



Northern Sea Route Navigation

Best Practices and Challenges

(First edition 2017)



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Oil Companies International Marine Forum

29 Queen Anne's Gate
London SW1H 9BU
England
Telephone: +44 (0)20 7654 1200
Fax: +44 (0)20 7654 1205

Email enquiries@ocimf.org

www.ocimf.org

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Glossary

The following are agreed definitions for terms used within this paper.

Bergy bits A large piece of floating ice of land origin, showing less than 5m above sea level and no more than 20m long.

Circadian rhythm The cyclical 24-hour period of human biological activity. Commonly known as the body clock.

Company As defined by The International Convention for the Safety of Life at Sea (SOLAS) Chapter IX/1, 2014 - the company means the owner of the ship or any other organisation or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the owner of the ship and who on assuming such responsibility has agreed to take over all the duties and responsibilities imposed by the International Safety Management Code. This company would normally be the name recorded on the ship's Document of Compliance.

Ice accretion The process by which a layer of ice builds up on solid objects which are exposed to freezing precipitation or to super-cooled fog or cloud droplets. It is most likely during time periods when surface air temperatures are between zero and -15°C. Below this threshold spray tends to freeze directly in the air so that it does not adhere to surfaces.

Ice Class notation The notation assigned to the ship by a Classification Society showing that the ship has been designed for navigation in sea-ice conditions.

Ice massif A variable accumulation of close or very close ice covering hundreds of square kilometres which is found in the same region every summer.

Ice pilot A person trained and experienced in navigation in ice who will join a ship to augment and advise the Master and navigational team.

Icebreaker Any vessel whose operational profile may include escort or ice management functions, whose powering and dimensions allow it to undertake aggressive operations in ice-covered waters.

Low temperature A generic term used to describe the range of temperatures expected in an area where the lowest Mean Daily Low Temperature (MDLT) is below -10°C, as described in the Polar Code.

Polar Ship Certificate The certificate issued either by the administration or by any person or organisation recognised by it to a ship that complies with the relevant requirements of the Polar Code.

Squat Squat or squat effect is the hydrodynamic phenomenon as a vessel moves through shallow water, which creates a low pressure area under the hull and results in a change in draught and trim and potential change of under keel clearance. The greater the speed the greater the effect of squat.

Winterisation The preparation of the ship for safe operation in extreme cold weather conditions by adapting the design and operating procedures to the requirements imposed by the intended service.

Abbreviations

AARI	Arctic and Antarctic Research Institute
ABS	American Bureau of Shipping
DSC	Digital Selective Calling
ECDIS	Electronic Chart Display and Information Systems
ENC	Electronic Navigation Chart
EPIRB	Emergency Position Indicating Radio Beacon
ERP	Emergency and Rescue Preparedness
FOL	Forward Operational Locations
GLONASS	Global Navigation Satellite System
GMDSS	Global Maritime Distress and Safety System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GUNiO	Russian Hydrographic Office
HFO	Heavy Fuel Oil
IOGP	International Association of Oil & Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
MEPC	Marine Environment Protection Committee
MMSI	Maritime Mobile Service Identity
MRCC	Maritime Rescue Coordination Centre
MRSC	Maritime Rescue Sub Centre
NAVTEX	Navigational Telex
NSR	Northern Sea Route
PWOM	Polar Water Operational Manual
SAR	Search and Rescue
SMS	Short Message Service
VHF	Very High Frequency

Bibliography and useful websites

Hyperlinks to websites and documents are correct at the time of publication, but in all cases the latest source of information should be used.

Bibliography

American Bureau of Shipping (ABS)

Guide for Vessels Operating in Low Temperature Environments

Low Temperature Operations: Guidance for Arctic Shipping

Navigating the Northern Sea Route: Status and Guidance

Winterisation Guidelines for LNG/CNG Carriers in Arctic Environments

International Maritime Organization (IMO)

International Code for Ships Operating in POLAR Waters (POLAR Code), Resolution MSC.385(94) and Resolution MEPC.264(68)

International Petroleum Industry Environmental Conservation Association/International Association of Oil & Gas Producers (IPIECA/IOGP)

Health Aspects of Work in Extreme Climates IOGP report 398

Lloyds and Chatham House

Arctic Opening: Opportunity and Risk in the High North

Oil Companies International Marine Forum (OCIMF)

Offshore Vessel Operations In Ice And/Or Severe Sub Zero Temperatures

The Use of Large Tankers in Seasonal First Year Ice and Severe Sub Zero Conditions

Useful websites

Northern Sea Route Administration

The NSR Administration is a federal state institution of the Russian Federation. It issues permits for transits of the NSR and contains useful information for planning.
www.nsra.ru/en/home.html

Northern Sea Route Information Office

Provides businesses and international organisations with relevant and practical information in English for planning and arranging transits on the NSR.
www.arctic-lio.com/
www.arctic-lio.com/nsr_icepilotage (ice pilot listing)
www.arctic-lio.com/nsr_icebreakersassistance (icebreakers)

The Arctic Maritime and Aviation Transportation Infrastructure Initiative

Has an interactive map of the Arctic region and a database of all ports in the Arctic.
www.arcticinfrastructure.org

The Arctic Monitoring and Assessment Programme

A working group of the Arctic Council. The website has information on the status of, and threats to, the Arctic environment.
www.amap.no

Rosatomflot

Company offering icebreaker/ice pilotage and emergency response services.
www.rosatomflot.ru/?lang=en

1 Introduction

Climate change and the associated warming of the Arctic seas has opened up the Northern Sea Route (NSR) as a possible alternative to more southerly trading routes between Europe and Asia Pacific. The NSR is currently navigated only occasionally by merchant ships. It presents unique challenges to any ship using it and a thorough risk assessment should be conducted before any transit. The risk assessment should take into account the remoteness of the Arctic, the unique hazards to safe navigation and what measures need to be in place to mitigate them (see section 4.1). The type of vessel, operational procedures and personnel preparedness all need to be planned in advance.

