

# Navigating the Northern Sea Route

*Status and Guidance*



## Our Mission

The mission of ABS is to serve the public interest as well as the needs of our clients by promoting the security of life and property and preserving the natural environment.

## Health, Safety, Quality & Environmental Policy

We will respond to the needs of our clients and the public by delivering quality service in support of our mission that provides for the safety of life and property and the preservation of the marine environment.

We are committed to continually improving the effectiveness of our health, safety, quality and environmental (HSQE) performance and management system with the goal of preventing injury, ill health and pollution.

We will comply with all applicable legal requirements as well as any additional requirements ABS subscribes to which relate to HSQE aspects, objectives and targets.



# Navigating the Northern Sea Route Advisory

Introduction .....	2
Section 1: The Northern Sea Route (NSR) .....	4
Section 2: The Arctic Environment .....	5
Section 3: NSR Regulations .....	8
Section 4: Winterization .....	13
Section 5: Practice of Navigation in Ice Covered Waters .....	17
Section 6: NSR Port Information .....	22
Port of Amderma .....	22
Port of Dikson .....	22
Port of Dudinka .....	22
Port of Khatanga .....	23
Port of Tiksi .....	23
Port of Pevek .....	23
Port of Mys Shmidta .....	23
References .....	24
Contact Information .....	24

# Introduction

Once impenetrable by any vessel other than powerful, polar class icebreakers, the Northern Sea Route (NSR) between Europe and Asia, transiting the waters of the Russian Federation, is now open to passage by most commercial vessels for a protracted period during the summer and autumn periods. Climatic changes associated with the long term trend towards increased global temperatures have rendered the fabled Northeast Passage largely ice free for a limited time each year.

For shipowners the changing conditions have opened new operational and trading opportunities. Using the NSR for a voyage between the principal Asian and European ports can reduce the distance by almost 4,000 miles compared to the traditional route through the Suez Canal. The reduction in distance means not only a reduced overall transit time, implying greater vessel productivity over a calendar year, but also significantly reduced bunker consumption with a concomitant reduction in emissions.

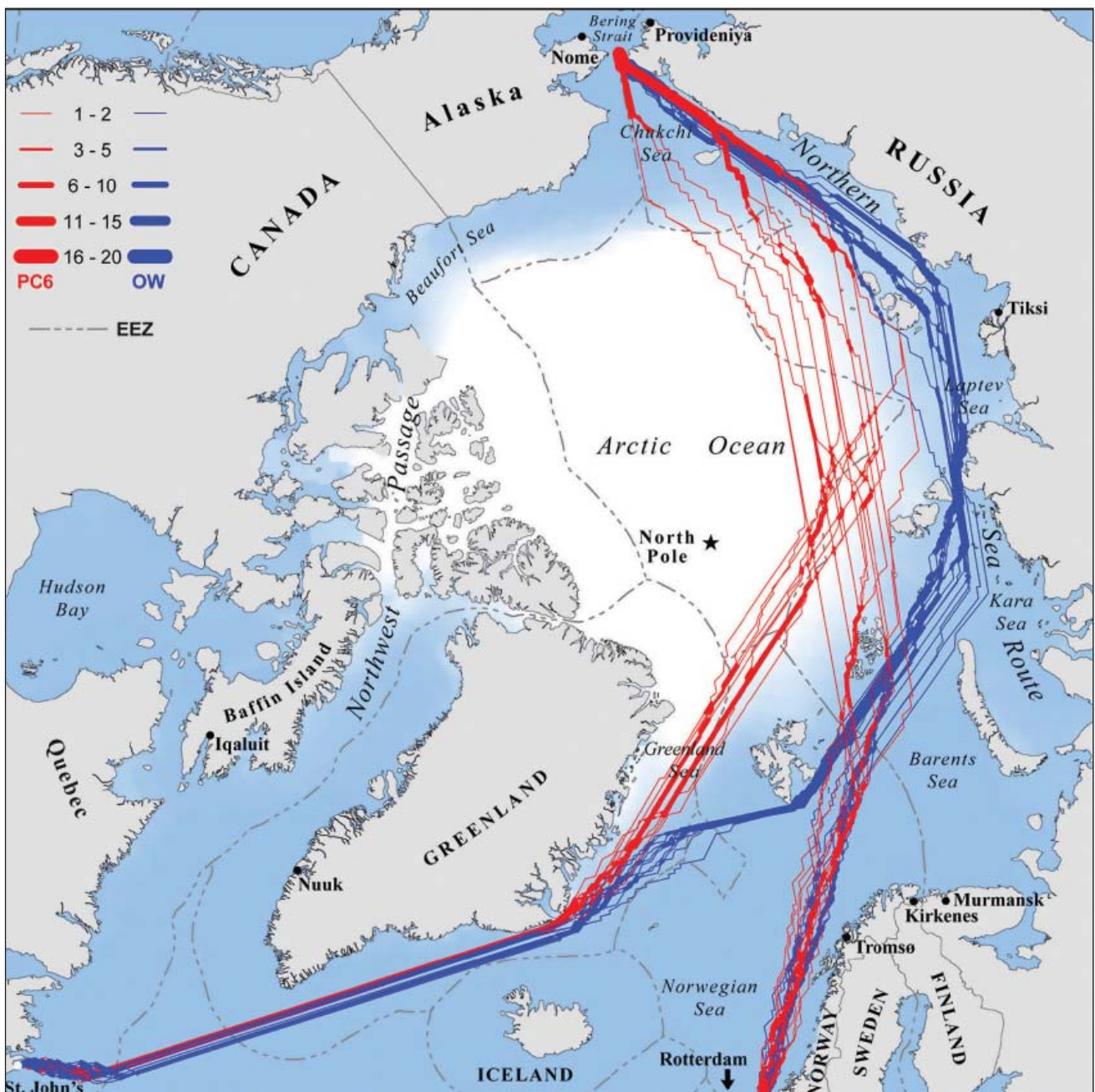


Figure 1. The fastest navigation routes for ships seeking to cross the Atlantic Ocean during September currently favor the Northern Sea Route along Russia's coastline. (Proceedings of the National Academy of Sciences)



Additionally, the open waters off Russia's northern coast are contributing to the development of the energy and mineral rich area, opening new export opportunities for tankers, gas carriers and bulk carriers and in-bound trades for the specialized vessels bringing in the project cargoes and materials needed for the enhanced industrial and mining activity.

Responding to these changes, the Russian Government continues to expand and modernize the permitting process under which ships of all flags can now enter or transit the region. Control of the waters is vested with the Northern Sea Route Administration (NSRA). This Advisory contains six sections:

<b>Section 1</b>	Navigating the Northern Sea Route
<b>Section 2</b>	The Arctic Environment
<b>Section 3</b>	NSR Regulations
<b>Section 4</b>	Winterization
<b>Section 5</b>	Practice of Navigation in Ice Covered Waters
<b>Section 6</b>	NSR Port Information

The Federal State Institution, the Administration of the Northern Sea Route, was established according to the updated Russian laws and orders in 2013 to organize navigation in the water area of the NSR.

The main targets for the Institution are to ensure safe navigation and protect the marine environment from pollution.

- Obtaining and considering the submitted applications and issuing the permissions for navigation through the NSR
- Issuing the certificates of the ice conventional pilotage
- Researching weather, ice, navigational and other conditions
- Coordinating the installation of navigational aids and the harmonization of regions to carry out hydrographic survey operations
- Providing assistance with the organization of search and rescue operations

- Assisting with the elimination the consequences of pollution from vessels of harmful substances, sewage or garbage
- Rendering information services about ice and weather conditions for safe navigation
- Making recommendations for navigational routes using icebreaking fleets
- Timely data retrieval from the Russian hydrometeorological service including forecast and ice analysis

This Advisory is intended to give owners contemplating sending ships into the area sufficient information to initiate the necessary permitting process and to better identify the risks that may be attendant on such a voyage.

It must be emphasized, however, that the official requirements have been subject to significant change in the recent past and there are indications that the Russian Federation is contemplating introducing further changes in the near future in light of the increased traffic. For that reason, this Advisory has been developed strictly for informational purposes. It refers only to the key elements of the official requirements, together with other information pertinent to safe navigation in ice-infested waters and operations in low temperature environments.

Although every attempt has been made to include the latest regulatory information possible at the time of publication of this Advisory, shipowners and others interested in navigating the NSR are strongly urged to refer to the NSRA website at [www.NSRA.ru](http://www.NSRA.ru) and contact the NSRA directly by email at [nsra@morflot.ru](mailto:nsra@morflot.ru) for the specific, latest requirements applicable to a proposed voyage.

Owners are also strongly urged to refer to the *ABS Guide for Vessels Operating in Low Temperature Environments*, available for free download from the ABS website at [www.eagle.org](http://www.eagle.org). This Guide contains the ABS criteria that are intended to assist in the design, operation and maintenance of vessels when operating in low temperature environments and also specifies the ABS requirements and criteria for obtaining the optional notations: Cold Climate Operation, Cold Climate Operation-Polar, Cold Climate Operation Plus, Cold Climate Operation-Polar Plus and the notation DE-ICE for vessels occasionally operating in ice.

