

International Northern Sea Route Programme (INSROP)

Central Marine Research & Design Institute, Russia



The Fridtjof Nansen Institute, Norway



Ship & Ocean Foundation, Japan



INSROP WORKING PAPER NO. 108-1998

Box B:

The Simulation Study of NSR Commercial Shipping

Work Package 1:

Routes and Associated Operational Infrastructure

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Title:

Routes and Associated Operational Infrastructure

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FOREWORD INSROP WORKING PAPER

INSROP is a five-year multidisciplinary and multilateral research programme, the main phase of which commenced in June 1993. The three principal cooperating partners are Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia; Ship and Ocean Foundation (SOF), Tokyo, Japan; and Fridtjof Nansen Institute (FNI), Lysaker, Norway. The INSROP Secretariat is shared between CNIIMF and FNI and is located at FNI.

INSROP is split into four main projects: 1) Natural Conditions and Ice Navigation; 2) Environmental Factors; 3) Trade and Commercial Shipping Aspects of the NSR; and 4) Political, Legal and Strategic Factors. The aim of INSROP is to build up a knowledge base adequate to provide a foundation for long-term planning and decision-making by state agencies as well as private companies etc., for purposes of promoting rational decisionmaking concerning the use of the Northern Sea Route for transit and regional development.

INSROP is a direct result of the normalization of the international situation and the Murmansk initiatives of the former Soviet Union in 1987, when the readiness of the USSR to open the NSR for international shipping was officially declared. The Murmansk Initiatives enabled the continuation, expansion and intensification of traditional collaboration between the states in the Arctic, including safety and efficiency of shipping. Russia, being the successor state to the USSR, supports the Murmansk Initiatives. The initiatives stimulated contact and cooperation between CNIIMF and FNI in 1988 and resulted in a pilot study of the NSR in 1991. In 1992 SOF entered INSROP as a third partner on an equal basis with CNIIMF and FNI.

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GENERAL

The main aim of WP1 Project is to select routes for usage while simulating commercial navigation along the NSR.

Report consists of three main parts.

First part, prepared by AARI describes how the routes were chosen. The routes choosing is based on the long-term navigation experience of the Russian vessels along the NSR, experimental high latitudes routes exploration, statistical data on the ice cover.

Second part, prepared by CNIIMF describes operational infrastructure along the routes. It includes description of rules, radiocommunications, pilotage, ice convoying tactics, aids to navigation along the routes.

Third part, prepared by CNIIMF describes the routes, routine procedures of routes plotting, navigational-hydrographic description of sailing conditions along the routes, contains general maps and route tables. Route tables are the main WP1 deliverables.

Tables include:
coordinates of routes points;
courses and distances between points;
depths at the points;
description of dangers;
Admiralty numbers and scales of charts.

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1. ROUTE SELECTION

THE INSROP PROGRAM WP1

Section 1. CHOICE OF NAVIGATION ROUTES

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1.1. STANDARD SEAWAYS ON THE NORTHERN SEA ROUTE (NSR)

According to the official documents the NSR is bounded on the west by the western entrances to the Novaya Zemlya straits and the meridian running north through the Mys Zhelanya Cape, and on the east (in the Bering (Beringov) Strait) -- by the parallel 66°N and the meridian 168°58'W.

A major factor, determining the choice of a route for navigation along the NSR is distribution of ice cover. In the seas of the Siberian shelf, through which the NSR passes, the ice along the navigation routes can be met practically all the year round.

Numerous and great variations of the NSR are possible, depending mainly on the seasonal and transient ice conditions. The Marine Operations Headquarters of the West and East regions of the NSR select the most favourable variants of routes to follow in ice conditions. Vessels navigating along the NSR receive the routing recommendations elaborated with respect to the ice cover observations and forecast data

The most favourable navigation routes in the Arctic regions essentially depend on distribution of the ice cover during the navigational season. However, the information on standard routes is a foundation for developing normative documents (sailing directions for different seas, handbooks etc.) and for economic feasibility reports of development of navigation on the NSR.

The most typical (standard) navigation routes are established on the basis of long-term practice of organization of sea operations, generalization of experience of ice navigation and study of peculiarities of ice conditions.

In summer periods (June - October) the position of standard routes is determined by situation of ice massifs, distribution of zones of openings, clearings, polynias, leads, very open pack ice and open water.

In winter and spring periods, when the coast and islands of the Arctic seas are blocked by shore ice, the situation of standard navigation routes is determined by development and stability of water openings between the shore and sea ice, possibility of crossing the shore ice by icebreakers in key areas of the NSR.

The location of standard navigation routes on the NSR depends on the bathymetry, for the reason that the seas of the Siberian shelf have the depths in general not exceeding 40-60 metres, extensive zones with depths of less than 20 metres and banks with depths of 8-15 metres.

At last, since vessels are employed either in port-to-port navigation within the NSR or in transit navigation along the NSR, the choice of standard routes should be carried out in view of this circumstance. However, in all cases there are adopted points of the beginning (and termination) of separate legs of standard navigation routes. The coordinates of these points are shown in the normative documents and, in particular, in "Guide to navigation through the NSR, 1995".

Proceeding from the above general information, the location of standard navigation routes along the NSR during the navigational (June - August) period (fig. 1) and winter-spring (November - May) period (fig. 2) is shown.

There are no distinctions in situation of standard routes in the Southwest part of the Kara Sea in summer and in winter-spring periods. From season to season only the use of each specified route is subject to changes. It is not the same in the Northeast part of the Kara Sea and in the Laptev and East Siberian Seas. The formation of powerful shore ice and the presence of water openings between the shore and sea ice together with some other circumstances are responsible for shifting of standard routes toward water openings in the winter-spring period (fig.2).

Due to variability of standard navigation routes, the routes between various waypoints along the NSR may have large year-to-year variations (tab.1). Besides, the use of various variants of navigation involves differences in distribution of the basic characteristics of an ice cover along navigation route.

For each of the standard variant of navigation AARI combined the information on all characteristics of ice cover (thickness, concentration, age etc.) for the whole period of regular ice observations (1946-1990)

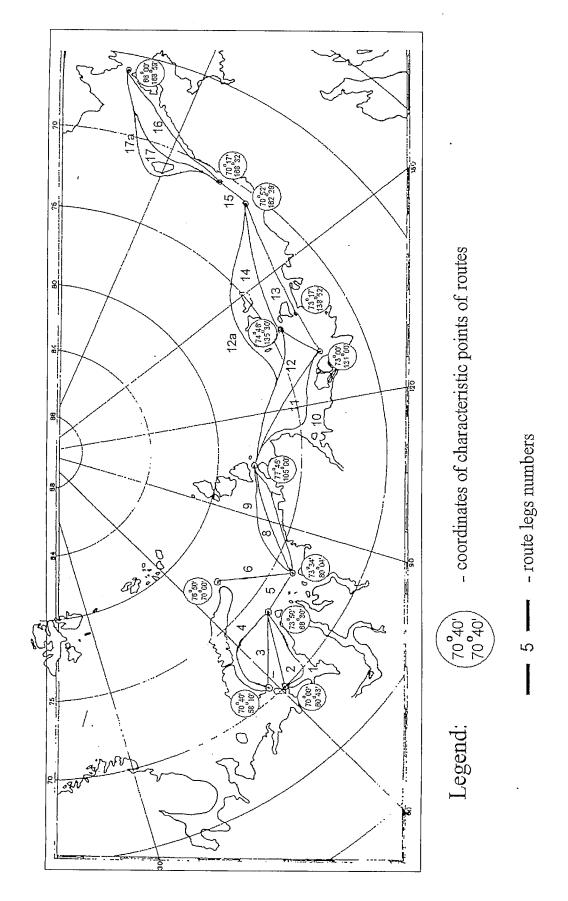


Fig.1. Standard (recommended) routes of navigation along the NSR in navigational period (June - October)

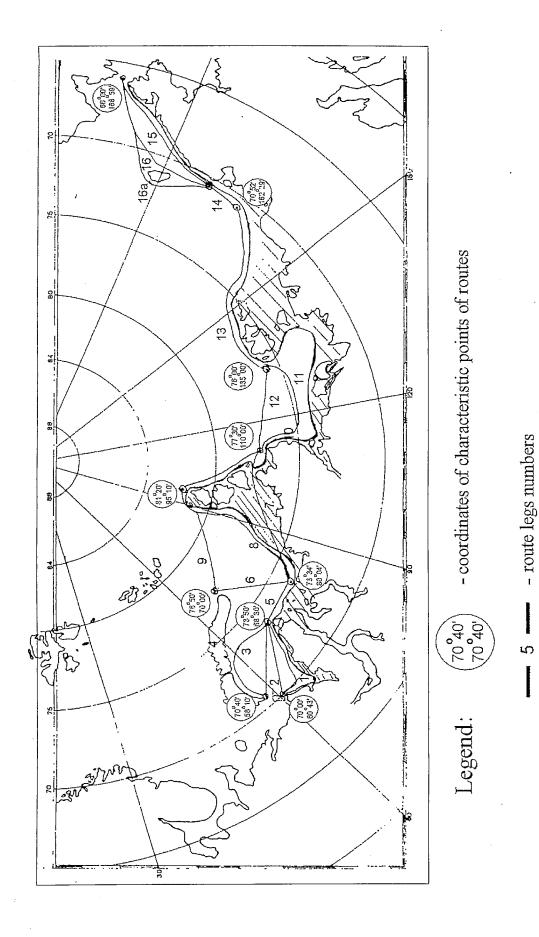


Fig.2. Standard (recommended) routes of navigation along the NSR in winter-spring period (November - May)

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Table 1
Distance of the standard variants of navigation in the main regions of the NSR (nautical miles) (see fig.1, 2)

Region	Variant of	navigation	Distance (nautical miles)		Note
of navigation	June-	November-	June-	November-	
	October	May	October	May	
South-West	1	1	355	355	
Part of the	2	2	270	270	
Kara Sea	3	3	265	265	
	4	4	345	345	
	5	5	205	205	
	6	6	245	245	
South-East part of the Kara Sea	7	7	450	505	
	8	8	440	505	
	9	9	560	385	
Laptev Sea	10*	10	635	275	10,11* - variants of navigation from the Vil'kitzkogo Strait to the turn point to the port of Tiksi
	11*	11*	570	660	
	12	12	540	455	
East-Siberian Sea	12a	13			11,12 - variants of winter navigation from the Vil'kitzkogo Strait to the Anisiy Cape
	13*	14	600	540	13,14* - variants of summer navigation from the turn point to the port of Tiksi to the Medvezh'y Islands
	14*		665	135	
	15	,	135		
Chukchi Sea	16	15	540	540	
	16a	16	570	570	
	17	16a	665	665	

1.2. VARIANTS OF NAVIGATION ROUTES FOR EXPERIMENTAL TRANSIT PASSAGES

On the basis of long-term experience in Arctic navigation the main variants of navigation with more favourable ice conditions are determined. These variants of navigation, with modern hydrographic support and determined geographical position, are standard or traditional (see section 1.1). In general the NSR standard variants of navigation are determined and rather well investigated for the summer period (June - October). In this connection, the analysis of routes of experimental transit passages to be carried out in an early spring period and also in a summer period, off the traditional routes, will be rather useful for the solution of problems of the present work.

For period 1971-1993 11 experimental transit passages in spring period were carried out along the NSR (tab.2).

The tasks of these voyages were to operate transport vessels under icebreaker escort through the entire NSR and deliver cargoes to the port of Pevek. Besides, some autonomous passages were carried out by icebreakers in the East sector of the NSR.

In the spring period experimental passages were carried out most frequently along a route which passed through the Karskye Vorota Strait, further through the Ob-Yenisey and Central Kara water openings (see fig.6) to the shore ice region of the Vil'kitzkigo Strait. After passing through the shore ice and the Taymyr ice massif the vessel entered the Novosibirsk water opening. The further navigation was carried out along the shore ice of the Novosibirsk Islands to Cape Shelagskiy, then through the Longa Straits by way of the Chukchi water opening to the Bering Strait. When some water openings did not develop or some sectors of the route were blocked by heavy ice, the other variants of routes were selected (tab.2, fig.3).

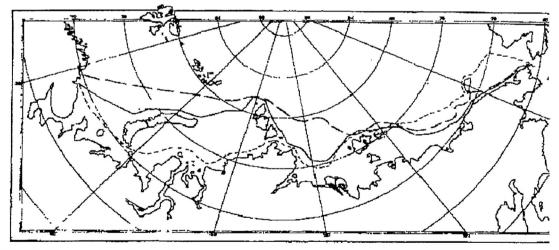


Fig. 3. The routes of transit passages

May - June 1978, nuclear powered icebreaker Sibir and electrically driven ship Kapitan Myshevskiy,

April - May 1993, nuclear powered ice-breaker Rossia and m/v Kandalaksha,

August1995, m/vKandalaksha.

Table 2

The summarized information on the variants of navigation for transit passages in the spring period

Year	Month	Ships forming convoy	Route	Cha	racte	eristi	c poi	ints o	f the	NSF	k (*)	The region of the route with the most difficult ice conditions
		-		Ī	П	Ш	IV	V	VI	VII	VIII	
1971	June	,	P.Murmansk- P.Pevek	+	-	+	-	+	-	+	-	Arkticheskiy C Maliy Taymyr Isl.
1978	May- June	Dev KAPITAN	P.Murmansk- Serdtze-Kamen' C.	+	-	+	-	+	-	+	-	Vil'kitzkogo Isl. – Shelagskiy C.
1984	June	Nib <i>ARKTIKA,</i> M/v <i>MONCHEGORSK</i>	P.Murmansk- P.Pevek	+	-	-	+	+	-	+	-	Maliy Taymyr Isl Anisiy C.
1985	June		P.Murmansk- P.Pevek	+	+	-	+	+	-	+	-	no data
1986	May- June	Nib ROSSIA, M/v MONCHEGORSK	P.Murmansk- P.Pevek	-	-	-	+	+	-	+	-	Vil'kitzkogo Isl. – Shelagskiy C.
1987	May- June	,	P.Murmansk- P.Pevek	-	+	-	+	+	-	+	-	Vil'kitzkogo Str., Vil'kitzkogo Isl – Shelagskiy C.
1988	May- June	4	P.Murmansk- Beringov Str.	-	+	_	+	+	-	+	-	Vil'kitzkogo Str., Vil'kitzkogo Isl. – Shelagskiy C.
1989	May- June	1	P.Murmansk- Shmidta Str.	-	+	-	+	+	-	+	-	Shelagskiy C Shmidta C.
1990	June	1	P.Murmansk- Beringov Str.	-	+	-	+	+	-	+	-	Vil'kitzkogo Str.
1991	June		P.Murmansk- Beringov Str.	-	+	+	+	+	-	+	-	Vil'kitzkogo Str.
1993	April- May	Nib <i>ROSSIA</i> ,	P.Murmansk- Beringov Str.	-	+	-	+	+	-	-	+	Vil'kitzkogo Isl. - Vrangelya Isl.
Repeat	ability of	the route variant, %		36	64	18	82	100	0	91	9	

* I - Zhelaniya Cape

II - Karskiye Vorota Strait

III - Arkticheskiy Cape

IV - Cheluskin Cape

V - Anisiy Cape

VI - Sannikova Strait

VII - Shelagskiy Cape

VIII - Vrangelya Cape

So, in four spring passages the navigation was carried out northward of Cape Zhelanya, in two passages - northward from Cape Arcticheskiy.

The shore ice of the Novosibirsk Islands and the essential restrictions imposed on depths for modern types of vessels excluded an opportunity of navigation through the

Sannikova Strait in the spring period. The data, given in table 2 prove, that in the above period vessels encountered the greatest difficulties in navigation through the shore ice in the Vil'kitzkogo Strait and drift ice of the Ayon ice massif. If the old ice blocks the coastal route between the Shelagskiy Cape and the Bering Strait, it is wise to use the route which runs to Vrangel Island and to the Northern or Southern Vrangel water opening, and then to the edge of one-year ice. Just this variant of navigation was used when the m/v Kandalaksha was escorted be the icebreaker Rossia in May 1993 (fig.3).

Thus the navigation routes in spring periods are characterized by gravitation towards stationary water openings between shore and sea ice. In the absence of such water openings the disintegration of ice cover - channels, breaks, cracks - should be used for routing.

It is possible to prove that the same features of routes are also typical of the winter period.

In summer periods the routes of transit passages trough the NSR frequently coincide with standard variants of sailing. Therefore attention should be focused on those cases, when the passage is carried out by non traditional variants.

