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Ballast Water Management on Icebreakers

A feasibility study about the ballast water management convention implementation on Arctia Icebreaking Ltd icebreakers

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Abstract

Having been involved in a classification process to acquire a ballast water management certificate for an icebreaker I grew familiar with the regulations and legislation concerning ballast water management and its implementation. The goal of ballast water management is simple: to prevent invasive aquatic organisms or pathogens spreading from one location to another with vessels' ballast water. This is however where the simplicity ends and there are a lot of questions concerning the implementation and interpretation of the ballast water management convention and the retrofitting of ballast water treatment systems to older vessels. There are a lot of regulations related to this matter and it takes some effort to familiarise oneself with the essential knowledge. Some matters even require confirmation and interpretation of flag state authorities.

I noticed the existence of a confusion regarding this subject in Arctia Icebreaking Ltd and offered my help to make a study about the requirements and possible beneficial solutions regarding ballast water management on Arctia Icebreaking Ltd. icebreakers. The aim of this study was to study the feasibility of different possible solutions to fulfill the requirements of ballast water management convention by studying the legislation and IMO resolutions and to interview the authorities of Baltic Sea countries about the possibilities available when taking in account the operational scope of the fleet. The secondary aim of this study was to make a comprehensive general information guide for the office and operational personnel about the issue and its background to provide answers to many unclear issues about ballast water management on icebreakers.

The result of the study provides support for decision making for the office regarding ballast water management and serves as a general information package about the subject for reference for the operational crew of the icebreakers.

Language: English
Key Words: ballast, water, management, icebreaker

EXAMENSARBETE

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Abstrakt

När jag var med i klassifikationsprosessen för att skaffa en barlastvattenshanteringssertifikat för en isbrytare blev jag bekant med regler och lagstiftning gällande barlastvattenshanteringen och dess implementation för fartyg. Syftet med barlastvattenhanteringen är enkel: att förhindra att skadliga akvatiska organismer eller patogener sprids med fartygens barlastvatten från ett område till ett annan. Enkelheten gällande ämnet slutar här. För att fylla alla bestämmelser och installera barlasvattenhanteringsapparater i gamla fartyg finns det en uppsjö av frågor och saker som kräver tolkning och utredningsarbete. Det finns en hel del regler med barlastvattenshanteringen och det krävs mycket arbete för att sätta sig in saken. Vissa saker kräver även tolkningar och godkännande från myndigheter.

Jag märkte att det finns många oklarheter med barlastvattenshantering i Arctia Icebreaking AB och jag erbjöd mig att för att göra en forskning om krav och möjligheter som gäller barlastvattenshanteringen på Arctia Icebreaking AB isbrytare. Syftet med denna forskning är att ta reda på möjligheterna att fylla kraven i barlastvattenkonventionen samt vilka åtgärder som krävs för att följa den nationella lagstiftingen i det operationella omfattningen av isbrytarflottan. Det andra syftet är att göra ett fullständigt informationspaket om barlastvattenshanteringen för rederiets befäl och operativ besättning.

Resultatet av denna forskning gör det lättare för rederiets befäl att fatta beslut gällande barlasthantering. Det är också meningen att resultatet inom rederiet kan användas som en generisk informationskälla om barlasthantering.

Språk: engelska
Nyckelord: barlast, vatten, hantering, isbrytare

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Tiivistelmä

Osallistuttuani jäänmurtajan luokittamisprosessiin painolastivesisertifikaatin saamiseksi, tutustuin painolastiveden käsittelyn vaatimuksiin ja sen toimeenpanemiseen liittyviin säännöksiin ja lakeihin. Painolastiveden käsittelyn tavoite on yksinkertainen: estää haitallisten vesieliöiden ja taudinaiheuttajien kulkeutuminen aluksen painolastiveden mukana alueilta toisille. Tähän yksinkertaisuus asiassa kuitenkin loppuu ja painolastivesiyleissopimuksen toteuttamiseen ja painolastinkäsittelylaitteiden jälkiasennuksiin vanhoihin aluksiin liittyy paljon kysymyksiä ja tulkintaa vaativia asioita, jotka vaativat selvitystyötä. Painolastiveden käsittelyyn liittyy paljon säännöksiä ja siihen perehtyminen vaatii asiaan paneutumista. Jotkut asiat vaativat virkamiesten ja lippuviranomaisen hyväksyntää ja tulkintaa.

Huomasin, että Arctia Icebreaking Oy:ssä oli paljon epäselvyyttä liittyen painolastiveden käsittelyyn ja tarjouduin tekemään tutkimuksen Arctian jäänmurtajia koskevien painolastiveden käsittelyyn liittyvien vaatimusten ja hyödyllisten mahdollisuuksien selvittämiseksi. Tämän tutkimuksen tarkoituksena on selvittää kannattavat mahdollisuudet painolastivesiyleissopimuksen ja siihen liittyvien kansallisten lakien vaatimusten täyttämiseksi alusten operointilaajuudessa. Toinen tavoite tutkimuksella on tehdä kattava tietopaketti aiheesta ja sen taustoista varustamon johdolle ja alusten operoivalle miehistölle.

Tämän tutkimuksen tulos helpottaa varustamon johdon päätöksentekoa painolastinkäsittelyyn liittyen ja toimii yleisenä tietolähteenä aiheesta jäänmurtajien miehistöille.

Kieli: englanti
Avainsanat: painolasti, vesi, käsittely, jäänmurtaja

Abbreviations

Ballast Water	Water taken on board a ship to control trim, list, draught, stability or stesses of the ship
Ballast Water Management	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.
BWM Convention	The Ballast Water Management Convention
BWTS	Ballast Water Treatment System
Harmful Aquatic Organisms and Pathogens	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.
HELCOM	The Baltic Marine Environment Protection Commission – also known as the Helsinki Commission
IMO	International Maritime Organisation
IOPP Certificate	International Oil Pollution Prevention Certificate
JHP	Joint Harmonised Procedure for the Contracting Parties of HELCOM and OSPAR on the granting of exemptions under International Convention for the Control and Management of Ships' Ballast Water and Sediments, Regulation A-4
MEPC	The Marine Environment Protection Committee

Table of Contents

1 Introduction

I was working as a chief officer on board the multi support icebreaking vessel Fennica when a ballast water treatment system was installed on board. While I was involved in the classification process to acquire a ballast water management certificate for msv Fennica I grew familiar with the regulations and legislation concerning ballast water management and it's implementation.

According to the requirements of the Ballast Water Management Convention along with the renewal of the IOPP Certificate vessels need to meet the ballast water treatment D-2 standard requirements after a transitioning period that will end on 8 September 2024. All Arctia Icebreaking Ltd. icebreakers had acquired ballast water management certificates for D-1 ballast water exchange standard soon after Finland adopted the Ballast Water Management Convention to its legislation in 2016. During 2022 the issue of D-2 standard ballast water management requirements was yet to be sorted out with five of the icebreakers of the Arctia Icebreaking Ltd. fleet and I was willing and interested in clearing out any questions involving the implementation of Ballast Water Management Convention requirements for these vessels considering the operational scope of the icebreakers. Because I already had experience in getting the multipurpose ice breakers Fennica and Nordica classified to D-2 standard requirements I contacted Arctia Operations Manager and Technical Director and offered my help to make a study about the applicability of the Ballast Water Management Convention requirements for Arctia Icebreaking Ltd. They welcomed my proposal and I started to work on the issue.

The goal of ballast water management is simple: to prevent invasive aquatic organisms or pathogens spreading from one location to another with vessels' ballast water. However upon closer investigation the subject of ballast water management, regarding regulations and the evolving technology are of a complex nature. The goal of preventing the spread of invasive aquatic organisms and pathogens is a giant challenge to achieve in a way that the original purpose of the Ballast Water Convention is achieved. The requirements and technologies are evolving and it can be a bit confusing for shipping companies to stay compliant with the requirements.

In this study I will examine the requirements and possibilities of the implementation of the Ballast Water Management Convention on Arctia Icebreaking Ltd. icebreakers as they exist at the time of the study. Different icebreakers of Arctia Icebreaking Ltd. fleet have different characteristics and operational possibilities depending on the age, type and intended operational use of the vessel. I studied the possibilities of ballast water management requirements and possibilities from the perspective of the fleet specifics in order to make the operation of the vessels clear for the Arctia Icebreaking Ltd management and the crews of the icebreakers. I also studied the possibility on how to make visits to dry docks in other Baltic Sea countries possible if the ballast water treatment systems are not installed on certain icebreakers.

The results of the study aim to support decision making for the Arctia Icebreaking Ltd management and at the same time serve as a general information package for the crew operating the vessels regarding ballast water management. Possible modifications to the company's and vessels' manuals were studied and proposed to include the results of this study.

This study is limited to only the details about ballast water management that concern the operation of Arctia Icebreaking Ltd. icebreakers.

1.1 Background

Ballast water is water that has been taken on board a ship to control trim, list, draught, stability or stresses of the ship. According to studies, almost 12 billion tonnes of ballast water transport an estimated number of 15 000 different species annually. This creates a great threat to local biodiversities around the globe, threatening fisheries, aquaculture and also human health (Wright, 2021). When almost 80% of the cargo is carried by ships, the issue of ballast water management is critical for the future of the seas (Lakshmi, Priya & Achari, 2021). Finland is geographically situated by the Baltic Sea and most of the imported cargo is carried on ships so the transported ballast water is a matter that we must take with great concern. Stephan Gollash and Erkki Leppäkoski (2007) have studied the brackish water of the Baltic Sea and found in their research that there are approximately 120 alien invasive species recorded of which almost 80 have established reproducing populations. They argue that most of them have been introduced during the last 100 years. They also

state that in this case it is shipping that has been the most important individual factor for the spread of alien invasive species. This is the reason why ballast water management on vessels operating in the seas all over the world and on our own shores of the Baltic Sea is very important. The concern for the condition of world seas and the ecological aspect of the maritime industry started the long process to make the maritime industry more ecologically sustainable. Australia and Canada were among the first nations who acknowledged that they were having serious problems with aquatic invasive species that were harmful to native biodiversity. They brought their concerns to IMO's Marine Environment Protection Committee, and finally after years of negotiations, a diplomatic conference was held (Lakshimi, Priya & Achari 2021). As a result, the International Convention for the Control and Management of Ships' Ballast Water and Sediments was published by IMO in 2004. The goal of the convention is to globally harmonise the ballast water management on vessels and to take action against the transfer of harmful aquatic organisms and pathogens via ships' ballast water and related sediments. On September 8, 2017 ballast water management became mandatory for vessels of the countries that had adopted the IMO Ballast Water Management Convention (Implementing the Ballast Water Management Convention, n.d.).