## Section 1

# Navigating the Northern Sea Route

The NSR of the Russian Federation provides a shorter distance between ports adjacent to the northern polar region and many ports in the northern Pacific and Atlantic Oceans that are ordinarily reached via the Suez Canal.

For example: the steaming distance between Rotterdam and Japan, using the Suez Canal is around 11,000 miles; via the NSR this reduces to around 7,600 miles equating to a saving (depending upon service speed) of around ten days.

The NSR also provides access to the growing energy, mining and industrial activity in Northern Russia which has already led to increased tanker traffic in the area and has prompted large series orders of ice class liquefied natural gas (LNG) carriers for the future gas export trades.

The first transit of the newly opened (to foreign flag vessels) NSR was completed in the summer of 2009. The number of commercial transits has increased significantly in each succeeding year with more than 300 movements in the area scheduled for 2013. To date transits have been made by tankers (up to suezmax in size), gas carriers, bulk carriers (up to panamax), reefers and general cargo ships.

The NSR extends for about 4,800 km (3,000 miles). Actual voyage length will vary depending upon the route selected, ice conditions, the draft of the transiting vessel and other variants. Annual navigation on the NSR has two main seasons: summer season (typically July to November) and extended season of the rest of the year.

During the summer period, the location of standard routes is determined by the position of ice massifs, the distribution and characteristics of open floating ice and open water. During winter and spring periods, when the coast and islands are blocked by fast ice, the location of standard navigation routes is determined by the characteristics of the ice and the ability of the icebreakers to create a passage on key stretches of the NSR.

## Physical Characteristics

The NSR is described as running through the Kara, Laptev, Vostochno-Sibirskoye (East Siberian) and Chukchi Seas. The NSR can be entered from the west through the Yugorskiy Shar Strait or the Karskiye Vorota Strait, or by passing north of the Novaya Zemlya Islands around Mys Zhelaniya; and from the east through the Bering Strait.

Open water depths for the NSR vary from between 20 to 200 m. Different route options require transiting one or more of the many straits along the route. The water depths in the straits are as follows:

- Kara Strait (in the fairway part) – 50 m
- Matisena and Lenina – not less than 20 to 25 m
- Vilkitskogo – 50 to 250 m
- Shokalskogo – 200 to 250 m
- Yugorskiy Shar – 13 m
- Sannikova – 13 to 15 m
- Dmitriya Lapteva – 8 to 9 m
- Bering – 30 to 50 m



Voice of Russia

## Section 2

# The Arctic Environment

The entire Arctic area has been subject to a clearly identifiable warming trend over the last several decades. This has resulted in a decline in the extent of the sea ice coverage (by as much as 30 percent). The formation and growth of sea ice depends on the air temperature falling below freezing ( $0^{\circ}\text{C}$ ) and subsequent lowering of sea surface temperatures below  $-1.6^{\circ}\text{C}$ .

Enormous variability is inherent in the prevailing conditions of the NSR. During the period in which the route is open, vessels can expect to encounter moderate and strong winds, low air temperatures, a high number of days with fog and, late in the season, long polar nights, snowstorms and possible blizzards.

The NSR can be divided into three principal climatic areas.

- **Atlantic Area** (Barents Sea, western part of the Kara Sea and part of the Arctic basin extending to the north of them). Frequent storms in winter and dull weather with frequent fogs and precipitation in summer are characteristic for this area.
- **Siberian Area** (eastern part of the Kara Sea, Laptev Sea, western part of the East Siberian Sea). This area is influenced by the Siberian Low in winter. Air temperatures here tend to be lower than in surrounding areas in winter and higher in summer near the continental coast although the northern parts of the area remain cool even during summer.
- **Pacific Area** (eastern part of the East Siberian Sea, the Chukchi Sea). In winter it is strongly influenced by Pacific weather systems. Air temperature is higher and wind strength, and the amount of precipitation in this area are greater than in the surrounding areas. Summer can be stormy with wide fluctuations in temperatures and periods of dense fog.

Among the large number of natural conditions (climatological factors) characterizing the Arctic seas, the main ones directly influencing navigation along the NSR are as follows.

### Polar Lows

Polar lows are small, intense and usually form quickly causing a rapid increase in wind speed or heavy snow flurries. They tend to form either near the coast or near the edge of the ice sheet where cold air flows out onto relatively warmer open air and usually dissipate within a day.



Figure 2. Map of the NSR





## Air Temperature

Snow and ice thawing in summer result in temperatures remaining close to 0°C. In late summer and autumn, temperatures drop below 0°C with regional variations. In the northern parts of the Kara and Laptev seas and in the central part of the East Siberian Sea, this transition occurs in late August. In the central parts of the Kara and Laptev seas, as well as in the northern parts of the Barents and Chukchi seas and along the coast of the East Siberian Sea, this transition occurs in late September. In the south-western part of the Barents Sea the transition to freezing temperatures may not occur until mid-November.

## Visibility

Northern lights or the Aurora Borealis are the most obvious manifestation of the unique visual sights that can be experienced in the NSR area. The aurorae are created by the collision of energetically charged particles within the atmosphere. Microscopic ice crystals are also suspended in the air, changing how light travels over distances. Layers of hot and cold air refract light rays and light will bounce off the surfaces of clouds, water and ice to create optical illusions.

The NSR is particularly susceptible to frequent fogs during the summer months, reducing visibility. Fog is most frequent near the edge of concentrated ice. Sea fog forms either when warm, moist air moves over colder seawater or cold air moves over warmer seawater. Fog may cover large areas of the NSR and may persist for long periods.

Visibility can also be adversely affected by blowing snow. The incidence of blowing snow is dependent upon there having been recent snowfalls (autumn, winter and early spring) coupled with strong winds.

The more hazardous whiteout condition occurs when the sky and snow assume a uniform whiteness, making the horizon indistinguishable. These occur most frequently in spring and autumn when the sun is near the horizon and the sky is overcast.

Optical Haze, or shimmer, can also be experienced in the NSR area. Once again it occurs when layers of colder and warmer air interact in a convective pattern, refracting light in a manner that causes objects to appear blurred.

Ice blink refers to a white glare seen on the underside of low clouds. An ice blink indicates the presence of light-reflecting ice which may be too far away to see and can, therefore, be used to identify possible ice conditions at a distance.

## Noise

Atmospheric conditions can also allow noise to travel much further in the Arctic than in more temperate areas. The cold surface temperatures hold sound waves captive. Under the right combination of air temperature, wind speed and the surrounding surface (snow absorbs sound, ice reflects it) normal conversations can carry over distances of up to 3 km.

## Wind

Direction, speed and persistence of wind can directly influence the success of navigation due to its impact on drifting ice. Winds are characterized as either pushing-off or pushing-in with the first contributing to the weakening of compression in concentrated ice, and the latter strengthening the ice. Blizzards may be encountered early (June) and late (October) in the season with their incidence being higher in the northern parts of the region. In the eastern and western parts of the NSR the number of days with blizzards during winter months averages around 12 to 14.

## Sea Level Variations

In most Arctic sea areas the set-up and set-down amplitude of sea level variations is several times greater than the values of tidal variations alone. All Arctic seas are characterized by the pronounced seasonal level variations: the minimum level (0.2 m on average) is observed in March-April and the maximum (0.4 m on average) in October-December.



## Waves

The development of waves in the Arctic seas depends on the speed and direction of wind, water depth and the presence and distribution of ice. The most severe sea states (wave heights of 4 to 5 m) usually develop in early autumn (September and October) but by November the seas, except the southern part of the Chukchi Sea, are almost completely covered by ice.

## Ice

Ice may be encountered on the NSR at any time. In years with heavy ice conditions, Arctic seas are almost completely covered with drifting ice throughout the summer. In years with light ice conditions, the ice edge withdraws towards the northern sea boundaries. The ice cover normally begins melting around mid-June. Refreezing in the northern part of the Kara and Laptev seas and in the northern part of the Chukchi Sea does not usually begin until mid to late September.

By late October, ice thickness on level stretches reaches on average 25 to 30 cm. By December it will typically reach 70 to 90 cm. The thickest level ice (140 to 210 cm in addition to hummocking) occurs in May prior to the opening of the traditional period of activity on the NSR. Second and multi-year ice in the northern reaches of the transit area may exceed 2 to 3 m.

Sea ice is generally classified by age and thickness:

- New ice is usually considered to be up to 10 cm (3.9 inches) thick.