This information paper highlights the challenges and best practices that ship managers and operators should consider when planning and executing a transit of the NSR. It supplements information available from existing sources, particularly from the Northern Sea Route Administration which organises navigation in the NSR and whose goals are to ensure safe navigation and protection of the marine environment from pollution. The NSR Administration is the final authority and definitive source of up-to-date information related to permissions and requirements for a transit of the NSR. Only the NSR Administration issues permits for transits of the NSR.

The purpose of this information paper is to help members make informed decisions about the NSR transit. OCIMF neither endorses nor discourages transits along the NSR.

1.1 Planning a transit and the regulatory process

Companies should carefully consider all factors involved in a transit of the NSR before beginning the process of planning a transit, which can take many months. The NSR Administration provides the regulatory requirements of the Russian Administration for a ship to apply for and obtain the necessary permits to transit. These requirements include additional equipment to be carried including navigational and communication requirements, searchlights, suitable clothing and also specific requirements for personnel competence. Permits can be applied for up to four months in advance, but no later than fifteen days before the transit is due to begin. Companies should examine the full application process before selecting a ship. The regulatory process can change at short notice, so make sure the latest version of the application document has been downloaded.

The Northern Sea Route Information Office website provides businesses and international organisations with relevant and practical information in English for planning and arranging transits on the NSR. Companies may also wish to consult the American Bureau of Shipping (ABS) advisory *Navigating the Northern Sea Route: Status and Guidance*.

The Polar Code was adopted through IMO Resolutions MSC 385(94) on 21 November 2014 for SOLAS chapter XIV, and MEPC 264(68) on 15 May 2015 for MARPOL. The full text of the Polar Code can be found in Resolution MEPC 264(68).

From January 2017, the Polar Code became mandatory. Part 1-A, chapter 2 of the Code requires the owner, operator, Master and crew to be provided with sufficient information about a ship's operational capabilities and limitations to support their decision-making process, i.e. a Polar Water Operational Manual (PWOM). Part 1-A, chapter 2 and part 1-B, section 3 of the Polar Code covers all of the requirements of a PWOM with appendix 2 providing a model table of contents. Companies are recommended to use the PWOM to identify risks and to provide mitigating measures.

All ships transiting the NSR should have a valid Polar Ship Certificate on board that confirms their compliance with applicable provisions of the Polar Code.

2 Description of the Northern Sea Route

The NSR extends for about 3,000 miles, typically passing through the Kara, Laptev, East Siberian and Chukchi seas. It is entered from the west either through the Yugorskiy Shar Straits and Karskiye Vorota (Kara Gate), or by passing north of the island Novaya Zemlya around Mys Zhelaniya (Cape Zhelaniya). From the east, it is entered via the Bering Strait. Figure 2.1 shows typical routeing for the NSR. The red line shows traditional routeing and the light blue line shows deeper draught routeing. Alternative passages can be taken depending on the draught and season. In general, the further north the routeing, the greater the likelihood of encountering ice. The navigation season starts around the beginning of July and lasts to the second half of November but can vary considerably. The exact details of the transit, its timing and the Class of ship to be used will be subject to approval from the NSR Administration.

More detail may be found in *ABS Navigating the Northern Sea Route: Status and Guidance*, which also includes information on weather patterns and physical characteristics.



Figure 2.1: Typical passages through the Northern Sea Route

3 Selecting a ship for transit

Selecting a ship for a transit of the NSR requires additional considerations to a standard voyage. The following process is suggested, to ensure all factors are considered:

1. Identify acceptable ships through the company internal vetting process, i.e. follow the voyage clearance procedure.
2. From this list of ships, identify ships that would be acceptable to the NSR Administration. The NSR Administration will consider the category of ice strengthening, period of transit, season of transit, planned route, ice conditions and assistance of icebreakers. Specific requirements and additional advice are available on their website.
3. Other factors to consider include:
 - Whether the ship has sufficient bunkers, fresh water and provisions for the proposed transit. Allowance should be made for potential significant delays caused by the ship being beset in ice.
 - Whether the ship has sufficient storage capacity in its holding tanks (sludge, bilge, waste, etc.) to allow for any significant delays. The Polar Code part II-A requires a prohibition of annex I, II, IV and V MARPOL discharges (with certain exceptions). OCIMF endorses retention of all waste, including grey water, as best practice over and above Code requirements.
 - Additional manning requirements, with particular emphasis on experience of ice navigation.
 - Additional oil spill response equipment, taking into account the remote location.
 - Other equipment requirements, including: navigation and communications equipment as per part 1-A sections 9 and 10 of the Polar Code; additional life saving appliances and fire fighting appliances as per sections 7 and 8 of the Code; and the provision of up-to-date charts.
4. With the above considerations complete the company should begin the transit application with the NSR Administration.
5. Assuming the application is successful, transit preparations should be made. It can take up to three months to put arrangements into place and this should be factored into the planning.

4 Risk assessment

As a best industry practice, companies are encouraged to carry out a thorough risk assessment for the anticipated conditions of the transit before executing the passage.

Subjects to consider in the risk assessment include:

- Low temperatures.
- Presence of ice of varying thickness.
- Long polar days and nights.
- Reliability of hydrographic data.
- Lack of infrastructure for oil spill response and Search and Rescue (SAR).
- Polar communications.
- Satellite coverage.
- Winterisation requirements.

