The Polar Code: Gap analysis for protection of marine environment and Arctic safety

Captain / Mohamed ESSALLAMY

Arab Academy for Science, Technology and Maritime Transport

Maritime Safety Institute

Egypt
Abstract:

The polar pristine regions particularly the Arctic Ocean “the future Mediterranean” are economically and trading promising areas. The Arctic Ocean shipping routes attract shipping companies to transit surplus of cargo between east and west, for the shorter distance than other routes. The regions need to be regulated for environmental and safety related issues, should they are used for international trade.

New propulsion innovations in mild ice allow longer navigation periods per year along the routes without ice breakers escort. Therefore, the operating cost would be reduced to optimum levels compared to other famous competitors trading routes.

The International Maritime Organization, IMO has showed great concern in building a draft Polar Code to regulate safety and environment protection related issues. Both the Arctic and Antarctic were targeted by the application of the Polar Code. After long periods of being forgotten by international standards, the Arctic is finally about to apply a unified Code.

However, there are some vague rules that need to be clarified in the draft Code. For instance, the Code ignores a large portion of the Arctic Circle, perhaps based on the supposedly ‘ice-free’ polar waters that need to be clarified. Furthermore, the Code neglected some of MARPOL\(^1\) annexes that need to be clarified or regulated. The Code should consider ballast water management and environment protection from TBT paints, *inter alia*.

Moreover, the Code implies some communication difficulties above certain latitudes and states that other systems than GMDSS\(^2\) may be more efficient. Finally, manning and training in addition to thermal protection and safety equipment requirements are found insufficient and vague. Consequently, IMO’s other conventions would be reviewed and amended on affect.

The research targets analyzing the need to fully cover the Arctic Circle; it reviews the Code regulations in order to show some observations to enlighten readers and decision makers for better environment and safety of the Arctic region.

Key words: Arctic routes/Circle, communication, ship design and propulsion, safety, environment protection, Polar Code.

\(^1\) The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol relating thereto (MARPOL 73/78)

\(^2\) Global Maritime Safety and Distress Systems
About the author:

The author is a master mariner served on board many types of merchant ships since 1991 in almost all of trading routes. In addition to oil tankers and high speed passenger craft, he commanded general/ RORO cargo, and bulk carriers. Since 2001, he moved to teaching maritime safety management subjects in the Maritime Safety Institute, MSI of the Arab Academy for Science, Technology and Maritime Transport, AASTMT in his home city Alexandria, Egypt. He also acted as marine safety consultant for some shipping companies and marine operation manager for another.

He received his basic studies in maritime transport collage of the AASTMT, and his MSc. dissertation was awarded for the best thesis in the World Maritime University in 2008, based on which the Polar Code and SOLAS³ chapter XIV were referred. Before the IMO, his dissertation topic studied creation of environmental and safety related international maritime regulation along shipping Routes in the Arctic Ocean. Subject of his award, he successfully passed two diplomas in marine surveying from the Lloyds’ Maritime Academy with merit and distinction in 2009 in ISM⁴ survey, and in 2012 in warranty survey including MODUs⁵.

Between the period 2009 and 2013 he served as a dean assistant for education and management representative in the maritime safety institute. Currently, he is a senior lecturer in the safety management systems division of the same institute.

---

³ International Convention for the Safety of Life at Sea (SOLAS), 1974
⁴ International safety Management Code
⁵ Mobile Offshore Drilling Units
Introduction:

Hidden on the top of Earth, far away from noise and crowds lies a pristine area that has been referred to as the future Mediterranean, the Arctic is commonly defined as the area north of the Arctic Circle of latitude 66°32'N (14), that includes the area of the midnight sun. (18) The Arctic Ocean is one of the most affected areas of climate change. Warming up caused melting of the sea ice there has awakened the dream of transshipment across the Arctic Ocean Routes as they may significantly reduce the trip distance between East and West. Accordingly, there will be safety and environmental consequences of the increased shipping traffic in the area. Unlike most of the shipping routes, the Arctic Ocean is barely covered by international environmental instruments (14), (7).

