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# ICE CLASS IN ARCTIC WATERS

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It has long been thought that the Arctic is of interest to the states bordering or located near the Arctic. These countries have established the Arctic Council to take care of the ecosystem and monitor-Arctic climate change.

Global warming and the presence of significant deposits of minerals have been of increasing interest in recent years. The countries of the world, which have observer status in the Arctic Council, are showing interest in working in the Arctic.

The UK's plans include research, environmental protection, future trade routes and the development of energy infrastructure.

Germany's policies in the Arctic region are the development of raw materials and energy resources, as well as the search for optimal and rational ways of delivering goods.

Japan's interests lie in technology exports, Arctic shipping and scientific cooperation. Today, Japan invests in Greenland companies, providing expertise for fishing and mining companies.

South Korea's Arctic strategy is to develop Arctic shipping and related industries. Investments in the development of marine technologies and the development of land infrastructure.

Singapore is convinced that climate change in the Arctic is affecting the situation in other parts of the globe.

It is impossible not to pay attention to the significant growth of Beijing's interest in the Arctic. China believes that international maritime law guarantees it some access to the Arctic marine environment, including the right to conduct research, freedom of navigation, flight, use of natural resources, offshore hydrocarbons, international seabed areas and others special marine waters and areas, laying of submarine cables and pipelines, fishing in the international waters of the Arctic Ocean [12].


Fig. 1. The "XueLun" in Arctic waters

The fleet operates the icebreaker ship "XueLun" ("Snow Dragon") - icebreaker-transport diesel-electric ship, ice class B1 / 1 A Super, built by the Kherson Shipyard.

In September 2018, the Xue Lun-2 icebreaker, a joint development of Aker Arctic Technology (Helsinki) and the Marine Design and Research Institute in Shanghai, was launched. The ice class ship Polar Class 3, can break ice 1.5 meters thick at a speed of 2 to 3 knots and operate at temperatures down to minus 30º C.

Fig. 2. 2020, Chinese research icebreaker "Xue Lun-2" in the port of Shanghai

It should be noted that Ukraine is involved in the Arctic issue. However, for the last 20 years, Ukraine has not had its own icebreaker for Antarctic research, which has significantly limited its work. Ukraine's recent acquisition of the James Clark Ross icebreaker (renamed the Noosphere) will allow it to return to exploring the world's oceans, solve logistical problems at the Academic Vernadsky Antarctic Station, and expand seasonal expeditions.


Fig. 3. Ukrainian icebreaker

Ukraine and Malaysia signed a Memorandum on Scientific and Technical Cooperation in the Field of Antarctic Research.

South Africa is interested in exploring Antarctica with Ukraine, using the capabilities of the purchased vessel.

NASA scientists have released a video showing the melting of Arctic ice since 1984. Rapid climate and environmental changes (global warming) are facilitating navigation by the Northern Sea Route from Northeast Asia to Europe.

In total, three sea routes are considered. The two main routes, the Northwest Passage and the Northeast Passage, which connect the Atlantic to the Pacific Ocean, create the right conditions and

give quick access for Northeast Asia to European and Norrth American markets. It is estimated that this route is 40% shorter than the traditional route through the Indian Ocean and the Suez Canal. The Third Arctic Passage, or Transpolar Sea Route, crosses the Arctic [12]. However, it can be accessed only with the help of icebreakers. But it should be noted that most Arctic routes have an underdeveloped infrastructure, limited opportunities for search and rescue operations.