In August 1995 on the whole NSR, from the Bering Strait up to the Barentz Sea, there were easy ice conditions of navigation, not requiring icebreaking support. During experimental passage of the m/v Kandalaksha under the INSROP program (II and III ten-days period of August) there was an opportunity to pass the NSR in the open water and open ice conditions. However, the heads of expedition and captain of a m/v Kandalaksha decided to follow not traditional variant of navigation, in other words, to move along the close ice edge with a view to entering this ice area at regular intervals to conduct experiments. This decision predetermined the high latitude character of this sailing (fig.3.), which resulted in the fact that the time spent on passage from the Bering Strait to the port of Kirkenes (Norway) was 317 hours (13 days), including the time spent on experiments. For the first time, since 1932, transport vessel without icebreaking support doubled the Arkticheskiy Cape on the north. The transit passage of the m/v Kandalaksha proved the possibility, expediency and prospects of the use of high latitude variant under appropriate ice conditions (Yamaguchi, 1996).

During the last decade there has been more frequent icebreaker navigation in the central Arctic Ocean. During 1987-1997 icebreakers 25 times reached the North Pole. The information on ice conditions obtained during these sailings (Frolov, 1997) proves the possibility of transarctic transit navigation under specific ice conditions.

In July - August 1994 the ice breakers LOUIS S. ST.-LAURENT (Canada) and POLAR SEA (USA) crossed the central Arctic Ocean. The expedition, named ARCTIC OCEAN SECTION 1994, began in the Bering Strait on July 25. Both vessels entered the Canadian basin, then moved in a Northwest direction over the Mendeleev midocean ridge, and reached the North Pole on August 22. The vessels left the ice northward from Svalbard on August 29, having been in ice 2300 nm (fig.4). The vessels worked in tandem, taking turns as leading icebreaker. It can be said that the

first icebreaker escorting of a vessel was carried out by the transit transarctic variant. Both vessels attained acceptable average speed of navigation (about 6 knots) and have proved the possibility of sailing of non-nuclear ships in the central area of the Polar Ocean (Brigham, 1995).

In July - August 1996 the Russian nuclear-powered icebreaker *Yamal*, carrying out cruises, has twice used a transarctic variant of navigation.

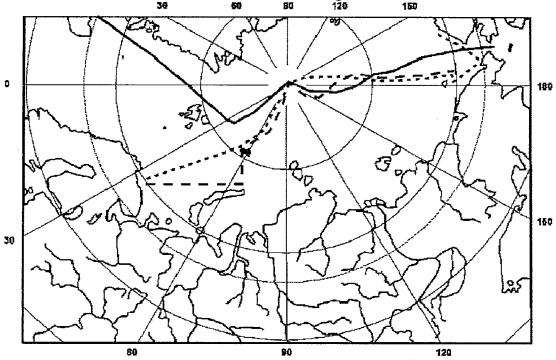


Fig. 4. The routes of transarctic passages

July 25 -August 29, 1994, POLAR SEA and LOUIS S. ST.-LAURENT;

July 22 - August 5, 1996, Yamal

August 10 - August 21, 1996, Yamal

In this period on the NSR there were rather difficult ice conditions. The close ice of the Severozemelskiy, Taymyrskiy and Ayonskiy ice massifs blocked some areas of the NSR, so the Novosibirsk water opening did not developed. At the same time, in the Arctic basin wide areas of ice became less close (up to the concentration 8/10), extending from Svalbard through the polar region along the 180° meridian to Vrangel Island. The icebreaker *Yamal*, after leaving the port of Murmansk on July 22, approached the close ice edge westward of Franz Josef Land and on July 27 reached the North Pole. Navigation from the North Pole passed along the 180° meridian. On August 1 the icebreaker left the open ice near Vrangel Island (fig.4). The icebreaker returned approximately along the same route, though after reaching of the Pole of relative inaccessibility (84°N, 175°W) the icebreaker turned northwest to meet the icebreakers *ODEN* and *POLARSTERN* (see fig.4).

Navigation of the icebreaker Yamal passed under favourable ice conditions through wide leads among mainly one-year and two-year old ice. The close ice with the

concentration 9/10 to 10/10 was observed in the northern approaches to Franz Josef Land and near Vrangel Island.

The navigation of the icebreakers LOUIS S. ST.-LAURENT, POLAR SEA and Yamal has proved the possibility of use of a transit transarctic variant of navigation in the summer when the ice conditions on the NSR line can be rather difficult.

The advantages of the transit transarctic variant of navigation are obvious: the shortest distance between the Bering Strait and ports of Europe, hydrographic safety of navigation (absence of low depths), insignificant compression in ice cover because of long distance from the coasts. However, the efficiency of shipping in this variant will entirely depend on quality of hydrometeorological support to navigation, structure and ice class of transport vessels.

1.3. CHOICE OF NAVIGATION ROUTES

When choosing navigation routes in the Arctic Seas, besides the restrictive depths and dangers to navigation, it is necessary to take into account the distribution of ice cover.

Ice cover compels the navigator to choose not the shortest and direct routes but those that provides the most favorable ice conditions.

In choosing navigation routes within the framework of the present project for the summer period, the most probable location of recurring ice massifs and zones of intensive clearing of sea ice (see fig.5) was taken into account. For the winter period the location of fast ice, zones of regional clearings and poles of ice massifs (fig. 6) were taken into consideration.

In choosing navigation routes for this project section, the experience obtained from the standard passages (section 1.1), experimental passages on the NSR, including the sailing of the m/v Kandalaksha under the INSROP program in 1995 (section 1.2) was also used.

For a coastal transit route one of the standard variants of navigation in the coastal part of the seas with the largest probability of occurrence and with the most rapid clearing of ice (fig.5) is offered. Besides, under influence of south winds in the coastal part of the seas, zones of open water and open ice, favourable for navigation will be formed with large probability.

In the Kara Sea a route leg between the Karskiye Vorota Strait and Beliy Island is advisable for plotting across this area and — as to the leg between Belyy Island and the port of Dikson — in the close vicinity to the coast where the probability of favorable ice conditions is high. Vessels are recommended to round the Nordensheld archipelago northward of Russkiy Island, using a standard central coastal variant of navigation in the Northeast part of the Kara Sea.

In the Laptev Sea it is advisable to plot the route along the coast of the Taymyr Peninsula to the Petra Islands and further directly up to the 130°E meridian through

the ice of the southern periphery of the Taymyr ice massif and further, skirting Stolbovoy Island from the North, and then through the Sannikova Strait to the East Siberian Sea.

In the East Siberian Sea it is wise to plot the route directly to the Medvezhiy Islands through the Novosibirsk ice massif, which with large probability is destroyed in the summer period. Further, the route is offered to follow along the coast, where favourable ice conditions are observed more often, from Ayon Island and Cape Shelagskiy to the Chukchi Sea.

In the Chukchi Sea it is advisable to plot the route in close proximity to the coast of the Chukotsky Peninsula.

In the winter period the passage of the Vil'kitzkogo and Sannikova Straits involves the necessity to pass through the extensive shore ice of the Northeast part of the Kara Sea and the region of the Novosibirsk Islands (fig. 6).

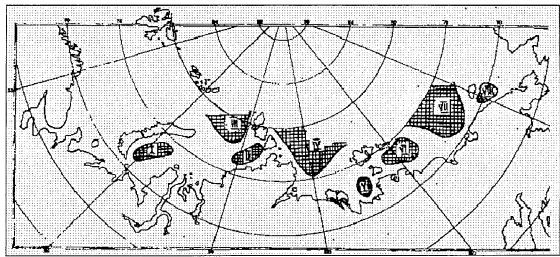
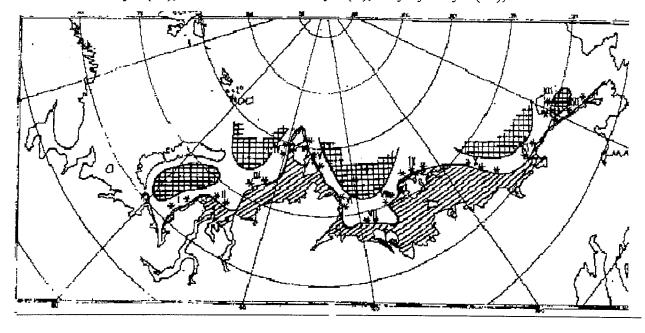


Fig. 5. The basic ice massifs: Novozemelskiy (I), Severozemelskiy (II), Northern Karskiy (III), Taymyrskiy (IV), Yanskiy (V), Novosibirskiy (V), Ayonskiy (VI), Vrangelevskiy (VII).

Fig. 6. The basic ice formations and clearings during the winter:

Yamalskaya (I), Ob-Yeniseyskaya (II), Central Karskaya (III), Western Severozemelskaya (IV), East Severozemelskaya (V), Taymyrskaya (VI), Anabaro-

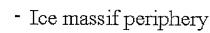




- Fast ice



- Ice massif core



* * * * *

zones of clearings

Lenskaya (VII), Western Novosibirskaya (VIII), Novosibirskaya (IX), East Novosibirskaya (X), Ayonskaya (XI), Southern Vrangelevskaya (XIII), Chukotskaya (XIII).

In choosing a high latitude transit route, one is recommended to use the experience of the experimental passage and the passage of the m/v Kandalaksha in 1995 and to plot the route near the northern capes of the Arctic islands: Cape Zhelanya (Novaya Zemlya Islands), Cape Arkticheskiy (Severnaya Zemlya Islands), Cape Anisiy (Novosibirskiye Islands).

In the Kara Sea it is offered to plot a route from Cape Zhelaniya to Uedineniya Island through the peripheral zone of ice massifs, which are the most quickly destroyed in the summer period, and further from Uedineniya Island along the 90°E meridian to the Arkticheskiy Cape. The 90°E meridian is a line where the boundary between the

Karskiy and Severozemelskiy ice massifs passes the most frequently in summer. This division zone is recommended for navigation (fig. 5).

In the Laptev Sea from the Arkticheskiy Cape to the beam of the Petra Islands one is recommended to choose the root in the vicinity of the coast, as the most probable zone clear of ice, and further northward of Bel'kovskiy Island to the Anisiy Cape, skirting the Taymyr ice massif on the South edge. Then doubling the north end of the Novosibirskiye Islands, the navigation route follows to the East Siberian Sea.

In the East Siberian Sea, starting from the Novosibirskiye Islands the route should be plotted directly to the turning point (waypoint) located a little bit to the East of the Medvejye Islands, along the line of the most probable division of the Novosibirskiy and Ayonskiy ice massifs. Further the route should be plotted to Vrangel Island to pass along the Ayon ice massif on its South edge.

In the Chukchi Sea from the beam of the Billings Cape the route is offered for plotting southward of Vrangel Island, running northward of the Vrangel (Longa) ice massif. Besides, under influence of winds from the North the clearing develops southward of Vrangel Island, which may be used for navigation; in the vicinity of the Chukchi Peninsula coast the ice conditions at such winds will become difficult. The navigation route near the island is alternative to the coastal variant of navigation when the South air shifts to the Northern ones.

In winter period the high latitude transit route closer adheres to the position of fast ice, zones of breaks in the ice and water openings (fig. 6).

Section 2 DESCRIPTION OF OPERATIONAL INFRASTRUCTURE

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2 DESCRIPTION OF OPERATIONAL INFRASTRUCTURE

2.1 Legal Regulations

The legal regulation of navigation on the NSR is applied on two levels -- international and national. The international standards are valid both for the World Ocean and area of the Arctic seas. It must be noted that Russia has ratified all main international conventions, including the conventions for navigation. The key ones ratified are:

- International Convention for the Safety of Life at Sea, 1974 (SOLAS) with Protocol 1978 and Protocol 1988;
- Convention on the International Regulation for Preventing Collisions at Sea, 1972 with amendments (COLREG);
- International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978;
- International Convention on Maritime Search and Rescue (SAR), 1979;
- Paris Memorandum of Understanding on Port State Control, 1982.

The IMO resolutions, adopted first of all by the Marine Safety Committee, as well as Standards establishing technical and operational requirements to the navigational means and systems are considered as legal acts.

The national documents, which have direct relation to the Arctic navigation, are considered below.

"Regulations for Navigation on the Seaways of the Northern Sea Route" were approved by the USSR Ministry of the Merchant Marine on September 14, 1990. These rules designate the NSR as a route open for vessels of all States on the basis of equal rights and under condition of correspondence with technical, operational and other established requirements.

"Instruction for Communication on the Seaways of the Northern Sea Route over the Arctic Navigation Season" is obligatory for all vessels navigating along the NSR. The instruction contains the full and latest information on relevant radiostations, their frequencies and operating modes, organization of radiocommunication and other necessary data.

"Northern Sea Route State Ice Pilot Regulations" specify pilot functions, order of request for pilot and transportation of him to the vessel, actions to be coordinated with the captains, relevant responsibilities and so on.

"Guide to Navigation through the Northern Sea Route" was issued as methodical materials of more than 400 pages. This guide contains detailed and full information practically covering a wide range of navigational aids and aids to navigation. In particular, navigational, geographic and hydrometeorological information, navigational description of the NSR lines, data on radiotechnical and visual aids to navigation, recommended routes, rules and navigational tactic in ice and many other information materials. The Guide is being published in English by the Head Department of Navigation and Oceanography.

Notices to Mariners are an important normative documentation, which affects the condition and effects changes in the navigational information. These notices are weekly published by the Head Department of Navigation and Oceanography under the Ministry of Defense – (HDNO). The main purpose of the Notices is in good time to inform and notify navigators of changes in navigational situation and sailing conditions on seas and oceans, as well as to publish data to be used for correction of relevant charts and for navigational guidance.

Issue No 1 of Notices is published at the beginning of the year and presents collective rules and instructions about navigational conditions in the Russian water area, including the NSR, which were in force at the beginning of this year. The issue contains the whole texts and some fragments from the documents concerning marine legislation: decrees, resolutions, directions, regulations, rules, instructions of the Russian Government and its competent bodies.

Issue No 1 of Notices, 1997, announces ports open for foreign ships. They are: Igarka, Dikson, Tiksi, Pevek. This permission remains valid for a year and can be changed at the beginning of the next year.

2.2 Technical aids to navigation along the NSR

The main modern means of position fixing while navigating in the Arctic, as well as in the World Ocean, is the global navigating satellite system (GNSS) or GPS (global positioning system) NAVSTAR. The accuracy of position fixing (90 m with probability 0.95) and possibility of continuous position fixing provides the safety of navigation along the predicted routes.

GLONAS is a similar SNS created in Russia. Its functioning principles and technical operation specifications are practically identical to those of GPS, and by some parameters exceed them. Unfortunately, this system is unknown to consumers in spite of its high characteristics. It would be of great interest to do comparative testing of these two systems during the experimental passage in 1998.

With the two systems being integrated, the performance will be improved as far as accuracy and reliability are concerned. The development of unified hardware and software for joint processing of signals from both SNS involves no technical difficulties.

In order to achieve higher accuracy with GPS, a differential mode (DGNSS) has been recently introduced. This allows a position accuracy of up to several meters for moving and less than a meter for immobile objects.

This accuracy provides sailing under the most difficult navigational conditions - when approaching ports, in narrows, and while sailing close to the seaside or to navigational dangers.

Dozens of DGNSS stations have already functioned on the European and American seacoasts.

In the Russian Arctic there are many regions where a higher accuracy of ship position fixing is necessary. Therefore all coastal area is planned to be covered by DGNSS.

Today 4 DGNSS stations are in operation in the West sector (the Kara Sea) in the beacon locations - Oleny, Sterligov, Yugorsky Shar, Lipatnikovo. These stations operate in experimental temporary mode. The main purpose consists in maintenance of safe navigation in Yugorsky Shar Strait and in the Kara Gates, as well as in approaches to Yenisey Bay and the Yenisey River estuary.

The operating area of these stations provides a high accuracy of vessel position while sailing along the West part of the South route.

It should be noted that high accuracy within this region is essential for researching, projecting, constructing and exploitation works on development of natural resources of the Kara Sea shelf.

While sailing along the south routes from the Novaya Zemlya straits to the port of Dikson these 4 stations provide the maximum accuracy of determination of coordinates (10 m). A shipborne GNSS receiver processing signals in differentiating mode is necessary to provide this accuracy.

The working areas of these stations are shown in fig.1

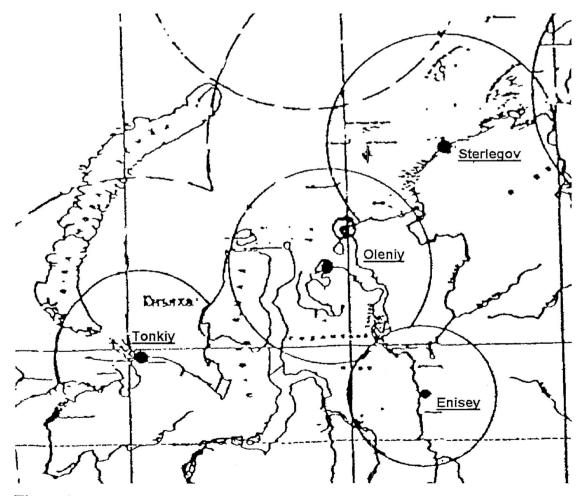


Figure 1

In order to contribute to the safety of navigation under severe Arctic conditions, an efficient network of coastal aids to navigation have been developed, including:

- radio beacons:
- land navigational nightmarks;
- sea daymarks;
- navigation radar beacons;
- passive radar reflectors;
- buoyant obstruction beacons.