Finally, after ages of being forgotten by international maritime regulations, the IMO’s 6 Committees considered initiation of Polar Code; SOLAS and MARPOL conventions would also be amended for the same purpose. However, there are some observations to be taken into considerations while initiating and applying the Code, in Jan. 2016.

The Polar Code is being developed to provide standard guidelines for ships operating in ice-covered or ice-infested waters in high latitudes, with a consideration on appropriate ship design “polar ship”, proper training for “polar officers”, and environmentally navigation scope. With the escalation of the use of the Arctic routes, its goal is to reduce the risks within shipping adventures in icy conditions. (4)

The Arctic Routes contain the Northern sea routes (internal Russian route) and the north east passage (international law), *Inter alia*. (12)

The Arctic Circle definition and research problem:

To begin with the limitation of the application, the Polar Code figures the polar areas, as shown in figure 1, the Antarctic as a complete circle southern of the latitude 60° South, while figure 2 shows the Arctic Circle after deducting a large portion of the Norwegian and Barents seas for no specified reason, perhaps claimed so for the worm north Atlantic drift that allows ice free waters for year round. The Code also depends on a newly applied definition in both SOLAS and MARPOL conventions that were put for the purpose of application of this Code.

---

6 International Maritime Organization, London, UK
Figure 1: Maximum extent of Antarctic area application

Figure 2: Maximum extent of Arctic waters Application

Source: IMO Polar Code (11)

The area ignored by the Code, as shown in figure 3, carries a great shipping and trade importance. Excluding the areas northern of 66° and 32’ north would exempt in/out shipping traffic of important ports in Russia e.g. Murmansk\(^7\) 68.9667° N, 33.0833° E and 9 ports of northern coast of Norway, *inter alia*, subject of this research.

Figure 3: Focus on the avoided area of the Norwegian and Barents seas in the Arctic Circle.

Source: IMO Polar Code (11)

The Arctic region is commonly known to include parts of Canada, Greenland, Russia, the United States (Alaska), Iceland, Norway, Sweden, and Finland, or in other words the Arctic 8 states. Only five nations i.e. Russia, Canada, Denmark, Norway and the United States are having coasts on the Arctic seas. (18) Iceland may be also considered in many publications among these. The figure below shows that Iceland north coast is just touching the Arctic Circle. (4)

Figure 4 also shows the actual Arctic Circle that when compared to the Polar Code (figure 2 and 3) found neglecting a large portion of Russian, Norwegian and Iceland coasts. “The Polar Code

\(^{7}\) Murmansk, a Russian port is on the Barents sea that was excluded from the application of the Code.
has been developed on a risk-based approach in determining scope and to adopt a holistic approach in reducing identified risks”. (11) Leaving such portion out of the scope of the Polar Code would result in a safety breach and threat to the environment.

The UN defined the Arctic as the area north of the Arctic Circle (66°32’N), which includes the area of the midnight sun. This definition gives an Arctic region of 33 million km², which is larger than Africa or Asia. The marine boundary of the Arctic is formed from melting ice covers i.e. 20 million km², eight times the area of the Mediterranean Sea. (18)

A report by the USA congress describes the Arctic as: the land and sea area north of the Arctic Circle (a circle of latitude at about 66.34° North). The sun is generally above the horizon for 24 continuous hours at least once per year, and below the horizon for 24 continuous hours at least once per year, (20) as shown in figure 4 above.

Another different Arctic definition states that the Arctic is the region within the Arctic Circle, the line of latitude that runs 66° 33’ 44” N (or 66.5622°N), *inter alia*. (23)
In contrast, Jasmin Sinclair includes Iceland, and northern coast of Norway in the Arctic Circle, as per figure 5. (22)

![Figure 5: Iceland, northern coast line of Norway and Russian coast included in the Arctic Circle](image)

Source: Jasmin Sinclair, 2014

To sum up, however, there might be a doubt defining exact Arctic Circle, most of the definitions go with the full circle of 66°32′N of the equator, with no deduction.