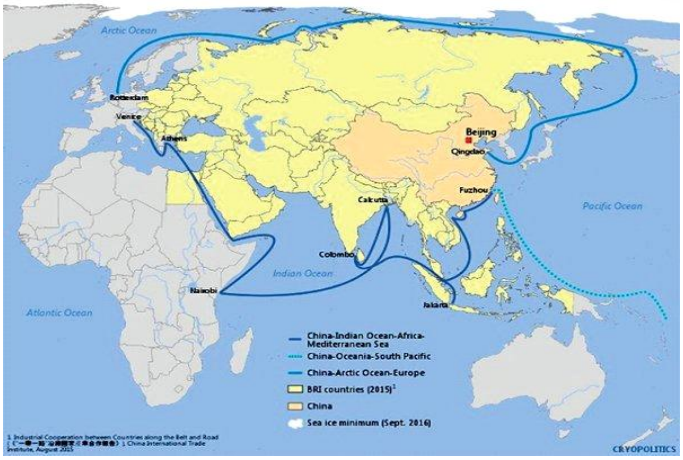


Fig. 4. Map of three sea routes

The conditions of the Arctic and Antarctic are so severe and specific compared to normal maritime conditions that the application of normal standards to the design and equipment of a vessel creates an unacceptable level of risk. On January 1, 2017, the International Code for Ships Operating in Polar Waters (Polar Code) entered into force [10].

1. Ice can affect the structure of the hull, the characteristics of stability, mechanical installations, navigation, working conditions in the open air, maintenance, lead to disruption of the normal operation of equipment and safety systems [3];

2. Icing of superstructures, cargo can reduce the stability and efficiency of equipment [3];

3. Low temperatures affect the working conditions and efficiency of people, the properties of materials and efficiency of equipment, survival time and performance of equipment and safety systems [3];

4. Prolonged periods of polar night and polar day can affect navigation and people's ability to work [3];

5. High latitudes affect navigation systems, communication systems and the quality of visual information about the ice situation [3];

6. Remoteness of the navigation area - possible lack of accurate and complete hydrographic data and information, limited number of navigation aids and signs, remote location of search facilities [3];

7. Potentially insufficient experience of crew actions in polar conditions - and this is the possibility of people committing wrong actions [3];

8. Lack of adequate equipment for emergency assistance [3];

9. Severe weather conditions, which can change rapidly can potentially lead to an increase and development of the scale of events [3];

10. The environment in terms of its sensitivity to harmful substances [3].

Mandatory part I-A sets out the requirements of the Polar Code for ship safety. In particular: to the equipment of the bridge, special equipment for ice removal, rescue equipment and equipment for firefighting in low temperatures.

According to Chapter 3 of the Code (Ship Structure), materials that can withstand particularly low temperatures, and in ice, must be used in the construction of ships approved for operation in subpolar waters. The requirements for water tightness of the vessel and its protection from other atmospheric phenomena, provisions on fire safety on the vessel, provisions of stability of the vessel, on increased requirements for the machine equipment of the vessel allowed for

navigation in polar waters are of regulatory importance. The decision on the conformity of the vessel design to the established requirements shall be made by the state of registration of the vessel or an organization authorized to do so by such state. According to the Polar Code, a vessel must have a Polar Navigation Certificate and a ship's Polar Water Operation Manual."Polar vessel certificate" contains confirmation that the vessel meets the requirements of the Code regarding the construction of the vessel, the availability of life-saving equipment, means of communication, fire safety, etc [5].

Prior to the Polar Code, Arctic and Antarctic vessels were built under the supervision of various classification societies that develop and apply technical standards in the field of design, construction and supervision of marine facilities. There are more than 50 classification societies in the world. The International Association of Classification Societies (IACS) unites 10 major national classification societies, which classify about 94% of the world's commercial tonnage.

Table 1. MAKO classification societies

| |
|---|
| I. ABS - American Bureau of Shipping |
| 2. BV – BureauVeritas |
| 3. CCS - ChinaClassificationSociety |
| 4. DNV – DetNorskeVeritas |
| 5. GL – GermanischerLloyd |
| 6. KRS - Korean Register of Shipping |
| 7. LR- Lloyd Register of Shipping |
| 8. NKK – NipponKaijiKyokai |
| 9. RINA – RegistroItalianoNavale |
| 10. RS - Russian Maritime Register of Shipping |

In 2006-2008, the association developed and adopted a "Unified requirements for Polar Class ships". In developing this classification, the description of ice types adopted by the World Meteorological Organization was taken into account.