Today there are 47 radio beacons in operation along the NSR, 17 of them are attended. All the beacons are home-made and of two types, AGAT and ALMAZ, with a beacon range of 100 miles and 150 miles, respectively.

The work on design of new radio beacons with a range of up to 300 miles is close to completion. Provision is made for interfacing the beacons with the equipment transmitting data for GPS differential correction.

The NSR coast, especially its dangerous areas, is well equipped with navigational markers. About 30 radar beacons and more than 200 passive radar reflectors are deployed throughout the region. In most cases these are combined with night marks and day marks. Radar beacons are deployed mainly in the river estuaries and in approaches to them, and operate all year round.

Some 250 night marks and 200 day marks are operating along the NSR. A total of 1000 buoyant obstruction beacons is deployed along the NSR to operate during summer navigation period.

All aids to navigation are shown on the nautical charts, their characteristics are given in the «List of lights».

2.3 Radiocommunication

Basic elements of communication system

An organization basis of the system is daily communication between ships, ship owners and Arctic radio centres.

The basic elements of communication system are the following:

- * Each ship should keep communications in a radio-telex mode with a radio centre in its sailing area. The radio-telex channels are used for transmission of routine information, such as navigation and service information.
- * Interconvoy communications with coast radio stations deployed at the Arctic points and polar stations and communications between ice reconnaissance aircraft are carried out in the VHF band.
- * Ships and aircraft communicate at a frequency of 125 KHz.

- * The ships get access to the national and international communication and data networks via satellite channels of the International INMARSAT and the Russian OCEAN systems.
- * The automatic interfacing of ship radio channels with shore channels is carried out by message switching centres.

Provision of distress and safety communications

- * For distress and safety communications, the coast radiostations:
- Keep continuous radio watch in sea area A1 on VHF distress frequencies on channel 70 and on channel 16 using digital selective calling (DSC);
- Keep continuous MF radio watch in sea area A2 on distress frequencies;
- Keep watch on the telegraph safety frequencies 500 kHz and HF distress frequencies using DSC.
- Transmit navigational warnings, hydrometeorological and urgent information. * Each ship should keep continuous radio watch on appropriate distress frequencies using digital selective calling.

Reliability of radiocommunications

In the Arctic navigation areas there are reliable MF communications between radio centres and ships sailing within the coverage of these centres.

Long-range HF communications with ships in the Arctic are not reliable because of severe ionospheric disturbances. Magnetic storms are more frequent in the auroral zone of peak magnetic activity which crosses the Laptev Sea at the latitude of the New Siberian Islands. The magnetic storms normally last for several hours, but in specific cases their duration is 24 hours and longer. The magnetic storms are known to recur, and the recurrence interval is 25-30 days.

The zones of unreliable radiocommunications are shown in Fig.2 (hatched areas). While sailing along the transit high latitude route the above effects are especially observed in the area lying northward of Novaya Zemlya, 72-74 N, in the north part of Severnaya Zemlya and in the estuaries of the Ob' and the Yenisei Rivers.

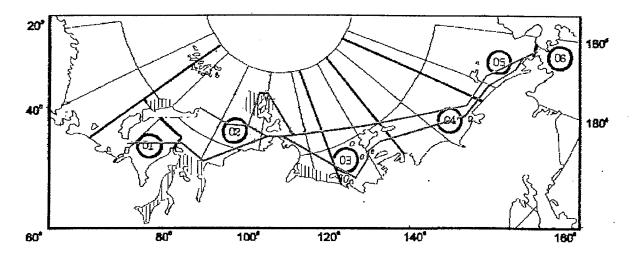


Figure 2

Shipborne radiocommunication equipment

In addition to the conventional radiocommunications equipment (described in Report INSROP I.1.2.3 - 95), the ships should be fitted with:

- * ship earth satcom station (SES);
- * equipment for sound recording and reception of facsimile, including means for reception of weather maps;
- * VHF radio station operating on 122.5 MHz for communication with aircraft, helicopters, and ships in convoy.

Basic documents regulating communications procedures

The basic documents regulating communications procedures over navigation season in the Russian Arctic are the Guides to Radiocommunications in the Maritime Mobile and Maritime Satellite Services, 1991; the Radio Rules of the USSR Maritime Mobile Service, 1980; Instructions for Communications on the Seaways of the Northern Sea Route over the Arctic Navigation Season, issued annually, Guide to Navigation through the Northern Sea Route (publication of the Head Department of Navigation and Oceanography, 1995).

All ships sailing the NSR should comply with the provisions of "Instructions for Communication on the Seaways of the NSR over the Arctic Navigation Season". These instructions specify such items as frequencies, operating channels, schedule, radio calls and other necessary information.

When employing the INMARSAT system, the INMARSAT Maritime User's Manual should be complied with.

Communications through the OCEAN satcom system are effected as prescribed in the OCEAN System User's Manual; communications are carried out in compliance with

the Instructions for Communicating via Satellite Channels of the OCEAN Domestic Satellite System in the Automatic Mode.

Communication Procedures

NSR regions and radio centres service areas

For the purpose of operational traffic control the NSR are divided into a West and East Regions.

The West Region of the NSR extends from 50°E and Zhelaniya Cape to 125°E, including the Franz Josef Land Archipelago and other islands, the Yenisey River area up to Igarka, the Khatanga River area up to the port of Khatanga and the Gulf of Ob' up to Cape Kamenny.

The West Region is served by the communications centres of Amderma, Murmansk and by the radio stations of Igarka, Dudinka, Khatanga.

The East Region of the NSR extends from 125°E to the Bering (Beringov) Strait, including all islands and the Kolyma River area up to the port of Zeleny Cape. The East Region is served by the Tiksi, Pevek and Shmidta Cape communications centres. Service areas of the Arctic radio centres are shown in Fig.2 Boundaries of coverage of these radio centres are as specified below.

- 1. Amderma: 50° E 70° E 74° N, including the Barents Sea, the East part from Kolguev Island to the Gulf of Ob', the Ob' River up to Salekhard, the western part of the Kara Sea.
- 2. Murmansk: 70° E 125° E, including the Kara Sea, the Gulf of Yenisey, the Yenisey River up to Igarka, the Arctic Ocean including the Franz Josef Land Archipelago, the western part of the Laptev Sea, the Gulf of Khatanga, the Khatanga River up to the port of Khatanga.
- 3. Tiksi: 125° E 150° E, including the Laptev Sea, the western part of the East Siberian Sea, the Arctic Ocean.
- 4. Pevek: 150° E 175° E, including the East Siberian Sea, the Arctic Ocean.
- 5. Shmidta Cape: 175° E 169° W 65° 50' N, including the Chuckchee Sea, the Arctic Ocean.

Radiocommunication service through coast radio centres.

Each ship should keep communications at MF with any radio centre, which covers her sailing area. Medium frequencies are used for transmission of routine information, such as ice reconnaissance data, weather maps, maritime safety information, etc.

When entering or leaving the service area of a radio centre, a ship (or, when in convoy,

the leading icebreaker) should notify the chief radio officer of the radio centre involved.

All ships sailing the NSR should keep watch at 500 kHz on schedule in accordance with "Instructions for Communications on the Seaways of the NSR over the Arctic Navigation Season".

The captains of ships sailing the NSR on its own should report to the Marine Operation Headquarters twice a day at 00-00 and at 12-00 Moscow time about their position, course, speed, visibility, condition of the sea, ice and weather.

Organization of efficient navigation warnings.

The coastal warnings are provided by arctic radio centres and radiometeocentres at the hours and at the frequencies prescribed in "The Instruction for Communications on the Seaways of the NSR over the Arctic Navigation Season".

The main radiostation providing navigational warning transmission for the West region is "Murmansk-radio", for the East Region is "Pevek-radio".

The numbering of coastal warnings is carried on by each Marine Operations Headquarters independently. The coastal warnings is numbered throughout the calendar year, commencing with 0001 at 0000 UTC on January 01.

The ice condition maps are delivered to the ships by an ice patrol aircraft provided with special phototelegraphic equipment operating at 4670 kHz in telephone mode. Preliminarily notification of the ships about transmission hours is carried out by circular call at the frequency 500 kHz.

Provision of VHF communications

Employed for VHF communications on the NSR and in the Arctic are the following channels and frequencies:

- 156.80 MHz (Channel 16) watch and calling in the international VHF band;
- 156.30 MHz (Channel 6) operating frequency for ship-to-ship communications in the international VHF band;
- 122.50 MHz (Channel 1) calling and operating frequency for communications between ice reconnaissance aircraft and coast radio stations;
- 137.50 MHz (Channel 2) calling and operating frequency for ship-to-ship communications in outside waters.

When VHF equipment is available both on ships and on shore objects, the VHF band is preferable for radiotelephone communications.

Used as radio call signs are:

- by ships ship name or international call sign;
- by aircraft aircraft side number;
- by coast stations call sign specified by the State Inspectorate of the Ministry of Communications of Russia.

Radiocommunication between ships and aircraft are provided: in direct visibility conditions at 125 KHz; in indirect visibility conditions at MF. The ships are called by aircraft at 500 KHz, the transmission is to be carried out on the working frequency 488 KHz.

When lying out in sea ports, ships should keep their VHF stations tuned to Channel 16 (156.80 MHz) during first five minutes of each half hour. Coast stations are called on Channel 16, and operating frequencies are used for communications.

The use of the 137.50 MHz frequency is prohibited within 50 miles off Amderma, Dikson, Tiksi, Pevek and Shmidta Cape.

Listed in APPENDIX I are the points and polar stations where VHF radiotelephone stations operating in the band of the maritime mobile service are available. Installation locations, call signs, schedule and operating channels of the VHF stations are given.

Interconvoy communications

Interconvoy communications are employed only at VHF. For interconvoy communications, at least two dual channels must be employed, operating in the receive-transmit mode.

Responsible for operational management of on-scene NSR communications over the Arctic navigation season are the heads of the Murmansk, Tiksi and Vladivostok territorial communication centres.

When in convoy, transport ships may operate MF and HF bands for communications with coast radio centres and radio stations only when permitted to do so by the leading icebreaker.

Satellite communications

Communications via satellite channels for support of NSR sailing are currently possible through two satcom systems: the International INMARSAT and the Russia's OCEAN systems.

The NSR is partially covered by the two INMARSAT geostationary satellites: the Indian (IOR) 64°E and the Pacific (POR) 178,0°E. Shown in Figure 3 are the boundaries of INMARSAT coverage in the Russian Arctic at elevation angles of 0 and 5 degrees.

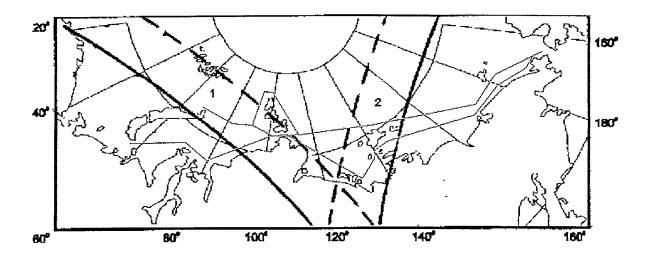


Figure 3

The Arctic coverage capability of the INMARSAT IOR and POR satellites is reduced because of the gaps in the western part of Laptev Sea. Satcom services in this area are provided by the OCEAN system.

The NSR is covered by three OCEAN geostationary satellites: the Atlantic 40°E, the Indian 80°E and the Pacific 140°E. Shown in Figure 4 are the boundaries of OCEAN coverage in the Russian Arctic at elevation angles of 0 and 5 degrees.

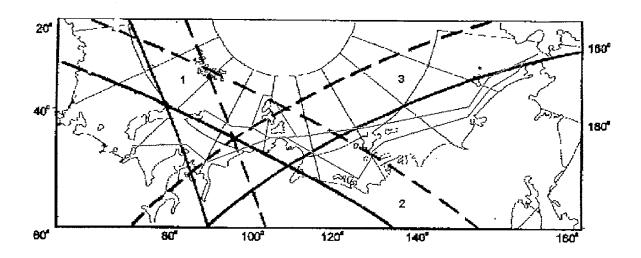


Figure 4

Only few INMARSAT SES models are suitable for operation in the OCEAN system. They are: the Russian Volna-C, Iceberg and the Norwegian Saturn-3C and the Japanese JUE-45 (the only models, where the OCEAN interrogation frequencies may be used).

The OCEAN system is described in the INSROP Report N17 (I.1.2.3).

7 icebreakers involved in Arctic navigation is fitted with the INMARSAT-A SES capable of operation in both the INMARSAT and OCEAN systems.

As to the Arctic coast radio stations, INMARSAT SES is installed at Arkhangelsk, Pevek, Khatanga, Tiksi, Dudinka, Beringovsky', Anadyr, Nakhodka, Vladivostok (Far Eastern Shipping Company).

The list of INMARSAT-A SES icebreakers involved in the Arctic navigation is shown in APPENDIX II.

The list of the Arctic Coast stations where SES in operation is shown in APPENDIX III.

Provision of commercial communications

Commercial radiocommunication can be carried out on MF and HF frequencies allocated for public correspondence through a service radiocentre or on satcom channels of the INMARSAT and OCEAN systems.

APPENDIX I

LIST OF POINTS AND POLAR STATIONS WHERE VHF RADIOTELEPHONE STATION ARE IN OPERATION

Geographic Name	Radio Station Position	Radio Call	Watch and Radio Channels
Amderma	Port	Amderma-port	24 h
Belyy (island)	Port station named Popov	Bely' Island- 88	By agreement - channel 9
Vaigach (island)	port station named Fedorov	Vorobei	By agreement - channels 6, 13, 14
Igarka	port station named 60 years of VLKSM	Igarka-radio	By agreement - channels 6, 9, 12
Novaya Zemlya (islands)	port station Karmakuly	Fortuna	By agreement - channels 6, 9, 12
Dikson	Radiometeocentre	Dikson-radio	24 h – channel 16
	Hydrobase	Dikson-radio23	09.00 - 18.00 local time and by agreement
	Port	Dickson-radio1	24 h
	Supervisory port body	Portnadzor	24 h
Medvezhiy (island)	, , , , , , , , , , , , , , , , , , , ,	Medvezhiy-radio	On request via Dikson
Vise (island)	port station	Vise-radio 2	On request via Dikson
Dudinka	Pilot watchkeeping	Lotsvakhta	24 h — channel 9
	Port radio office	Dudinka-radio	09.00 - 13.00 except Saturday, Sunday -
	Supervisory port	Portnadzor	channel 13
	body	Dort	24 h — channel 14
	Port control office Port agency	Port Moragenstvo	24 h — channel 10 24 h — channel 12
Zhelanya	port station	Zhelany-88	By agreement - channels 64

Geographic Name	Radio Station Position	Radio Call	Watch and Radio Channels
Igarka	Hydrobase control office	Igarka-radio 23	04.00-13.00 (except 08.00- 09.00) channel 9
	Hydrobase radio office	Igarka-radio 4	04.00-13.00 (except 08.00- 09.00) channel 13
Lipatnikovo	Swawmill water levelcontrol post	Transflot Lopatnikovo-radio 23	24h-channel 6 24h-channel 9
Chelyuskin (cape)	Hydrometeooffice	Chelyuskin-88	On request via radiometeocentre, Channels 12,16
Khatanga	Radiometeocentre Port control office Port fleet Port agency Harbour master Hydrobase	Khatanga-radio 1 Khatanga-radio 2 Khatanga-radio 6 Khatanga-radio 3 Khatanga-radio 4 Khatanga-radio 23	24 h during navigation 15 June – 01 Octobre channel 16 24 h during navigation 15 June – 01 Octobre channel 14 08.00 – 20.00 channel 14 08.00 – 20.00 channel 14 08.00 – 20.00 channel 14 Call by agreement via seaport
Sopochnaya Karga	port station	Sopochnaya-Karga 88	24 h channels 9, 16
Kheisa (island)	hydrometeooffice named Krenkel	Kheisa-88	By agreement - channel 64
Tadibe-Yakha	port station	Tadibe-Yakha 88	By agreement - channel 14
Novyi Port	port station	Novyi Port 88	By agreement - channel 9
Tiksi	Hydrobase	Tiksi-radio 23	24 h
Tiksi Arctic shipping company	Fleet exploitation agency Port agency Harbour master Port	Tiksi-radio 1 Transflot Tiksi-radio 5 Tiksi-radio	03.00 – 12.00 channel 9 work from 1 July to 01 November 09.00 – 18.00 channel 30 09.00 – 18.00 channel 8 24 h – channel 9
Kotelnyi	port station	Kotelnyi 88	24 h – call via Tiksi channels 6, 9, 14
Sannikova	port station	Sannikova 88	24 h – call via Tiksi channels 6, 9, 14
Kigilyakh	port station	Kigilyakh 88	24 h – call via Tiksi channels 6, 9, 14
Terpyai- Tumsa	port station	Terpyai-Tumsa 88	24 h — call via Tiksi channels 6, 9, 14