**The importance of Arctic Circle “Arctic Region” – Norwegian and Barents seas:**

In addition to the high environmental concerns, the Arctic region carries great commercial values for the minerals, hydrocarbons and fishing in addition to shorter shipping routing between east and west. However, the Arctic Circle represents only about 6% of the Earth’s surface area, but it could account for about 20% of the world’s undiscovered hydrocarbon resources, but recoverable. However, resources in the Arctic has been known for decades, but only in recent years has the opening to full-scale resource development and navigation become technically and economically feasible. (3)

Non-ice class ships are allowed to sail within the Arctic ocean in 2013; figure 6 illustrates more than 40% of permissions had been issued for non-ice class vessels, and 27% of vessels were designed to operate in Non-Arctic ice conditions. Almost half of the ships carried liquid cargo, carrying more than 67% of their volume capacities for restricted drafts and their large size. (16) Non-ice large size ships in restricted depths means high opportunity of accident occurrence and severe consequences that need special precautions and strict rules, which would be applicable by applying the Polar Code for the whole Arctic Circle.
Figure 6: Share of vessels with different Ice Classes, which got permission to navigate in Northern Sea Route waters in 2013

Source: Nataliya Marchenko, 2014

Safety and Environmental Concerns:

Recalling the Titanic and Exxon Valdez cases, contacting with ice and cold water may affect hull structure, ship’s stability and integrity, machinery systems, navigation, human performance, maintenance and emergency preparedness on board, and may cause topside icing and accumulation of ice on deck, which may cause potential reduction of stability. Survival time and performance of safety equipment and systems are significantly affected by low temperatures. Extended periods of darkness or daylight affect navigation. Furthermore, remoteness and possible lack of accurate and complete shore assistance and coverage compounded by remoteness of SAR facilities, including delays in response and limited communications capabilities may make a ship’s trouble worse. (11) Therefore, all ships operating within the full Arctic Circle ‘with no deduction’ should be better treated as polar ships.

Operational and Accidental Marine Pollutions:

Daily operation of ship may result in production of many pollutant types, if directly released to the environment e.g. waste oil, sewage. Ships, MODUs and other marine installations cause around 20% of marine pollution. (17) MARPOL regulates the disposal of these pollutant substances at sea on certain distances from shore or via certain equipment such as discharge monitor. Failure to regulate certain area with such environmental fragility such as the ‘full’ Arctic Circle with such regulation would be considered a backward step.

Ships accidents such as grounding, sinking and collision could have serious effects on marine environment and on economy. The great increase in ships using the Arctic Routes and region bring a need for more incisive environmental emergency response capability. (17) Application of the Polar Code on full Arctic Circle increases safety and environmental protection. On effect
reception facilities would be available for ship to dispose its waste, emergencies response team would be available to react on spillage and other emergencies.

Economic aspects and region importance:

The area of study contains a very high economical value. The current and potential shipping in the northern coasts of Russia and Norway are of great importance; large quantities of cargo are shipped not only along the Arctic Routes but also to other EU, Canada and USA neighboring countries. Iceland is also undergoing pursuit research to create hub ports for transshipment of cargo.

Russia:

Russian seaports witnessed significant increase of more than 30% in the cargo turnover in 11 years study (1999-2010). In 2010, the cargo turnover was 526 million tons, versus 162 million tons in 1999. In particular, Northwest region seaports on Baltic and Barents seas, took the leading position in the Russian ports cargo turnover, (1) ‘which shows the importance of regulating the shipping traffic under a suitable regime e.g. the Polar Code.’ In 2010 alone, the North-western seaports, particularly Murmansk, transshipped 228 million tons of cargo or 43% of the Russian seaports freight turnover. Furthermore, Murmansk alone handled 25 million tons of cargo and the total freight turnover operations amounted 33 million tons.’ (1) Moreover, a quit big fleet can carry many types of cargo, Murmanrsk Shipping Company owned in 2014 more than 300 ships of different types. (12)

Murmansk is better alternative for transatlantic shipping, due to Panamax size limitations of other ports. Murmansk monthly volumes varied from around 900,000 tons in February as lowest to around 1.7 million tons in July as highest. 87% of the westwards transit shipments departed from Murmansk, (1) that shows how high a shipping traffic that need to be covered within Arctic Circle and Polar Code requirements.

