems may leave vessels without adequate direction or safeguards when implementing compliance measures.

4. Strategies for Shipowners to Address the Revised Convention

4.1. Timely Learning and Interpretation

The revision of the convention updates the standards of compliance, and the level of understanding among crew members regarding these changes directly affects their subsequent compliance performance. Ship management should prioritize accessing the complete revised text of the convention and related supporting documents-such as *BWM.2/Circ.80/Rev.1* and *MEPC.387(81)*-through official channels, including the International Maritime Organization (IMO) website and notifications issued by competent authorities, thereby avoiding misunderstandings caused by unofficial sources. Training sessions should be structured according to crew members' roles and operational relevance. Personnel responsible for certification must focus on provisions concerning certificate validity, while operational staff should concentrate on ballast water exchange procedures. In addition, all crew members must gain a clear understanding of processes related to the treatment of Coastal Water Quality (CWQ), recordkeeping requirements, and key Port State Control (PSC) inspection points. Technical experts should contextualize the interpretation of revisions by linking them to their ecological and regulatory background, helping crew members understand the necessity of these changes. After training, the crew should adapt the general provisions to the specific operational characteristics of their vessels and voyage routes, using internal communication to eliminate discrepancies and establish a shared understanding.

4.2. Adjusting Management Systems and Operational Plans

The ship's management system and operational plans serve as the primary vehicles for implementing the convention's requirements. If these elements are not updated in line with the revised provisions, gaps in the compliance management chain may arise. Shipowners, based on the company's operational context, should take the lead in overseeing adjustments to management systems. Designated auditing personnel should systematically review the Safety Management System (SMS) against the revised provisions, with a particular focus on sections pertaining to ballast water management, identifying any inconsistencies in the delineation of responsibilities, workflow arrangements, or reporting protocols. For discrepancies identified, auditors must devise corrective measures tailored to the vessel's operational realities, ensuring the coordination of duties among different positions under the new requirements. The ballast water management plan must be updated in accordance with factors such as the ship's ballast tank capacity, differences in water quality across navigation areas, and new recordkeeping requirements. The revised plan should undergo internal trial operations to verify its feasibility before being submitted to the competent authority for approval. Upon approval, shipowners must synchronize updates across all operational documents and organize comprehensive training for crew members to ensure seamless implementation.

4.3. Strengthening Equipment Maintenance and Crew Training

The operational state of ballast water treatment equipment, along with crew proficiency, forms the material and technical foundation for meeting the new convention requirements. Technical departments must reassess the maintenance demands of core components-such as filters and sterilization units-in light of updated efficiency and discharge standards, formulating maintenance schemes that more accurately reflect real-world conditions[8]. Regular filter cleaning is essential to prevent blockages and ensure that differential pressure remains within prescribed limits; for example, in high-sediment ports such as certain sections along the Yangtze River, cleaning cycles must be shortened to avoid automatic shutdowns of the Ballast Water Management System (BWMS). Variations in water quality and sediment levels across ports make these adjustments critical, and comparative performance data (as illustrated in Figure 1) underscore their importance. During the maintenance phase, performance tracking through parameter recording and analysis is essential to identify potential system inefficiencies. Crew training programs must address both the updated maintenance standards and operational protocols. Theoretical modules should ensure crew members grasp the underlying technological principles, while practical drills develop operational proficiency. Competency assessments should combine practical evaluations with theoretical testing, ensuring that crew capabilities align with the revised requirements.

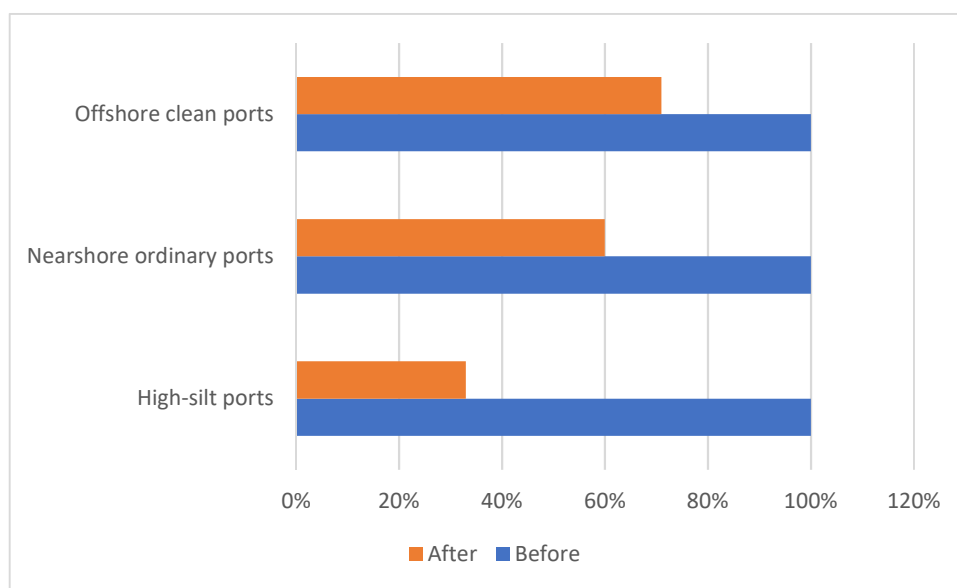


Figure 1. Comparative Effects of Adjusted Filter Cleaning Cycles

4.4. Enhancing Shore-Based Support and Pre-Assessment

As the logistical backbone of vessel operations, shore-based teams play a crucial role in mitigating compliance risks during long voyages by providing proactive support and pre-assessments. Following the completion of the convention's revision, shore-based teams must immediately collaborate with technical experts to develop guidance materials outlining key operational requirements, common errors, and avoidance strategies under the new standards. These materials should be disseminated promptly to ships via efficient communication channels, such as online platforms and satellite links, to ensure timely delivery. Pre-assessment procedures must address key compliance elements, including ship certificates, management plans, and equipment condition[9-10]. Evaluations should be tailored to the latest regulatory policies and inspection priorities at the ports the vessel is scheduled to visit, producing targeted checklists. Issues identified during pre-assessments should be documented in corrective action reports, complete with step-by-step remediation measures and designated responsible

personnel. Shore-based teams must monitor the progress of corrective actions through regular communication, providing additional assistance as needed to ensure that all issues are resolved before port arrival, thereby laying the groundwork for successful compliance inspections.

5. Conclusion

The revision of the Ballast Water Management Convention reflects the combined imperatives of global ecological protection and the developmental needs of the shipping industry. These changes present new challenges for maintaining certificate validity, standardizing equipment operations, enhancing crew competencies, and strengthening shore-based management systems. By promptly familiarizing themselves with the revised provisions, optimizing management plans, reinforcing equipment maintenance and personnel training, and improving shore-based support mechanisms, shipping enterprises can effectively adapt to the regulatory changes and mitigate compliance risks. This process not only elevates the standard of compliance management within the maritime sector but also contributes practical support to global marine ecological protection efforts. As environmental priorities and maritime technologies continue to evolve, further amendments to the convention may emerge, necessitating that the shipping industry maintain close attention to regulatory developments and continually refine its compliance management strategies.

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