In 2017, a ballast water treatment system was installed on board the multipurpose icebreaking vessel msv Fennica to meet the requirements of the IMO Ballast Water Management Convention for approval of the classification society DNV. Working as a Chief Officer, I was involved with the implementation and classification of the ballast water management requirements for the multipurpose icebreakers Fennica and Nordica. Because of a retrofit installation, there were some special considerations that needed to be sorted out before the classification society issued the certificate for the vessels. I was involved with every step of the classification process and familiarised myself with the requirements of the Ballast Water Management Convention. This was also the time I became interested in this topic and wanted to do my master's thesis about the ballast water management on icebreakers.

The commissioner, Arctia Icebreaking Ltd., is a subsidiary company of Arctia Ltd. which is a 100% Finnish state owned company providing maritime services including icebreaking, hydrographic survey, fairway and port design, fairway maintenance, hydraulic engineering and polyethylene buoys and navigational aids. Arctia Icebreaking Ltd. is the main operator

of the Baltic Sea icebreaking and the icebreaking fleet consists of eight icebreakers (Arctia Ltd., n.d.).

1.2 Research questions and research approaches

In this study my aim is to understand what is required and what are the possibilities in implementing the ballast water management convention requirements on Arctia Icebreaking Ltd. icebreakers.

-Do the icebreakers need to comply with the Ballast Water Management Convention requirements and why?

-How does the compliance or non-compliance affect the operation of the icebreakers?

-How can a non-Ballast Water Management Convention compliant icebreaker make a trip to a dry dock in a different country?

My overall approach to my topic, this study's general principal, is a qualitive research. My aim is to find deeper knowledge about the Ballast Water Management Convention requirements in Finnish icebreaker vessels with different characteristics.

In general, a feasibility study is commonly used as a part of a study that strives to investigate or predict the outcome of a planned scheme along with a possible gain. A Feasibility study can be divided in five types or categories which are technical, economical, legal, operational and scheduling feasibility. This study can be best described as a legal feasibility study about the implementation of the Ballast Water Management Convention regulations and national legislation concerning ballast water management for Arctia Icebreaking Ltd. icebreakers. The legal feasibility study aims to find the possible solutions and requirements that are feasible within the limits of law regarding the subject of ballast water management in the operational status of the Arctia Icebreaking Ltd. icebreaking fleet. The study considers the feasibility firstly from a legal point of view and secondly from economical, technical and operational points of view. An economic feasibility part of the study considers the costs of different solutions available by the law. A technical feasibility part of the study considers the possibility of a technical retrofit installation of a ballast water treatment unit or a connection to be able to pump ballast water to a port reception facility. An operational feasibility is a tool to examine the viability and feasibility of a

proposed plan, an idea or a system. In this case, the operational feasibility study is to determine which solutions are feasible from the operational point of view on how to make visits to dry docks in other countries possible for non-Ballast Water Convention compliant icebreakers e.g., is it possible to find access and pump ballast water to a port reception facility (Mukherjee & Roy, 2017).

1.2.1 Literary research

Literary research is a way to better understand the field of my study and the topic to find out what themes and approaches have been studied and what data has been used. Literary review is part of the qualitive research and stimulus for thinking and not only about establishing what has already been written about (Burns, 2000, p.390). The following literary research material about the background of the subject of ballast water management are used: IMO Ballast Water Management Convention regulations and publications, articles and studies about ballast water management related topics, HELCOM agreements, and the legislation of countries involved in the operation of the icebreakers. The legislation about ballast water management is the backbone for the whole ballast water system management requirements and is critical for this study. According to Lakshmi, Priya and Achari (2021), ballast water and its management is a very recent development. For the past 20 years or so Ballast Water Treatment Systems have been researched quite a lot due to the subject's importance for the future of the seas. Since the global climate crisis is now changing the biodiversity as it makes the ballast water management very important. There are studies of different fields, research articles, books and database on ballast water management available from around the world. There are also technical reports by the Finnish Environmental Institute commissioned by Traficom. Research conducted by Okko Outinen and Maiju Lehtiniemi (2019) is investigating the effectiveness of indicative ballast water analysis testing for port State control purposes. Arctia Icebreaking Ltd. IB Polaris was one of the test vessels of this study. Also, the person I interviewed for this study was a part of the research executive team. Marine scientist Outinen works at the Finnish Environment Institute and has written several research articles regarding ballast water management. Erkki Leppäkoski has also contributed to the scientific field of ballast water management, invasion of species and biodiversity. He is a professor of biosciences, environmental and marine biology at Åbo Akademi and has written an important risk assessment report for the HELCOM. Matej David and Stephan

Golasch (2018) stated in their article's abstract that "the latest research continues to show that the ballast water issue is very complex, which makes it very challenging to manage.". A lot of research is still done and needed from different fields to find the most effective and functioning systems to stop the harmful transportation of aquatic invasive species.

1.2.2 The Interviews

Additionally, interviews were used as a research method. Interviewing is one of the most used research methods in the field of qualitative research since it is a very flexible method (Hirsjärvi & Hurme, 2004, p. 34). The most common types of interviews are unstructured, semi-structured and structured interviews (Dawson, 2002, p.27). In my study I wanted to get more information about the ballast water management from the flag state authority and chief adviser of Traficom Ville-Veikko Intovuori. I had been in contact with him while getting msv Nordica & Fennica classified according to the D-2 standard by DNV on a few issues where the classification society wanted to know the opinion of the flag state authority. I knew from my previous interactions with him that he is the correct person to provide answers and interpretation about ballast water management related questions. I chose semi-structured interviews since I wanted to get deeper comprehension about my research topic. I wanted also to be able to compare and confirm the information of literary research materials about the interpretation and practical implementation of ballast water management requirements and possible solutions and to clarify any unclear issues related to the topic. A semi-structured interview method was chosen as it permits more flexibility as only direction was given so that the content focuses on the topic (Burns, 2000, p.424). I did two separate interviews with the Finnish flag state authority Ville-Veikko Intovuori of Traficom. The interviews were made as semi-structured flexible theme interviews where I sent the questions to the interviewee in advance. The main questions were as follows:

- How does the Finnish law about the compliance of Ballast Water Management Convention requirements affect the Arctia Icebreaking Ltd. icebreakers?
- Are the Finnish icebreakers allowed to operate and pump ballast water in foreign economical zones while doing icebreaking operations?
- What are the possibilities on making a trip to a dry dock in a foreign Baltic Sea country if the icebreaker is not compliant with Ballast Water Management Convention requirements?

- What is the meaning of the term ”same location” used in the Ballast Water Management Convention?

The interview occurrences themselves were relaxed discussions about the topic on the themes mentioned above-mentioned themes over internet video calls. I think that video calls were a good option to do the interviews because I was able to see the interviewee, and with modern technology, this is very easy to arrange. In general, interviews made by phone are more suitable for more structured interview methods since they lack all the visible clues of conversations (Hirsjärvi & Hurme, 2004, p.64). The first interview was held on the 25th of November 2022 and the second one on the 21st of February 2023. I felt that a second interview was needed to get further information about the data I found out about during the research. The aim of the interviews was to acquire a more deeper understanding about the interpretation and practical implementation of ballast water management requirements and possible solutions and to clarify any unclear issues related to the topic.

I also contacted the environmental authorities in Denmark by email and asked them a number of questions about how to make a dry dock visit to Denmark possible for non-Ballast Water Management Convention compliant vessels.

1.3 The structure of the thesis

In Chapter 1 I explained my starting point to this study, the background of the topic and its importance. I presented the study’s research questions, methods and purpose.

In Chapter 2 I will examine more closely the ballast water convention and its outcome. I will introduce the international and national legislation that concern the ballast water management requirements for the operation of the icebreakers.

In Chapter 3 I will explain the characteristics of the icebreakers and their status concerning ballast water management.

I will continue to inspect the possibilities to conduct dry dock outside of Finnish waters for non-Ballast Water Management Convention compliant vessels in Chapter 4. This was especially requested by the commissioner because they wanted to have the possibility to compare and ask for bids from different dry docks in Baltic Sea countries.

In Chapter 5 there are the suggestions for amendments to the company manuals. In Chapter 6 one can find the conclusions of this thesis.

2 International and national legislation

In this chapter, the corresponding legislation and agreements which concern ballast water management for Arctia Icebreaking icebreakers operation are explained. The background and the main points of the adopted International Maritime Organisation and HELCOM regulations, the legislation of Finland and countries with which Finland has a treaty on icebreaking co-operation are explained. Additionally, the effect on icebreaking operations in Estonian waters concerning the regulations of the Ballast Water Management Convention is explained.

2.1 Ballast Water Management Convention

The Ballast Water Management Convention herein after referred to as the BWM Convention. The full name is International Convention for the Control and Management of Ships' Ballast Water and Sediments which was published in 2004 is a treaty adopted by the International Maritime Organization (IMO). The BWM Convention was prepared by a Ballast Water Working group established by Marine Environment Protection Committee (MEPC) in 1994. The goal of the BWM Convention is to establish common rules in order to help prevent the spread of potentially harmful aquatic organisms and pathogens in ships' ballast water. The BWM Convention is a document describing the main terms of the treaty (BWM Convention and Guidelines, n.d.). In the BWM Convention it is stated that it would enter into force 12 months after 35% of world merchant shipping tonnage had ratified the convention. Finland was the key party to adopt the BWM Convention on the 8th of September 2016 to fulfill the 35% requirement and this triggered the BWM convention to enter into force 12 months after on 8th of September 2017. (BWMC, 2004, Article 18, p.10) At the time of writing 96 countries have adopted the BWM Convention. An updated list of the countries that have adopted the BWM Convention can be found on the IMO website (Status of Conventions, n.d.). From 8th of September 2017 ships registered under contracting parties to the BWM Convention which take up and use ballast water during international voyages must manage their ballast water so that harmful aquatic organisms and pathogens are removed or made harmless before the ballast water is released to a new

location. This will help prevent the spread of invasive species as well as potentially harmful pathogens.