- Young ice is 10 to 30 cm (3.9 to 11.8 inches) thick.
- First-year ice is thicker than 30 cm (11.8 inches), but has not survived a summer melt season.
- Multiyear ice is ice that has survived a summer melt season and typically ranges from 2 to 4 meters in thickness. It contains less brine and more air pockets than first-year ice making it more difficult to break.
- Ridges are formed when sheet ice forms into piles as a result of wind or currents. Ridges in the NSR can be several meters thick, forming a significant barrier to navigation. Eroded ridges are referred to as hummocks.
- Fast ice is ice that forms along the coastline and extends seawards in generally shallow water.
- Drift ice forms in open water and moves under the influence of wind and currents

The most important characteristic of ice conditions in summer is the location and amount of concentrated ice (ice massifs). Ice massifs represent accumulations of ice of high concentration and greater thickness and hummocking. The most significant obstacles for navigation along the NSR are the Novozemelskiy, Severozemelskiy, Taymyrskiy and Ayonskiy massifs.

Winds and currents can drive ice to move fast and ice situations may change quickly. It is recommended to follow the orders of the Master of the icebreaker or ice pilot along the NSR.

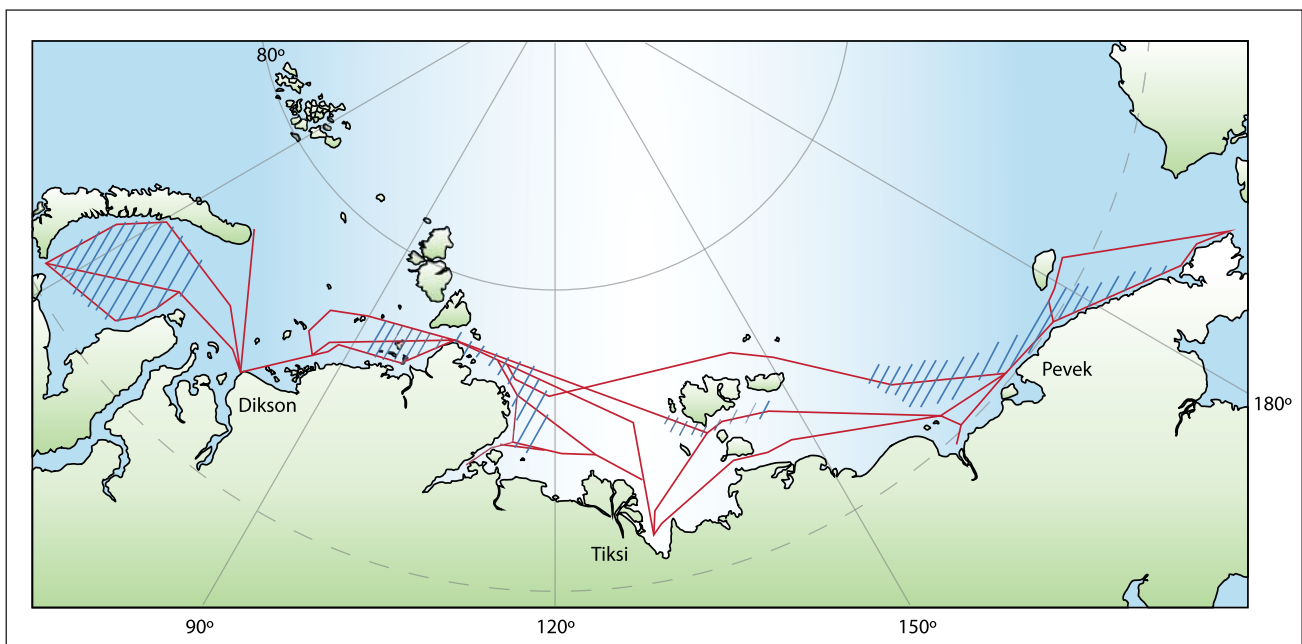


Figure 3. Main tracks of navigation along the NSR and regions with unfavorable ice conditions

## Section 3

# NSR Regulations

The responsibility for administering the NSR is vested with the NSRA. For more information, consult [www.NSRA.ru](http://www.NSRA.ru). Based on Federal Law, in January 2013, the Ministry of Transport of Russian Federation developed and approved the *Rules of Navigation on the Water Areas of the Northern Sea Route*. This document provides articles on:

- Procedure of the navigation of ships in the water area of the NSR
- Rules of the icebreaker assistance of ships in the water area of the NSR
- Rules of the pilot ice assistance of ships in the water area of the NSR
- Rules of the assistance of ships on seaways of the water area of the NSR
- Provision about the navigational-hydrographic and hydrometeorologic support of the navigation of ships in the water area of the NSR

- Rules of the radio communication during the navigation of ships in the water area of the NSR
- Requirements to ships pertaining to the safety of navigation and protection of the marine environment from the pollution from ships
- Other provisions in relation to the organization of the navigation of ship in the water area of the NSR

This section provides essential elements of the *Rules of Navigation on the Water Areas of the Northern Sea Route*. More detailed regulations can be obtained from NSRA.

## Submitting an Application for Passage through the NSR

Granting permission for the navigation of ships in the water area of the NSR is effected by the NSRA on the basis of applications, that can be submitted to the NSRA by email up to four months prior to the intended passage and not less than 15 days prior to entry into the NSR. Applications in Russian or in English, in pdf format can be submitted by the shipowner, the shipowner's representative or the ship's Master (provided a copy of authorization from the owner is included in the submission). The following key documents in pdf format are to be submitted in Russian and/or in English with the application:

- Information about ship and voyage
- Copy of the classification certificate
- Copy of the measurement certificate
- Copies of documents certifying availability of the insurance

The NSRA will notify the shipowner within twelve days if permission has been granted or, if not, of the reasons justifying the refusal. The information will also be posted to the NSRA website. Successful applicants will be notified at this time of the proposed route and given information on the need for icebreaker assistance in the various sections of the route.

## Notification Prior to Entry into the NSR Area

A ship which was granted permission should not enter the water area of the NSR earlier than on the permitted date and should leave in accordance with the permitted date. For example, 72 hours prior to entry into the NSR area, or immediately after the departure from the last port of call if the navigational period of the ship from the port to



the boundary of the NSR is less than 72 hours, the ship's Master must notify the NSRA of the vessel's estimated time of arrival:

- When eastbound, the meridian 33° East
- When westbound, parallel 66° North and/or meridian 169° West

In addition, 24 hours before approaching the Western or Eastern boundary the ship's Master should notify the NSRA of the planned time of the arrival of ship to the appropriate boundary.

### Rules for Icebreaker Assistance

Most vessels entering or transiting the NSR will require icebreaker escort. Information on the necessity to use icebreaker assistance under heavy, medium and light ice conditions while sailing in the water area of the NSR is provided by the NSRA. Icebreaker assistance is rendered by the icebreakers authorized to navigate under the State flag of the Russian Federation. The list of organizations that provide icebreaker assistance is provided in this Advisory.

Icebreaker assistance involves ice reconnaissance. Icebreakers make channels in ice. This involves the formation of a group of ships following the icebreakers. Ships sail through the channel behind an icebreaker in tow, without towing in an independent mode or as part of a group of ships to ensure the navigation safety. Communications between icebreakers and ships are carried out by radio communication on channel 16 at a very high frequency (VHF).

The fee rate of the icebreaker assistance of a ship in the water area of the NSR is determined by the legislation of the Russian Federation taking into account the capacity of the ship, the ice class of the ship, the escorting distance and the period of navigation.

The point and time of the beginning and end of the icebreaker assistance for a ship are agreed to by the shipowner with the organization rendering service of the icebreaker assistance in the water area of the NSR. The ice convoy is under control of the Master of the icebreaker rendering the icebreaker assistance. The order of the allocation of ships within the ice convoy is specified by the Master of the icebreaker that is rendering the assistance.

While moving in the ice convoy, the ship's Master must maintain the ship's placement within the convoy and maintain the proper speed and



distance between the ship that is ahead of it based on the instruction of the Master of the icebreaker. The ship's Master will also maintain communication with the Master of the icebreaker. This information would include difficulty with maintaining a fixed place within the ice convoy, speed and/or distance between a leading ship, or any information about damages inflicted on the ship.

### Rules of Pilot Ice Assistance

Pilot ice assistance of ships is carried out with the purpose of ensuring navigation safety, the prevention of accidents as well as the protection of the marine environment in the water area of the NSR. The fee rates for the pilot ice assistance in the water area of the NSR is determined in accordance with legislation of the Russian Federation taking into account the capacity of ship, the ice class of ship, the escorting distance and the period of navigation. The list of organizations that provide pilot ice assistance is provided in the Advisory.

During the pilot ice assistance of ship, recommendations are given to the ship's Master regarding:

- Assessment of ice conditions and possibility of the safe navigation of ship under these conditions
- Selection of optimum route of the movement of ship and of the relevant scenario of the navigation of ship in ice independently





- Selection of speed and ways of performing maneuvers of ship avoiding dangerous interaction of hull and rudder propeller system with ice
- Ways to maintain safe speeds and distance between the icebreaker or ship ahead when moving in convoy
- Ways to execute the instructions from icebreaker Masters rendering assistance

### Guidance of Ships on Sea Ways of the NSR

The guidance of ships on the NSR implies continuous supervision of ships from the NSRA. This includes the coordination of ship traffic flows and the icebreakers servicing the seaways of the NSR. It includes the provision of an ice pilot for ships, securing icebreaker assistance as well as the systematic notification to ship Masters of ice and hydrometeorological conditions so that they are able to rapidly and safely navigate through the NSR. Recommended guidance is also provided for the ships navigating in the NSR areas when no ice is present as well as for the ships that are classified as ice class so that they are able to independently move along the NSR under known ice conditions.