The risk assessment should specifically address the following:

- Compatibility of ship to the intended voyage, including Class notation and operability and reliability of the ship.
- Safety margin of critical supplies (bunkers, fresh water, provisions, critical spare parts).
- Ice accretion and its effect on decks, equipment and ship stability, and means of de-icing.
- Ice accumulation in sea water intake for engine cooling systems.
- Reliability of communications equipment in the anticipated weather conditions and high latitudes.
- Efficiency and protection of fixed and portable fire fighting systems in the anticipated low temperature and weather.
- Efficiency and protection of life saving appliances in the anticipated low temperature and weather.
- Efficiency and protection of deck machinery and hydraulic systems in the anticipated low temperature and weather.
- Quality and behaviour of bunkers and lubricants in the anticipated low temperatures.
- Efficiency and behaviour of cargo and ballast venting system in the anticipated low temperatures and weather when they can become blocked by ice and snow.
- Protection of equipment and liquids that are not designed for operation in low temperatures against freezing, e.g. by heating, insulating and restricting ventilation in the fore-castle, engine room and steering gear room.
- Protection of hatches and doors against freezing.
- Temperature rating of any lifting appliances, including ancillary equipment.
- Response in event of medical emergency.
- Sewage management for the whole length of transit allowing for delays.
- Garbage management for the whole length of transit allowing for delays.
- Response in event of oil spill.
- Protection of personnel when outdoors (suitable clothing, effect of clothing on ability to operate machinery safely, safe access to the deck, etc).

5 Personnel: manning, training and competency

The human element is possibly the single most important factor for a company to consider when determining requirements for a transit of the NSR. A ship with sufficient manning, and with ice-experienced and well-trained personnel on board, can mitigate many of the challenges encountered.

5.1 Watches

Watchkeeping arrangements should consider the following factors:

- Provision of sufficient number of ice experienced personnel. When navigating in the vicinity of ice, it is recommended that navigation watches are doubled up. Hours of work regulations should be factored in to ensure that all personnel are adequately rested.
- The effects on personnel of prolonged daylight and darkness, and the vibration and noise of ice on the hull. See section 11 for more on personnel health and safety.
- The composition of watches and lookouts, in particular:
 - Additional lookouts, taking into account cold weather exposure and rest requirements. This may include a forecastle watch to monitor the distance of the icebreaker from the ship.
 - Helmsman for manual steering, as recommended throughout the NSR when under ice escort.
 - Manning the engine room, as recommended throughout an NSR transit.
 - Translators for communication with the Russian icebreakers and ice pilots/ice helmsmen.

5.2 Ice pilots and ice helmsmen

Where practicable, an experienced Russian ice pilot should be embarked.

The ice pilot may allow the ice helmsmen to make autonomous decisions about course direction, particularly when avoiding smaller ice features. This is because it can be impracticable for the ice pilot to continuously direct the ship using verbal commands for each piece of ice that appears astern of the icebreaker.

A list of service providers of ice pilots is available on the NSR Information Office website. Pilots are embarked and disembarked via the icebreaker at a place agreed with the service provider and the icebreaker. OCIMF recommends the use of ice pilots and that consideration is given to use of ice helmsmen, especially if high levels of ice are anticipated during the passage or the ship is conducting an unescorted passage.

5.3 Polar Code requirements

The Polar Code mandates manning and training requirements in chapter 12 of part I-A. The goal is to make sure ships operating in polar waters are appropriately manned by adequately trained, qualified and experienced personnel.

6 Navigation

Even though typical passages through the NSR exist (see figure 2.1), ships might not follow the exact same route each time. The actual route will depend on the presence and thickness of ice. Icebreakers will attempt to follow the safest and most efficient line through the ice. Whatever route the icebreakers take, the following ships remain responsible for their own navigational safety. Navigation and communication equipment will be required to maintain functionality in all anticipated environmental conditions and operational areas. For this section, companies should pay particular attention to the Polar Code part 1-A, chapters 9 *Navigation*, 10 *Communications* and 11 *Voyage Planning*.

6.1 Charts

Up-to-date and corrected charts covering the NSR area must be obtained in advance. These are available from official chart providers in Russia. The charts use the Cyrillic alphabet and may need to be translated for a full understanding of how to plan and execute the proposed passage.

Electronic Navigation Charts (ENC) do not currently cover the entire NSR. Ships that use Electronic Chart Display and Information Systems (ECDIS) may have to use paper charts instead, or use alternative means of navigation acceptable to the ship's Class, Flag and the NSR Administration.