According to Article 4 of the Ballast Water Management Convention in general the contracting Parties are required to implement the Ballast Water Management Convention in the following manner:

> Each Party shall require that ships to which this Convention applies and which are entitled to fly its flag or operating under its authority comply with the requirements set forth in the Convention, including the applicable standards and requirements in the Convention Annex, and shall take effective measures to ensure that those ships comply with those requirements.
>
> Also Each Party shall, with due regard to its particular conditions and capabilities, develop national policies, strategies or programmes for Ballast Water Management in its ports and waters under its jurisdiction that accord with, and promote the attainment of the objectives of the Ballast Water Management Convention (BWMC, 2004, p.5).

In other words, the contracting parties are responsible and shall make sure that the requirements of the BWM Convention are met on the vessels flying their flag or under their authority and also in ports and waters under their jurisdiction.

Since the BWM Convention was published the set of rules has evolved greatly and many circular letters and guidance documents have been published to explain the methods to reach the goal of the BWM Convention in greater detail. One could say the convention is an evolving document which takes the benefitting changes into account. There is even a circular letter explaining the common interpretations of the BWM Convention (BWM.2/Circ.66).

2.1.1 Application of the BWM Convention

According to the BWM Convention Article 3 the regulations generally apply to all vessels operating under the authority of the contracting party of the BWM Convention. However according to the same article there are a few exceptions for vessels the BWM Convention requirements do not apply to. There exceptions include vessels that:

- are not designed or constructed to carry Ballast Water,
- only operate in the sea area under a BWM Convention contracting Party's authority or in that area and the high seas (the sea area not under the authority of any State),

- only operate in the sea area of another Party if that Party has allowed an exemption for the vessel to do so also considering BWM Convention requirements,

- are warships, naval auxiliary ships, or other vessels owned and operated by a state and used for governmental non-commercial service,

- are built with ballast tanks that are sealed and are not subject to be discharged.

According to Article 3 the before mentioned exceptions include terms that even though these vessels are exempted to discharge ballast water disregarding the BWM Convention requirements they should not do so if there is a risk of damaging the environment, human health, property or resources in the water area of a Party and also of other parties (BWMC, 2004, p.4).

The exceptions described above are valid for some of the icebreakers of the Arctia Icebreaking Ltd. fleet in their current operational scope. These exceptions are further adopted and described in national legislation and the interpretation has been consulted from the Finnish and Swedish authorities. More information about these exceptions can be found in chapter 2.2 of this study.

2.1.2 Implementation of the BWM Convention

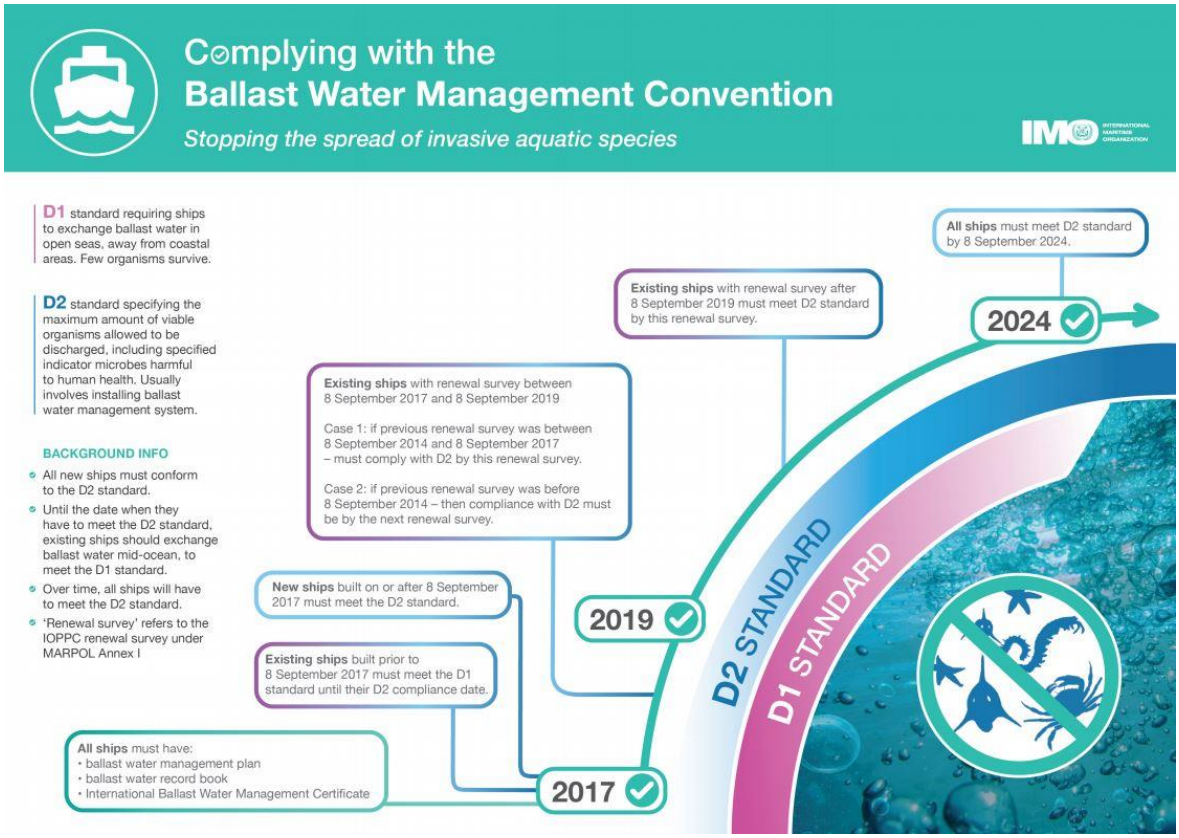
After the BWM Convention entered into force a schedule for the implementation was set. All of the vessels of the contracting parties of which the BWM Convention applies to should hold a ballast water management certificate issued by the flag state and manage their ballast water according to a vessel specific ballast water management plan from 8 September 2017 forward. According to the BWM Convention regulation B-1 all the complying vessels need to have at least a ballast water management plan in which all of the vessel specific operations and characteristics concerning ballast water management are described (BWMC, 2004, p.17). A ballast water record book is required for record keeping of ballast water intake, discharge, circulation, accidental discharge, exchange operations and other incidents regarding ballast water that are of interest to inspections (BWMC, 2004, p.17–18). According to the Finnish maritime authority Ville-Veikko Intovuori the circulation of the ballast water means the internal transfer of ballast water from tank to tank and this operation must also be recorded in the ballast water record book. When a

vessel has a ballast water management plan and a ballast water record book the flag state authority can issue an International Ballast Water Management Certificate for the vessels as long as the requirements are met and confirmed by survey. The authority of the contracting Party of the BWM Convention is responsible for issuing a ballast water management certificate to a vessel under it's authority. The flag state authority can delegate the issuing duties of the ballast water management certificate to a recognized organization.

There are two standards of ballast water management for which a ballast water management certificate is issued according to the BWM Convention. D-1 and D-2. These standards are explained in more detail in chapter 2.1.3.

Eventually all of the vessels the BWM Convention applies to need to comply with the D-2 requirements as described in the Regulation B-3 of the BWM Convention but there is a transitioning period from 8 September 2017 to 8 September 2024 depending if the vessel is built before or after 8 September 2017. Vessels built after 8 September 2017 need to comply with the D-2 requirements right away. Vessels built before 8 September 2017 need to comply at least with the D-1 requirements and they have a transitioning period until 8 September 2024 to meet the requirements of the D-2 standard depending on the renewal date of the IOPP Certificate which is renewed every five years. For existing vessels that renewed the IOPP certiticate before 8 September 2014 it is still possible to use D-1 standard after the renewal that has been done before 8 September 2019 but must comply with D-2 requirements by the next renewal date. Existing vessels that had a renewal date between 8 September 2014 and 8 September 2019 must comply with the D-2 requirements by the next renewal date (BWMC, 2004, p.18-19).

See the status of the Arctia Icebreaking Ltd. icebreakers in chapter 3.



Picture 1. The implementation schedule of the BWM Convention (Implementing the Ballast Water Management Convention, n.d.)

2.1.3 Ballast water management standards

There are two ballast water management standards that are determined to reach the goal of the BWM Convention. These standards are called D-1 and D-2 described in Regulations D-1 and D-2 in the BWM Convention.

The D-1 standard requires ships to exchange their ballast water in open seas, away from coastal areas. Ideally, this means at least 200 nautical miles from the nearest land and in water that is at least 200 metres deep. If this is not possible the BWM Convention further states that the distance from the nearest land should at least be 50nm and if this is not possible the authority of a party can determine the area where the ballast water exchange can be performed as long as it does not harm the environment. By doing the ballast water exchange, fewer organisms will survive and ships will be less likely to introduce potentially harmful species to a coastal area when they release the ballast water.

The D-2 standard specifies the maximum amount of viable organisms allowed to be discharged, including specified indicator microbes harmful to human health.

The difference between D-1 and D-2 standards is that D-1 relates to ballast water exchange, while D-2 specifies the maximum amount of viable organisms allowed to be discharged, including specified indicator microbes harmful to human health.

D-1 standard - The D-1 standard requires ships to conduct an exchange of ballast water in such a way that at least 95% of water by volume is exchanged far away from the coast

This can be carried out by using either of the two different methods:

- a sequential method, where a ballast tank is first emptied and the refilled or;
- a flow through method, where typically an amount of ballast water equivalent of three times the tank volume is pumped through the ballast tank

When using the sequential method the vessel's stability needs to be evaluated that no damage can occur when emptying and refilling the ballast tanks. For the flow through method the possiblity of icing needs to be concidered because while filling the tank three times the volume the extra water may exit from the deck air pipes to the deck causing freezing problems.