Geographic	Radio Station	Radio Call	Watch and Radio Channels
Name	Position		
Shalaurova	port station	Shalaurovo88	24 h – call via Tiksi
			channels 6, 9, 14
Pevek	Radiometeocenter	Pevek 88	24 h – channel 9
	Supervizory port	Pevek-radio 5	24 h
	body		
	Marine operation	Pevek-radio 19	24 h – channel 14
	headquarters Port control office	Daniel and die	241
		Pevek-radio 6 Pevek-radio 2	24 h – channel 9
	Seaport	Pevek-radio 23	24 h
	Hydrobase	revek-radio 25	Call via radiometeocentre
			or seaport channels
Murmansk	port station	Murmansk-radio 1	24 h – channels 3, 16, 26,
Sea trade port	Port control office	Providence-radio 2	24 h – channel 14
Provideniya	Supervisory port	Providence-radio 5	24 h – channel 9
l	body		
	Port fleet	Providence-radio 6	08.00 - 17.00 (local time) -
		•	channel 67
	Oil station	Providence-radio 13	08.00 – 17.00 (local time) -
			channel 29
	Hydrobase	Providence-radio 23	23.30-08.30 by agreement
Anadyr	Port control office	Anadyr radio 2	24 h - channel 9 from 15
	Supervisory port		June - to 15 November
	body, harbour	Anadyr radio 5	24 h – channel 14 from 15
	master		June - to 15 November
Beringovskiy	Radiometeocentre	Beringovskiy-radio 2	24 h during navigaion
			channel 9
	Port control office	Beringovskiy-radio 5	24 h – channel 9
Shmidta	Radiocentre	Shmidt 88	24 h
	Extracaptain	Neptun	call via radiometeocentre
			when required

APPENDIX II

List of INMARSAT-A SES icebreakers involved in the Arctic navigation

Icebreaker name	Identification number and answer-back of SES	
Arctica	1401405	УЦКХ
Vaygach	1400673	УБНЫ
Krasin	1400675	УПГК
Magadan	1401215	ЕМАГ
Sovetskij Soiuz	1401232/1402511 1404104/1404105	УЦЙЙ
Taimyr	1400635	УЕММ
Yamal	1404137 1405744/1405745	УЦЙТ

APPENDIX III

LIST OF ARCTIC COAST STATIONS WHERE SES IN OPERATION

Geographic name		Identification number and answer-back	
Arkhangelsk	1402440 1402441	НСЦР НСЦР	
Anadyr	1401141	ДВМИ	
Beringovskiy	1401142	ДВМХ	
Dudinka	1401305	ммпь	
Tiksi	1402255	ОПАК	
Pevek	1402645	двмс	
Khatanga	1402414	ммпд	
Vladivostok	1400342	ДВМА	
Nakhodka	1401377	ПМПА	

2.4 Hydrometeorological support to navigation through the NSR

Data collection, processing and analysis of observations, short and long-term weather forecasting, information on navigation conditions and appropriate recommendations, regular promulgation of relevant information to the vessels and organizations concerned are carried out by the Federal Service of Russia on Hydrometeorology and Monitoring of the Environment (Rosgidromet) via its territorial Departments of Hydrometeorological Service (DHS).

All hydrometeorological information consists of general purpose and special hydrometeorological information.

The Regional Hydrometeorological Centers (RHMC), which make a part of every DHS, are immediately responsible for providing vessels with general purpose hydrometeorological information.

Specialized hydrometeorological support to shipping in the NSR area is organized by the special Scientific Operational Groups (SOG).

General purpose information, as well as specialized information, are broadcast via the Rosgidromet and Marine Transport Department radio stations on schedule and frequencies in accordance with "Instructions for Communications on the Seaways of the NSR".

Responsibility areas of Departments of Hydrometeorological Service

Territorial DHS and their areas of responsibility along the NSR are as follows (see Figure 5.):

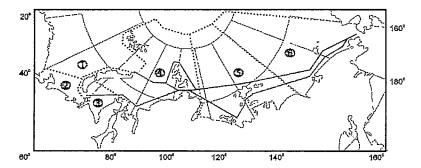


Figure 5

- 1. Murmansk DHS: the Greenland Sea, the Norwegian Sea, the area of Svalbard, the Barents Sea (excluding its South-East part);
- 2. Northern DHS: the White Sea and the South-East part of the Barents Sea;
- 3. Amderma DHS: the South-West part of the Kara Sea and the Obskiy Gulf;
- 4. Dikson DHS: the Kara Sea (except for the South-West part), the Franz Josef Land area, the Yeniseyskiy Gulf, the Gydanskiy Gulf, the area of Severnaya Zemlya, the Western part of the Laptev Sea and the Hatangskiy Gulf.
- 5. Tiksi DHS: Laptev Sea (except for the Western part with the Khatangskiy Gulf), the area of the Novosibirskiye Islands and the Western part of the East Siberian Sea (to

the meridian 160 E);

6. Pevek DHS: the East Siberian Sea (except for the Western part), the Longa Strait and the Anadyrskiy Gulf.

General purpose hydrometeorological information

General purpose information includes current factual and forecasting information.

Current hydrometeorological information of general purpose characterizes the hydrometeorological conditions for the current day, ice conditions for 1 to 5 days.

Current hydrometeorological information includes:

- 1. Weather charts characterizing meteorological conditions near the earth's surface (transmitted every 3 days);
- 2. Composite ice chart characterizing ice distribution, ice concentration, hummocking, rottenness, age, position of ice massifs, landfast ice, clear water areas (transmitted once in 2-3 days);
- 3. Ice reviews characterizing the prevailing distribution of the main ice formations, as averaged for a decade.

Forecast information of general purpose contains data about the expected state of hydrometeorological conditions on the whole of the particular DHS area of responsibility.

Forecast information includes:

- daily weather forecast, updated every 12 hours;
- one-day surface weather forecast (chart);
- three-day weather forecast;
- three day ice conditions forecast;
- one-day sea forecast for the areas of clear water;
- 1 to 3 days sea level prediction for coastal areas with critical depths;
- storm warnings (wind, snowstorm, fog, waves, sea level, ice phenomena).

Special hydrometeorological information.

Special current ice and hydrological information

Current information on factual ice conditions in a particular area is the information registered during 1 to 5 days prior to the time of the request.

Current specialized ice information is made available to mariners in the form of recommendations helping them to navigate in particular ice situation with maximum efficiency. The information is transmitted in charted and textual variants. Each variant contains information about means and time of information obtaining, the optimum route to follow, characteristics of conditions along route sections and in the point of destination.

Special forecasts

Prognostic specialized meteorological information is divided into short-term information (up to 3 days) for meteorological support of particular vessels' navigation and medium term information (up to 10 days) used for reviewing the shipping route for a period of up to 10 days. Medium-term specialized forecast is compiled for these areas where transit vessels are expected to pass.

Special forecasts are mainly short-term forecasts, which include expected synoptic situation, prevailing wind direction, possible wind direction deviations from prevailing direction, wind speed and possible gusts, air forecasts (in cold period).

12, 24, 48 and 72 hours short-term specialized weather forecasts are issued at requests, which must include information on vessel's route, speed and values of meteorological parameters critical for a particular ship.

Weather forecasts contain the information on storm probability, expected synoptic situation, horizontal visibility and events, which deteriorate the visibility, wind direction and speed, air temperature.

Specialized prognostic ice-hydrological information is included in the 1-3 and 8-10 days' ice forecasts prepared by Scientific Operational Groups.

2.5 Navigation aids to vessels on the NSR

The main factor complicating navigation along the NSR is the presence of ice, the thickness and concentration of which can vary with season in different NSR areas.

Any attempt to go along the NSR independently, especially to navigate through the NSR, not having and not using the complete information and a whole set of means of support, is doomed to failure. Even if a vessel under favourable ice conditions manages to sail throughout the NSR, nevertheless this passage is attended by serious risk, the vessel can not take an optimal route and complete the passage in the shortest time.

On the NSR seaways the traffic regulation is established. The traffic control is carried out by NSRA through MOH. The control is executed during shipping season, the terms of which are determined by NSRA and MOH (Marine Operations Headquaters, see "Operational Aspects" -1993-1995 WPs for more details) with allowance for actual ice, navigational, hydrographic and other conditions and forecasts.

The shipowner or master of a vessel, intending to navigate through the NSR, should submit to NSRA a request (a form of the request and terms of its submission are determined by "Regulations for navigation on the seaways of the Northern Sea route"). The NSRA examines the request and informs the applicant on opportunities of carrying out planned passage, and about other circumstances, which should be taken into account.

Monitoring of vessels and regulation of their movement during navigation along the NSR is referred to as navigation aids to vessels on the NSR.

Navigation aids to vessels is regulated by the following normative documents:

- "Rules of navigation Regulations for navigation on the Seaways of the Northern Sea Route";
 - "Regulations for icebreaker and pilot guiding of vessels through the NSR";
 - "Northern Sea Route State Ice Pilot Regulations";
- "Regulations for Vessels guided through ice by icebreakers (except for items 9, 14);
 - Arctic Port Regulations;
- other acts and instructions of State bodies of the Russian Federation on navigation, given in the Appendix to issue No 1 of Notices to Mariners.

On the basis of maintenance of safe navigation of each particular vessel and depending on conditions of navigation, MOH can require the following types of navigation aids:

- shore-based pilotage along recommended routes;
- aircraft-assisted pilotage (including helicopters) in some sections of the NSR;
- conventional pilotage;
- icebreaker leading escort;
- icebreaker escort with ice pilot on board.

During navigation MOH can substitute one type of guiding for another.

In view of difficult navigational and ice conditions in the Vil'kitskogo, Shokal'skogo, Dmitrija Lapteva and Sannikova Straits the compulsory icebreaker escort with an ice pilot on board has been established. In the other regions, any type of escort may be

established proceeding from specific ice conditions and for reasons of maintenance of safe navigation.

Under favourable ice conditions, when the vessel proceeds in clear water or in open ice, the first type of navigation aids is used most frequently. Any vessel proceeding along recommended routes should follow the specified routes as far as possible. The masters of vessels are obliged to follow all instructions of MOH, concerning route corrections connected with changes in ice conditions and with any circumstances involving the safety of navigation or in cases where the changes are able to impact the environmental conditions.

In cases where the detour of regions with hard ice conditions is necessary, the MOH can provide aircraft-assisted pilotage under Ice Patrol. Thus, the master of the vessel should be informed of a place and conditions of meeting, aircraft side number and rules of radiocommunication.

The icebreaker escorting, as a rule, is carried out only in zones of increased risk, in places of concentration of close ice.

Navigation aids in ice conditions are provided under supervision of MOH. Icebreaker leading escort is the main type of ice navigation in freezing seas of the NSR. The Murmansk Shipping Company (MSC) provides icebreakers for the West Arctic Region. The Far Eastern Shipping Company (FESCO) provides icebreakers for the East region.

The following MSC icebreakers operate in the Arctic seas: "Rossia", "Arctica", "Sovetsky Sojuz", "Yamal", "Vaygach", "Taymyr", (these icebreakers are nuclear-powered), "Kapitan Dranitsin", "Kapitan Nikolaev". The FESCO icebreakers "Krasin", "Magadan", "Ivan Moskvitin", "Ermak", "Admiral Makarov" ensure the navigation in the East region.

All icebreakers are under supervision of MOH during the Arctic navigation while conducting convoys and single vessels or operating in the most dangerous areas of the NSR.

The point and procedure of meeting an icebreaker at sea or near the ice edge when adrift or at anchor, are determined by MOH.

The master of an icebreaker engaged in escorting is responsible for making-up of the convoy. The class and type of a vessel, capacity of machinery, speed and draft should be taken into consideration. With changing ice, hydrometeorological or other conditions, the vessels sailing in convoy may change their place in the convoy and the order of leading vessels in the convoy can be changed as well. The master of a vessel shall immediately execute all orders of the master of the icebreaker.

If ice conditions along the route are not difficult, the MOH or icebreaker master may replace the icebreaker engaged in escorting a single vessel or several vessels by a leading vessel. The leading vessel is usually an ice-strengthened vessel of an icebreaker type, the master of which is sufficiently experienced in such operations.

Conventional pilotage is established along the Yenisey River (to the ports of Dudinka and Igarka), the Khatanga River (to the port of Khatanga), the Anabar River (between Cape Khorgo and the Yurung-Khaya settlement), the Kolyma River (from the mouth to the port of Zeleny Mys).

There are pilot vessels and pilot boats placed at disposal of pilot services and assisted by port icebreakers and leased helicopters, if necessary. Pilots deliver on board the updated nautical charts.

If the master of a vessel or his representative has no sufficient experience in vessel operation in ice, at request of the shipowner or master, the NSRA or MOH can send a State Ice Pilot on board the vessel to operate it along the NSR.

They should submit a request for a pilot to NSRA and a copy of the request to its Representations in Murmansk or Vladivostok.

In accord with the region of entrance in a particular lane (route) of the NSR, a pilot can be taken aboard in the approaches to Kol'sky Zaliv or on an external road of the port of Providenya or in the points specified by the Representations of NSRA or MOH.

If a pilot was not taken aboard earlier and the necessity of his presence has arisen during the navigation, it is for MOH to decide whether or not an ice pilot should be provided.

Two pilots should be provided for a vessel proceeding along the NSR. In case of necessity the helmsman experienced in steering in ice conditions can be taken on board the vessel at master's request.

In the event of conventional pilotage the ice pilot should be in the wheelhouse when navigating in regions with difficult navigational and ice conditions.

When an icebreaker with an ice pilot on board is leading an escort, the ice pilot with the consent of the master should continuously be in the wheelhouse; he can receive radiotelephone instruction directly from the master of the icebreaker.

The State Ice Pilot gives advice and recommendations to the shipmaster concerning the vessel manoeuvring and operation when navigating in regions with difficult navigational conditions, and also in ice, both for autonomous sailing, and for sailing under icebreaker escort. However, the full responsibility for movement and manoeuvring of the vessel under ice conditions remains with the shipmaster.

All orders to the helm and to the main engine should be given by the master or his representative personally, in accordance with the recommendations of the ice pilot. In some cases for the purposes of acceleration of execution of manoeuvring orders, the master can permit the State Ice Pilot to give orders to the helm and to the main engine. All the same in this case the responsibility for the consequences of manoeuvring remains with the master.

The activities of the State Ice Pilot and a range of his duties and responsibilities are defined by "Northern Sea Route State Ice Pilot Regulations".

2.6 ICE CONVOYING TACTICS

Several decades of use of the NSR by Russian seafarers allow the navigators of icebreakers and transport vessels to elaborate and continuously apply in practice the effective tactical methods of operations in ice conditions. Tactics of ice navigation is determined by the bathymetry, ice conditions, icebreakers and transport vessels characteristics.

The basic aim of icebreaking support is to provide a safe and fast sailing of vessels in ice. The navigators of icebreakers are obliged to do their best to prevent ice damages to escorted vessels. For this purpose they should perfectly operate the vessel in any conditions, be familiar with the peculiarities of icebreaking and be able in due time and correctly to use favourable ice conditions of navigation. While the main factor, determining success of any ice escorting, is a convoy structure, i.e. types and number of vessels lead by the icebreaker.

When making up a convoy a set of factors is to be taken into account. So, the formation of a separate convoy from several weak vessels is practicable and useful only when the navigators have good knowledge of ice conditions and possibility of their favourable change. Then, when ice conditions allow us to escort three-four vessels by one icebreaker, the presence of one weak vessel in the convoy will not negatively affect the sailing of other vessels. Nevertheless, it is necessary to place the weak vessel directly after the icebreaker, where, following at a short distance, it can easily maintain a prescribed speed and will not be a heavy burden for the convoy. When large vessels are involved, some other problems will arise. Their negative features from the point of view of ice navigation consist in weakness of the hull and limited manoeuvrability, though they have main engines powerful enough to operate in ice. The convoy of large vessels should as far as possible consist of a small number of vessels escorted by the most powerful and large-sized icebreakers.