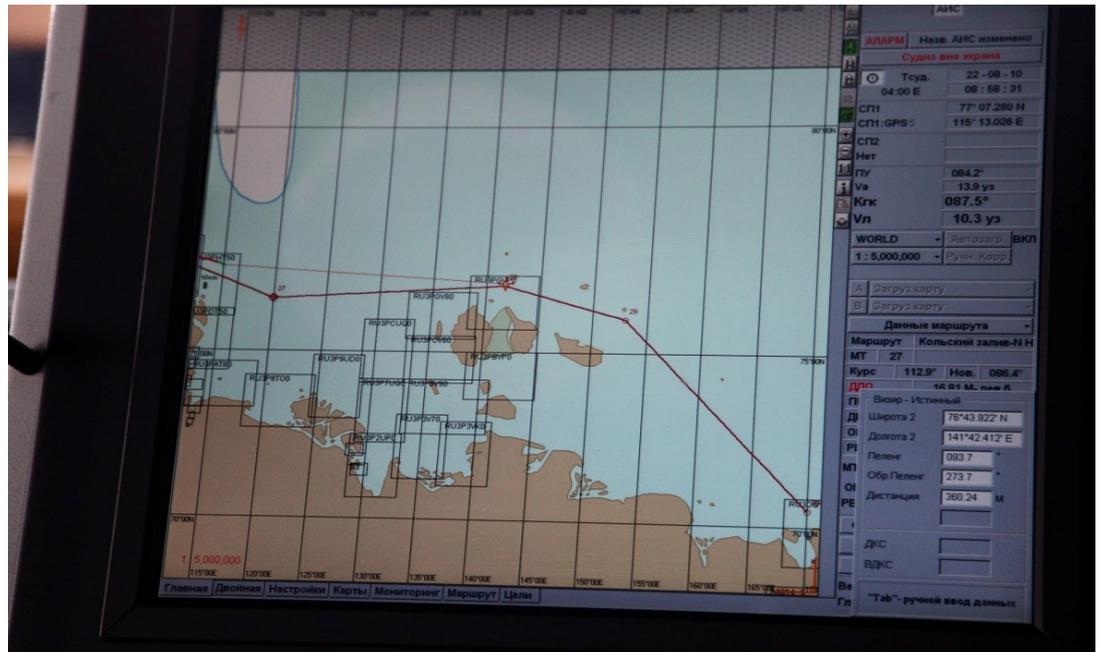


Figure 6.1: Limitations of Electronic Navigation Chart coverage. Courtesy of Shell

6.2 Survey data

Routes recommended by the NSR Administration have been surveyed and depths charted by the Russian Hydrographic Office (GUNIО). Details of any newly observed navigational obstructions, banks, etc. are promulgated through NAVTEX and Notices to Mariners. Depths on the recommended routes are regularly monitored and surveyed by the icebreakers working in the NSR area. However, because the actual route will depend on the current pattern of ice, it may not have been subjected to a recent multibeam hydrographic survey using modern equipment. Caution must therefore be exercised when determining under keel clearance.

6.3 Depths

When planning a passage through the NSR, the ship's draught, including allowances for under keel clearance, should be taken into account. Depths outside of the recommended routes cannot be guaranteed. Even within recommended routes, depths may be different from the survey data. Each voyage should be considered on an individual basis.

Typical draught limitations are:

- 7.7m The Dmitriy Laptev Strait.
- 10m General transit.
- 12m The Sannikov Strait, although at the deepest draughts speed will need to be reduced to take into account the effects of squat.
- 12m+ North of the Novosibirskiy (New Siberian) islands deeper draught ships may be accepted by the NSR Administration.

6.4 Direction heading

Magnetic compasses can be unreliable in the Arctic the higher the latitude reached. Gyro compasses work effectively to around 70° latitude and then become unreliable due to the lack of effectiveness of speed control errors. Because the NSR reaches latitudes of at least 78°, ships operating in the Arctic are normally fitted with Global Positioning System (GPS) or Global Navigation Satellite System (GLONASS) compasses as they are more reliable at higher latitudes.

6.5 Global Positioning System coverage

GPS coverage is available in the NSR region, but it is recommended that ships carry both a GLONASS satellite receiver and GPS units. Both systems used together reportedly provide excellent positional coverage in the region.

6.6 Radar

Some pack ice features can be difficult to interpret on radar. A 3cm X-band radar gives better detection and clarity than a 10cm S-band radar.

It may be beneficial for ships to also be equipped with an ice radar. Ice radars provide enhanced definition, particularly for the detection of bergy bits and small icebergs, and helps to identify the best route through the ice.

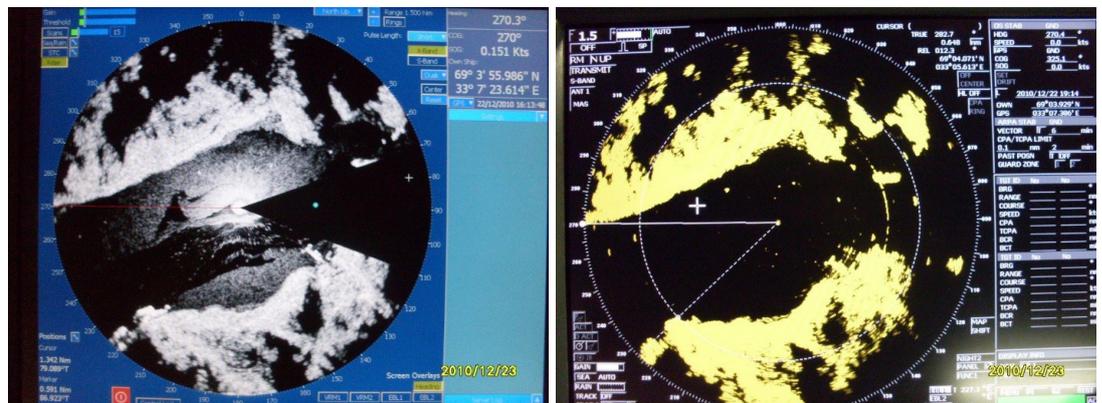


Figure 6.2: Ice radar display (right) vs conventional radar display. Courtesy of SovComFlot

6.7 Infra-red camera use

In addition to radars, infra-red cameras can be used for ice detection. These are particularly useful if the transit is at night or visibility is restricted. If infra-red cameras are not fitted, the 3cm X-band radar is efficient at detecting ice at night or when visibility is restricted.

6.8 Fog and restricted visibility

Ships often have to deal with restricted visibility when transiting through the NSR which reduces the ability to visually detect ice. The Polar Code requires that ships, with the exception of those solely operating in areas with 24 hours of daylight, be equipped with either:

- Two remotely rotatable, narrow-beam searchlights that provide 360° lighting. These should be controllable from the bridge.
- Another means to visually detect ice.

When transiting in a convoy, or with an icebreaker in close attendance, clear communications between the icebreaker and escorted ships are essential. Searchlights, i.e. Suez Canal lights or ice lights, should be used to help monitor the distance between ships in a convoy.