Shipping activates in the wealthy region:

The Arctic and sub-Arctic regions nowadays produce 98% of Russia’s diamonds and 90% of its oil, gas, nickel and platinum output. The Arctic Routes will be most interesting to the shipping owners and operators transporting LNG with tankers that might be cheaper than laying a pipeline in the difficult Arctic landscape. (2) The Norwegian and Barents seas contain gas, inter alia. In 2020, Russia can produce 50 million tons of LNG some of which is out of the Barents Sea. (1) Russia inherited 46,000 km of these crude oil pipelines, 15,000 km of petroleum product pipelines, and 152,000 km of natural gas pipelines. New pipelines are built to Murmansk, inter alia, (6) most of which would be used for transatlantic trade out of the scope of the Polar Code, if not modified to cover the full Arctic Circle.

In 2010, Russia and China had the largest production expansion with 20.6% of the world output of nickel; Norilsk Nickel's vessels made 54 voyages, 12 direct voyages to European ports and only one to South-East Asia. In 2010, terminals in Murmansk, handled 10 Norilsk Nickel's ships. (1)
Murmansk region is one of Russia's most important sources of economic minerals, e.g. iron, copper-nickel, other non-ferrous and rare metals, e.g. phosphates, mica, clays. Furthermore, in 2010, Russia, the second largest producer in the world, manufactured 3,850,000 tons of aluminum, constituting 9.3% of the global production. 76,000 tons of aluminum annually exported over the ports of Murmansk. (1)

Furthermore, Russia is by far the world's largest log exporter, Murmansk is potential for exporting timber; the Republic of Karelia in Northwest Russia is another large wood processing region where seaports at the White Sea in northeast. Moreover, the Russian North contributes to 22% of the country's fisheries. The Arctic Russian fishing fleet is doing commercial fishing in the Barents Sea, Norwegian Sea, _inter alia_. 21 Murmansk based companies catch 60% of the Russian’s catches in the Barents Sea. (1)

**Transatlantic or west bound trade:**

Rotterdam in 2011 received most of Russian petroleum products shipped from the North with 36% of all vessels, Amsterdam comes next (17%), followed by Houston on the gulf of Mexico (6%). About 4 million tons of crude oil, 3 million tons of gas, 3 million tons of petroleum products, and 2 million tons of heavy fuel oil were sent westwards during the same year, from Russian ports in the Barents seas, _inter alia_. (1)

Finally, table 1 shows the structure of freight turnover in Russian Western Arctic ports, where Murmansk shares with the highest of cargo quantities, in all types of criteria of comparison, giving good chance to trade out of the scope of the Polar Code.

**Table 1: Structure of freight turnover in the Russian Western Arctic ports in 2010, in thousand tons**

<table>
<thead>
<tr>
<th>Ports</th>
<th>Turnover</th>
<th>Dry cargoes</th>
<th>Liquid cargoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dudinka</td>
<td>1092.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varandey</td>
<td>751.02</td>
<td>45.6</td>
<td>7464.6</td>
</tr>
<tr>
<td>Naryan-Mar</td>
<td>103.1</td>
<td>70.7</td>
<td>32.4</td>
</tr>
<tr>
<td>Mezen'</td>
<td>23.2</td>
<td>13.4</td>
<td>9.8</td>
</tr>
<tr>
<td>Arkhangelsk</td>
<td>3667.1</td>
<td>2241.4</td>
<td>14257.7</td>
</tr>
<tr>
<td>Onega</td>
<td>65.3</td>
<td>58.9</td>
<td>6.4</td>
</tr>
<tr>
<td>Vitino</td>
<td>4376.1</td>
<td>-</td>
<td>4376.1</td>
</tr>
<tr>
<td>Kandalakha</td>
<td>862.6</td>
<td>-</td>
<td>862.6</td>
</tr>
<tr>
<td>Murmansk</td>
<td>32809.2</td>
<td>15172.5</td>
<td>176367.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50509.4</strong></td>
<td><strong>18695.1</strong></td>
<td><strong>31814.3</strong></td>
</tr>
</tbody>
</table>

Source: Akvaplan-niva AS & Clients, 2012

The above mentioned trade is not only with Far East countries but also with American and some other EU countries. In case of transatlantic or west bound trade, the Code would not apply; the Polar Code should be applied by including of the full Arctic Circle within the Code.