D-2 standard - The D-2 standard specifies that ships can only discharge ballast water that meets the following criteria:

- less than 10 viable organisms per cubic metre which are greater than or equal to 50 micrometres in minimum dimension;
- less than 10 viable organisms per millilitre which are between 10 micrometres and 50 micrometres in minimum dimension;
- less than 1 colony-forming unit (cfu) per 100 mililitres of Toxicogenic Vibrio cholerae;
- less than 250 cfu per 100 millilitres of Escherichia coli; and
- less than 100 cfu per 100 milliliters of Intestinal Enterococci (BWMC, 2004, p.22).

It is not concluded in the BWM Convention on how the D-2 standard must be reached and the door has been left open on purpose for future solutions. In practice at the time of

writing to reach the D-2 Standard on vessels requires the installation of a type approved ballast water treatment system.

2.1.4 Ballast water treatment systems

The requirements of the Ballast water treatment systems used for achieving the requirements of the D-2 standard are described in Regulation D-3 of the BWM Convention (BWMC, 2004, p.22). These instructions have been further developed with the release of an IMO publication BWMS Code. The BWMS Code includes robust test and performance specifications as well as detailed requirements for type approval reporting (MEPC.300(72), 2018). In addition to the IMO published instructions the US Coast Guard has a different set of rules concerning the requirements for type approval of ballast water management systems. The administrations of the contracting parties of the BWM Convention have the responsibility to approve the developed ballast water treatment systems according to the BWMS Code. The approval process of a ballast water treatment system results to a type approval of the system and the results of the approval are forwarded to IMO. Administrations ofter delegate the type approval process to recognized organizations. Additionally Ballast water treatment systems which make use of Active Substances in achieving the D-2 standard need to be approved also by IMO. The administrations that type approve the ballast water treatment systems pass the approval information to IMO. On the IMO web page there can be found a list of all the type approved ballast water treatment systems and the list is updated regularly (BWM Technologies n.d.). Worth noting is that the way to achieve the D-2 standard of ballast water management is technology free and in the BWM convention the door has been left open for future development of technologies on purpose. The standard D-4 of the BWM Convention describes the process on prospecting prototype ballast water treatment technologies.

This study does not concentrate on the benefits or drawbacks of different BWTS technologies but it is worth noting that according to Traficom environmental authority Ville-Veikko Intovuori the UV filtration technology is best suited for the Baltic Sea traffic at the time of writing.

2.1.5 Exemptions

There are a few possibilities to acquire exemptions to vessels from BWM Convention requirements described in the BWM Convention Regulation A-4:

> 1 A Party or Parties, in waters under their jurisdiction, may grant exemptions to any requirements to apply regulations B-3 (which is the requirement for a vessel to do ballast water management) or C-1 (which are any additional measures a party determines to further, in addition to those exemptions contained elsewhere in this Convention, but only when they are:
>
> .1 granted to a ship or ships on a voyage or voyages between specified ports or locations; or to a ship which operates exclusively between specified ports or locations;
>
> .2 effective for a period of no more than five years subject to intermediate review;
>
> .3 granted to ships that do not mix Ballast Water or Sediments other than between the ports or locations specified in paragraph 1.1; and
>
> .4 granted based on the Guidelines on risk assessment developed by the Organization.
>
> 2 Exemptions granted pursuant to paragraph 1 shall not be effective until after communication to the Organization and circulation of relevant information to the Parties.
>
> 3 Any exemptions granted under this regulation shall not impair or damage the environment, human health, property or resources of adjacent or other States. Any State that the Party determines may be adversely affected shall be consulted, with a view to resolving any identified concerns.
>
> 4 Any exemptions granted under this regulation shall be recorded in the Ballast Water record book (BWMC, 2004, p.16).

The possibility for an exemption voyage in the Baltic Sea has been further developed by HELCOM joint harmonised guidance described in chapter 2.3.1 of this thesis.

2.1.6 The Same Location

The Same Location is a term that is described in the BWM Convention Regulation A-3 to make it possible to load and discharge ballast for example in a port basin without ballast water treatment (BWMC, 2004, p.16). The condition for this exemption is that untreated ballast water from a different location is not allowed to be discharged to a new location. In practice a vessel can load and discharge ballast water without managing it if the vessel is in a port discharging and loading cargo and the ballast water needs to be loaded and discharged to manage the stability, trim and stresses to the hull. The same location exchange of ballast water in a tank can be used also in a part of a fairway as long as the

untreated and treated ballast water subject to be discharged elsewhere are not mixed. If any mixing has occurred, the ballast water is subject to be managed according to the BWM Convention regulations if the BWM Convention applies to a vessel.

The term same location according to the Finnish Maritime Authority Ville-Veikko Intovuori means an area similar to a port basin or a fairway. He also stated that the term of same location has been under discussion in IMO meetings for as long as he has attended these meetings and an exact definition for the term has not been resolved.

There was a case study done in Vuosaari harbor between two harbor basins about the concept of same location by sampling the water from both basins for harmful aquatic organisms and pathogens and according to the results different harbor basins should be considered as separate locations. The same study also concludes that in practice the same locations should be limited to smallest practicable areas (Okkonen et al., 2021).

2.2 National legislation

In icebreaking operations, the icebreakers are sometimes required to operate in the exclusive economic zone (EEZ) of a neighboring country. In the exclusive economic zone of a country the national laws apply and in this chapter the relation of the legislation of the countries in regard with icebreakers operation and ballast water management convention requirements are described.

2.2.1 Finland

The implementation of the Ballast Water Convention in Finland was first proposed to the President of the Republic on 16 of June 2016 (17.6.2016/473) with amendments to the Act on Environmental Protection in Maritime Transport. This was approved by the President and a result of this Finland signed the IMO's International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) on the 8 September 2016 which as a result entered into force after 12 months on September 8, 2017. Finland made some significant changes to the law on the 23 November 2018 (990/2018) to further specify the implementation of the BWM Convention. For example, in this amendment Finland reserved the right to add any additional measures it deems necessary for vessels, port and waters under its jurisdiction as a right for contracting party

to do described in the BWM Convention Regulation C-1. Another amendment was made on the 29 June 2021 (29.6.2021/669). This amendment included an addition to the application of the BWM Convention and the regulations concerning ballast water. The added part on the 4§ moment 5 says that the BWM Convention regulations and other regulations concerning ballast water do not apply to:

> Vessels that are built before year 1990 and that provide ice breaking services for the Finnish Transport Infrastructure Agency with a contract, and vessels that provide icebreaking services for the Finnish Transport Infrastructure Agency based on a treaty (Merenkulun ympäristönsuojelulaki, 29.6.2021/669).

Arctia Icebreaking Ltd has a contract with the Finnish Transport Infrastructure Agency to provide icebreaking services for it. Icebreakers Voima, Urho, Sisu, Otso and Kontio of the Arctia Icebreaking Ltd fleet have been built before 1990. This moment in the legislation allows these Arctia Icebreaking Ltd. icebreakers built before year 1990 to be exempted from the BWM Convention requirements when providing icebreaking services for the Finnish Transport Agency.

Upon beginning this study, the fact that the icebreakers built before year 1990 are exempted from the requirements of the BWM Convention was not widely known among the crews of the icebreakers.

Finland has made the following treaties about co-operation in icebreaking services:

- Sweden, Norway and Denmark (36/1961)
- Sweden (77/2013)
- Russia (90/2015)

Most active co-operation in icebreaking is between Finland and Sweden in the Bay of Bothnia and it is a highly developed co-operation that has continued for several years.

I confirmed with the person that prepared the moment that the purpose of the amendment to the law was to also include the Swedish icebreakers (all of which are built before 1990) to be excluded from the BWM Convention and other national requirements concerning ballast water when providing icebreaking services for the Finnish Transport Infrastructure agency based on a treaty in Finnish waters.

2.2.2 Sweden

The implementation of the BWM Convention in Sweden is adopted in the national legislation in “Transportstyrelsens föreskrifter och allmänna råd om hantering och kontroll av fartygs barlastvatten och sediment;” TSFS 2022:19. The application of the law is described in 1§ and in moment 6 of the law it is stated that the Swedish law does not apply to vessels that are owned by the state or that are used by the state only for governmental non-commercial services (see the equivalent terminology in 2.1.1) (TSFS 2022:19).

As a part of this study, I contacted the Finnish Transport Infrastructure Agency and asked them if they knew if the before mentioned moment applied also to Finnish icebreakers providing icebreaking services for Sweden in Swedish waters based on a treaty. Swedish flag state authority was consulted about the interpretation of the law and the authority confirmed that the Finnish icebreakers providing icebreaking services in Swedish waters based on a treaty are considered to be equal to the Swedish state-owned icebreakers. As a result, the Finnish icebreakers are exempted from the BWM Convention requirements in Swedish waters while providing icebreaking services based on a treaty. I forwarded the written statement of the Swedish authority for Arctia Operations Manager who forwarded it to Arctia icebreaker captains.

2.2.3 Russia

Russia has adopted the BWM Convention and is also a member of the HELCOM. At the time of writing the Finnish icebreakers have not ever entered the Russian economic sea area for ice breaking operations and there have been no instructions from the Finnish Transport Agency on how to co-operate with Russia in ice breaking operations.

The way that Russia does the icebreaking for vessels heading to Russian ports in Gulf of Finland is that they often transit to the economic sea areas of Finland and Estonia to assist vessels towards the east.

The background of the treaty between Finland and Russia concerning the icebreaking co-operation is such that the initiative to form a treaty came from Russia in the fall of 2011. During two hard winters 2009-2010 and 2010-2011 Russia had great difficulties with ice breaking in getting the shipping traffic to and from Russian ports in the east end of Gulf of Finland (HE 314/2014). In 2014 a treaty was signed between the Finnish and Russian

representatives was adopted by Finland to its legislation in 2015 and entered into force 15 January 2016. The treaty itself explains framework of the possibility to arrange the use of Finnish icebreakers in Russian coastal waters and Russian icebreakers in Finnish coastal waters. The details should be sorted out with an agreement if one of the parties of the treaty takes the initiative to suggest the icebreaking co-operation (SopS 90/2015).

2.2.4 Estonia

Finland does not have a treaty with Estonia concerning icebreaking operations. There has been talks between the Finnish and Estonian governments about the possible co-operation concerning icebreaking but still no contracts have been made (HE 314/2014).