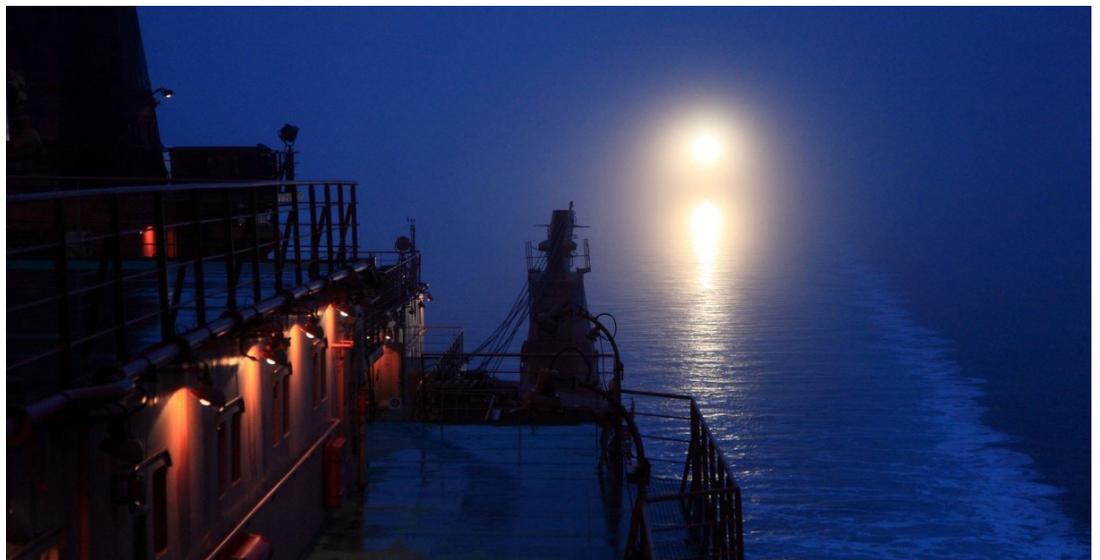


Figure 6.3: Use of lighting for ships under convoy. Courtesy of Shell



Figure 6.4: Icebreaker conducting escort duties. Courtesy of SovComFlot

6.9 Icebreaker assistance

The NSR Administration will decide whether an NSR transit requires the use of an icebreaker. The Administration takes the following into account:

- Ship condition and construction.
- Ice Class.
- Cargo categories.
- Current and anticipated ice conditions for the transit.
- Experience of shipboard personnel.

Ships will occasionally require assistance from nuclear icebreakers, which are more powerful than the conventional icebreakers. There are a limited number of nuclear icebreakers and they are normally strategically positioned along the NSR, depending on ice conditions and local requirements. Use of nuclear icebreakers should be taken into account when planning the transit if it is known in advance where they will be.

Table 6.1 gives an example of contact details of icebreakers operating within the NSR. From this list, Vaygach and Krasin carry equipment to enable a limited oil spill initial response. The NSR Administration and NSR Information Office websites have further information concerning rules relating to icebreakers. Both websites should be consulted for up-to-date information.

No.	Name of icebreaker	Radio and telegraph call sign	Inmarsat ship earth station numbers	DSC numbers
1	n/i “Vaygach”	UBNY	Inmarsat F77 764715293 764715295-VOICE 764715296-FAX Iridium – 881677743333 and 881626429726	273133100
2	n/i “Yamal”	UCJT	Inmarsat F77 761136943 761136945-VOICE 761136946-FAX Iridium 881677743493	273132400
3	n/i “50 let Pobedy”	UGYU	Inmarsat F77 764660542 Voice 4.8 764660543 Voice 4.8 761120938 Voice 4.8 761120939 Fax 9.6 Inmarsat C 427351996 Iridium 881626429725	273316240
4	n/i “Taymyr”	UEMM	Inm-F77 761142068 761142070-VOICE 761142071-FAX Iridium 881677743381	273135100
5	d/i “Krasin”	UGSN	Inmarsat C 427302057 MINI-M 762137613 Phone 762137614 Phone 762137615 Fax FLEET 77 764626488 Phone 764626489 Phone 754626490 Phone 764626491 Fax	273148110

Table 6.1: Example icebreaker contact details. Courtesy of NSR Administration. Check website for up-to-date information

6.10 Ice massifs

Ice massifs are variable accumulations of pack or very close pack ice that cover hundreds of square kilometres. They are found in the same region every summer and are regularly encountered along the NSR. Ships must take into account potential damage to hull and propeller when sailing in these massifs. Ships should evaluate the possibility of taking additional ballast in order to increase draught, to prevent damage to the propeller.

Speed may need to be adjusted depending on the thickness and age of the ice. Details of the ice conditions provided by the icebreakers should be evaluated against the ship's performance criteria as set out in the Polar Ship Certificate in order to determine a safe speed.

Ships should at all times try to navigate in the channels created by the icebreaker.