Table. 2. MAKO ice classes

| **Polar Class – PC** | **GeneralDescription requirements for the vessel** |
|---|---|
| PC 1 | Year-round swimming in any waters covered with ice |
| PC 2 | Year-round swimming in conditions of perennial ice of medium thickness |
| PC 3 | Year-round swimming in biennial ice, with areas of perennial ice occurring. |
| PC 4 | Year-round swimming in conditions of one-year-old ice of large thickness, with areas of old ice that occur. |
| PC 5 | Year-round swimming in conditions of annual ice of medium thickness, with areas of old ice occurring. |
| PC 6 | Swimming in the summer-autumn period in the conditions of annual ice of average thickness, with the sites of the old ice meeting. |
| PC 7 | Swimming in the summer-autumn period in the conditions of one-year thin ice, with the sites of the old ice meeting. |

The requirements of the Polar Code apply to all new ice-floating vessels built after the entry into force of the Code. To be able to apply the requirements of the Polar Code to ships of Arctic and Antarctic navigation, built earlier, it is necessary to establish correspondence between the classes of classification societies, MACO, the Code. During the preparation of the Code, a table of such approximate compliance was drawn up.

Table 3. Sample correspondence between the polar classes of MACO and the ice classes of classification societies

| Классификационное общество | Ледовый класс | | | | |
|---|---|---|---|---|---|
| **IMO Guidelines, 2002 (IACS Polar Ship Rules, 2006)** | **PC2** | **PC3** | **PC4 / PC5** | **PC6** | **PC7** |
| **Russian Maritime Register of Shipping (Rules 2007)** | **Arc9/Arc8** | **Arc7** | **Arc6** | **Arc5** | **Arc4** |
| CASPPR, 1995 | CAC2 | CAC3 | CAC4 | A | B |
| American Bureau of Shipping | A4 | A3 | A2 | A1 | A0 |
| Det Norske Veritas | POLAR-20 | POLAR-15 | POLAR-10<br>ICE-15 | ICE-10<br>ICE-1A* | ICE-05<br>ICE-1A |
| Lloyd's Register | AC2 | AC1.5 | AC1 | 1AS | 1A |
| Germanischer Lloyd | Arc3 | Arc 2 | Arc1 | E4 | E3 |
| Finnish-Swedish Ice Rules | - | - | - | 1A Super | 1A |
| Bureau Veritas | - | - | - | 1A Super | 1A |
| Nippon Kaiji Kyokai | - | - | - | 1A Super | 1A |
| Korean Register of Shipping | - | - | - | ISS | IS1 |
| China Classification Society | - | - | - | B1* | B1 |
| Registro Italiano Navale | - | - | - | 1AS | 1A |

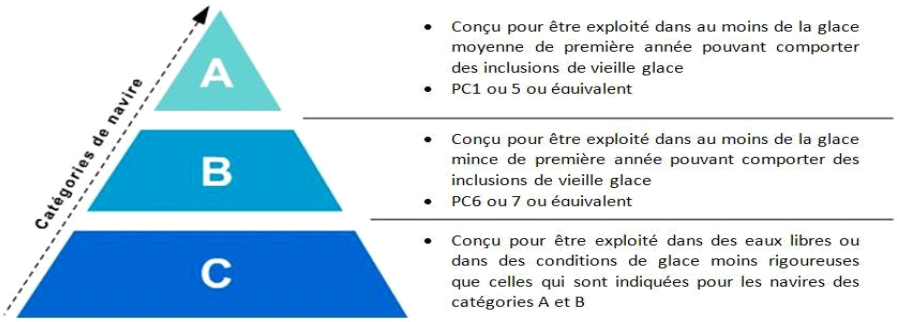


Fig. 5. Sample correspondence between IMO polar classes and MACO ice classes

Thus, due to the lack of consistency in the ice classes of different classification societies, additional risks and difficulties are created for ship-owners, flag administrations and classification societies, as they will have to decide this issue on their own, based on the recommendations contained in the Polar Code.

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