When taking command of a convoy, the captain of the icebreaker should instruct the captains of vessels on the planned route and special features of sailing in convoy, rules of navigation in the wake of the icebreaker, means of communication and an order of vessels in a convoy. Special attention should be given to discipline of vessels in a convoy.

As to modern methods of sailing in small convoys, for example, of two vessels, such convoys are usually formed under heavy ice conditions. As a rule, a convoy under icebreaker escort consists of a greater number of vessels and has an appreciable length. The vessels should be placed in such convoy so as to make the best use of the most powerful vessels. Especially it is important, that the strongest and the most adapted for ice navigation vessels are to be the last in the convoy and, what is also important, operated by an experienced ice captain. Such vessels, if necessary, not only will proceed on their own in the tail of convoy, but can render some assistance to a weaker vessel sailing ahead of it, which will facilitate the work of the icebreaker and will speed up common progress. The same general principle usually forms the basis of so-called "complex" convoy of vessels, in which two or more icebreakers are engaged in escort. Second and third icebreakers are usually disposed in the middle of convoy

and the task of "breaking out" of the vessels gripped by the ice, and of moving closer to the vessels became detached, is charged with them.

A vessel with bad handiness should not follow immediately after the icebreaker. It is also not wise to place ahead of the convoy a vessel with slow reverse of the engine. When the convoy includes vessels of different breadth but with almost identical other characteristics, the vessels are to follow the icebreaker in order of sequential reduction of their breadth.

Under average ice conditions with ice concentration of up to 5-6, three-four vessels are considered as a normal number of vessels in convoy escorting by a single icebreaker. At ice concentration of about seven, the convoy of four vessels even of an ice class is too great for one icebreaker. With ice concentration of eight and more even a powerful icebreaker can usually escort only one or some times two vessels.

The cases are rather frequent, where the thickness and durability of ice do not present any serious obstacle to the convoy, but the strong drift of ice strongly complicates the sailing of vessels. Being exposed owing to drift to almost constant compression, even rather weak ice closes the trace of an icebreaker almost immediately. When there is a risk of ice compression the number of vessels in convoy, as a rule, is reduced. With especially strong compression the method used by icebreakers "for breaking off", shown on Fig.6. In applying this tactical method icebreakers should break the parallel channels in the ice. Under influence of the wind the drifting ice is displaced to and consolidated in the channel of the leeward icebreaker. The clearing in the ice formed at the windward side may be used by vessels which should follow the windward icebreaker as close as possible.

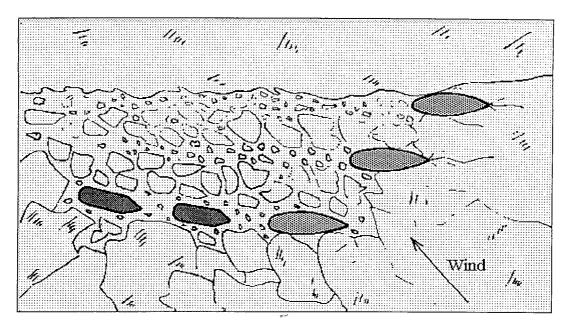


Fig. 6

The success of escorting of vessels by icebreakers in ice conditions is ensured not only by proper arrangement of vessels in the convoy, but to a greater extent by a

correctly chosen and well-kept distance between them. For average conditions and characteristics, the distances between vessels in convoy are (top limit relates to the largest vessels): 1.5-2.5 cables when moving in the ice concentrated to 4-5; 1.0-1.5 cables - in the ice concentrated to 5-6; up to 1.0 cables - in the ice concentrated to 7-8; up to 0.5 cables - in the ice concentrated to 8 and more. Sometimes the distance can be reduced up to 40-50 metres.

In practice the channels through the close ice or compact ice are broken by three basic variants: unary (Fig.7), double (Fig.8) and threefold.

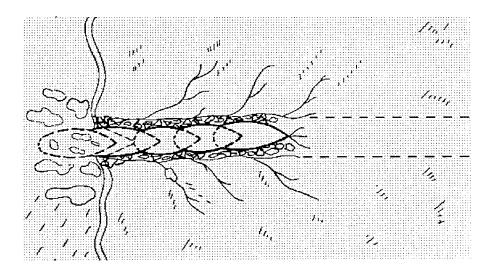


Fig. 7

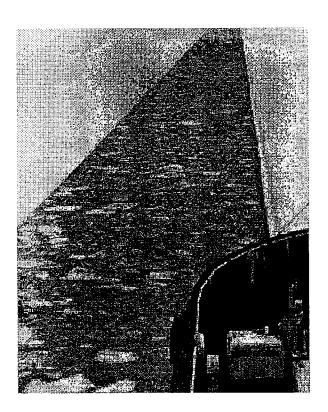


Fig. 8

The advantage of double and threefold channels is that, while breaking the ice around the vessels, the icebreaker is unlikely to be embayed by the ice, because it always has the weak ice on one side (Fig.9).

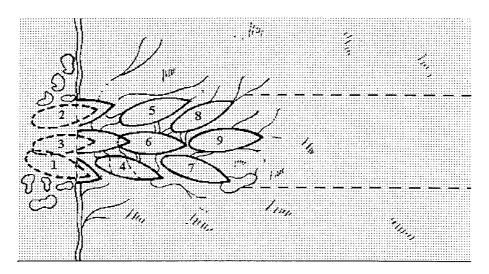


Fig. 9

There are several tactical ways of "breaking out" of vessels by icebreakers. The essence of "breaking out" is that an icebreaker, passing along a side of a vessel which gets nipped in ice, creates near it some slack ice zone, giving an opportunity to the vessel to proceed after the icebreaker. Experience shows, that the closer to a side of the vessel the icebreaker will pass, the less time will take this manoeuvre the more successful will be the entire operation for setting the vessel free. The practice knows two basic variants of "breaking out" the vessel. The first of them, the most convenient and fast is - stern "breaking out". It consists in the following: on receiving a message of an icebound vessel, the icebreaker works screw astern and passes the back course as close as possible to a side of the icebound vessel (Fig. 10).

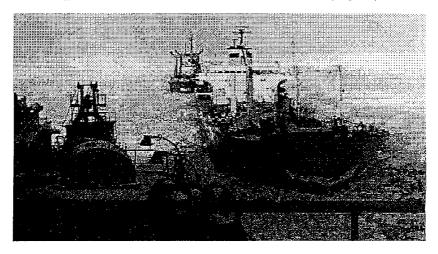


Fig. 10

In general case the "breaking out" is considered correct, when it is made on a windward side of a vessel. With this manoeuvre the icebreaker does not need to pass along the whole board of the vessel. In most of cases it is enough when the icebreaker stern passes the broadest part of the vessel, i.e. at most 3/4 of its lengths. When the **bow "breaking out" method is used**, the icebreaker leading the convoy, reverses the course, comes nearer to an icebound vessel, doubles its stern and then, passing along its side, leads out the vessel.

Always, when the icebreaker passes along a vessel lying or proceeding in ice conditions (especially with significant speed), it is necessary to take care of the fact that the hull of the icebreaker can be thrust towards a close vessel. Even if the surrounding ice is everywhere of the same strength, some slack of ice in the location, where the vessel is, results, with movement of the icebreaker, in cracks in the ice cover, which run in the direction of the above slack and the icebreaker will be inevitably displaced toward the vessel. In broken ice under influence of pushes of the separate pieces of ice the icebreaker may be moved directly towards the ice slack and can contact hard with the vessel by the bow or stern. Besides when the icebreaker passes close to a vessel, it is necessary to take care of the fact that the fragments of heavy ice pieces pushed aside by the icebreaker, can with large force impact or press a board of the vessel. It can threaten serious damages not only to its rudder and propeller, but also to outside plating. Even in compact ice the close passing of the icebreaker at a large speed will form so strong pressure on boards of the vessel that at some weakness of framing it can cause local deformations of a ship's side.

The astern towing by an icebreaker with a short tow is applied to the vessels being conducted in areas especially difficult to traverse. Usually it occurs, when the channel in heavy ice is already broken through by the icebreaker, and the vessel is not capable to proceed under its own power. A general view of a towing line at astern towing of a vessel by the icebreaker is represented in Fig. 11.

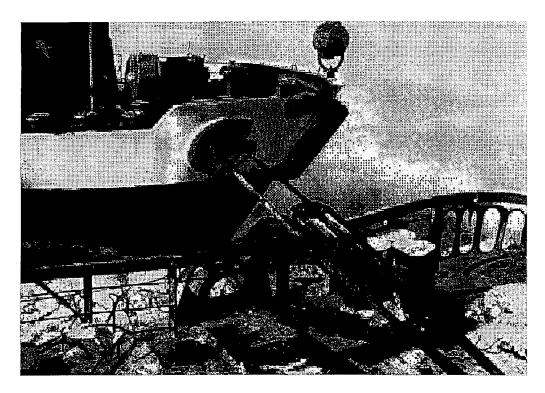


Fig. 11
Fig. 12 gives a general view of a convoy under especially difficult conditions of navigation.



Fig. 12

The main shortcoming of astern towing is that the icebreaker occasionally loses its already limited in ice handiness. The towed vessel, which frequently has no way on it, involuntarily becomes a kind of an additional rudder for the icebreaker. With involuntary deviations of a towed vessel from the course, it is impossible to

overpower the influence of such "rudder" with the aid of the icebreaker rudder and engines working contrary; the more is the speed of towage, the more dramatic effect this influence has. The influence of a towed vessel on steering ability of the icebreaker is sometimes used to speed up the turning of the icebreaker if necessary or to help it to swing by the desired course.

Section 3 DESCRIPTION OF ROUTES

Key personnel:

V.VASILYEV, S.SAMONENKO, V.ISAKOV

GENERAL DESCRIPTION OF ROUTES

The Route from the port of Hamburg to the port of Yokohama consists of routes running inside and outside the NSR.

We consider the NSR in the light of "Regulations for navigation on the seaways of the Nothern Sea Route", the official text of which is published in Notices to Mariners. According to these Regulations the extreme points of the NSR "in the west are the western entrances to the Novaya Zemlia Straits and the meridian running from Mys Zhelaniya northward, and in the east, in the Beringov Strait, are the parallel 66°N and the meridian 168°58'37"W".

Routes' indexes. Each route is marked by a capital letter:

- N high latitude transit route;
- S coastal transit route;
- W western regional route;
- E east regional route;
- H-route from the port of Hamburg to the North Cape;
- B routes of the Barents Sea;
- Y route from the Beringov Strait to the port of Yokohama.

Routes outside the NSR are:

- H route from the port of Hamburg to the North Cape;
- B routes of the **Barents Sea** including the **Karskiye Vorota Strait**. As there are several **Barents Sea** routes, they are indexed by numbers;
 - Y-route from the Beringov Strait to the port of Yokohama.

NSR routes are:

- N high latitude transit route for 12.5 m draft vessels. The article deals with the main N route passing north from the Severnaya Zemlya Islands with its transitional part via the Vil'kitzkogo Strait.
 - S coastal transit route for 9.5 m draft vessels.
 - W western regional route;
 - E eastern regional route

These routes are branches of the route S and may be used by limited draft vessels entering the Arctic ports (Tiksi and Pevek). We consider the 125°E meridian as a border between the East and West parts of the NSR.

The turning points of routes (waypoints) are marked by a route index and an index number (e.g.: N-01, B2-01, B2-04).

Route descriptions are given in geographical sequence from the west to the east as is common for navigation editions.

CHOICE OF ROUTES INSIDE THE NSR

We considered the following reasons for selection of routes:

- 1. Position of NSR entry points and ports of possible call (Tiksi and Pevek routes E1, and E2).
 - 2. Draft limitation 12.5 or 9.0 metres, with 2.0 meters clearance under hull.
 - 3. Available navigational and hydrographic data.
 - 4. Ice conditions data.

Recommended routes should be marked in red on appropriate charts. These recommended routes were established with due regard for hydrographic exploration of the region and coastal aids to navigation. In consideration of GPS or GLONASS used for positioning, the above routes were not treated as mandatory. An exception is route legs running through the Vil'kitzkogo, Sannikova and Longa Straits.

ROUTING

The Route "Port of Hamburg - Port of Yokohama" was plotted strictly in accordance with the "Recommendations for organisation of navigational service", 1989.

At the first stage a preliminary plotting in pencil was made. A general scale chart was used for this purpose (scale 1:20 000 000). This chart was used for route selection purposes and in discussions with AARI experts. The chart was also used for selection of sailing charts.

1:2 000 000 - 1:5 000 000 scale charts were used for routing outside the NSR and 1:200 000 - 1:750 000 scale charts for routing inside the NSR.

Loxodromic (mercator) bearing estimates were made for each route leg and for each route leg length. In this way the co-ordinates of each 20 miles waypoint point of route was estimated. A common "two men" routing procedure was carried out in accordance with the "Recommendations for organisation of navigational service", 1989. According to this procedure, the first navigator makes calculations and preliminary plotting, the second navigator makes a complete check of routing procedure. The second man is responsible for the result.

Then 20 miles points were plotted and the depth for each point was calculated. All dangers to navigation within 15 miles zone on both sides of the route were found out. The dangers were plotted by red half circle and directions to dangers were also marked in black line. The final check plotting was made in ink.

Tables have the following structure:

Column 1. Number of point

Waypoints are marked bold. Intermediate points are marked - 20, 40, 60 ... - according to distances from waypoints (turning points).

Column 2. Latitude.

Column 3. Longitude.

Latitude and longitude of each waypoint are given in degrees and minutes with an accuracy of 0.1'.

Column 4. Course.

Direct course is given with an accuracy of 1°.

Column 5. Distance.

Distance is given with an accuracy of 1 mile.

Column 6. Depth.

Depths of more than 20 metres are given with an accuracy of 1 metre. Depths of less than 20 metres are given with an accuracy of 0.5 m.

Columns 7 and 8. Danger.

A position of a danger is determined by course and distance to an appropriate point. An accuracy of course is 1°, an accuracy of distance is 1 nautical mile.

Column 9. Chart number.

A chart (charts) of a current route leg is given.

Column 10. Note.

A short description of dangers to navigation or other additional information is given. Geographic titles are given as published in HDNO publications.

NAVIGATIONAL HYDROGRAPHIC DESCRIPTION OF ROUTES

The Route H (Port of Hamburg - North Cape)

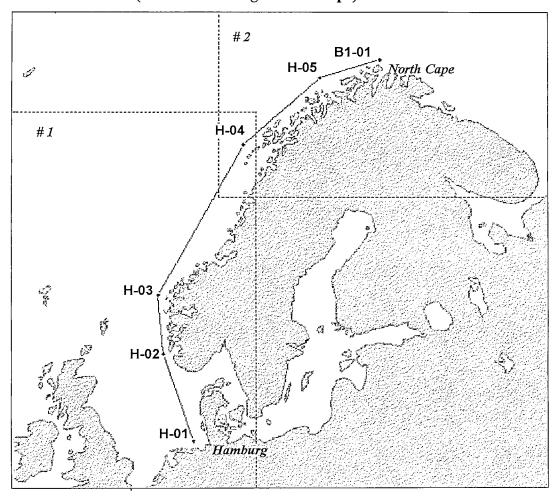


Fig. 1

The initial point of the route is in the southern part of Gelgoland Bay near the port of Hamburg. The route runs in the area where the depths exceed 25m and passes through the North Sea and Norwegian Sea along the East and Northeast coasts of Norway at least 20 miles off the dangers.

The route has five legs with a total length of 1265 nm. The route is plotted on Russian navigational charts # 20040 and 947 (Fig.1).

Route H (approaches to the port of Hamburg - North Cape)

Note	10	Approaches to the port of Hamburg					North Cape
Chart #	6	20040	20040	20040	20040, 947	947	947
ger miles	∞						
Danger o n	7						
Depth m	9	25	250	265	140	130	200
Distance Depth Miles m	5		316	171	445	214	611
Course	4		342	355	29	47	73
Latitude Longitude	3	07 30.0	04 30.0	04 00.0	12 30.0	20 00.0	25.50.0
Latitude ° '	2	54 00.0	59 00.0	61 50.0	68 20.0	70 45.0	71 20.0
Number of point	I	H-01	H-02	H-03	H-04	H-05	B1-01

Routes B (Barents Sea routes)

Barents Sea routes are plotted to provide the shortest way from the North Cape to initial points of the Routes N and S of the NSR and the port of Murmansk and port of Archangel entry points.

All routes are plotted in the area where depths are capable to ensure the navigation of deepdraft vessels; these routes run far enough from dangers to navigation with the exception of the route legs lying in the regions with the traffic separation schemes. In the traffic separation schemes the route are plotted upon the separation line or the middle of the separation zone.