**Norway:**

The Norwegian government has defined 31 ports as national hubs. Only 9 of the national hub ports are located in north Norway, (1), on the Norwegian sea, the area of this research.
These potential 9 hub ports would be able to host and develop a maritime trading particularly transit cargo from Russia to Arctic Routes and transatlantic. Especially, as per table 2, Hammerfest among the 9 ports is seen to have the vast majority of the trade. That may be seen as a good reason for targeting this important area by safety and environmental protection regulations under the Code.

Table 2: Navigation and traffic at hub ports in north Norway

<table>
<thead>
<tr>
<th>Ports</th>
<th>Sailing depth (m)</th>
<th>Anchoring</th>
<th>Access to space onshore</th>
<th>Traffic development (loaded/offloaded tons)</th>
<th>Changes %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28</td>
<td>20</td>
<td></td>
<td>2004</td>
<td>2010</td>
</tr>
<tr>
<td>Mo i Rana</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>3 648 194</td>
<td>3 418 173</td>
</tr>
<tr>
<td>Bodø</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>661 157</td>
<td>827 645</td>
</tr>
<tr>
<td>Narvik</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>15 586 790</td>
<td>17 583 344</td>
</tr>
<tr>
<td>Harstad</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>473 169</td>
<td>411 779</td>
</tr>
<tr>
<td>Tromsø</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>767 082</td>
<td>1 181 763</td>
</tr>
<tr>
<td>Alta</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>701 000</td>
<td>600 000</td>
</tr>
<tr>
<td>Hammerfest</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>535 131</td>
<td>10 212 835</td>
</tr>
<tr>
<td>Honningsvåg</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>204 832</td>
<td>102 600</td>
</tr>
<tr>
<td>Kirkenes</td>
<td>+</td>
<td>+</td>
<td>Good</td>
<td>94 842</td>
<td>1 662 169</td>
</tr>
</tbody>
</table>

Source: Akvaplan-niva AS & Clients, 2012

Figure 7 shows Hammerfest and Kirkenes location and a large portion of the Arctic Circle that contains important ports in Russia and Norway.

Figure 7: Full Arctic Circle that contains Murmansk and 9 important Norwegian ports e.g. Hammerfest

Source: HANS JØRGEN WETLESEN AND ØYSTEIN RØ. 2006

Some other countries in the region have interests to reach the northern most Norwegian ports by construction of a railroad from Rovaniemi in Finland. (1)

The Arctic Bridge:

Figure 8 shows a new trend of understanding of the emerging European northernmost shipping traffic areas. Apart from Middle East oil and gas, resources found in Barents Sea could become Europe’s most important petroleum source. Small Norwegian city like Kirkenes finds itself in the
midst of this super region. The Arctic Bridge links the Russian port of Murmansk or the Norwegian port of Narvik to the Canadian port of Churchill that could be used for many types of trade. (8) This Bridge increases the possibility of the avoided research area use, which escalates probability of risk in shipping operation in such region.

Apart from Middle East oil and gas, resources found in Barents Sea could become Europe’s most important petroleum source. Small Norwegian city like Kirkenes finds itself in the midst of this super region. The Arctic Bridge links the Russian port of Murmansk or the Norwegian port of Narvik to the Canadian port of Churchill that could be used for many types of trade. (8) This Bridge increases the possibility of the avoided research area use, which escalates probability of risk in shipping operation in such region.