Because there is no treaty or a contract between Finland and Estonia according to the Finnish Maritime Authority Ville-Veikko Intovuori if a non-D-2 compliant Finnish icebreaker needs to enter the Estonian economic sea area no ballast water operations should be performed without an authorization from Estoniam Maritime Authority.

If during the icebreaking season the ice situation is such that some vessels need to be assisted from the Estonian economic sea area to Finnish ports, BWM Convention compliant icebreakers should be used for this, or discussions should be started at an early phase between Finnish and Estonian authorities to find out how the icebreaking operation of non-BWM Convention compliant icebreakers is possible in Estonian waters.

2.3 HELCOM

In 1974 the Convention on the Protection of the Marine Environment of the Baltic Sea Area – also known as the Helsinki Convention or HELCOM – was originally signed by all Baltic Sea coastal countries. The purpose of the convention is to protect the Baltic Sea from pollution as well as to preserve biological diversity and to promote the sustainable use of marine resources. HELCOM has 10 contracting parties: Germany, Denmark, Estonia, European Union, Finland, Lithuania, Latvia, Poland, Russia and Sweden. There is a two-year rotating chairmanship between the contracting parties. The contracting parties arrange a meeting annually and the heads of delegation meet at least twice a year.

2.3.1 Exemption application procedures in the Baltic Sea

HELCOM has prepared a "Joint Harmonised Procedure for the Contracting Parties of HELCOM and OSPAR on the granting of exemptions under International Convention for the Control and Management of Ships' Ballast Water and Sediments, Regulation A-4" (or JHP from now on) as a 49-page document describing the procedures on how the ballast water related exemptions should be processed among the HELCOM Contracting Parties for vessels that do not have a D-2 BWTS installed. All the HELCOM countries have agreed to follow the before mentioned procedure even though Latvia and Poland have not yet ratified the BWM Convention at the time of writing.

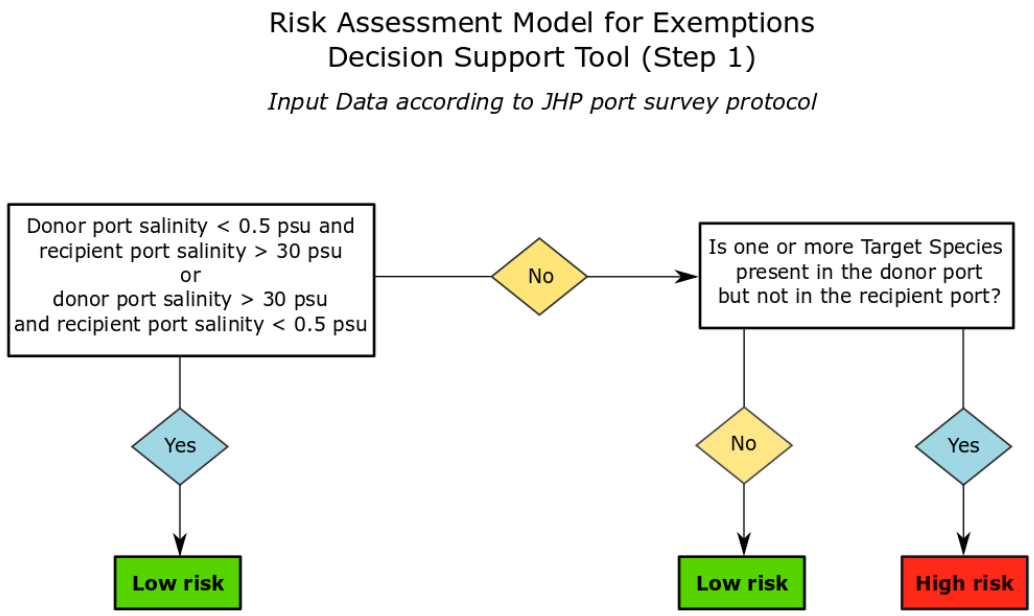
In the JHP it is advised that if a shipping company wishes to apply for an exemption from a HELCOM contracting party the contact should be made to the port state administration possibly years in advance to have ample time for processing the application. The application must include a risk assessment the applicant is responsible for preparing.

The exemption is granted to a ship or ships that plan to transit between specified ports or locations for a maximum of five years at a time. The ship must not mix ballast water of sediments elsewhere than in the locations of origin or destination stated in the granted exemption.

2.3.2 The JHP risk assessment

In the JHP the procedure of the risk assessment with which a shipping company can apply for an exemption for a non-D-2 classified vessel is described. The risk assessment is in compliance with the requirement described in regulation A-4.1.4 on the BWM Convention. The procedure is further described in the IMO Resolution MEPC.162(56) Guidelines For Risk Assessment Under Regulation A4 of the BWM Convention. What is different with the JHP is that it describes the procedure in closer detail and defines the practices agreed by the contracting parties to be used in the HELCOM area. The risk assessment consists of port survey data of the donor port and the destination port. The specifications of these locations need to be prepared for the risk assessment by doing port surveys in both locations. By doing the port surveys in the described manner the risks are done in a two-step risk assessment approach.

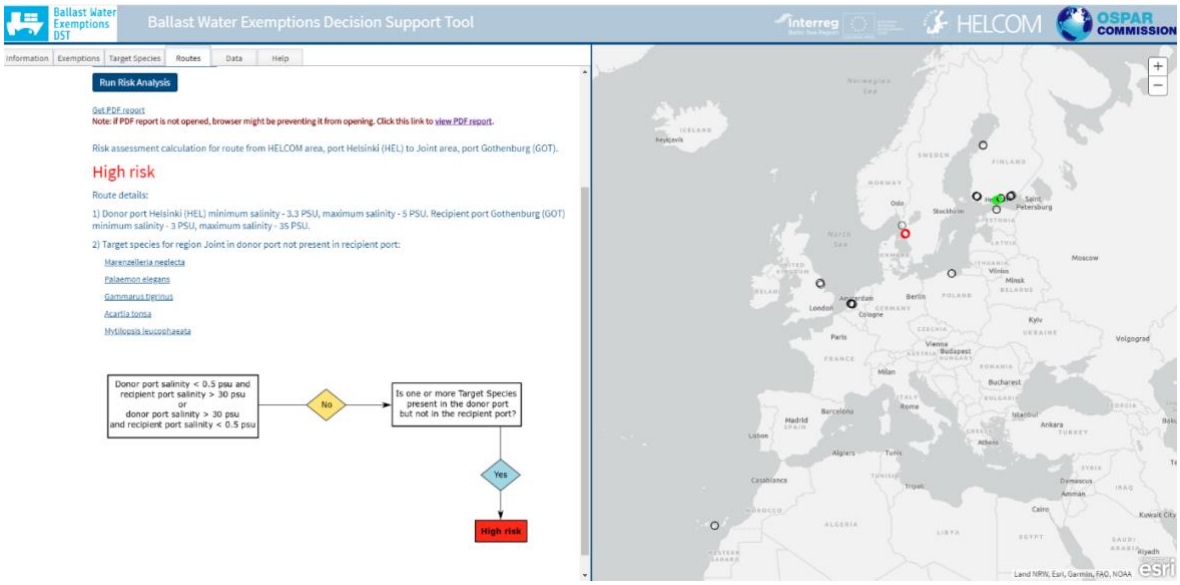
In the 1st step essential information for the risk assessment are the difference in water salinity between the planned locations and the presence of certain target species that are considered to be harmful. The difference in salinity between locations is determined and the presence of harmful target species. If there is a great difference in salinity between the ports <0.5 psu to >30 psu this is considered to be a low risk and also if there are no target species in the donor port that can be found in the recipient port. The result of these two factors will give the first indication if the planned journey will be of high risk.



Picture 2. HELCOM JHP Port Survey Risk assessment step 1 (HELCOM Ballast Water Exemptions Support Tool, n.d.)

The 2nd step of the risk assessment shall include more detailed information about the ports and the explanations on how the risk could be managed. Assessing the procedure to make the port surveys with sampling and the use of laboratories and the use a lot of environmental information to make a risk assessment it does not seem that the personnel of a shipping company is necessarily competent enough to make these procedures by themselves between two different ports in different countries. It is not described in the procedures on how to contact professionals that would be able to prepare the risk assessment properly.

HELCOM has established a “Ballast Water Exemptions Decision Support Tool” -web page that provides information about the process to apply for an exemption. The results of new port surveys should be uploaded to the web page by using an excel template that can be downloaded from the same page (HELCOM Ballast Water Exemptions Support Tool, n.d.). According Traficom’s Ville-Veikko Intovuori the ”Ballast Water Exemption Decision Support Tool” can also be used to monitor the spread of aquatic species.



Picture 3. A screenshot of the support tool (HELCOM Ballast Water Exemptions Support Tool, n.d.)

The rule of thumb in applying exemptions is that the authorities of the target port need to be contacted well in advance. According to the JHP they are obliged to assist in the process of the exemption application. In practice the authorities seem to be very occupied. I contacted the authorities in Denmark and asked about the different possibilities for the BWM Convention exempted vessels to make a single voyage to dry dock in Denmark. I received replies to a selection of my questions by email after more than a month. Some questions such as: “Are there mobile port reception facilities available in Denmark?” or “Who is it that does the port surveys in Denmark?” were left unanswered. After I while I received information from the Danish authorities that they would discuss about the possible solutions with Finnish authorities and I have not received any more information since. This needs to be considered and an active direct contact method should be applied to the port state authorities when planning to consult them about feasible solutions

concerning a single trip for non-BWM Convention compliant vessel to a location outside of the Finnish exclusive economic zone, EEZ.

When the application or the intended plan of ballast water management has been prepared and accepted by all the authorities for a single trip between two locations a ballast water management plan needs to be prepared to include all the details required by the authorities. The ballast water management plan is then sent to the flag state authority for approval and if the application is approved the flag state authority issues an international ballast water management certificate for the vessel for a single exemption trip.

3 The Icebreakers

There are eight icebreakers in Arctia Icebreaking Ltd fleet. All the icebreakers have a contract with the Finnish Transport Agency to provide icebreaking services during the icebreaking season in Finland. Here are descriptions of the icebreakers regarding the status related to the requirements of the BWM Convention and the applicable legislation.