The route schemes are shown in Fig. 2. #4 B1-02 #3 Mys Zhelaniya Cape # 2 B5-03 B1-01 .B4-01 **B5-02** B7-02 B2-04 B4-02/ 1. B5-01 Karskie Vorota Strait **B2-01** B6-01 B4-04 B7-01 Murmansk B6-02 B6-03 White Sea Bottlened

Fig. 2

Routes B (Barents Sea routes)

Route **B1** (North Cape - Mys Zhelaniya Cape)

Note	10	North Cape	Mys Zhelaniya Cape
Chart #	6	749	269
Danger miles	8		
Dan	7		
Depth m	9	200	270
Distance Miles	5		764
Course	4		63
Latitude Longitude Course Distance D	3	25 50.0	0.00 89
Latitude ° '	2	71 20.0 25 50.0	77 11.0
Number of point	I	B1-01	B1-02

Route **B2** (North Cape - Kara Sea via Kara Strait)

B1-01	71 20.0	25 50.0			200	947	North Cape
B2-01	70 00.0	56 00.0	86	605	85	697, 11164	
B2-02	70 17.0	57 56.0	29	43	100	697, 11164	697, 11164 Traffic separation scheme
B2-03	70 23.4	57 58.0	9	9	55	697, 11164	697, 11164 Traffic separation scheme
B2-04	70 32.0	58 15.0	33	10	128	697, 11164	697, 11164 Traffic separation scheme

Route **B4** (Route **B2** - Kola Gulf)

Route B5 (Kola Gulf - Routes B1, B2 and B6)

B4-04	69 25.0	33 45.0			210	 947	
B5-01	69 47.0	34 46.0	48	31	170	947	Route B6
B5-02	70 48.0	38 22.0	48	95	200	947	Route B2
B5-03	76 07.0	59 00.0	48	473	09	947, 697	Route B1

Route **B6** (Route **B4** - White Sea Bottleneck)

B4-02	69 59.0	33 34.0			130		947	Route B4
B6-01	69 20.0	36 30.0	122	73	180		246	
B6-02	67 50.0	41 10.0	130	136	20		947	Traffic separation scheme
B6-03	67 30.0	41 24.0	691	21	30		947	Traffic separation scheme

Route B7 (White Sea Bottleneck - Routes B2 and B5)

Traffic separation scheme		Route B2	Route B5
947	947	947	947
30	55	7.5	170
	26	105	338
	22	31	31
41 24.0	43 00.0	45 35.0	55 30.0
67 30.0	0.00 69	70 30.0	75 20.0
B6-03	B7-01	B7-02	B7-03

Route B1 (North Cape - Mys Zhelaniya Cape)

Route B1 is the shortest route for deep-draft vessels from the North Cape to Mys Zhelaniya Cape, where the high latitude transit route begins.

The Route length is 764 nm.

The route is plotted on charts #947, 697 and 11167.

Route B2 (North Cape - Kara Sea via Kara Strait)

Route B2 is the shortest route for the shallow-draft vessels, leading from the North Cape to the Kara Sea up to the coastal transit route. There is a traffic separation scheme in the Karskie Vorota Strait; the scheme is taken into account when plotting from point B2-02 to point B2-04.

The route length is 664 nm.

The route is plotted on charts #947 and 11164.

Route B4 (Route B2 - Kola Gulf)

The route branches off Route B2 and is intended for call in the port of Murmansk.

The route leg from point B4-02 to point B4-03 goes through the traffic separation scheme.

The total route length is 169 nm.

The route is plotted on chart #947.

Route B5 (Kola Gulf - Routes B1, B2 and B6)

This route is the shortest way for the deep-draft vessels going from the Kola Gulf to Route B1; the route leads to the Mys Zhelaniya Cape.

Vessels sailing to the Kara Sea through the Karskie Vorota Strait can change the course to starboard and enter Route B2 at point B5-02.

At point B5-01 Route B5 crosses Route B6, which leads to the White Sea Bottleneck.

The route length to point B5-01 is 31 nm.

The route length to point B5-02 is 126 nm.

The route length to point B5-03 is 599 nm.

The route is plotted on chart #947.

Route B6 (Route B4 - White Sea Bottleneck)

This route branches off Route B4 and is intended for vessels going to the White Sea Bottleneck and further to the port of Archangel.

The final leg from point B6-02 to point B6-03 goes through the region where a traffic separation scheme is used.

The total route length is 230 nm.

The route is plotted on chart #947.

Route B7 (White Sea Bottleneck - Routes B2 and B5)

The route begins in the traffic separation scheme of the White Sea Bottleneck and is intended for proceeding of the deep-draft vessels to the point of intersection with Route B5 and further along the Northeast coasts of the Ostrova Novaya Zemlya Islands to point B1-02 i.e. the starting point of the high latitude transit route.

The vessels proceeding to the Karskie Vorota Strait may turn to Route B2 at point B7-02.

The route length to point B7-02 is 202 nm. The route length to point B7-03 is 540 nm. The route is plotted on chart 947.

Route N (high latitude transit route)

The Route starts from point B1-02 that lies north of the Ostrova Novaya Zemlya Islands. The coastline of the north end of the Ostrova Novaya Zemlya Islands has clear distinctive contours, which can be used during radar position fixing.

The route proceeds further eastward to Ostrov Uyedineniya Island. The route rounds the island from the South and proceeds northeastward.

At point N-02 the route turns to the north and proceeds along the western coast of the Ostrova Severnaya Zemlya Islands to Ostrov Shmidta Island. This island is covered by glacier.

The first part of the Route N goes through the central and north part of the Kara Sea with no dangerous depths; in this region the selection of route depends on ice closeness.

At point N-03 the route turns to the east, goes north of the Mys Archticheskiy Cape of Ostrov Komsomoletz Island (the extreme north end of the Ostrova Severnaya Zemlya Islands) and enters the Laptev Sea.

The first variant of the Route N through the Laptev Sea was plotted along the shortest way from the Mys Archticheskiy Cape to the point lying north of the Novosibirskiye Ostrova Islands. But due to AARI recommendations the route was shifted considerably to the south and plotted along the eastern coast of the Ostrova Severnaya Zemlya Islands and the Taymyr Peninsula. The nearest land to the route is Ostrov Bolshevik Island situated 10-15 miles from the route.

The depths on the route in the western part of the Laptev Sea are 45-50 metres or more. In the eastern part of the sea near the Novosibirskiye Ostrova Islands the depths decrease to 20 metres.

There are no dangers to navigation in the vicinity of the route in the Laptev Sea but some shoals with dangerous depths are situated in the north end of the Novosibirskiye Ostrova Islands.

The Route rounds the Novosibirskiye Ostrova Islands and enters the East Siberian Sea.

A part of the route from point N-08 to point N-09 passes between the Ostrova Anjou Islands and the Ostrova De-Longa Islands. The depths in this part of the route are about 25-30m. With going further to the east the depths in the East Siberian Sea increase.

The first variant of the route was plotted along the shortest distance to the point northward from the Ostrov Vrangelya Island and further to the Beringov Strait, with Ostrov Geral'd Island kept westward of the route.

The AARI experts recommended another route. The route is plotted through the central part of the East Siberian Sea to point N-11, and then to the Chukchi Sea via the Longa Strait. In the Chukchi Sea the route skirts the South coast of Ostrov Vrangelya Island deviating to the Northeast.

The route leg from point N-12 to point N-13 coincides with the recommended track of navigation in the Longa Strait. This way is plotted 15-20 miles from the South coast of Ostrov Vrangelya Island in the area with depths of 30-50 metres. The hills of the island are convenient for radar position fixing.

At approaches to the Beringov Strait, the high and conspicuous Mys Uelen and Mys Dezhneva Capes serve some good landmarks visible at a considerable distance.

The point Y-01 in the Beringov Strait is a final point of the Route N. Route N has 14 legs, with a total length of 2446 nm.

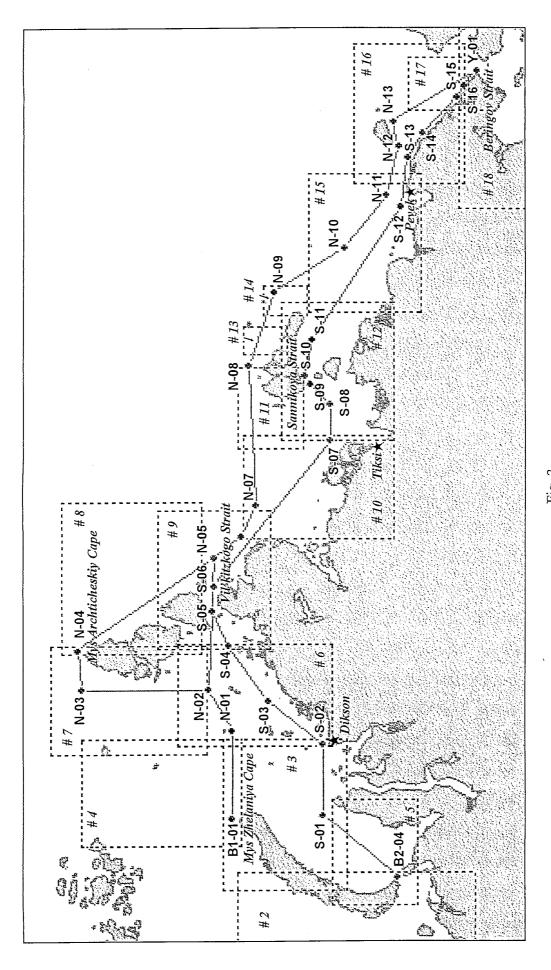


Fig. 3
The Route is plotted on charts 697, 11167, 948, 11134, 11135, 949, 951, 11143, 12417, 12418, 954, 955 and 11151 (see Fig. 3)

Route N (high latitude transit route) waypoints

	i -	T	· 	Τ	1	1	T	1	T	T-	1	T	T	1	Ι	T
Note	10	Mys Zhelaniya Cape.			Ostrov Shmidta Isl.	Mys Arhticheskiy Cape				Novosibirskie Ostrova Isl.				Ostrov Vrangelya Isl.	Ostrov Vrangelya Isl.	Beringov Strait
Chart #	6	697, 11167	948	948	11134	11134, 11135	676	676	156		12418	954	954	955	955	11151, 60092
ger miles	8															
Danger o	7														-	
Depth m	9	270	30	20	06	100	230	52	57	20	30	28	33	49	40	45
Distance Miles	ß		193	96	202	63	569	02	75	317	185	205	193	163	87	328
Course	4		06	19	0	98	144	138	113	88	108	144	128	101	80	147
Longitude	3	0.00 89	82 30.0	89 00.0	89 00.0	96 00.0	110 48.0	114 20.0	119 20.0	142 00.0	154 20.0	161 45.0	170 00.0	178 04.0	177 39.0	169 32.0
Latitude ° '	2	77 11.0	77 11.0	77 58.0	81 20.0	81 24.0	77 47.0	76 55.0	76 26.0	76 40.0	75 44.0	72 58.0	71 00.0	70 30.0	70 45.0	0.01 99
Number of point	I	B1-02	N-01	N-02	N-03	N-04	N-05	90-N	N-07	N-08	N-09	N-10	N-11	N-12	N-13	Y-01

Transitional part of the high latitude route via the Vil'kitzkogo Strait

Note	01		Vil'kitzkogo Strait	Vil'kitzkogo Strait	
Chart #	6	948	949	949	949
ger miles	8			-	
Danger o m	7				
Depth m	9	20	122	180	230
Distance Miles	5		84	51	19
Course	4		89	92	92
Number of Latitude Longitude Course Distance Depth point "Miles m	3	89 00.0	77 52.0 102 00.0	77 50.0 106 00.0	77 47.0 110 48.0
Latitude ° '	2	77 58.0	77 52.0	77 50.0	77 47.0
Number of point	I	N-02	S-05	90-'S	N-05

The transitional part of the high latitude route via the Vil'kitzkogo Strait

This part of the Route branches off the main line in point N-02 and goes to the east to the Vil'kitzkogo Strait, where enters Route-S leg from point S-05 to point S-06 and then meets again the Route N at point N-05.

The Vil'kitzkogo Strait separates the Ostrova Severnaya Zemlya Islands from the Taymyr Peninsula and is a key place of the NSR connecting the Kara Sea and the Laptev Sea.

The bottom in the Strait is flat, except the region of the Ostrova Geyberga Islands. The depth in the Strait is about 100-200 m, at the west approaches to the Strait the depths are slightly shallower.

The possibility to navigate in the Vil'kitzkogo Strait and approaches to it depends mainly on ice conditions.

The transitional part of the high latitude route via the Vil'kitzkogo Strait has a total length of 196 nm.

The route is plotted on charts #948 and 949 (see Fig. 3).

The transitional part of the high latitude Route N via the Vil'kitzkogo Strait reduces the Route N length by 15%.

The Route S (coastal transit route)

The route begins at the east entrance to the Karskie Vorota Strait in point B2-04 in the coastal zone of the Kara Sea with difficult navigation conditions. The main factors complicating the navigation in the Kara Sea are: a great number of submarine dangers to navigation, frequent fogs, almost constant presence of ice and poor knowledge of currents.

The first leg of the route to Ostrov Belyy Island runs far from the dangers. The depths are 50-100 metres.

At point S-01 the route turns to the East and goes to Ostrov Dikson Island in the Yeniseyskiy Bay region. From point S-02 to the entrance to the Vil'kitzkogo Strait (point S-05) the route goes along a number of islands and archipelagos. The main part of dangers to navigation in this region lies southward of the route at distances of 6-14 nm.

While sailing from Ostrov Dikson Island to the Vil'kitzkogo Strait the vessel's position fixing may be done using radio beacons, night and day landmarks and prominent features.

The route leg from point S-05 to point S-06 comes through the Vil'kitzkogo Strait. The navigation in the Vil'kitzkogo Strait is difficult because of the continued presence of close ice, strong currents and poor visibility. More often vessels proceed eastward keeping close to the south coast of the Strait and taking advantage of the prevailing ice drift direction caused by a following current.

This part of the route is well equipped for navigation under any weather conditions. In good visibility the position can be fixed by lights and landmarks (Mys Chelyuskin Cape, Mys Chekina Cape), in restricted visibility - by radar fixing.

At radar fixing it should be borne in mind that the shores of the Vil'kitzkogo Strait give interrupted image of medium intensity at radar screen from a distance of 4 to 6 miles, in some places from 10 to 12 miles. Radar reflectors mounted on beacons can be distinguished at distances of 10 to 14 nm.

After the Vil'kitzkogo Strait the route enters the Laptev Sea. The South part of the Sea is shallow, which forces vessels to sail beyond the visibility of coastal line.

In point S-06 the route turns southeast, rounds the Taymyr Peninsula and proceeds to the River Lena Delta. At the beginning of this section the route goes northward of the Ostrova Komsomol'skoy Pravdy Islands and the Ostrova Petra Islands.

In point S-07 the route turns eastward and goes to the Novosibirskiye Ostrova Islands, to Ostrov Stolbovoy Island and then to the Sannikova Strait.

From point S-08 situated southward of Ostrov Stolbovoy Island to point S-11 the route coincides with the recommended track for navigation up to the Sannikova Strait.

The conditions of radar position fixing in the Sannikova Strait are satisfactory only in its narrow western part, where the shores of Ostrov Malyy Lyakhovskiy Island and Ostrov Kotel'nyy Island can be detected by radar at distances of 8-12 nm. The East coasts of Ostrov Malyy Lyakhovskiy Island, Ostrov Bol'shoy Lyakhovskiy Island and the South coast of Ostrov Zemlya Bunge and the Novaya Sibir' Islands can not be detected by radar from the middle of the Sannikova Strait up to its east exit.

After passing the Sannikova Strait vessels enter the East Siberian Sea. The navigation in the East Siberian Sea is made difficult by shoals, poor investigation (except coastal regions), frequent fogs and presence of close ice. Depending on bathymetry the East Siberian Sea can be divided into two parts: the West part is a deep part and the East one is a shallow part.

From point S-11 to point S-12 situated northward of Ostrov Ayon Island, the route runs the shortest way far from dangers to navigation.

From point S-12 and across the entire Chukchi Sea to the last point Y-01 the route coincides with the recommended track of "Coastal variant".

The Chukchi Sea is entirely situated on the continental shelf. Depths of 40-50 m prevail in the central part of the sea and in the Longa Strait.

There are few dangers to navigation in the Chukchi Sea.

The route is plotted along the continental coast sometimes within 10 nm from the shore. This region is equipped well with aids to navigation. Usually the navigational marks are well visible at any time and evenly allocated along the coast.

The conditions of radar position fixing are usually favourable along this section of the route.