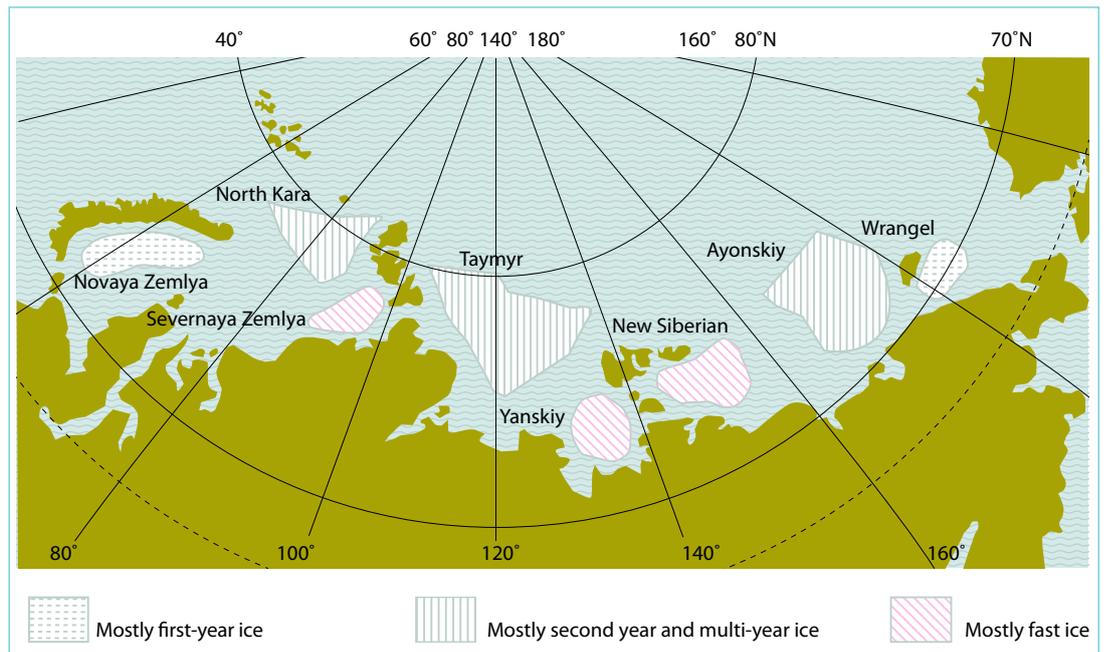


Figure 6.5: Ice massifs, shown in grey, along the Northern Sea Route. Courtesy of the Arctic and Antarctic Research Institute (AARI)

7 Communications



Figure 7.1: Ice accretion on a GPS compass scanner. Courtesy of Shell

Communications in the polar region present particular challenges. The Inmarsat satellite system may become unreliable in latitudes above 70°N, and between 86°E to 120°E longitude. It is vital that the unreliability of satellite systems is taken into account at the planning stage since there are implications for SAR.

It is essential that ship to shore communications are maintained throughout the transit and that emergency communications are functional.

The NSR Administration website has information on communications with coastal stations. The requirements of part 1-A, chapter 10 of the Polar Code have to be complied with.

Language can be a barrier to effective communications between English-speaking personnel and Russian-speaking personnel, for example between ships and icebreakers or between ships and land stations. Ice pilots can help overcome the language barrier, but proper and effective dialogue between the bridge team and the ice pilot is essential. A translator could be employed if necessary, particularly if an ice pilot will not be used. Ships under convoy should maintain a continuous listening watch on VHF channel 16, with a separate working channel as determined by the Master of the escorting icebreaker.

7.1 Reliability of GMDSS communications

Non-GMDSS satellite systems using polar satellites have been reported by transiting ships to be a reliable means of voice communication and their use is recommended. Iridium phones could also be considered. The satellites for iridium phones are in a low Earth orbit and give good coverage in high latitudes. Further guidance may be found in the Polar Code, part 1-B, section 11.1, *Limitations of Communications Systems in High Latitude*.

Before the transit begins, a contingency plan should be in place in case the GMDSS system becomes unavailable for short periods of time. The contingency plan should include an alternative means of receiving ice, weather and navigational warnings, e.g. from an icebreaker.

8 Winterisation

Before transiting the NSR, companies should assess the ship's capability to operate in the anticipated ice and low temperature environment. Winterisation notations issued by Classification Societies are not the same as Ice Class notations. Ice Class notations refer to the ability to structurally withstand navigation through ice, whereas winterisation notations refer to the ability to operate within a low temperature environment. A company may choose to apply for a ship to have a winterisation notation but this may involve a considerable amount of retrofitting of equipment.

The following winterisation measures are recommended, even if a ship is only going to be used for a single transit of the NSR:

- Assurance of the proper operability of ship's equipment and systems in the anticipated low temperatures.
- The provision of equipment and supplies that are capable of being used in the anticipated low temperatures.
- The implementation of procedures for safe operation and personnel welfare in the anticipated low temperatures.

These measures are in addition to any hull and machinery requirements necessary for safe navigation through ice.

Winterisation requirements regarding the safety of navigation and protection of the Arctic environment are addressed in chapter VIII of the NSR Administration *Rules of Navigation*.

8.1 Winterisation checklist

Before transiting the NSR, companies are encouraged to review their winterisation procedure and make sure the following are addressed in the winterisation checklist:

- Test of communications equipment.
- Test of deck lighting and projectors.
- Operational test of navigation equipment.
- Operational test of bridge windows heating and clearing systems.
- Operational test of horn and whistle heating system.
- Operational test of equipment heaters (in steering gear room, control equipment, electric motors, radar scanners, radar gear box).
- Lifeboat and davit readiness.
- Deck lines liable to freeze are drained dry.
- Sufficient amount of salt, sand and equipment to remove snow and ice is on board for the anticipated voyage.
- Fire fighting equipment and life saving appliances are protected from low temperatures. Potable water normally stored in the lifeboats should be removed and placed in a heated compartment close by unless the lifeboat interior is kept heated.
- Continuous steam supply is available on deck, while ensuring that any deadlegs are drained to prevent freezing.
- Ventilation to interior spaces has been reduced to prevent outside air from coming into direct contact with inside equipment.
- Switch to lower sea chest and operate steam injector if provided.
- When fitted, the Pressure Vacuum Breaker (PV Breaker) is checked for correct level of antifreeze and that steam is supplied to the deck water seal.
- Deck hydraulic systems free of water/moisture.

Regular checks should be carried out on all equipment exposed to low temperatures to make sure they are working properly and are safe.