When the ship moves on the seaways in the water area of the NSR after crossing the Western or Eastern boundary, before leaving the water area once a day at 12.00 of Moscow time, the ship's Master sends a report to the NSRA. The following information must be included in the report:

- Name of ship and IMO number
- Geographical coordinates of the ship (latitude and longitude)
- Planned route and time, including ship's speed
- Ice condition, temperature, wind speed and direction, visibility
- Amount of fuel, fresh water aboard and other vessel information

### Navigational-hydrographic and Hydrometeorologic Support

Navigational-hydrographic support for ships navigating in the water area of the NSR involves investigating submarine relief in order to maintain navigational nautical charts, guides and manuals to keep navigation information up-to-date for navigation facility equipment (NFE). In addition, this information can be used to inform seafarers of changes to navigation for the route. The navigational-hydrographic support in the water area of the NSR is provided by Rosmorrechflot, the federal body of the execution power performing functions of rendering State services and State property control in the sphere of sea transport.

As for navigational-hydrographic support of ships navigating the NSR, functions of the agreement include the installation of NFE and identifying areas for carrying out hydrographic works in the water area of the NSR. Support also includes rendering information services (as applied to the water area of the NSR) for the navigational-hydrographic support of the navigation of ship are performed by the NSRA.

### Communications

Radio communication between ships, icebreakers and the NSRA is carried out with the use of radio equipment designed for the application within the operating zones of sea regions A1, A2, A3 and A4 of the Global Maritime Distress and Safety System (GMDSS). While moving in ice convoy, icebreakers and ships maintain continuous radio watch on the VHF channel 16. While moving in the ice convoy, radio communication between ships and between ship and icebreaker/icebreakers is carried out on the VHF communication channel established by icebreaker master supervising the movement of the ice convoy.



## Ice Strengthening Criteria

Table 1. For ships without ice strengthening meeting the criteria for categories Ice1 to Ice 3 during the navigation period from July to November 15<sup>1</sup>.

Ship's ice reinforcement class	Ice navigation mode	The Kara Sea		The Laptev Sea		The East Siberian Sea		The Chukchi Sea
		Southwest part	Northeast part	Southwest part	Northeast part	Southwest part	Northeast part	
		H M L	H M L	H M L	H M L	H M L	H M L	
No <sup>2</sup>	Ind. <sup>3</sup>	---	---	---	---	---	---	---
	IA	--+	--+	--+	--+	--+	--+	--+
Ice1	Ind.	--+	--+	--+	--+	--+	--+	--+
	IA	--+	--+	--+	--+	--+	--+	--+
Ice2	Ind.	--+	--+	--+	--+	--+	--+	--+
	IA	-++	-++	--+	--+	--+	--+	--+
Ice3	Ind.	--+	--+	--+	--+	--+	--+	--+
	IA	+++	+++	--+	--+	--+	--+	-++

Notes:

1. For ships without ice strengthening and with category of ice strengthening Ice1 to Ice3 navigation in the water area of the NSR from November 16 to December 31 and from January to June is prohibited.
2. Oil tankers, gas carriers, chemical carriers with a gross tonnage of 10 000 and over without ice strengthening can navigate in the water area of the NSR only in open water assisted by icebreaker during the period from July to November 15.
3. For ships without ice strengthening it is allowed to independently navigate in the water area of the NSR only in open water.

Table 2. For ships meeting the category of ice strengthening Arc4 to Arc9 during the period of navigation from July to November.

Ship's ice reinforcement class	Ice navigation mode	The Kara Sea		The Laptev Sea		The East Siberian Sea		The Chukchi Sea
		Southwest part	Northeast part	Southwest part	Northeast part	Southwest part	Northeast part	
		H M L	H M L	H M L	H M L	H M L	H M L	
Arc4	Ind.	-++	-++	--+	--+	--+	--+	-++
	IA	+++	+++	-++	-++	-++	-++	-++
Arc5	Ind.	+++	+++	-++	-++	-++	-++	-++
	IA	+++	+++	+++	+++	+++	+++	+++
Arc6	Ind.	+++	+++	+++	+++	+++	+++	+++
	IA	+++	+++	+++	+++	+++	+++	+++
Arc7	Ind.	+++	+++	+++	+++	+++	+++	+++
	IA	+++	+++	+++	+++	+++	+++	+++
Arc8	Ind.	+++	+++	+++	+++	+++	+++	+++
	IA	+++	+++	+++	+++	+++	+++	+++
Arc9	Ind.	+++	+++	+++	+++	+++	+++	+++
	IA	+++	+++	+++	+++	+++	+++	+++

Table 3. For ships meeting the categories of ice strengthening Arc4 to Arc9 during the period of navigation from January to June and in December.

Ship's ice reinforcement class	Ice navigation mode	The Kara Sea		The Laptev Sea		The East Siberian Sea		The Chukchi Sea
		Southwest part	Northeast part	Southwest part	Northeast part	Southwest part	Northeast part	
		H M L	H M L	H M L	H M L	H M L	H M L	
Arc4	Ind.	- - +	- - +	- - +	- - +	- - +	- - +	- - +
	IA	- - +	- - +	- - +	- - +	- - +	- - +	- - +
Arc5	Ind.	- - +	- - +	- - +	- - +	- - +	- - +	- - +
	IA	- - +	- - +	- - +	- - +	- - +	- - +	- - +
Arc6	Ind.	- - +	- - +	- - +	- - +	- - +	- - +	- - +
	IA	- + +	- + +	- - +	- - +	- - +	- - +	- + +
Arc7	Ind.	+ + +	- + +	- - +	- - +	- - +	- - +	- + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc8	Ind.	+ + +	+ + +	- + +	- + +	- + +	- + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc9	Ind.	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +

Table 4. For icebreakers meeting the criteria for categories of ice strengthening Icebreaker6 to Icebreaker8 during the period of navigation from January to June and in December.

Ship's ice reinforcement class	Ice navigation mode	The Kara Sea		The Laptev Sea		The East Siberian Sea		The Chukchi Sea
		Southwest part	Northeast part	Southwest part	Northeast part	Southwest part	Northeast part	
		H M L	H M L	H M L	H M L	H M L	H M L	
Icebreaker6	Ind.	- + +	- + +	- - +	- - +	- - +	- - +	- + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Icebreaker7	Ind.	+ + +	+ + +	- + +	- + +	- + +	- + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Icebreaker8	Ind.	+ + +	+ + +	- + +	- + +	- + +	- + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +

Designations used in the present annex:

Ind. – independent navigation;

IA – navigation under the icebreaker assistance;

H – heavy ice conditions in compliance with the official information of Roshydromet;

M – medium ice conditions in compliance with the official information of Roshydromet;

L – light ice conditions in compliance with the official information of Roshydromet;

+ – navigation of ship is permitted;

– – navigation of ship is prohibited

## Classification Standards

The criteria of ice class for the NSR was presented in reference to the *Rules and Specific Ice Class Notations of the Russian Register of Shipping (RS)*, while the application for navigation in the NSR requires a class certificate. The ABS class certificate is based on the *Rules for Building and Classing Steel Vessels*. Since specific equivalencies have not been rigorously established between RS criteria for various ice classes and those for the internationally recognized ice classes from the International Association of Classification Societies (IACS), an approximate correspondence can be used. However, owners are advised to seek confirmation from ABS that the approximations used are valid.

For guidance the following listing provides a comparison between the ice class notations of RS and those used by ABS and other IACS members:

RS	IACS/ABS
ARC 4	PC6
ARC 5	PC5
ARC 6	PC4
ARC 7	PC3
ARC 8	PC2
ARC 9	PC1

## Section 4

### Winterization

Recent experience has indicated that some ice class vessels have experienced difficulties operating in very cold regions. The vessels did not suffer damage to the hull or propulsion machinery which is adequately addressed in the ice class rules. They incurred failures as a result of the vessel not being prepared for operations in low temperatures, such as freezing hatch covers, frozen water lines etc.

Effective winterization requires a logical and methodical assessment of the ship, its equipment and the needs of its crew. An alternative or supplementary approach is the evaluation of the ship using a risk-based methodology which ABS has developed. Temperature data can be collected from climatology stations located in the area of

operation of the vessel then environmental loading scenarios are defined by statistical analysis of the temperature data to obtain probabilistic distributions for the loadings. Risk values are calculated under different loading scenarios and based on the risk values, appropriate winterization strategies can be determined or the winterization levels can be evaluated based on risk values.

Owners contemplating using the NSR are urged to refer to the *ABS Guide for Vessels Operating in Low Temperature Environments* which addresses many of these issues. It is available for free download from the ABS website [www.eagle.org](http://www.eagle.org). The following is a summary of some of the more important issues.