Figure 8: The Geography of Transport Systems along the Arctic

Source: Jean-Paul Rodrigue, 2015 (13)

Iceland:

Iceland also has introduced promising research on hub market, (17) along the Arctic Bridge. Iceland (65.0000° N, 18.0000° W) is an Arctic country and they have hopes to benefit from the emerging shipping traffic in the region, effective port side on the Arctic Bridge and possibilities to use its ports as hub for cargo transit in both ways.
The deep fjords ‘sea passages’ in East Iceland, together is ideal for such activities, which could equally serve as a transshipment hub for transatlantic trade. In Iceland, there are good natural conditions for hosting large size ships and plenty of land can be found there for container storage. (17) Proper administration, enhanced taxation systems and advertisements are to awaken shipping interests for the success of this objective.

To sum up, large quantity of transit cargo imported to Murmansk and northern ports of Norway would be re-transported and distributed to EU and American ports; ships accessing these ports should be following the Code regulation for more safety and environmental protection. In parallel, new innovative ship design facilitate for escalated shipping activities.

**Introduction of Double Acting Ships Technology:**

Development in navigation, steering and propulsion technologies especially the introduction of double acting technology increased the probability of the use of the ice invested waters in shipping trade. Ordinary merchant vessels designed to navigate through only open or ice free water; they may be fitted with bulbous bow to reduce water resistance, increase speed and decrease fuel consumption and exhaust emission. On the other hand, ice breakers are built with inverted special design bow that can break ice under weight of breakers, but in open water they consume more fuel than traditional ships.

Ordinary merchant ship has very limited capability to navigation into ice; therefore, ice breaker(s) assistance is required to navigate through ice. A large container ship may need more than an ice breaker escort, which is considered a commercial barrier. The introduction of double acting ship reduces operation cost, by limiting the need for breaker assistance.

Acer shipyard delivered two 70.000 ton double-acting Arctic shuttle tankers in 2007 and 2008 to operation at the Prirazlomnoye oil field in the Arctic Ocean. The medium size tankers are driven by 4 diesel-electric engines providing 25 MW, with propulsion arranged by twin pods drives, each 8.5 MW. (7), (17) The innovative design allowed a deeper propeller location with no ordinary propeller shaft and trust blocks; increasing propeller depth allowed for safer distance from ice contact, less engine room space and more cargo capacity. The ships are equipped with a normal bulbous bow and ice breaker stern that allow them navigate all the year round in Arctic region.

Such design as described in figure 9, shows a diagram of a tanker that is breaking ice while steering astern, increases the feasibility of Arctic Bridge navigation.
**Environment legislation concerns and conflicts:**

Each Arctic country has its own environmental restrictions, concerns and conflicts (19), which may lead to confusion for shipping operators, applying procedures and regulations. That would lead to a vague situation, while we need unified standard to apply, by applying the Code. Analysis should be done to different Code chapters and regulations in order to be amended to enhance safety and environmental protection.

**IMO Polar Code – PART I (SAFETY MEASURES):**

To begin with, the Code misses putting a proper definition for the Arctic Circle; the Code refers to other conventions i.e. SOLAS and MARPOL definitions. The Arctic Circle should be defined in the Code, as per the UN definition.

**Chapter 1:**

As mentioned previously, figure 3 and 4 describe the application of the Code within a reduced Arctic Circle; chapter one of the Code requires special polar ship certificate issuance for complying ship. Applying the Code requirements on full Arctic Circle and ships operating within it would promote ships performance, however, there might be open water areas as mentioned in regulation 1.4.2. Furthermore, survival systems and other equipment on board such ships shall be better operational in such cold climate.

**Chapter 3:**

The regulation 3.2.2 states that structure of ship shall be designed to resist both global and local loads that if applied on board all ships operating in the Arctic Circle would positively affect ship’s performance, safety and hence reduce environmental threats. Otherwise, early cracks, stresses and fatigue would be extreme when dealing with cold water and especially when breaking ice; ice contact leads to plating, bilge keels and frames damage.

**Chapter 8:**

Regulation 8.2.3.1 states vague thermal protection for persons that should be properly regulated. Furthermore, regulation 8.2.3.2 mentions about long period of darkness that needs special design.
equipment and larger battery life. The regulation didn’t state how long the battery should extend. It is known as per table 3 below that there are certain limits of such equipment battery. Therefore, there should be some more details about the polar special design equipment and batteries that can withstand the lengthy darkness periods and delayed SAR. At least these limits should be stated in the life saving appliances Code.