IB Voima

IB Voima is built in 1954 and renovated in 1979 and is Voima is classified for worldwide trade area by the Finnish Transport and Communications Agency Traficom. Voima holds a D-1 classification by Traficom, no BWTS installed, exempted from BWM Convention requirements in Finnish and Swedish waters when providing icebreaking services for the Finnish Transport Agency according to the Finnish law. Exempted from BWM Convention requirements when only operating in Finnish waters.

IB Urho

IB Urho was built in 1975 and is classified for worldwide trade area by the Finnish Transport and Communications Agency Traficom. IB Urho is a sister vessel with IB Sisu. Urho holds D-1 classification by Traficom, no BWTS installed, exempted from BWM Convention requirements in Finnish and Swedish waters when providing icebreaking services for the Finnish Transport Agency according to the Finnish law. Exempted from BWM Convention requirements when only operating in Finnish waters.

IB Sisu

IB Sisu was built in 1976 and is classified for worldwide trade area by the Finnish Transport and Communications Agency Traficom. IB Sisu is a sister vessel with IB Urho. An Optimarin UV-filtration BWTS was installed on board IB Sisu before the information about BWM Convention not applying to Sisu in its typical operation was known. There is a thesis describing the retrofit of a ballast water treatment system to IB Sisu (Lindström, 2020). IB Sisu holds D-2 classification by Traficom and has an Optimarin. According to the Finnish law IB Sisu is exempted from BWM Convention requirements in Finnish and Swedish waters when providing icebreaking services for the Finnish Transport Agency according to the Finnish law. Also exempted from BWM Convention requirements when only operating in Finnish waters.

IB Otso

IB Otso was built in 1986 and is classified for worldwide trade area by the Finnish Transport and Communications Agency Traficom. IB Otso is a sister vessel with IB Kontio. IB Otso holds a D-1 classification by Traficom, has no BWTS installed and is exempted from BWM Convention requirements in Finnish and Swedish waters when providing icebreaking services for the Finnish Transport Agency according to the Finnish law. Also exempted from BWM Convention requirements when only operating in Finnish waters.

IB Kontio

IB Kontio was built in 1987. IB Kontio is a sister vessel with IB Otso. IB Kontio is classified for worldwide trade area by the Finnish Transport and Communications Agency Traficom with a limitation not to leave the EEZ of Finland outside icebreaking operations unless a ballast water management certificate has been issued for the vessel. This is because a ballast water treatment system has not been installed on board and thus Kontio does not meet the D-2 requirements. IB Kontio holds a D-1 classification by Traficom has no BWTS installed and exempted from BWM Convention requirements in Finnish and Swedish waters when providing icebreaking services for the Finnish Transport Agency according to the Finnish law. Also exempted from BWM Convention requirements when only operating in Finnish waters.

MSV Fennica & MSV Nordica

Fennica and Nordica were built in 1993 and 1994 and are sister vessels. The vessels are classified for worldwide trade by DNV and have an approved D-2 classification with Optimarin ballast water treatment systems installed.

Special characteristics regarding ballast water include the following:

- The use of potable water in the interring tank: if the potable water is subject to be discharged in the EEZ of a different nation than Finland, the authorities of the nation need to be consulted about the allowance of the discharge.

- The ability to open a valve from sea chest to ballast water tank 3P or 3S and from there the sea water in the tanks can be used to cool the engines: this functionality works as a buffer cooling storage in case the sea chest is momentarily clogged with ice. When this functionality is used, the water in the ballast tank is no longer considered to be ballast water but rather the tank is a part of the sea water cooling system. When the use of this functionality has ended, the tank needs to be completely emptied without mixing the water with the water in other tanks, and afterwards it needs to be flushed with treated ballast water.

- The use of trim pump connected to the aft peak: the trim pump is a separate 1000m3/h pump able to pump water to and from the aft peak ballast water tank to quickly adjust the trim the aft end of the icebreaker to the bow of the vessel about to be towed. The trim pump bypasses the BWTS. Because of this if the functionality is used the tank needs to be emptied completely without mixing the water with the treated water in other tanks. After emptying the tank needs to be flushed with treated ballast water (BWMP Fennica, 2021).

IB Polaris

IB Polaris was built in 2016 and is classified for worldwide trade by Lloyd's Register. Polaris has been classified for D-2 standard from construction and has an Auramarine ballast water treatment system installed. Polaris has three ballast pumps: one 100m3/h capacity centrifugal pump to load and discharge ballast water through the installed BWTS and two 250m3/h centrifugal pumps for internal transfer of ballast water (BWMP Polaris, 2015).

3.1 The scope of operations

The present scope of operations in Arctia Icebreaking Ltd. fleet is mostly built around Baltic Sea icebreaking operations and all the icebreakers hold a contract for Baltic Sea icebreaking with the Finnish Transport Infrastructure agency.

The design of the hull of the conventional icebreakers Voima, Urho, Sisu, Otso and Kontio is such that in open water the stability of the icebreakers is violent and in practice these vessels are not suitable for open water operations. This reduces the possibility to use these vessels outside Baltic Sea icebreaking as they need stable sea conditions for transit in open water. In hard weather the icebreakers need to stay in the shelter of the archipelago, transit along the coastline to reduce the impact of the waves or to stay in a stable ice field where there is no effect of waves or swell.

IB Otso has been equipped with a flume tank to reduce the violent movements of the icebreaker. Otso has also been in offshore operations in the east coast of Greenland. Presently IB Otso has not been classified to Polar Code. To achieve the Polar Code certification Otso would require massive investments and changes to its hull and steering machinery.

Multi support vessels Fennica and Nordica have a history of working in offshore operations all over the world. These vessels have been designed for both icebreaking and offshore operations. The vessels are classified by DNV to be Polar Code compliant, and they also have D-2 International Ballast Water Management Certificates. Fennica and Nordica have an icebreaking contract with the FinLinish Transport Infrastructure Agency from January to April.

IB Polaris has been D-2 certified from construction and ready for worldwide traffic. From the classification point of view there is no obstacle that IB Polaris could be in other operations other than Baltic Sea icebreaking. IB Polaris has been mainly designed for Baltic Sea icebreaking. Polaris is also equipped with oil recovery equipment.

3.2 Classification

All the Arctia Icebreaking Ltd icebreakers are classified for worldwide traffic area.

IB Polaris is classified on Lloyd's Register and msv Fennica and msv Nordica are classified on DNV.

The icebreakers built before 1990 were built for the use of the Finnish government agency for the purpose of Baltic Sea icebreaking. After joining the European Union, the Finnish government changed the agency to several state-owned companies. The classification duties of these icebreakers have been taken care by the Finnish Transport and Communications Agency Traficom. A flag state authority is not usually doing the classification of vessels.

The Finnish law regarding ballast water management requirements at present makes it possible for the conventional icebreakers to be excluded from the requirements of the BWM Convention. This exclusion also means that these vessels are not required to have or uphold a Ballast Water Management Certificate, Ballast Water Management Plan nor a Ballast Water Handling Log. This applies to Arctia ice breakers Voima, Urho, Otso and Kontio. Since the icebreakers Voima, Urho, Otso and Kontio do not have the BWTS installed and thus do not comply with the D-2 standard, Traficom adds a restriction for these vessels to the survey certificate. The restriction states that outside of the icebreaking operations the vessels are not to operate outside Finnish waters unless a ballast water management certificate has been issued for the vessel by the flag state authority.

4 Visits to dry docks

The commissioner wished for this study to find out the possibilities on how the vessels exempted from the requirements of the BWM Convention would be able to make single voyages to dry docks in the Baltic Sea area. Of special interest was the Fayard Dry dock in Denmark and the Danish authority was contacted to ask about the requirements and possibilities to make an exemption trip to dry dock. The results of the enquiry were told in chapter 2.3.2.

Generally, a vessel needs to go into a dry dock at least every 5 years. If the vessel is not required to comply with BWM Convention as it is with icebreakers Voima, Urho, Sisu (if it would not be classified for D-2, which at the moment it is), Otso and Kontio they do not need to hold a ballast water management certificate, a ballast water management plan nor do they need to keep a ballast water log book as long as they operate in icebreaking or

transit only in Finnish waters. However, for a single exemption return voyage to a different country they need to have a ballast water management certificate issued by the flag state. The process of applying for an exemption for a single voyage begins with contacting the authorities of the parties of the destination port state and Finnish flag state to inquire about the possibilities for conducting the exemption voyage.

In the following chapters different possibilities for a non-BWM Compliant vessels to do an exemption voyage to a different country in the Baltic Sea are explained.

4.1 Ballast water exchange

The IMO Circular BWM.2/Circ.52/Rev.1 published on 27 July 2017 headlined "Guidance on entry or re-entry of ships into exclusive operation within waters under the jurisdiction of a single Party" provides guidance for the parties to implement a possibility for vessels normally excluded from the application of the Convention to make an entry or re-entry into exclusive operation including ships which operate usually within waters under their jurisdiction, but which may occasionally need to leave these waters and return (e.g. to visit a dry-dock). A ship on a single voyage may be granted an exemption under regulation A-4 on the condition that the ship performs ballast water exchange in accordance with D-1 standard and an approved Ballast Water Management plan. The requirements of regulation A-4.1.4 should be addressed to the satisfaction of the countries of origin and destination of the ship (BWM.2/Circ.52, 2017, p.2). The ballast water exchange can be a bit problematic in the Baltic Sea where the distance to the nearest land is nowhere over 200nm nor the depths is 200m which is recommended by the D-1. Also, it has been agreed with the HELCOM countries that D-1 ballast water exchange should not be performed anywhere in the Baltic Sea because most of the alien species in the Baltic Sea have a wide tolerance in salinity (HELCOM, 2014, p.22). In the Baltic Sea there are no designated ballast water exchange areas. Because of this and because of the HELCOM agreement the ballast water exchange is not possible in the voyages between ports in the Baltic Sea.

One way of looking at this conflict is that with the IMO Circular BWM.2/Circ.52/Rev.1 IMO has expressed that they want to find a way to make a single dry dock trip for a non BWM Convention compliant vessel possible but in Baltic Sea the HELCOM agreement prevents the possibility of ballast water exchange.