For the operators who plan to navigate through the NSR, it is important that they understand the capabilities of their vessels with regard to the low temperatures and ice. This includes knowledge of the material grade of the structure and information about the temperatures that could affect performance of various systems, essentially the temperature when systems start to deteriorate, and the plan for actual operation is needed.

### Crew Considerations

The crew of any ship is perhaps the most susceptible system to the cold. For this reason the crew must be properly equipped with appropriate clothing to protect bodies, hands, head, eyes, and feet. (Refer also to the NSRA requirements for specifics with respect to numbers of sets of clothing and thermal floatation suits.) The crew must also be equipped with appropriate tools, such as shovels, mallets, and scrapers

### Materials, Machinery and Coatings

When vessels operate in low temperatures the materials used to construct the vessel are forced to perform at temperatures closer to their brittle transition temperature. A material in use below its brittle transition temperature will not demonstrate the large elastic behavior that is customarily associated with materials used to construct marine units. To mitigate the risk of materials being used below their transition temperature, most ice class rules require specific materials for specified applications and temperatures. In cases where no ice class rules apply or the ice class does not contain hull structural material requirements, requirements are included in the

ABS Low Temperature Environment Guide based on structure location, material thickness and the design service temperature.

In addition to hull structural material requirements, winterization efforts must include the material requirements for machinery. Due to the nature of most machinery use and the exposed structures of most machinery components, the material requirements are more demanding. This higher material demand is reflected in the requirements to use higher material classes and the lower Minimum Anticipated Temperature.

Machinery that is not needed while the vessel is subject to low temperatures, such as cranes on a bulk carrier merely transiting the NSR, need not be designed for the minimum anticipated temperature.

There are no specific requirements for special low temperature coatings but there is a considerable amount of information included in Appendix 2 of the ABS Low Temperature Environment Guide.

Coatings can help reduce ice accretion or aid in the removal of ice. Low friction coefficients for various hull coatings can help vessel movement through the ice. Proper selection of coatings can aid an operator in keeping their vessel safe, operational, and efficient.



## Hull Construction and Equipment

In low temperatures such as those experienced in the NSR, tanks and the fluids in them can be affected by the low temperature. Ballast tanks and fresh water tanks can freeze becoming impossible to pump out or having the potential to cause structural damage from the expansion experienced during the phase change. Fuel and lube oil can become cooled below the pour point and become unusable.

ABS offers guidance to minimize the effects of low temperatures on these tanks both from a tank positioning standpoint when considering a vessel design and the addition of systems to reduce the effects of the low temperature environment.

Environmental issues are magnified in a sensitive environment such as the NSR. For this reason ABS recommends the requirements in the *Steel Vessel Rules for Protection of Fuel and Lubricating Oil Tanks*, be applied in addition to, or as an adjunct to the specific requirements of the NSRA. The ABS requirements are in-line with MARPOL requirements for fuel tanks but are extended to lubricating oil tanks.

## Machinery Systems

Operation of internal combustion engines in ice covered waters and low temperatures can be problematic if those engines are not designed and well prepared for such operations. The large range of power requirements often require that the engines be operated for extended periods at very low power outputs and the rapid reversal of power must be expected. When running at low power, diesel engines can run inefficiently and can suffer internal damage to bearings.

Machinery spaces often have many systems that are susceptible to low temperatures and need to be kept from freezing. Under normal operating conditions the waste heat emanating off machinery maintains the machinery space at a relatively high temperature but, if combustion air is drawn from the machinery space, the high volume of cold air may reduce the temperature sufficiently to freeze systems. To remedy this problem, it is recommended that combustion air be routed directly to the engines from the vessel's exterior.

However, operating an engine with extremely cold combustion air can also give rise to operational problems. Starting may be difficult as the compression may not generate enough thermal



energy for auto ignition. A naturally aspirated running engine encountering cold dense air may experience cylinder over pressurization, and a turbocharged engine may experience surging. These issues can be remedied by pre-heating the combustion air or ensuring the combustion air is in accordance with the manufacturer's recommendations.

## Piping and Electrical Systems

Piping systems are particularly susceptible to the effects of low temperatures. ABS recommends that pipes be drained where possible or, where draining is not possible, the pipes should be heat traced and insulated.

Valves and connection stations can become covered in ice, rendering handles and connectors unusable, therefore these stations should be placed in a protective enclosure to protect them from the environment.

Safety critical systems such as fire lines should be drained, heated, insulated and/or positioned to remain effective at the minimum anticipated temperature. Portable fire extinguishers that are susceptible to freezing should not be placed in a location where freezing is likely.

Cooling and ballasting arrangements are to be such that the suctions remain effective in the presence of ice. Typical sea chests often become plugged with ice while transiting ice infested waters and loss of cooling is possible which could result in loss of propulsion power. There are several sea chest configurations offered in Appendix 4 of the ABS Low Temperature Environment Guide that will help designers address this problem.

The ships electrical power supply should to be designed to accommodate the extra load from heating and heat tracing systems, including the emergency generator's capacity. In an event where the ship must switch to emergency power, providing heat for the crew is essential for survival but other stations, such as the machinery space workshop, should be heated as well.

## Accommodation and Work Areas

The spaces where crews are accommodated or expected to perform routine tasks should be ventilated and heated to maintain safety and human performance. The vessel's heating system must be able to maintain the accommodation



spaces at approximately 20oC (68oF) while the ship is in the minimum anticipated temperature. On top of maintaining the temperature the humidity must be controlled, particularly to avoid the air becoming too dry.

## Safety Systems

When it comes to operations in low temperatures, such as can be experienced in the NSR, current international requirements and most flag Administration regulations may not be adequate. Owners should look to the NSRA requirements which are based on extensive experience with cold weather operations. ABS also offers recommendations which supplement SOLAS and the LSA Code.

Navigational equipment must be able to provide the master with enough information for tactical avoidance of hazardous ice formations, and do this at the design service temperature. This is typically achieved by a special radar unit supplemented by a weather telefax capable of receiving high resolution ice weather charts. (For more information, refer to the NSRA for specific requirements.)

Lifesaving appliances should be operable at the temperatures expected during transit. The sizing of lifesaving appliances should be appropriate for use when bulky low temperature clothing is worn by crewmembers. To maintain operation at low temperatures the propulsion system for the lifeboat must be heated and the doors must be kept from freezing. Items like food rations and drinking water also require protection while in storage. Regular checking of the functionality is of essence for essential systems and equipment. The hooks can become difficult or impossible to use if they are covered in ice for both release and retrieval, and should be protected from ice accretion and freezing.

Launching stations should offer protection for the crew as they are mustering or embarking.



## Ship Icing

Ship icing occurs when water (or, more frequently, water and snow, water and floating ice, wet snow) accumulates on the above-the-water surfaces of a ship and freezes. This type of icing may occur at any time throughout the year and presents a threat to ship safety if allowed to persist as ice thickness can reach as much as 1 m.

Ice buildup usually occurs in the forward parts of the vessel and above the vessel's center of gravity (CG). This added mass on the vessel's superstructure and outfitting will cause a change in the CG and can result in reduced stability. Additionally the ice accretion on the forward part of the vessel will affect the vessel's trim, possibly exposing the rudder and propeller to damage. The vessel's master should be provided with sufficient information to address such risks.

Vessel icing is a function of the ship's course relative to the wind and seas and generally is most severe in the following areas: stem, bulwark and bulwark rail, windward side of the superstructure and deckhouses, hawse pipes, anchors, deck gear, forecastle deck and upper deck, freeing ports, hatches, aerials, masts and associated rigging. Small vessels are usually more prone to the effects of icing. Careful observation of the changes in the rolling period can detect the accretion of ice.

It is important to maintain the anchor windlass free of ice so that the anchor may be dropped in case of emergency. Constant spray entering the hawse pipes may freeze solid inside the pipe, also anchors stowed in recessed pockets may freeze in place. It is good practice in freezing spray to leave anchors slightly lowered in the hawse pipe in order to free them from ice accretion when needed. It is also advisable to maintain securing claws in place

in case of slippery brakes, so that the anchors can be readily released in the event of a power blackout.

The effects of freezing spray can be minimized by slowing down in heavy seas to reduce bow pounding, running with the sea, or seeking more sheltered sea conditions near-shore or in sea ice. Where practical, it is recommended that structures be included in the vessel's design to protect the bow area so that personnel can access and use the equipment in all weather conditions. The ice buildup may also occur in places such as navigation bridge windows, doors, decks and stairs on emergency escape routes. Possible solutions to counter these adverse effects include heating or the use of de-icing chemicals.

## Consideration for Vessel Types

Different types of vessels require special attention with regards to winterization. The vessel types that are included in the ABS LTE Guide are listed below with a brief description of items that should be considered when winterizing one of these vessel types.