Two papers issued by ABS address winterisation of ships and are recommended reading: *Low Temperature Operations: Guidance for Arctic Shipping* and *Guide for Vessels Operating in Low Temperature Environments*.

9 Protecting the environment

The remoteness of the NSR and its delicate ecology mean that special consideration needs to be given to protecting the environment during a transit. NSR Administration requirements should be adhered to strictly.

9.1 Waste management/discharges

Notwithstanding NSR Administration and MARPOL requirements which will impose restrictions as per part 2-A and the associated guidance in part 2-B of the Polar Code, it is recommended that a complete prohibition on all discharges is enforced when approaching and transiting the NSR. Companies should carefully consider how to implement this with factors including:

- Reducing bilge holding tanks to a minimum prior to transit.
- Incinerating sludge to a minimum so far as is practicable.
- Reducing sewage holding tanks to a minimum.
- Using garbage compactor units and reducing packaging to an absolute minimum at the last port of call before entering the NSR.
- Having a documented contingency plan in place should any of the above exceed a defined parameter. For example, if designated tanks are full, what alternatives tanks are available?

9.2 Fuel

The type of fuel and location of bunker tanks should be considered to mitigate environmental damage in the event of a bunker fuel spill to the environment.

At the time of release of this paper, the IMO are considering guidance on the available measures to reduce the risk of using and carrying Heavy Fuel Oil (HFO) in the Arctic.

10 Remoteness and emergency response

The remoteness of the NSR and the possibility of both minor and major delays to the transit because of changing environmental conditions need to be considered at the planning stage. The difference in transit time between an ice free passage and one where ice is encountered can be considerable. This can range from a few days to, in extreme cases, months. For example, in January 2017 two dry cargo ships with Arc5 Ice Class got beset in ice near Pevek, resulting in a four-month delay.

10.1 Fuel

It is recommended that ships are bunkered before starting the transit to account for the risk of delay and potential increase in consumption due to environmental conditions.

10.2 Provisions

Sufficient provisions and fresh water should be carried for the passage taking into account the potential for considerable delay. The ship might make its own water, but this may not be possible when beset by ice.

10.3 Repairs and spare parts

Given the nature of the transit and the extremely limited availability of any ports of refuge, companies will need to consider what additional spare parts and emergency repair equipment to carry. The additional vibration and engine load caused by pushing ice for prolonged periods may cause equipment damage beyond normal wear and tear. Icebreakers may have very limited equipment to support emergency repairs. As such, risk assessments should consider what additional spare equipment should be carried.

10.4 Medical emergencies

The ship should ensure that adequate medical supplies are available for an NSR transit bearing in mind that an immediate evacuation may not be possible. Icebreakers have medical assistance and a helicopter can assist when within range, but currently there is incomplete coverage of the NSR.

10.5 Oil spill response

Due to the remoteness and the current limited oil spill response facilities along the NSR, it is important to identify the specific challenges and mitigations necessary to deal effectively with a spill.

Companies should have a detailed understanding of the impact that an oil spill could cause while transiting the NSR. Oil spill response plans should take into account the following.

10.5.1 Impact of hydrocarbons

Companies should take into account the impact of any hydrocarbon spill onto ice or in icy waters and the behaviour of the particular type of hydrocarbons under such conditions with respect to natural dispersion.

In addition, the impact of any hydrocarbon spill should take into account any impact to marine sensitive environments, including native or migrating wildlife, and the impact on local communities.

For both, the nature of the intended cargo (colour and whether persistent or non-persistent in the anticipated ambient air and seawater temperatures) should be taken into account when identifying appropriate responses.

10.5.2 Local and international response capabilities

The capability of the shore infrastructure should be assessed with respect to the perceived effectiveness of any local oil spill response providers. The time taken to mount a response, taking into account the remoteness of the location and the amount of equipment available to be brought on scene, require special consideration. In addition, and with respect to a response from a tier 1 international oil spill response organisation, the logistical and potential political challenges of mounting an immediate response should be considered. Icebreakers operating in the NSR area carry a limited supply of oil spill response equipment and companies may wish to consider carrying additional equipment on board transiting ships. Keep in mind that an icebreaker may not be in attendance and local icebreakers might not be available to respond to an oil spill as first responders.

10.5.3 Response equipment

A list of response equipment located within the boundaries of the NSR for Emergency and Rescue Preparedness (ERP) teams at Forward Operational Locations (FOL) is given in table 10.1. It is reproduced from the NSR Administration website. Companies should consult the website for the latest information. The equipment is minimal and would not cope with a large oil spill.

ERP in FOL	Equipment	Quantity
Sea port of Dikson (4 persons) (all year round)	Booms BPP-1100	250m
	Booms BPP-830	100m
	Skimmer “Desmi Mini-Max” (productivity 35 cub.m/hour)	1 set
	Inflatable boat with suspended motor	1 set
Sea port of Tiksi (3 persons) July-October	Booms BPP-600	200m
	Oil-gathering system “Desmi-250” (productivity 70 cub.m/hour)	1 set
Sea port of Pevek (3 persons) July-October	Booms BPP-1100	130m
	Booms BPP-830	150m
	Skimmer “Walosep W2” (productivity 40 cub.m/hour)	1 set
	Sorbent	150kg
Sea port of Provideniya (3 persons) July-October	Booms BPP-830	150m
	Skimmer “Walosep W1” (productivity 40 cub.m/hour)	1 set
	Sorbent	150kg

Table 10.1: Example list of local oil spill response equipment. Courtesy of NSR Administration. Check website for up-to-date information

10.5.4 Insurance

Additional insurance cover is required. It is currently understood that any insurance cover for transiting the NSR, i.e. for hull and machinery, P&I and cargo, is handled on a case-by-case basis by insurance providers. The NSR Administration will require evidence that insurance is in place before granting a permit.