Point Y-01 inside the Beringov Strait is the last point of the Route S. The Route S has 17 legs. The total length is 2680 nm.

The Route is plotted on charts # 11164, 697, 948, 949, 951, 952, 954, 955 and 11151 (Fig. 3).

Route S (coastal transit route) waypoints

Note	10	Traffic separation scheme					Vil'kitzkogo Strait	Vil¹kitzkogo Strait			Sannikova Strait	Sannikova Strait		
Chart #	6	697, 11164 T	269	697, 948	948	948, 949	949	1 646	951, 952	952	952 S	952 S	952	954
er miles	8											•		
Danger ° n	7													
Depth m	9	128	23	35	42	20	122	180	14	23	22	22	15	35
Distance Miles	S		273	195	171	144	84	51	436	105	72	33	92	466
Course	4		44	06	41	56	89	92	126	06	46	02	100	121
Longitude	ç	58 15.0	68 30.0	80 10.0	87 20.0	96 00.0	102 00.0	106 00.0	129 50.0	136 00.0	139 05.0	141 00.0	146 38.0	168 32.0
Latitude ° '	2	70 32.0	73 50.0	73 50.0	76 00.0	77 20.0	77 52.0	77 50.0	73 32.0	73 32.0	74 22.0	74 34.0	74 18.0	0.71 07
Number of point	I	B2-04	S-01	S-02	S-03	S-04	S-05	90-S	2-02	S-08	S-09	S-10	S-11	S-12

S-13	70 01.0	70 01.0 176 19.0	96	160	39		955	
S-14	0711 69	69 11.0 179 29.0	120	101	41		955	
S-15	67 12.0	173 42.0	133	176	26		955, 11151	
S-16	67 00.0	171 34.0	104	51	37		955, 11151	man of a fact of the second
Y-01	66 10.0	169 32.0	136	20	45		11151	11151 Beringov Strait

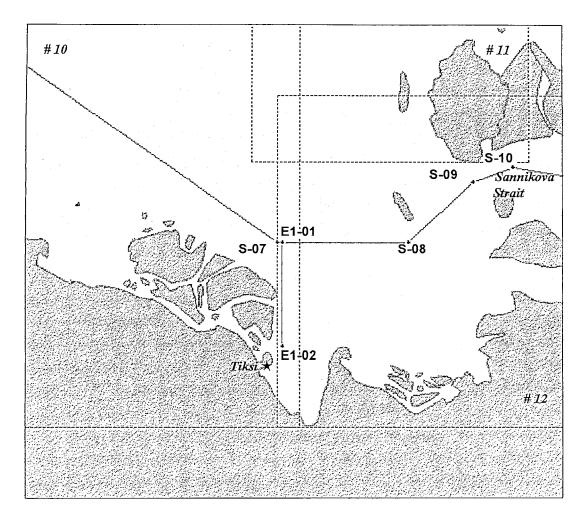


Fig. 4

Route E1 (Route S - approaches to the port of Tiksi)

This route branches off the Route S in the Laptev Sea between points S-07 and S-08 (intermediate point 20) and is intended for call in the port of Tiksi.

The route is plotted along the east boundary of the River Lena Delta. The conditions of navigation on the Route E1 are mainly the same as conditions in the Laptev Sea. The last point E1-02 is near the Ostrov Muostakh Island in the area where a pilot may be taken aboard.

The route length is 122 nm.

The route is plotted on chart #951 (see Fig. 4).

Route E (regional east routes)

Route **E1** (Route **S** - approaches to the port of Tiksi)

Note	10		10 m isobath N of Ostrova Grigogiy Isl.	10 m isobath SE of Ostrova Grigoriy Isl.	10 m isobath NE of Radio Beacon Urasalaakh	10 m isobath E of Radio Beacon Urasalaakh	10 m isobath E of Mys Muostakh Cape	10 m isobath SE of Ostrov Muostakh Isl.	10 m isobath SE of Ostrov Muostakh Isl.
Chart #	6	951	951	156	156	156	951	951	951
ger miles	8		13	7	5	6	II	9	9
Danger o n	7		253	260	261	290	222	265	282
Depth m	9	24	.23	19.0	18.0	14.0	14.0	12.0	12.0
Distance Miles	ĸ		20	40	09	80	001	120	122
Course	4		180	180	180	180	180	180	180
Longitude	3	130 30.0	130 30.0	130 30.0	130 30.0	130 30.0	130 30.0	130 30.0	130 30.0
Latitude	2	73 32.0	73 12.0	72 52.0	72 32.0	72 12.0	71 52.0	71 32.0	71 30.0
Number of point	I	E1-01	20	40	09	80	001	120	E1-02

Route **E2** (Route **S** - approaches to the port of Pevek)

E2-01	70 14.0	170 10.0			20	140	8	954	10 m isobath NW of Mys Shelagskiy
									Cape
E2-02	69 54.0	170 10.0	180	70	14.5	180	4	954	10 m isobath

Route E2 (Route S - approaches to the port of Pevek)

The route is plotted in the Chukchi Sea and is intended for call in the port of Pevek. This Route is rather short. It branches off the Route S in a place close to the continental shore.

The route enters the Sredniy Strait with 13-15 metres depths.

A pilot may be taken aboard not at the last point of route E2-02, but just on the Route S.

The route length is 20 nm.

The Route is plotted on chart # 954 (see Fig. 5).

#15 N-11

#16

N-12 Ostrov
Vrangelya Isl
N-13
Longa Srtait
S-13

Pevek

Fig 5

Route Y (Beringov Strait - approaches to the port of Yokohama)

The route begins in the Beringov Strait at the point Y-01 i.e. the final point of the Route N and the Route S. After rounding the Chukotskiy Peninsula, the Route Y is plotted along the shortest way to Honshu Island on the deep sea far from dangers to navigation.

The route has four legs with a total length of 2721 nm.

The route is plotted on charts # 60092 and 60091 (see Fig. 6).

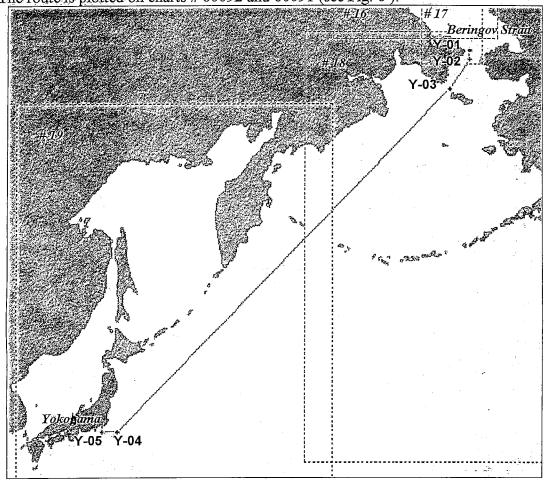


Fig. 6

Route Y (Beringov Strait - approaches to the port of Yokohama) waypoints

					т	
Note	10	11151, 60092 Beringov Strait				Approaches to the port of Yokohama
Chart #	6	11151, 60092	11151, 60092	60092	16009	16009
ger miles	8					
Danger n	7					
Depth m	9	45	50	50	0059	2000
Distance miles	5		10	135	2463	II3
Course	4		180	208	224	270
Latitude Longitude Course Distance Depth	3	66 10.0 169 32.0	66 00.0 169 32.0	64 00.0 172 00.0	34 35.0 142 00.0	34 35.0 140 00.0
Latitude ° '	7	0.01 99	0.00 99	64 00.0	34 35.0	34 35.0
Number of point	I	Y-01	Y-02	Y-03	Y-04	Y-05

ROUTES DISTANCES

The total route distance to be run at a transit passage through the NSR, that may take two weeks or more depending on navigational season, ranges from 2100 to 3400 nautical miles (nm). At the same time even in the period of the maximum ice cover development (the first decade of June) it is only about 2350 nm.

The total distance of above recommended routes makes the following values:

Route N (high latitude transit route)	
main variant	- 2446 nm;
variant via the Vil'kitskogo Strait	- 2108 nm;
Route S (coastal transit route)	- 2680 nm.

DETAILED ROUTE TABLES

Route S -coastal transit route

	<u> </u>	T	T		T	1			1	T	<u> </u>		T	T_			
Note	10	Traffic separation scheme															
Chart #	6	697, 11164	11164	11164	11164	11164	11164	11164	11164	11164	11164	11164, 697	11164, 697	11164, 697	269	269	269
ger miles	8																
Danger	7																
Depth	9	128	200	175	105	100	130	100	100	65	09	20	53	39	29	23	15
Distance miles	5		20	40	09	80	100	120	140	091	180	200	220	240	260	273	20
Course	4		44	44	44	44	44	44	44	44	44	44	44	44	44	44	06
Longitude	3	58 15.0	58 56.5	59 38.5	60 21.1	61 04.1	61 47.8	62 31.9	63 16.7	64 02.1	64 48.0	65 34.6	66 21.8	2.60 29	67 58.3	68 30.0	8.14 69
Latitude ° ′	2	70 32.0	70 46.5	71 01.0	71 15.5	71 30.0	71 44.5	71 59.0	72 13.5	72 28.0	72 42.5	72 57.0	73 11.5	73 26.0	73 40.5	73 50.0	73 50.0
Number of point	I	B2-04	20	40	09	80	100	120	140	091	180	200	220	240	790	S-01	20

10 m isobath N of Mys Belyy Cape, Ostrov Belyy Isl.		10 m isobath	Depth 10.8 m	Shoal 9.8 m													Depth 9.0 m	10 m isobath N of Ermak Bank	8.8 m, Bruzevitz Bank	
269	269	269	269	269	269	269	269	697, 948	948	948	948	948	948	948	948	948	948	948	948	948
6		12	9	13													13	13	14	
177		132	215	187													131	192	115	
18	19.5	29	91	17,5	61	24	29	35	38	35	40	46	36	40	50	31	42	50	38	50
40	09	80	100	120	140	091	180	195	20	40	09	80	100	120	140	160	171	20	40	09
06	06	06	06	06	06	06	06	06	41	41	41	41	41	41	41	41	41	56	56	56
70 53.7	72 5.5	73 17.3	74 29.2	75 41.0	76 52.8	78 4.7	79 16.5	80 10.0	80 57.2	81 45.1	82 33.7	83 23.2	84 13.4	.85 04.5	85 56.5	86 49.3	87 20.0	88 29.2	89 39.3	90 50.3
73 50.0	73 50.0	73 50.0	73 50.0	73 50.0	73 50.0	73 50.0	73 50.0	73 50.0	74 05.2	74 20.3	74 35.5	74 50.6	75 05.8	75 20.9	75 36.1	75 51.2	76 00.0	76 11.1	76 22.2	76 33.3
40	09	80	100	120	140	091	180	S-02	20	40	09	80	100	120	140	091	S-03	20	40	09

10.2 m, Stamukha Bank	Shoal 13.0 m		10 m isobath NW of Mys Russkiy Cape. Ostrov Russkiy Isl.	10 m isobath NW of Mys Russkiy,	Depth 12.4 m		10 m isobath NW of Mys Zapadniy Cape, Ostrov Russkiv Isl.	10 m isobath NE of Ostrova Gevberga Isl.	10 m isobath NE of Ostrova	10 m isobath N of Mys Chelyuskin	Io m isobath NE of Mys Chekina	8.6 m, Stvor Bank	Shoal 3.8 m NE of Ostrov Dezhneva Isl.	10 m isobath N of Mys Gagarina Cape, Ostrov Samuila Isl.	Shoal 9.6 m 10 m isobath NE of Mys Bolshoy Cape, Ostrov Bolshoy Isl.
948	948	948	948	948, 949	949	949	949	949	646	949	949	949	949		949
6	9		12	II	6		11	01	12	6	II	14	11	<u> </u>	II
302	180		127	147	217		103	861	29	142	210	174	238		258
24	50	85	58	02	110	06	100	130	122	200	210	180	100		65
80	100	120	140	144	20	40	09	80	84	20	40	51	20		40
56	56	56	56	56	89	89	89	89	89	92	92	92	126		126
92 2.3	93 15.3	94 29.3	95 44.4	0.00 96	97 24.7	98 50.2	9.91 001	101 43.8	102 00.0	103 35.0	105 09.9	106 00.0	107 15.8		108 30.5
76 44.4	76 55.4	77 6.5	77 17.6	77 20.0	77 27.6	77 35.3	77 42.9	77 50.5	77 52.0	77 51.2	77 50.4	77 50.0	77 38.1		77 26.3
80	100	120	140	S-04	20	40	09	80	S-05	20	40	90-S	20		40

	10 m isobath E of Ostrov Andreya Isl.	10 m isobath NE of Ostrov Koshka Isl.	10 m isobath N of Ostrov Uzhniy Isl.	10 m isobath NE of Ostrov Uzhniy Isl.													10 m isobath N of Ostrov Amerika- Kuba-Arita Isl.	10 m isobath NE of Ostrov Amerika- Kuba-Arita Isl.
949	949	949	949	494, 951	494, 951	494, 951	951	951	951	951	156	951	951	951	951	951	951	951
	14	8	7	13													11	10
	176	227	204	246													216	232
45	28	28	24	42	40	49	35	33	41	40	27	30	32	32	28	28	22	19
09	80	100	120	140	091	180	200	220	240	260	280	300	320	340	360	380	400	420
126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126
109 44.0	110 56.4	112 07.7	113 18.0	114 27.3	115 35.5	116 42.9	117 49.3	118 54.7	119 59.3	121 03.1	122 06.0	123 08.1	124 09.5	125 10.0	126 09.8	127 08.9	128 07.3	129 05.0
77 14.4	77 02.6	76 50.7	76 38.9	76 27.0	76 15.1	76 03.3	75 51.4	75 39.6	75.27.7	75 15.9	75 04.0	74 52.2	74 40.3	74 28.4	74 16.6	74 04.7	73 52.9	73 41.0
09	80	001	120	140	091	180	200	220	240	760	280	300	320	340	360	380	400	420

10 m isobath			Shoal 10.2 m NW of Ostantzovaya Banke				10 m isobath SE of Mys Povorotniy Cape, Ostrov Stolbovoy Isl.			10 m isobath SE of Mys Medveziy Cape, Ostrov Kotelniv Isl.	10 m isobath N of Mys Vaygatch Cape, Ostrov Maly Lyakhovski Isl.	10 m isobath N of Mys Hvoyniy Cape, Ostrov Maly Lyakhovski Isl.	Depth 9.8 m	10 m isobath			10 m isobath	
951, 952	952	952	952	952	952	952	952	952	952	952	952	952	952	952	952	952	952	952
7			9				13			II	8	7	6	10			9	
44			160				300			38	145	181	09	91			22	
14	23	18	91	91	25	23	19	21	20	22	22	22	17	12,5	16,5	15	15	14
436	20	40	09	80	100	105	20	40	09	72	20	33	20	40	09	80	92	20
126	06	06	06	06	06	06	46	46	46	46	20	20	100	100	100	100	100	121
129 50.0	131 00.6	132 11.1	133 21.7	134 32.2	135 42.8	136 00.0	136 50.8	137 42.3	138 34.5	139 05.0	140 14.4	141 00.0	142 13.8	143 27.4	144 40.7	145 53.8	146 38.0	147 40.9
73 32.0	73 32.0	73 32.0	73 32.0	73 32.0	73 32.0	73 32.0	73 46.0	73 59.9	74 13.9	74 22.0	74 29.2	74 34.0	74 30.5	74 27.0	74 23.5 .	74 20.0	74 18.0	74 07.6
S-07	20	40	09	80	100	S-08	20	40	80	80-S	20	S-10	20	40	09	80	S-11	20

															10 m isobath S of shoal 4.8 m	10 m isobath N of shoal 9.4 m		10.2 m, Leningrad Banke		
952	952	952	952. 954	954	954	954	954	954	954	954	954	954	954	954	954	954	954	954	954	954
															15	15		6		
									12.						42	186		144		
15	14,5	15,5	13,5	20	30	30	21	20	20	20	20	14,5	20	21	17	22	22	22	27	31
40	09	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440
121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121
148 43.1	149 44.6	150 45.5	151 45.8	152 45.5	153 44.6	154 43.1	155 41.0	156 38.4	157 35.2	158 31.5	159 27.3	160 22.5	161 17.2	162 11.5	163 5.2	163 58.5	164 51.3	165 43.6	16635.5	167 26.9
73 57.3	73 46.9	73 36.5	73 26.2	73 15.8	73 05.4	72 55.0	72 44.7	72 34.3	72 23.9	72 13.6	72 03.2	71 52.8	71 42.5	71 32.1	71 21.7	71 11.3	71 01.0	70 50.6	70 40.2	70 29.9
40	09	80	00I	120	140	091	180	200	220	240	260	280	300	320	340	360	380	400	420	440