### Gas Carriers

Due to the nature of the cargo, gas carrier cargo related systems generally have no issues with low temperature environments. The problems faced by these ships are the exterior structures and machinery. Consideration of static and dynamic loads due to ice and snow buildup on the containment system, including sliding/falling ice must be considered. The stability of gas carriers must be carefully considered as the ice mass could sit high on the vessel depending on the containment system employed.

Relief valves, vent masts and piping need to be kept ice free as they can become plugged or blocked with ice formation. Vapour heating by steam is recommended to prevent vapours from descending to the vessel's deck.

Vessels operating on "gas only mode" may experience lower boil off volumes at lower temperatures, the ship's provisions for forced boil-off should be evaluated to determine if it will be adequate for the design service temperature.

### Tankers

Piping systems on the main deck of an oil carrier need to be protected from freezing. Special consideration must be given to the inert gas system

as considerable amounts of condensate can drain into the liquid breaker. This can cause two issues with the breaker, the liquid level will change and the glycol solution will become diluted increasing the risk of freezing.

The condensation that normally arises from the cargo can cause pressure/vacuum valves to freeze and must be protected.

### **Bulk Carriers**

The specific areas of bulk carriers where winterization should be considered are in way of the cargo area. The hatch covers and their seals can become frozen, too stiff to seal, or tear due to being stuck to the cover at low temperatures. Experience has shown that a frozen hatch cover can overpower the strength of the main deck in way of the hydraulic ram. The sealing arrangements must be suitable for operation at the minimum anticipated temperature at which they will have to operate.

Additionally if the ship is expected to conduct cargo operations while in the low temperature area the large openings effectively expose the cargo hold interior to the outside temperature. This can cause a number of issues for systems such as water ingress detectors or freezing of ballast tanks and pipes. Topside tanks are especially susceptible to freezing as they are exposed on multiple sides. Materials used on tank tops must be designed for operation at the design service temperature.

### **Offshore Support Vessels**

OSVs used in the Arctic may double as ice breakers and as such may be subjected to beaching. Stability in this case should be considered and also the effects of the trailing wave riding up the inclined plane of the stern deck when the vessel beaches on ice. Repetition of this wave breaking on the stern in low temperatures will result in rapid ice accretion on the vessel's stern.

Drilling fluids that OSVs often carry can be very susceptible to low temperatures becoming very difficult to pump, and the connection stations can become completely covered in ice.

Towing winches can be subjected to large loads while exposed to low temperatures, therefore any material used in the winch construction that will be under tension should be able to do so at the minimum anticipated temperature

## **Section 5**

# **Practice of Navigation in Ice Covered Waters**

## **Ice**

Drift ice is the main ice form encountered within the NSR. A vessel navigating in drift ice is affected by dynamic factors (shearing, pressure/compression etc.), as well as by hull icing. The most dangerous phenomena when navigating in close ice are ice pressures of more than 2 points (see below) and ice rivers which occur when grated and repeatedly rafted young ice, that may be more than 1 mile wide, drifts along the outer limit of relatively less mobile, or fixed fast ice.

For ship traffic on the NSR ice compression is the principal concern. Compression is the horizontal shift of ice cover accompanied by the deformation of ice edges leading to the formation of hummocks. A three-point system is used for assessing compression:

- **1 point** – low intensity compression. Rafting of young ice with brash ice at the edges;
- **2 points** – considerable compression. Hummocking of young ice with rollers of small cake and brash ice forming; and
- **3 points** – high compact hummocking with intensive hummocking of the first-year and multi-year ice.







Compression is generally more common close to shore, less prevalent in the open sea and is exacerbated by pushing-in wind flows which typically last for two to three days. The frequency of 1 point compression on the NSR in winter and spring is estimated at 65 percent; 2 points at 29 percent and 3 points and higher at 6 percent.

On the western stretches, where navigation takes place in first-year ice, the presence of compression, in the majority of cases, results only in a reduction of speed; on the eastern stretches ships may encounter second-year and multi-year ice requiring icebreaker assistance.

Navigation through ice is assisted by the presence of leads and polynyas, regions of open water between ice sheets. Leads are narrow, constantly evolving features formed from the motion and shearing of the ice sheets. They can vary considerably in size and generally have a relatively short lifespan. Recently frozen leads also offer easier navigation as the ice tends to be thinner and more easily broken. Polynyas formed from either upwelling warm water or persistent winds, are relatively stable and tend to remain open for extended periods.

### General Ship-handling Techniques in Ice

Although most navigation along the NSR is done with the support of experienced ice pilots and icebreakers, the following general recommendations for navigating in ice covered waters should be borne in mind at all times.

It is essential that a vessel's Master and crew should never underestimate the power and strength of ice. It is also essential to keep the vessel moving at a prudent speed at all times even if only at dead slow. A stationary vessel can quickly become locked in

the ice and will lose all maneuvering capability and be carried by the ice in the direction of the drift. Excessive speed, even in patches of open water, should be avoided as contact with floating ice is an ever present danger with attendant damage to the ship structure and visibility can deteriorate quickly from fog, blowing snow and other causes.

The prudent Master will not attempt to maintain a constant course but will patiently work with the ice, picking paths of least resistance through the ice mass. It is always advisable to encounter ice at 90 degrees to minimize the possibility of structural damage from a glancing blow.

Before entering an ice field, the following actions are generally recommended:

- Follow the instructions of the regulating authority at all times.
- Post extra lookouts particularly in heavy ice or times of reduced visibility (bridge and bow may be necessary under certain conditions).
- Have high powered searchlights available on the bridge (refer to NSRA requirements for specifics).
- Reduce speed to a minimum to minimize the initial impact of the ice.
- Enter the ice pack at right angles to avoid glancing blows
- Select an entry point of probable lower ice concentration.
- Maintain an alert watch in the engine room as changes in speed and the need to go astern may be frequent.
- Trim the vessel by the stern to provide adequate coverage and protection of the rudder and propeller.



- Keep the propeller turning at all times if possible as ice damage to stationary propeller blades is likely.

Once the ice is entered, speed of the vessel should be increased slowly, according to the prevailing ice conditions and the vulnerability of the ship. If visibility decreases while the vessel is in the ice, speed should be reduced until the vessel can be stopped within the distance of visibility. If in doubt, the vessel must stop until the visibility improves. The potential of damage by ice increases with less visibility. If the vessel is stopped, the propeller(s) should be kept turning at low revolutions to prevent ice from building up around the stern. When navigating in ice, the general rule is:

- Follow open water patches and lighter ice areas as much as possible even if initially it involves large deviations of course.
- Do not allow the speed to increase to dangerous levels when in leads or open pools within an ice field, or when navigating open pack conditions.

Changing course in ice poses specific challenges for the navigator. It requires a much larger turning circle and greater power than in open water. When turning in partially open water, the speed of turn should not be such as to risk excessive contact between the side shell and floating ice, exposing the vessel to possible damage.

If there is insufficient area to make the preferred wide arc turn, the vessel should use the Star turn maneuver using short bursts ahead and astern to slowly turn the vessel in the limited space

available. However, great care should be exercised when moving astern in ice as the rudder and propeller blades are exposed to possible ice contact and damage. In particular, the rudder should be held amidships when going astern and the engine kept to dead slow.

Backing in ice is a dangerous maneuver as it exposes the most vulnerable parts of the ship, the rudder and propeller, to the ice. It should only be attempted when absolutely necessary and in any case the ship should never ram astern. The ship should move at dead slow astern and the rudder must be amidships. If the rudder is off center and it strikes a piece of ice going astern, the twisting force exerted on the rudder post will be much greater than if the rudder is centered. If a good view of the stern is not possible from the bridge, post a reliable lookout aft with access to a radio or telephone. Please avoid backing in ice whenever possible. If you must move astern, do so with extreme caution at dead slow.

The easiest way to avoid being beset is to avoid areas of ice under pressure. Ice can be put under pressure in several ways. The most common pressure situation occurs when open pack ice closes because of prevailing winds, but it may also occur when tides, currents, or on-shore breezes blow ice onto the shore. Pack ice that has been under pressure for some time will deform, overriding as rafts or piling up as ridges or hummocks. When the sail on a ridge or hummock may be only 1 to 2 metres above the ice cover but the keel could be several metres below. Any ship that is not strengthened for operating in ice should avoid floes that are rafted or ridged. When in pack ice, a frequent check should be made for any signs of the track closing behind the ship.