10.5.5 Double hull

The ship being considered for a transit of the NSR must be fit for purpose. Notwithstanding any of the NSR and MARPOL requirements related to Ice Class, it is recommended that all transiting ships are double hulled, including bunker tanks. It is also recommended that the ship has a contingency plan in place that covers transfer of cargo, should the need arise. This may require slack or empty tanks or a dedicated spill tank if appropriate.

10.5.6 Planning

Grounding is a key hazard that may lead to an oil spill. It can be avoided by good passage planning based on reliable hydrographic data, regular meteorological updates and execution by trained and experienced personnel.

Collision with an icebreaker or another ship can be mitigated by using an ice pilot and helmsman supported by trained and experienced personnel.

The oil spill response plan may require amendments due to the harsh environment and will require regular review during the transit.

10.6 Search and Rescue

This section should be read in conjunction with the sections on oil spill response and communications.

An Emergency Position Indicating Radio Beacon (EPIRB) with built-in GPS is recommended, as this gives rapid communication with the low earth orbiting satellites.

SAR facilities throughout the NSR are reportedly being expanded. Table 10.2 shows the facilities available for SAR at the time of publication, but the NSR Administration website should be consulted for the latest information. The NSR Administration and the NSR Information Office websites have diagrams showing the current extent of SAR coverage.

The following points should also be considered:

- Ports of refuge in the vicinity are extremely limited, particularly those accessible to larger ships.
- Ships should ensure that their towing arrangement remains accessible and is ice free at all times.

Maritime Rescue Coordination Centre Dikson

1	Name of centre	MRCC Dikson Lat 73°30'23N Long 080°31'35E	
2	MMSI, call sign, VHF voice call sign	VHF MMSI VHF voice call sign HF/MF frequency MMSI Voice call sign	Channel 16 002731107 Dikson MRCC 2182kHz 002733717 Dikson Radio
3	Landline communications	Tel.: +7(39152) 2-41-00 Mob.: +7 905 998 24 99 Tel/fax: +7(39152) 2-42-00 Telex: 788790 SPAS E-mail: dikson@morflot.ru INMARSAT BGAN ICCID: 870772397954 (voice, voicemail, SMS, GPRS)	
4	Types of SAR facilities normally available	Rescue Boat, Rescue Vessel, Long Range Aircraft	

Maritime Rescue Sub Centre Pevek			
1	Name of centre	MSRC Pevek Lat. 69°42'03 N; Long. 170°15'.26E (MRCC Dikson)	
2	MMSI, call sign, VHF voice call sign	VHF MMSI VHF voice call sign MF/HF frequency MMSI Voice call sign	Channel 16 002731117 Pevek MRSC 2182kHz 002733730 Pevek Radio 3
3	Landline communications	Tel.: +7 42737 42113 Fax: +7 42737 42114 Mob. +7 918 416 41 75 E-mail: pevek@morflot.ru pevek87@inbox.ru Telex: 354471 INMARSAT BGAN ICCID: 870772397870 (voice, voicemail, SMS, GPRS)	
4	Types of SAR facilities normally available	Rescue Boat, Rescue Vessel, Long Range Aircraft, Light Helicopter	
5	Remarks	MRSC's service time period during summer navigation (approx. July-October)	
Maritime Rescue Sub Centre Tiksi			
1	Name of centre	MRSC Tiksi Lat. 71°41'.36N; Long. 128°52'.21E (MRCC Dikson)	
2	MMSI, Call Sign, VHF voice call sign	VHF MMSI Voice call sign HF/MF frequency MMSI Voice call sign	Channel 16 002731196 Tiksi MRSC 2182 kHz 002733718 Tiksi Radio 7
3	Landline communications	Tel.: +7 924 321 20 90 (Head) +7 41167 530 65 (Duty Officer) Fax: +7 41167 523 90 Mob.: +7 924 321 20 90 E-mail: tiksi@morflot.ru Inmarsat- C:427351446 Inmarsat BGAN ICCID: 870772397397 (voice, voicemail, SMS, GPRS)	
4	Types of SAR facilities normally available	Rescue boat, rescue vessel, long range aircraft, light helicopter	
5	Remarks	MRSC's service time period during summer navigation (approx. July-October)	

Table 10.2: Example contact details for Maritime Rescue Sub Centres. Courtesy of NSR Administration. Check website for up-to-date information

11 Personnel: health and safety

Companies should give specific guidance on safe working conditions to ships preparing to transit the NSR. Guidance should consider the effects on personnel of working in a low temperature environment, e.g. the increased risk of hypothermia, frostbite and ice glare.

Ships should have the following on board:

- Clothing adequate for working in low temperatures for all personnel.
- Tools with insulated handles.
- Life saving appliances and fire fighting equipment that are regularly checked to make sure they are working.
- Adequate window blinds/deadlights to counter circadian rhythm unbalances allowing personnel to be well rested before duty.

Additional manning may be required to ensure that increased levels of watchkeeping during ice navigation does not impact upon mandatory hours of rest requirements.

Personnel should be trained on the following:

- Ice operations.
- Safe working in low temperatures.
- How to identify, treat and avoid hypothermia.

The ABS publications *Low Temperature Operations, Guide for Vessels Operating in Low Temperature Environments* and *Winterisation Guidelines for LNG/CNG Carriers in Arctic Environments* and the IPIECA/IOPG publication *Health Aspects of Work in Extreme Climates* (IOGP report 398) contain useful information on the human element and personnel health and safety issues.



A voice for safety

**Oil Companies
International Marine Forum**
29 Queen Anne's Gate
London SW1H 9BU
United Kingdom

T +44 (0)20 7654 1200
F +44 (0)20 7654 1205
E enquiries@ocimf.org
ocimf.org