**Table 3: Battery life in survival equipment**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal life buoy light</td>
<td>2 hrs</td>
</tr>
<tr>
<td>Normal life raft light</td>
<td>12 hrs</td>
</tr>
<tr>
<td>Normal life jacket light</td>
<td>8 hrs</td>
</tr>
<tr>
<td>Normal life boat engine</td>
<td>24 hrs / 6 kt</td>
</tr>
</tbody>
</table>

Source: As obtained from IMO lifesaving appliances Code

Regulation 8.2.3.3 states that resources shall be provided to support survival following abandon ship for maximum expected time of rescue. As per table 3 above, a life boat engine is supposed to work for only 24 hours with a speed of 6 knots “in calm weather in normal operating temperature” that may not be enough for such harsh environment in the Arctic. More research should be conducted to estimate maximum SAR delay and the Polar ship life boat and other survival equipment capabilities.

**Chapter 10 – “additional guidance”:**

Regulation 11.1.3 states “instability and signal dropouts can occur at latitudes as low as 70° north or south under certain conditions.” Furthermore, regulation 11.1.4 of the Code states “Non-GMDSS systems may be available and may be effective for communication in polar waters”. (15) Then these systems should be approved by recognized organization or alike. These regulations are decreasing the GMDSS credibility, and reliability, therefore, research should be conducted for other solutions and on new innovative systems of communication, particularly for GMDSS area 4 requirements.

This is against the area 4 GMDSS principles and requirements. The Global Maritime Distress and Safety System should be ‘GLOBAL’ in application; if there are problems in the GMDSS Code application of any kind should then come up to the globe and to find out barriers of application and solutions.

**Chapter 12:**

Regulation 12 mentions only management level of deck officers, no single requirement about the training and education or even familiarization for other operation level or engine officers on board a polar ship. Polar ships are perhaps operated by diesel electric engine e.g. double acting ships or nuclear power e.g. ice breaker, therefore engine officers as well should be well trained, educated and receive proper pre-joining familiarization. These requirements should also regulated
by the STCW\textsuperscript{8} convention and Code, and the ISM Code should also regulate pre-joining familiarization for all officers on a polar ship.

**IMO Polar Code part II-A (prevention of pollution):**

Chapter 3 – harmful substances in package forms - is left blank intentionally - perhaps there is undergoing work on initiation of such requirements.

Harmful substances in package forms are also considered pollutant as per MARPOL Annex III, and then there should be at least a hint about compulsory application of the IMDG\textsuperscript{9} Code on board all types of ships operating in the Arctic Circle.

**Atmospheric Pollution**

Furthermore, the Code doesn’t regulate emission control and there is no ‘left intentionally blank’ note, which needs clarification.

Annex VI of MARPOL regulates and prevents air pollution from ships, there are rules to regulate sulphur and nitrogen oxide content, bunker quality, engines exhaust and incinerators, 	extit{inter alia}, for their severe negative effects on ozone depletion and that they cause acid rain, for example. The Arctic Routes are not included in Sulphur Emission Control Areas-SECA (7) that need to be included for the severe importance on the environment and effects on life cycle particularly with escalation in shipping traffic.

However, ships are emitting a very few percentage of air pollutants, the English Channel and Malacca Strait suffer emissions of sulphur from ships of about 4\% of global output, while nitrogen oxides account for 7\%. Arctic is a very pollutant fragile region that needs ‘intensive’ care. (17) Therefore, it would be better to regulate emission control from ships by applying MARPOL annex VI requirement in the Code.

**Other pollutant materials and pollution prevention conventions:**

However, the part B-II mentions in regulation 4 some guidance about ballast management and anti-fouling, yet it is really important to regulate such requirements under the compulsory part of the Code.

**Ballast management:**

Ballast is extremely important for ships stability and stresses control during loaded and ballast voyages and for better steering capability. The Code doesn’t set the ballast management requirements on board polar ships; perhaps this may be left for future plan once the ballast management convention is put into force.