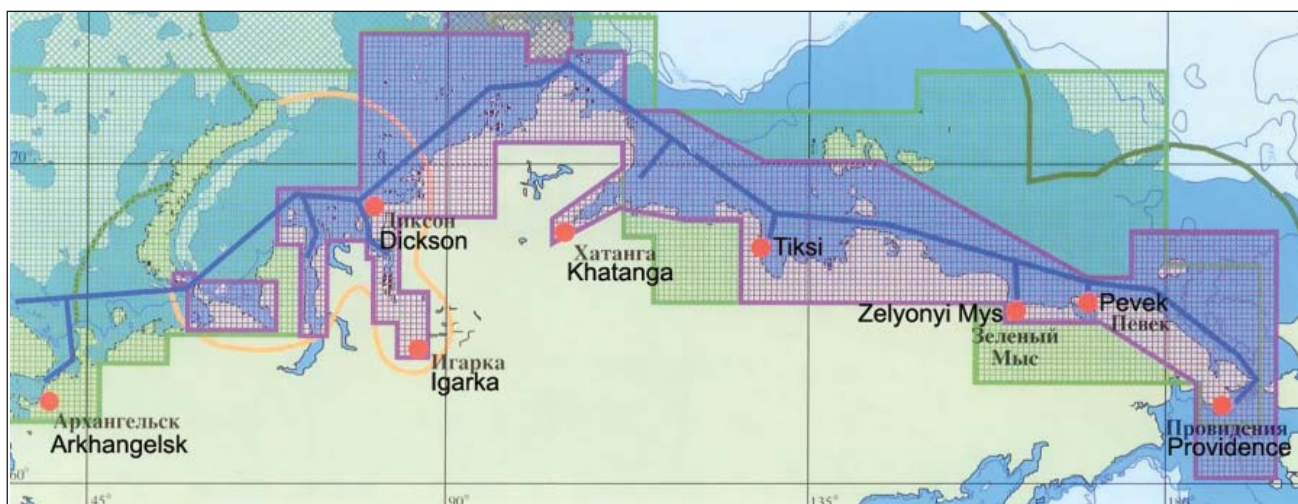


Figure 4. Coverage by electronic navigational charts

Normally there will be a slight closing from the release of pressure as the ship passes through the ice, but if the ice begins to close up completely behind the ship it is a strong sign that the pressure is increasing.

### Icebreaker Assisted Navigation within the NSR

Most vessels entering or transiting the NSR will require icebreaker escort. Escort and pilotage is mandatory in specified, ecologically vulnerable areas. As the volume of traffic on the NSR continues to increase, icebreaker escorted convoys are arranged where practicable.

Classification of arctic convoys within the NSR area is as follows:

- A simple convoy is a group of vessels of the same class, or of different classes, guided by one icebreaker;
- A compound convoy is a group of vessels escorted by several icebreakers, one of which is the leader. A compound convoy may be divided into smaller sub-convoys, each guided by a support icebreaker.

As a rule, a convoy should be formed in the open water in close proximity of ice edge at of the area for guiding. Movement of a convoy is always ordered by a master of guiding icebreaker. Masters of vessels being guided should know that master of the guiding icebreaker has the most complete information on ice conditions in the area.

### Leading and Towing

Leading and towing are the two principal methods of icebreaker guidance. Leading is when the icebreaker creates the channel through the ice and the ships in the convoy follow in the icebreaker's wake at predetermined distances and speed. The speed and distance will vary depending upon prevailing ice conditions. In heavy ice the icebreaker may enforce towing where the supported vessel is made fast to the icebreaker either close up (in the notch at the stern of the icebreaker), on a short tow line (less than 50m) or a long line (greater than 50m).

Most ice classed vessels are provided with arrangements for being towed but ABS recommends that these arrangements be extended further for areas such as the NSR where it is possible that the escorted ship may need to be towed in the notch by an icebreaker. In those cases arrangements to pull the vessel's anchors away from the icebreaker's stern are required. This may be done using the ships mooring lines.

### General Actions of Masters of the Vessels Guided by Icebreakers

Vessels moving in a convoy should have trim by the stern as to provide good maneuverability and protection of propellers, rudder, and keep strictly their positions in a Formation and distance. It is absolutely prohibited to try to overtake vessels ahead, or to try to find an independent way without icebreaker master permission.

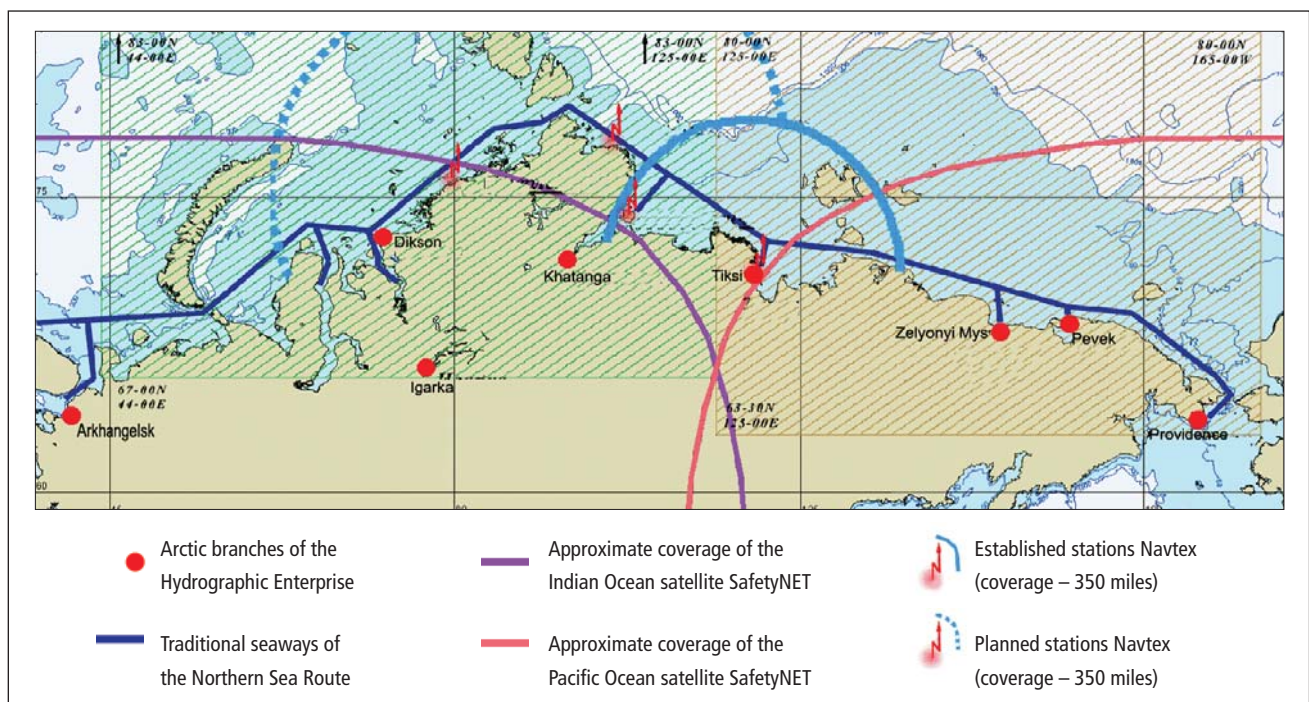


Figure 5. Zones for the reception of information on the safety of navigation in the SafetyNET and NAVTEX systems



One of the main conditions of successful leading is a capability of keeping the distance between vessels assigned by icebreaker master. On the open water the way is taken off a vessel within a distance equal to four or five hull lengths on the average. When navigating in close ice the distance between vessels should be less than the distance when navigating in open ice. The distance should be sufficient to avoid collision in case of stopping of the vessel ahead.

When proceeding in a convoy it should be borne in mind that icebreaker may abruptly lose her speed having encountered heavy ice, or having got ice under her. Therefore each vessel proceeding within a convoy should be always ready to reduce the speed abruptly.

If a vessel experiences increasing ice resistance all measures should be taken to prevent a vessel from getting stuck in ice. If a vessel still gets stuck, the master should inform the guiding icebreaker and vessels behind this via VHF channel. Vessels under icebreaker guiding often get stuck in ice at the turning points. It is very important to prevent the vessel from stopping which can be achieved by increasing the main engine revolutions rate before the vessel loses her momentum. But this should not entail increased speed.

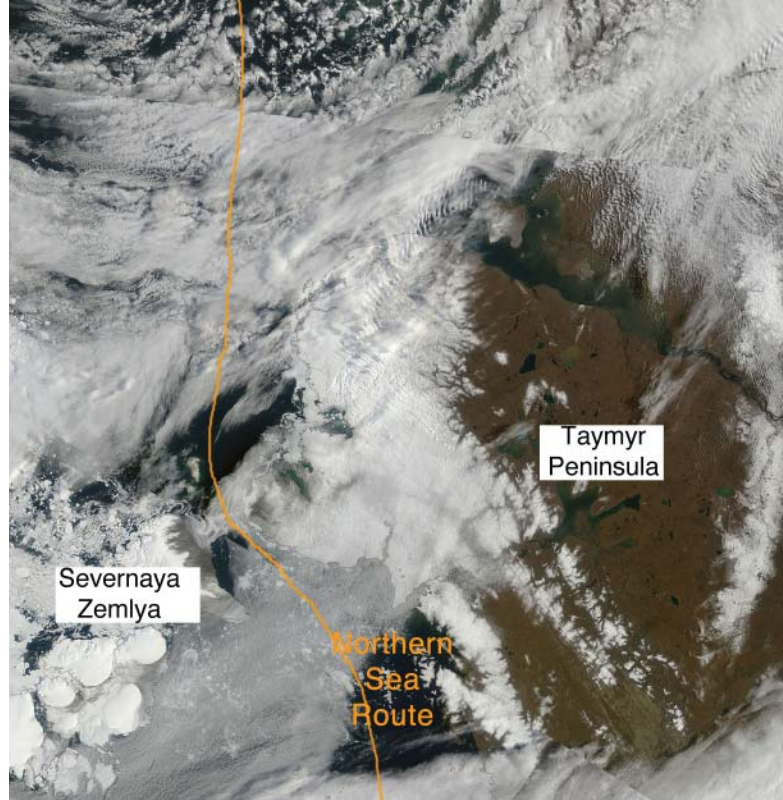
When a vessel is moving back the rudder should be in the amidships position. Inconsiderate turns should be avoided, especially when moving back. It is necessary to watch constantly the position of the stern relative to the position of heavy ice.