4.2 The JHP/A-4 exemption method

The JHP/A-4 risk assessment method can be used but this requires that an application including port surveys should be made in a way described in the JHP and preparing a risk assessment describing the biological and environmental risks included in the intended passage. The port survey needs to be of a robust scientific quality for the satisfaction of the authority. According to the Finnish Maritime authority Ville-Veikko Intovuori of Traficom it is pretty much only governmental organizations that have the scientifically qualified personnel to conduct these port surveys at the moment. In Finland the only organization that has done the port surveys is the Finnish Environmental institute and they have a handful of qualified biologists able to conduct a proper port survey. The cost of a port survey begins from 20000€ for a single port. The time frame to conduct a port survey takes at least 6 months from spring to the end of the summer when the algae is blooming in order to get scientifically adequate results in a port area. If a private ship-owner company wishes to take on the route of port sampling and preparing a risk assessment for the intended voyage between two or more ports a governmental organization should be contacted to do the survey and to prepare the risk assessment. The survey and the risk assessment can lead to considerations and terms with the authorities granting the exemption on how the exemption could be possible and these terms could be cost inducing. There is also a possibility that the exemption is not granted, and this would result in losing the funds invested in port surveys. With the exemptions in a voyage between ports there is also a possibility of an outside effect for the environment that alters the circumstances in such a way that the facts that have granted the exemption are no longer valid and the exemption is withdrawn. The exemption application needs to be renewed thoroughly every 5 years by doing new port surveys and an intermediate assessment of circumstances needs to be done during the duration of a 5-year exemption.

In an article concentrating on JHP exemption method "*Exceptions and exemptions under the ballast water management convention – Sustainable alternative for ballast water management?"* concludes that exceptions and exemptions should not be considered as alternatives to ballast water management (Outinen et al., 2021).

4.3 Installation of a Ballast Water Treatment System

If Arctia Icebreaking Ltd. decides to install ballast water treatment systems on the rest of their vessels even though they are generally exempted from BWM Convention compliance to make it easier to make trips to dry docks, the flag state authority Traficom should be contacted from an early stage to consult on the procedure for installation of the Ballast Water Treatment System. A retrofit installation of a BWTS is more complicated and expensive than planning a BWTS on a new vessel. The retrofit installation of BWTS for Fennica, Nordica and Sisu has cost a few hundred thousand euros per vessel on average. There is a lot of work to be done in a retrofit installation of a BWMS including planning, technical installation, preparation of manuals and classification of the system including commissioning sampling to verify the D-2 standard compliance of the BWMS installation. Generally, when the BWTS is installed, and the D-2 standard is attained the vessel should no longer be able to discharge any untreated non-D-2 compliant water. The installation of the BWMS needs to be classified by the administration and its use needs to be described in the vessel specific ballast water management plan. Traficom can delegate the classification duties to a recognized organization to classify the installation of a BWTS for a vessel. There is no strict rule that a BWTS should correspond to the ballast water pump capacity. There are solutions on vessels with a smaller pump to load and discharge ballast water through a BWTS and at the same time there are more efficient pumps installed to circulate the ballast water from tank to tank internally. An installed BWTS treatment capacity should reflect the flow rate of the ballast water pump to be used for load and discharge of the ballast water (MEPC.300(72) 2018 p. 19). According to Traficom's Ville-Veikko Intovuori, a BWTS using UV filtration technology is at the moment best suited for Baltic Sea operation.

The icebreaker Voima has a simple ballast water system with a single ballast pump that is able to load and discharge ballast water to and from all of the ballast water tanks. If a BWTS would be installed it could be installed to the pipeline after the ballast pump. On the icebreaker Voima ballast water is used in such a way that before departing for an icebreaking operation the ballast water is loaded into tanks and after the icebreaking season the ballast water is discharged (BWMP Voima, 2017).

Icebreaker Urho has the same ballast water tank and pipeline setup as icebreaker Sisu, and if the BWTS is be installed to IB Urho the plan from IB Sisu can be used. In addition to the main ballast water pump with the capacity of 1000m3/h Urho also has a bilge pump with capacity of 100m3/h. The possibility to install the BWTS for D-2 compliance in conjunction with the smaller capacity pump should be considered if the BWTS is installed (BWMP Urho, 2017).

Icebreakers Otso and Kontio have a common ballast pump in the pipeline that is able to fill all of the ballast water tanks. A ballast water treatment system could be installed in conjunction with this common ballast pump to the pipeline. However, both vessels also have two separate pipelines with separate trim pumps forward and aft that are able to pump water from the sea water well to forward and aft peaks and the listing tanks forward and aft. The trim pumps serve a purpose of filling and emptying water quickly to forward and aft in order to adjust the trim. If a BWTS was installed in conjunction with the ballast pump, then the use of a trim pump would be an illegal BWTS bypass condition causing a non-D-2 compliant contamination in a ballast tank (BWMP Otso, 2015). A possibility could be to use the BWTS in a D-2 compliant mode only outside icebreaking operations when the vessel is non BWM Convention compliant. Outside of icebreaking operation the functionality of the trim pumps could be sealed, and full D-2 BWM Convention compliance could be attained with the BWMS installed in conjunction with the ballast pump. This kind of a dual operation mode when taking advantage of the exemption of BWM Convention compliance during icebreaking and then changing the operation status to D-2 compliance with an installed BWTS outside of an icebreaking operation when exiting Finnish EEZ is possible according to Ville-Veikko Intovuori. There is however a problem with this approach. This problem is that the ballast tanks and the pipelines should be thoroughly cleaned in a way that there is no possibility that contaminated non-D-2 standard water contaminates the treated D-2 standard water when changing the operating status from exempted icebreaking operation to D-2 compliant operation. This was very important when I was getting the Ballast Water Management Plans for msv Fennica and msv Nordica classified by DNV because of the BWTS bypass possibilities described in Chapter 3. If the water and the sediments are not cleaned thoroughly before changing the status to D-2 standard compliant, there will be contamination to the ballast water in the form of regrowth in ballast tanks. There is an article warning about the growth in ballast tanks even

though the water has been treated during the loading of the ballast water. According to the article, regrowth occurs in ballast tanks with treated water and depending on the length of the voyage only a few surviving organisms can cause the discharged water to exceed the D-2 discharge standard when deballasting (Grob & Pollet, 2016). If the before mentioned dual operation approach is chosen, this should be described in the ballast water management plan. The possibility to do this is confirmed with the Finnish Maritime Authority Ville-Veikko Intovuori.

The effort and the cost of installing a BWTS to a BWM Convention exempted vessel only for the purpose of making it possible to visit a dry dock outside Finnish waters every 5 years is in my opinion not worth the cost or effort.

According to the Resolution MEPC.325(75) new installations of ballast water treatment systems require a commissioning test if they are installed after June 1, 2022. According to the DNV web page, the commissioning test requires samples to be taken from the discharged ballast water that are then inspected in a laboratory to verify that the discharged water meets the D-2 requirements. (DNV, n.d.)

The D-2 compliance of discharged water is sometimes subject to sampling in Port State Control inspections. According to a few articles some ballast water treatment systems are struggling with D-2 compliance in testing, and concerns are rising that present and future ballast water treatment systems will not always comply with D-2 regulations (Outinen & Lehtiniemi, 2019); (Wright 2021).

4.4 Port Reception Facilities

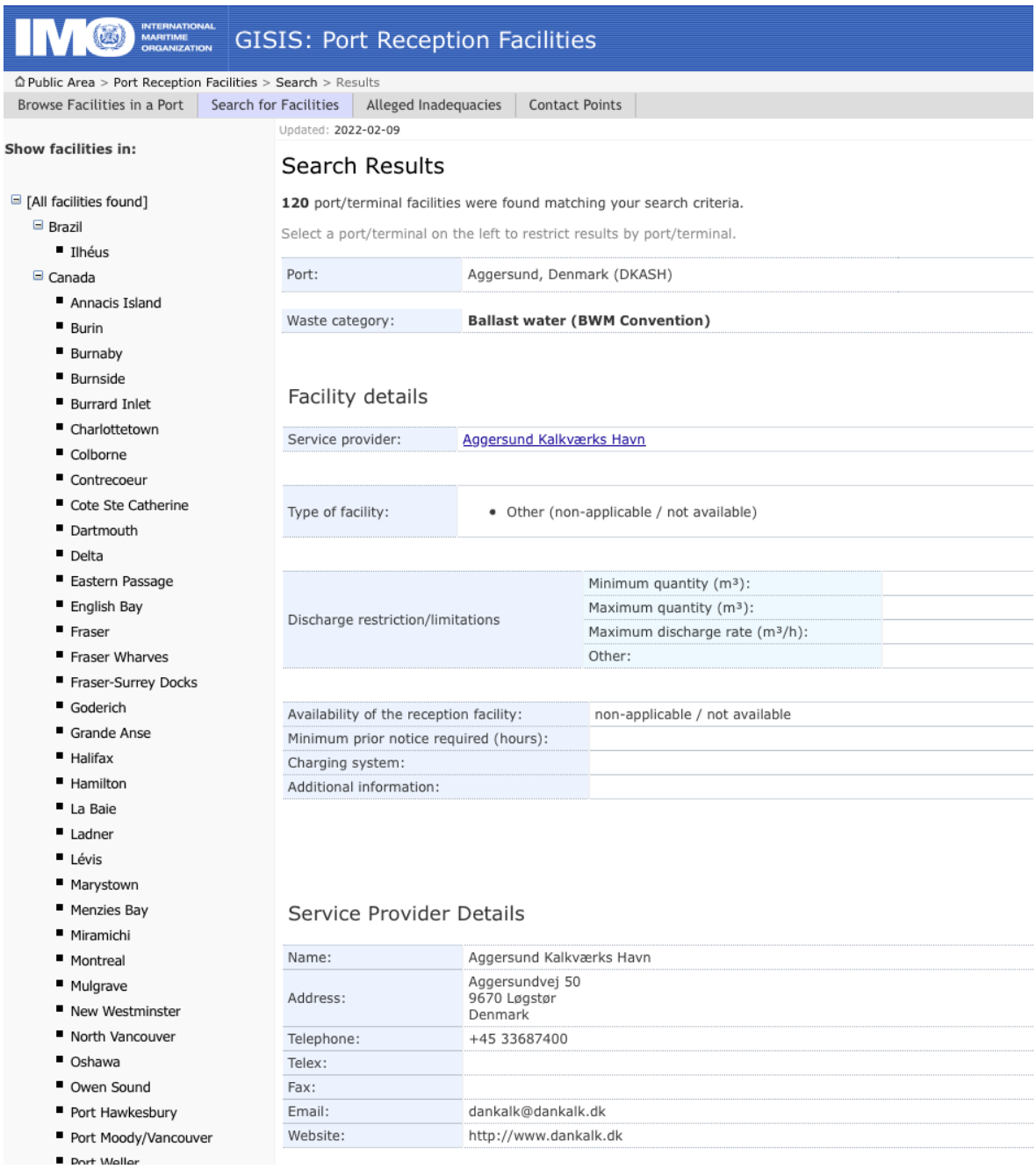
The pumping of the ballast water to a port facility is in compliance with the BWM Convention Regulation B-3.6 and an approved method by the port state authorities. This possibility might prove to be the most feasible, simple and the most certain method to acquire an approved ballast water management certificate for a single voyage return trip to a dry dock in another country. The benefit of this method is the simplicity, and the cost of pumping ballast water ashore is not very big. Also, when dry docking the ballast water tanks are emptied from ballast water and sediments completely in order to assess the condition of the tanks. The biggest problem with this is that the port facility needs to have the capacity to receive the ballast water. In other words, the port facility needs to have a