\textsuperscript{9} International Maritime Dangerous Goods Code
In contrast, ballast water may be considered as one of the major threats to the environment (10), as it introduces and spreads Invasive Aquatic Species into the environment. The Arctic is a fragile environment for the lack of speedy biological process due to the extreme coldness. (7)

Therefore, ballasting/de-ballasting should be monitored on board polar ship, however, the convention is not yet entered into force. Many countries apply the ballast management requirements locally and they ask foreign ships to apply it e.g. USA and Canada. There are many ballast management technologies available in the market and many of them were discussed in the IMO’s MEPC meetings, some of which could be approved for application on polar ship after assessment.

**Anti-fouling:**

Fouling is a term used to describe the marine organisms that attach to a ship’s hull. The resulted roughness of the ship’s hull increases friction within underwater area, which result in more fuel consumption thereby increases exhaust gas emissions. Accordingly, under water areas need a special coating not only to prevent rust and corrosion but also to prevent fouling. (7) after (21)

The organotin tributyltin (TBT) was banned on board ships after found responsible for the development of male sex characteristics in female marine snails. Furthermore, it affects the immune system of some marine organisms. (7) after (21)

Accordingly, the IMO took the initiative to issue an instrument in 1990, a convention was adopted in 2001 and entered into force on 17 September 2008 requiring alternatives for TBT anti-fouling, including copper based coatings and silicon based paints to ensure that the ship’s paints does not harm the marine environment. (9)

A polar ship in direct ice contact would most probably lose underwater paint that carries an economic value and environmental threat, if the Polar Code didn’t apply the Anti-fouling requirements.

**Conclusion and Recommendation:**

The Arctic region is still clean and environmentally sensitive area that needs special care and more attention. There are promising and current shipping and commercial investments in the region. The IMO has made good efforts by initiating a Polar Code; however, additional review efforts should be done before January 2017, when the Code and SOLAS chapter XIV are entered into force. Arctic Circle should properly be defined in the Code, SOLAS and MARPOL conventions. Other review should be done for STCW, LSA and GMDSS. Ballast management, Anti-fouling conventions should be made compulsory on polar ships. There will be a need to take precautionary environmental protection measures for the whole Arctic Circle not only for the Arctic Routes e.g. adoption of special areas under MARPOL. Consequently, there will be a need to build and maintain a stable, well-functioning navigation services; for example, Traffic Separation Schemes, port reception facilities and multiple shipping services infrastructure along the Arctic Circle.
No matter how low accident rate is in Arctic Routes; it is understood that this rate had been ensured by powerful icebreaking assistance. At the same time, powerful restriction would go for all the Arctic Circle, without any deduction. Even small fuel leakages in such fragile environment, as a result of ship damage can lead to ecological disaster. Moreover, safety of lives should come in the first priority, fatalities are very likely in the severe high latitude conditions in case of abandon ship especially with delayed SAR for the severs working environment. As the Code is based on risk minimization, we should therefore try to avoid any kind of failure and minimize risks.
**References:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Essallamy, Mohamed, The Arctic Ocean Routes: Precautionary environmental measures to mitigate the environmental impacts on effect of the climate change and opening of the passages for international shipping traffic, MSc., World Maritime University, 2008.</td>
</tr>
<tr>
<td>15</td>
<td>Maritime Environmental Protection Committee MEPC 68/21/Add. 1, June 2015, London, UK</td>
</tr>
<tr>
<td>18</td>
<td>Olav Orheim, Protecting the environment of the Arctic ecosystem, Norwegian Polar Institute, Tromsø,</td>
</tr>
<tr>
<td></td>
<td>Author(s)</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>20</td>
<td>Ronald O'Rourke</td>
</tr>
<tr>
<td>21</td>
<td>Showalter, S., &amp; Savarese, J.</td>
</tr>
<tr>
<td>22</td>
<td>Sinclair, Jasmin</td>
</tr>
<tr>
<td>23</td>
<td>UNEP</td>
</tr>
</tbody>
</table>