Collisions between vessels in convoy are rare. The most likely scenario is when the lead icebreaker has entered an ice field and then is suddenly slowed when it encounters a heavier ridge of ice. Alertness on the navigating bridge of all vessels is required at all times and the engine room should be alert for possible sudden engine astern orders.

### **Convoy in Restricted Visibility**

Icebreaker guiding of a convoy in restricted visibility becomes more complicated because of two reasons. First, it becomes more difficult for the icebreaker operator to choose the way in ice, and second, it becomes more difficult for the convoy vessels to keep the distance.

The use of ice radar can facilitate guiding. It is necessary to distinguish for sure the images of vessels and hummocked ice echoes on radar screen. Master of the guiding icebreaker can take



a decision on convoys on the basis of ice conditions assessment. When starting vessels guiding in restricted visibility icebreaker master should reduce the convoy speed first of all.

On vessels navigating in thick fog, bow and stern searchlights, or other strong lights, must be switched on. A lookout having reliable quick communication means with the bridge, may be on the forecastle. During polar night searchlights can be used for lighting up ice ahead and on the sides of guiding icebreaker.

### **Navigating in Specifically Adverse Conditions and Under Ice Pressure**

The most adverse navigational situation occurs during the guiding of vessels through intensive ice pressure and shearing. Severe ice pressure may result in serious damages to the hull, propellers and steering gear, down to vessel's loss. Icebreakers in such conditions are practically unable to render effective assistance to vessels. Consequently, when choosing a route for a convoy, areas where strong pressure can be expected should be avoided, as far as possible.

Ice drift with speeds of more than 1.2 knots is a great danger to navigation. The most dangerous in this respect are straits as well as drift separation areas at the borders between fast ice and drifting ice. "Ice river" is a particular case of intensive ice drift. This phenomenon typically occurs in autumn-winter period, when grained and repeatedly rafted young ice, in the form of a several cables to more than 1 mile wide strip, drifts along the outer limit of ice and young coastal ice.

Hummocks, i.e. at stationary obstacles, ice pressure attains a great strength. The strength of ice pressure near the shores can be so high that the icebreaker guiding becomes impossible: icebreakers themselves become helpless, and the escorted vessels risk getting crushed by ice. A convoy should not be taken near the coast, if there is a threat of ice pressure.

If the convoy vessel cannot avoid colliding into the leading icebreaker, it is necessary to direct the stem exactly to the center of the fender on the aft notch of the icebreaker, since the gliding contact with the icebreaker's fender can cause more damage to the vessel than the one directed to the centre of icebreaker's aft fender, with momentum getting weakened under the influence of the icebreaker propellers' backwash.

In restricted visibility vessels show lights prescribed by the International Regulations for Preventing Collisions at Sea: sound signals can be used only at icebreaker master permission.

## Section 6

# NSR Port Information

On the NSR from the Kara and Yugorskiy Shar straits to the Bering Strait there are seven principal Arctic seaports; they are as follows:

- Amderma
- Dikson
- Dudinka
- Khatanga
- Tiksi
- Pevek
- Mys Shmidta



Besides the principal ports, there are more than 100 informal port locations with no equipment and limited facilities where ships load and discharge direct to shore.

## Port of Amderma

The Port of Amderma is located at the mouth of the Amderminka River in the north-western part of the Yugorskiy peninsula 30 km from the eastern outlet from the Yugorskiy Shar Strait. The climate is severe with changeable weather. Fast ice in the port area is formed in November-December. Ice thickness by the end of winter is 140 to 160 cm. Clearance of ice from the coast occurs on average by the 2 of August. The duration of summer navigation is 90 to 95 days.

Seagoing ships remain two to three miles offshore and load cargo onto barges and pontoons.

Reception of petroleum products from tankers is performed outside the port – in the Morozova Strait, where tankers anchor 3 km from the shore in water depths of 13 to 14 m. Petroleum products are delivered ashore by temporary hoses and pipelines.

## Port of Dikson

The Port of Dikson is located in the bay of the same name at the north-eastern boundary of the Yenisei Gulf. The port and its water area are sheltered. The port handles commodities and equipment for the local area as well as the transshipment of small quantities of cargo from the Arctic. Water depths in the southern part of the inner roads are 10 to 12 m, and in the northern part they are 15 to 22 m. On the fairway from the Vega to Preven Straits, the water depths are between 16 to 24 m.

The climate is severe with changeable weather, frequent fogs in summer and blizzards and snow storms in winter. During the winter period the Yenisei Gulf and Dikson Bay are covered with fast ice floes. Stable ice formation occurs on average at the end of October, complete clearance from ice is expected by the end of July. Thickness of the stationary ice reaches 2 m.

## Port of Dudinka

The port is located on the right bank of the Yenisei River at the mouth of the tributary of the Dudinka River at a distance of 320 km from the Kara Sea. The port forms part of the Norilsk Mining and Smelting Complex, and is designed for year round



servicing of the enterprises of the complex and the supply of the Taimyr Okrug as a whole. There are eight dry cargo berths up to 11 m deep, and one bulk-oil berth

Climate on the Taimyr Peninsula is subarctic with transition to Arctic. On the scale of frigidity it ranks second on the planet after Antarctica. The average annual temperature is  $-10.2^{\circ}\text{C}$ . There are 252 days, on average, with average temperatures below zero degrees C.

The escorting of ships on the Yenisei River to the port of Dudinka is carried out by pilots. During the period from October 20 to May 20 the port works under winter navigation conditions. The escorting of cargo ice class ships along the NSR on the sea stretch of the track is performed by deep-draft nuclear icebreakers of the Rossia type and in the Yenisei Gulf and river stretch escort is by nuclear, shallow draft icebreaker of Taimyr type.

## Port of Khatanga

The Port of Khatanga is located on the right bank of the Khatanga River at a distance of 170 km from its mouth. Khatanga River is one of the largest navigable rivers flowing into the Laptev Sea. The port of Khatanga operates seasonally; navigation starts in mid-June and finishes at the end of September. Entry to the port is restricted to Russian flag vessels.

## Port of Tiksi

The Port of Tiksi is the most important commercial port on the NSR. It is located on the south-eastern shore of the Bulunkan Bay in the western part of the Tiksi Bay of the Laptev Sea. The main purposes of the port of Tiksi are the reception of cargo for enterprises in the Bulunkanskiy region, transshipment of export cargo arriving on the Lena River, and the servicing of ships sailing the NSR.

The water depths in the bay are 8 to 10 m (9.7 m in the approach channel). There are two offshore moorings in the port. Ships with a draft smaller than 5 m are handled at shoreside berths while larger draft ships are handled offshore. There are two offshore moorings, one of which is about 8 to 11 km offshore. The mooring front has a total length of about 1,330 m, and includes eight dry cargo berths, one bulk-oil berth and two auxiliary berths. The port equipment includes 19 portal cranes, one gantry crane and four mobile cranes.



The navigation period for the port lasts about 90 days. The period starts in mid-July and ends in mid-October.

## Port of Pevek

The Port of Pevek is a commercial sea port located in the bay of Chaunskaya of the East Siberian Sea. The principal activity of the port is the reception of cargo for ore mining enterprises of the Chaunskiy region, as well as shipping output from the ore mining enterprises.

There are five anchorages in the port area accessible for ships with drafts up to 13 m. Ships with a draft up to 8.4 m can be moored at shore side berths. The mooring front consists of three berths with a total length of 500 m. The port equipment includes 18 portal cranes with a capacity of 6 to 40 t.

The navigation period lasts on average about 120 days. The period starts in the second half of June and finishes at the end of October.

## Port of Mys Shmidta

The Port of Mys Shmidta is located on the shore of the Chukchi Sea in the south-eastern part of the Longa Strait. The main activity of the port is the transshipment of cargo for the mining and non-ferrous metal enterprises of the Shmidt region. The port includes three shallow bays: Vostochnaya, Severnaya and Zapadnaya. Cargo handling operations are carried out mainly offshore in Vostochnaya Bay about 1 km from the shore (water depths are about 10 m) by floating harbor facilities which are unloaded at shallow water piers. The unloading of tankers is done offshore by smaller tank vessels.

## References

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