port reception facility for receiving ballast water. One consideration for this method is that the vessel must be able to pump the ballast water from its ballast tanks to a reception facility so a pipeline needs to be installed for the connection to port reception facility.

According to Article 5 of the BWM Convention, the contracting parties must ensure that in port and terminals where cleaning or repair of ballast tanks occur, adequate facilities are provided for the reception of sediments (BWMC, 2004, p.5). This automatically includes dry docks where ballast water tank repairs are made. There is no similar requirement to be found in the BWM Convention for Ballast Water reception facilities. This is a bit of a problem for vessels wishing to use a ballast water reception facility to pump the ballast ashore according to Regulation B-3.6 because these facilities are not very common.

There is a database of approved port reception facilities in the IMO Global Integrated Shipping Information System (GISIS). It is a web page with the ability to locate port facilities services by conducting a search on the page. According to Ville-Veikko Intovuori, the GISIS portal is not necessarily up to date as countries are not updating the portal very conscientiously. Therefore, if planning for a visit to a port state, the port personnel or the authorities of the port state should be contacted to make sure if the discharge of the ballast water in compliance with the BWM Convention can be arranged through a port reception facility for ballast water.

I performed a search on the GISIS web site on waste category of “Ballast Water BWM Convention”. This should mean that there is a port reception facility able to receive untreated ballast water. I received 120 results in 13 countries. 24 were in Denmark but none in Finland. See picture 4.



Picture 4. A screenshot of the GISIS web page (GISIS, n.d.)

If the company wishes to choose to pump the ballast and the sediments ashore to a reception facility and to apply for a Ballast Water Management certificate for a single trip, the authorities of both countries should be contacted in order to arrange the pumping of the ballast water and the sediments to a port facility to the satisfaction of both authorities.

One recommended possibility is to invest in a type approved transportable port reception facility through which the ballast water could be pumped to shore. There are some facilities on the market the size of a container that could be transported to and used in the port of

destination to remove the ballast water from the tanks. The technology is the same as in BWTS units installed on board vessels and the minimum requirement for type approval of such devices is the D-2 standard. The information of the acquired transportable port reception facility could then be uploaded to the GISIS database and the service could be sold to others when not in own use.

There is a study conducted by a consortium of Danish Ship Owners' Association, Maers A/S, DSDF A/S and Danish Ports titled "Ballast Water Treatment in Ports. Feasibility Study" published in 2012 by Danish Naturstyrelsen. According to the study, the use of transportable ballast water reception facilities is a feasible option from the technical and operational point of view to manage the ballast water about to be discharged in the port. The study mentions that the use of a ballast water reception facility needs to be approved by the port state environmental authorities as the disposal of treated ballast water to be pumped into the sea needs to be approved and the filter residue from the backflushing of the filter needs to be collected and disposed of in an appropriate and approved manner (A consortium of Danish Ship Owners' Association et.al., 2012).

4.5 Other possibilities

According to Regulation 3.7 of the BWM Convention, other methods of ballast water management may also be accepted as long as those methods ensure at least the same level of protection for the environment as it is described to acquire the objective of the BWM Convention (BWMC 2004, p.19).

Before other methods for a return trip to dry dock are considered, the port state authorities should be consulted on what is acceptable to them. These terms should then be met and described in the Ballast Water Management Plan used to apply for a Ballast Water Management Certificate from the flag state authority.

These other possibilities could include, for example, a thorough washing of all of the ballast water tanks in Finland and filling the tanks with potable water for the voyage to the destination port. Then the potable water could be discharged in the destination port normally. Approval for this method should be confirmed with the environmental authorities of the destination port state.

One other possibility is to embark on the dry dock voyage without any ballast water to be discharged in the port of destination if the stability of the vessel allows it.

5 Amendments to the manuals

The icebreakers Voima, Urho, Otso and Kontio hold ballast water management plans prepared and approved by the flag state for D-1 ballast water exchange. While in operation only in Finnish waters and while providing ice breaking services for the Finnish Transport Agency, the vessels are exempted from BWM Convention requirements. This means that they do not need to have a ballast water management certificate, a ballast water management plan nor a ballast water record book.

If planning a visit to a dry dock outside of Finnish waters, a vessel needs to comply with the BWM Convention. A ballast water management certificate needs to be applied for from the flag state authority Traficom for a single return trip. The ballast water management plan with which the ballast water management certificate is applied needs to include the required information about the planned method of ballast water management for the single return voyage, for example, pumping ballast water to a reception facility according to Regulation B-3.6 of the BWM Convention. For the single trip, also the ballast water record book needs to be used.

The company environmental manual should be updated to include a section where the requirements that concern ballast water management are described.

6 Conclusion

At the beginning of this investigation regarding the feasibility of ballast water management possibilities on Arctia Icebreaking Ltd icebreakers, there was a lot of confusion and uncertainty about the issue among the vessels' operating crews and the office personnel. It was not very well known within the company what possibilities for the implementation of the Ballast Water Management are feasible and what the requirements of the fleet are. For this study I have gathered the essential information that provides the background information and answers to those questions.

According to the Finnish law the icebreakers that have been built before year 1990 and provide icebreaking services for the Finnish Transport Infrastructure Agency with a contract do not need to comply with the BWM Convention requirements. This answers the first research question about if the icebreakers need to comply with the Ballast Water Management Convention requirements and why.

The answer to the second research question about how this affects the operation of the non-compliant vessels is that the icebreakers Voima, Urho, Otso and Kontio, that are not required to be compliant with the BWM Convention by the Finnish law, are allowed to conduct icebreaking operations in Finnish and Swedish waters during icebreaking operations. If a non-BWM Convention compliant icebreaker should enter Estonian or Russian waters for icebreaking operations, an agreement needs to be reached with the environmental authorities of Estonia and Russia.

Outside the icebreaking operations the non-BWM Convention compliant vessels are not allowed to leave Finnish waters without a Ballast Water Management Certificate issued by the flag state. These vessels will have this restriction written in the classification certificate. The non-compliant vessels do not need to have a ballast water management plan, a ballast water logbook or a ballast water management certificate.

The vessels that are ready for worldwide operations, Fennica and Nordica, are equipped with ballast water treatment systems and are classified for D-2 standard of ballast water management. The icebreakers Sisu and Polaris hold a D-2 Ballast Water Management Certificate and they should operate according to their ballast water management plans.

The answer to the third research question on “How can a non-Ballast Water Management Convention compliant icebreaker make a trip to a dry dock in a different country?” is twofold:

1. One option is to install a type approved ballast water treatment system and apply for certification of the D-2 BWM Convention compliance or,

2. The other option is to apply for an exemption for a single voyage in another Baltic Sea country.

For visits to dry docks in other Baltic Sea countries there is no point in installing retrofit ballast water treatment systems for the conventional icebreakers Voima, Urho, Otso and Kontio as they are exempted from the regulations of the BWM Convention by Finnish law while operating only in Finnish waters and while providing icebreaking services for the Finnish Transport Infrastructure Agency because a retrofit installation is very expensive compared to the operational benefit of undertaking voyages to dry docks only every 5 years.

An exemption application for a single trip to a dry dock in another Baltic Sea Coastal state for BWM Convention exempted vessels is a viable option but the application process needs to begin well in advance, and the flag state and the destination port authorities need to be consulted for support. The BWM Convention exempted vessels need to apply for a Ballast water management certificate for a single return trip from the flag state, and the ballast water management plan for the trip needs to explain the compliance of the BWM Convention on the voyage and in the destination port state. Furthermore, the destination port state authorities need to be consulted beforehand to find the solution that is in compliance with the BWM Convention.

Ballast water exchange, according to the D-1 standard, is not an option in the Baltic Sea voyages because it is forbidden by the HELCOM countries agreement.

Choosing the HELCOM JHP method by doing the port surveys and the risk assessment for an exemption trip consumes a lot of work, time and money with an uncertain outcome.

Discharging the ballast water to a port reception facility is accepted and is in compliance with the BWM Convention. This is because at the dry dock all the ballast water is usually emptied from all the ballast water tanks and the sediments are removed. The problem with the port reception facilities is that they are not very common in ports.

One possibility for Arctia Icebreaking Ltd. is to purchase a transportable port reception facility to be used during the dry dock visits to other countries. When not in own use, the port reception facility service could be sold to other vessels.

Other possibilities for a single trip voyage to dry dock in other Baltic Sea countries need to be consulted with destination port state environmental authorities. As the compliance with the BWM convention is technology free and the regulations and the technology are

evolving all the time, this study explains the status of the situation during the time of writing. Further study about the subject could include studying the feasibility of the presented options in practice. Also, it is important to stay updated on the information about latest technologies and solutions that could make ballast water management on icebreakers more convenient.

The results of the study, I believe will be of assistance for the office personnel and the operating crew to resolve any uncertainties around this issue.

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