10 m isobath N of Ostrov Ayon Isl.	10 m isobath N of Ostrov Ayon Isl.	Shoal 10m	10 m isobath N of Mys Shelagski Cape	10 m isobath		10 m isobath N of Ostrov Shalaurova Isl.	10 m isobath N of Mys Aachim Cape	10 m isobath	10 m isobath	Shoal 10 m	10 m isobath	10 m isobath NE of Mys Yakan Cape	10 m isobath	10 m isobath		10 m isobath				
954	954	954	954	954	954, 955		955	955	955	955	955	955	955	955	955	955	955	955	955	955
13	6	14	5	7	01	II	8	01	01	9	01	01	9	6		15	01	01	10	6
165	180	228	175	185	201	147	175	193	172	175	219	243	203	218		229	213	225	226	219
32	35	21	30	32	22		20	33	28	39	34	30	35	40	41	41	32	34	33	30
460	466	20	40	09	80		100	120	140	160	20	40	09	. 08	100	101	20	40	09	80
121	121	96	96	96	96		96	96	96	96	120	120	120	120	120	120	133	133	133	133
168 17.9	168 32.0	169 30.9	170 29.7	171 28.4	172 27.0		173 25.5	174 23.9	175 22.2	176 19.0	177 09.6	177 59.9	178 49.7	179 39.2	17931.8	179 29.0	178 47.9	178 07.2	177 26.9	176 47.0
70 19.5	70 17.0	70 15.0	70 13.0	70 10.9	70 08.9		6.90 02	70 04.9	70 02.8	70 01.0	69 51.1	69 41.2	69 31.3	69 21.4	69 11.5	07II 69	68 57.4	68 43.9	68 30.3	68 16.7
460	S-12	20	40	09	80		100	120	140	S-13	20	40	09	80	100	S-14	20	40	09	80

100	1.E0 89	176 07.6	133	001	20	215	9	955	10 m isobath
120	67 49.5	175 28.5	133	120	23	226	4	955, 11151	10 m isobath
140	67 36.0	174 49.8	133	140	23	229	7	955, 11151	10 m isobath
				•		147	6		10 m isobath NW of Ostrov Koluchin
									IsI.
091	67 22.4	174 11.4	133	091	20	240	12	955, 11151	10 m isobath
S-15	67 12.0	173 42.0	133	9/1	26	173	5	955, 11151	10 m isobath N of Mys Janretlen
									Cape
20	67 07.3	172 51.9	<i>104</i>	20	23	99I	4	955, 11151	10 m isobath NW of Ostrov Idlidlia
									Isl.
40	67 02.6	172 02.1	104	40	34	149	5	955, 11151	10 m isobath NW of Mys Nettem
									Cape
S-16	0.00 29	171 34.0	70I	51	37	230	4	955, 11151	10 m isobath N of Mys Serdse-
									Kamen Cape
20	66 45.6	170 58.6	136	20	37	797	. 6	III5I	10 m isobath E of Mys Ikikur Cape
40	66 31.3	170 23.5	136	40	40	233	6	11151	10 m isobath NE of Mys Volnistiy
									Cape
09	691 99	169 48.7	9 <i>EI</i>	09	40	661	7	III5I	10 m isobath
Y-01	0.01 99	169 32.0	136	20	45	235	4	IIISI	Beringov Starit

Route N -high latitude transit route

Note	10	Mys Zhelaniya Cape.											10 m isobath SE of Ostrov Uedineniya Isl.	Depth 12.8 m			
Chart #	6	697, 11167	697, 11167	697, 11167	697, 11167	697, 11167	697, 11167	697, 11167	697, 11167	11167, 948	948	948	948	948	948	948	948
ger miles	8												15	13			
Danger " m	7												303	180			
Depth m	9	270	450	300	220	061	20	150	100	70	20	30	45	80	65	55	20
Distance miles	S		20	40	09	80	100	120	140	160	180	193	20	40	09	80	96
Course	4		06	06	06	06	06	06	06	06	06	06	19	19	19	19	19
Longitude	3	0.00 89	69 30.2	71 00.3	72 30.5	74 00.6	75 30.8	77 01.0	78 31.1	80 01.3	81 31.4	82 30.0	83 49.1	85 09.3	86 30.4	87 52.7	89 00.0
Latitude ° '	2	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 11.0	77 20.8	77 30.5	77 40.3	77 50.0	77 58.0
Number of point	I	B1-02	20	40	09	80	100	120	140	160	180	N-01	20	40	09	80	N-02

											Ostrov		Ostrov	Ostrov		moletz		
								SW end of Ostrov Shmidta Isl.	NW end of Ostrov Shmidta Isl.	NW end of Ostrov Shmidta Isl.	N of Mys Zemlyanoy Cape, Shmidta Isl.	Shoal 10 m	Mys Archticheskiy Cape, Komsomoletz Isl.	III34, III35 Mys Archticheskiy Cape, Komsomoletz Isl.	Ostrov Komsomoletz Isl.	Mys Lokotj Cape, Ostrov Komsomoletz Isl.		9.6 m of Nekrasovskaya Bank
								SW er	NW e	NW e	N of Shmic	Shoal	Mys Koms	Mys Koms	Ostro	Mys 1 Isl.		9.6 m
948, 11134	948, 11134	11134	11134	11134	11134	11134	11134	11134	11134	11134	11134	11134	11134, 11135 Mys Koms	11134, 11135	11135	11135	11135	11135
						i		13	13	14	8	91	7	8	7	7		14
				ı				09	123	128	190	961	174	202	240	240		239
100	001	140	180	150	180	091	200	150	06	06	80	35	100	100	140	35	130	85
20	40	09	80	100	120	140	091	180	200	202	20	40	09	63	20	40	09	80
0	0	0	0	0	0	0	0	0	0	0	98	98	86	98	144	144	144	144
0.00 68	89 00.0	89 00.0	89 00.0	89 00.0	89 00.0	89 00.0	89 00.0	89 00.0	89 00.0	89 00.0	91 12.6	93 25.5	95 38.8	0.00 96	97 17.8	98 33.3	99 46.6	100 57.8
78 18.0	78 38.0	78 58.0	79 18.0	79 38.0	79 58.0	80 18.0	80 38.0	80 58.0	81 18.0	81 20.0	81 21.3	81 22.5	81 23.8	81 24.0	81 07.9	80 51.7	80 35.6	80 19.4
20	40	09	80	100	120	140	091	180	200	N-03	20	40	09	N-04	20	40	09	80

		Submerged Rock 7.4 m	Shoal 10 m. Not well surveyed. Tzingera Cape, Bolshevik Isl.																	
11135	11135	11135	11135, 949	11135, 949	11135, 949	11135, 949	646	646	949	949	949	949	949	949, 951	949, 951	949, 951	156	951	951	951
		10	10 15																	
		200	290																	
100	350	200	150	210	200	65	40	280	230	65	58	52	52	50	45	45	57	63	20	73
100	120	140	091	180	200	220	240	260	269	20	40	09	02	20	40	09	7.5	20	40	09
144	144	144	144	144	144	144	144	144	144	138	138	138	138	II3	113	113	II3	88	88	88
102 07.1	103 14.6	104 20.4	105 24.5	106 27.0	107 28.0	108 27.7	109 25.9	110 22.9	110 48.0	111 50.3	112 51.4	113 51.3	114 20.0	115 41.1	117 01.3	118 20.9	119 20.0	120 45.2	122 10.5	123 35.8
80 03.3	79 47.1	79 31.0	79 14.8	78 58.7	78 42.5	78 26.4	78 10.2	77 54.1	77 47.0	77 32.1	77 17.1	77 02.2	76 55.0	76 47.3	76 39.5	76 31.8	76 26.0	76 26.9	76 27.7	76 28.6
100	120	140	160	180	200	220	240	260	N-05	20	40	09	90-N	20	40	09	N-07	20	40	09

									Shoal 9.2 m		Shoal 13 m	Shoal 9.2 m	•							
951	951	951	951, 11143	11143	11143	11143	11143	11143	11143	11143	11143			12417	12417	12417	12417	12417		12418
								i	10		9	∞								
,									125		215	130								
72	50	52	55	55	50	32	27	24	24	22	23		20	30	36	39	37	32	32	30
80	100	120	140	091	180	200	220	240	260	280	300		317	20	40	09	80	001	120	140
88	88	88	88	88	88	88	88	88	88	88	88		88	108	108	801	108	108	108	108
125 01.3	126 26.8	127 52.5	129 18.2	130 44.0	132 09.9	133 35.9	135 02.0	136 28.2	137 54.5	139 20.8	140 47.3		142 00.0	143 22.3	144 44.1	146 05.2	147 25.7	148 45.7	150 05.1	151 23.9
76 29.5	76 30.3	76 31.2	76 32.1	76 32.9	76 33.8	76 34.7	76 35.5	76 36.4	76 37.3	76 38.1	76 39.0		76 40.0	76 33.9	76 27.9	76 21.8	76 15.7	7.60 97	76 03.6	75 57.6
80	100	120	140	091	180	200	220	240	260	280	300		N-08	20	40	09	80	100	120	140

10 m isobath S of Ostrov Zhokhova Isl. 10 m isobath N of Ostrov Vil'kitskogo	135.												Shoal 6.8 m						
12418	12418	12418	12418				954	954	954	954	954	954	954	954	954	954	954	954	954
13 9													13						
3 202													212						
31	29	30	30	30	30	31	37	28	29	28	27	23	28	22	25	23	24	23	22
160	180	185	20	40	09	80	100	120	140	091	180	200	205	20	40	09	80	100	120
108	108	108	144	144	144	144	144	144	144	144	144	144	144	128	128	128	128	128	128
152 42.2	153 59.9	154 20.0	155 07.0	155 53.2	156 38.6	157 23.2	158 07.0	158 50.1	159 32.5	160 14.1	160 55.2	161 35.6	161 45.0	162 38.7	163 31.8	164 24.4	165 16.3	166 07.7	166 58.5
75 51.5	75 45.4	75 44.0	75 27.8	75 11.5	74 55.3	74 39.1	74 22.9	74 06.6	73 50.4	73 34.2	73 18.0	73 01.7	72 58.0	72 45.8	72 33.6	72 21.3	72 09.1	71 56.9	71 44.7
091	180	N-09	20	40	09	80	001	120	140	091	180	200	N-10	20	40	09	80	100	120

													10 m isobath S of Mys Blossom Cape, Ostrov Vrangelya Isl.	10 m isobath S of Ostrov Vrangelya Isl	10 m isobath S of Ostrov Vrangelya Isl	10 m isobath S of Ostrov Vrangelya Isl				
954	954	954	954	954	954, 955	954, 955	955	955	955	955	955	955	955	955	955	955	955	955	955	955
													12	14	13	15				
										 			340	9	342	339				
22	30	40	33	26	30	37	39	39	40	40	45	49	45	39	30	38	40	53	54	55
140	091	180	193	20	40	09	80	00I	120	140	091	163	20	40	09	80	87	20	40	09
128	128	128	128	101	101	IOI	IOI	IOI	IOI	101	101	101	80	80	80	80	80	147	147	147
167 48.7	168 38.4	169 27.6	170 00.0	171 00.2	172 00.3	173 00.2	173 59.8	174 59.3	175 58.6	176 57.8	177 56.7	178 04.0	179 03.1	179 57.7	178 58.3	177 58.8	177 39.0	187 06.2	186 33.9	186 02.1
71 32.4	71 20.2	71 08.0	71 00.0	70 56.3	70 52.6	70 48.9	70 45.2	70 41.5	70 37.7	70 34.0	70 30.3	70 30.0	70 33.5	70 36.9	70 40.3	70 43.8	70 45.0	70 28.2	70 11.4	69 54.6
140	160	180	N-11	20	40	09	80	100	120	140	091	N-12	20	40	09	80	N-13	20	40	09

11151, 60092 Beringov Strait	11151, 60092			45	328	147	169 32.0	0.01 99	Y-01
10 m isobath NE of Mys Uelen Cape	III5I	7	194	42	320	147	169 42.5	66 16.4	320
10 m isobath NE of Mys Volnistiy Cape	11151	15	239	43	300	147	170 09.6	66 33.1	300
	IIISI			41	280	147	170 37.1	66 49.9	280
	955, 11151			42	760	147	171 04.9	67 06.7	260
	955, 11151			47	240	147	171 33.0	67 23.5	240
	955, 11151			45	220	147	172 01.4	67 40.3	220
	955, 11151			46	200	147	172 30.2	67 57.1	200
	955, 11151			48	180	147	172 59.4	68 13.9	180
	955, 11151			48	091	147	173 28.9	68 30.7	091
	955, 11151			49	140	147	173 58.7	68 47.5	140
	955, 11151			50	120	147	174 29.0	69 04.3	120
	955, 11151			52	100	147	174 59.6	69 21.1	100
	955, 11151			54	80	147	185 30.6	69 37.8	80

Transitional part of the high latitude route via the Vil'kitzkogo Strait

Note		10		
Chart #		6	846	948
Danger	miles	8		
Dan	o	7		
Depth	ш	9	20	43
Distance	miles	5		20
Course	0	4		92
Longitude	, ,	3	77 58.0 89 00.0	90 35.8
Latitude	•	2	77 58.0	77 57.3
Number of	point	I	N-02	20

8 Shoal 8.2 m	3 10 m isobath S of Ostrov Voronina Isl.	8	C	10 m isobath SW of Mys Neupokoeva Cape, Bolshevik Isl.	If m isobath S of Ostrov Bolshevik Isl.	10 m isobath NE of Ostrov Geyberga Isl.	If m isobath NE of Ostrov Geyberga Isl.	10 m isobath N of Mys Cheluskin Cape	Or 10 m isobath NE of Mys Chekina Cape	8.6 m Stvor Bank	10 m isobath S of Mys Murmanetz Cape, Maly Taymir Isl.			Vil'kitzkogo Strait
948	948	948	646	949	949	949	949	949	949	949	949	949	949	949
2	14			12	4	11	12	6	11	14	13			
192	355			62	330	91	29	142	210	174	354			
30	89	100	40	125	85	115	122	200	210	180	200	295	280	230
40	09	80	100	120	140	160	84	20	40	51	20	40	09	19
92	92	92	92	92	92	92	89	92	92	92	92	92	92	92
92 11.5	93 47.1	95 22.6	96 58.0	98 33.3	100 08.5	101 43.6	102 00.0	103 35.0	105 09.9	106 00.0	107 34.7	109 09.3	110 43.7	110 48.0
77 56.5	77 55.8	77 55.0	77 54.2	77 53.5	77 52.7	77 52.0	77 52.0	77 51.2	77 50.4	77 50.0	77 49.0	77 48.0	77 47.0	77 47.0
40	09	80	100	120	140	160	S-05	20	40	90-S	20	40	09	N-05

Russian navigational charts used in routing

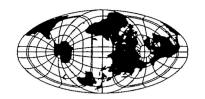
#	Catalogue #	Scale	Corner	
		Issued	фs°"	фи°"
			λ w ° "	λε°"
1	20040	1:5 000 000	48 00	69 30
	•	1990	45 30	13 40
2	947	1:2 000 000	66 15	77 00
		1990	10 00	59 10
3	697	1:700 000	72 50	77 30
		1991	56 00	81 00
4	11167	1:500 000	76 55	81 20
•		1996	63 20	81 00
5	11164	1:750 000	69 30	73 30
		1994	53 30	71 00
6	948	1:700 000	73 30	78 52
		1991	80 00	96 40
7	11134	1:500 000	78 00	82 00
		1994	78 40	96 20
8	11135	1:500 000	78 10	81 45
		1994	95 00	119 50
9	949	1:700 000	75 52	79 26
		1991	95 40	118 20
10	951	1:700 000	70 40	76 50
		1991	113 44	130 50
11	11143	1:500 000	74 38	77 00
		1994	128 34	141 44
12	952	1:700 000	70 40	75 30
		1991	129 50	152 30
13	12417	1:200 000	75 17	76 50
		1997	143 56	148 36
14	12418	1:200 000	74 30	76 08
		1996	150 30	155 10

15	954	1:700 000 1991	69 20 150 50	74 29 173 30
16	955	1:700 000 1996	66 50 172 00	72 30 165 20
17	11151	1:500 000 1994	65 25 175 56	69 52 167 30
18	60092	1:5 000 000 1993	31 00 168 00	67 10 149 00
19	60091	1:5 000 000 1996	21 30 128 00	63 00 171 45

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3 February 1998

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Review of the INSROP Paper Box B/WP1 — "Routes and Associated Operational Infrastructure"

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Dear Claes

I have had an opportunity to review the three parts of the report Box B/WP1 "Routes and Associated Operational Infrastructure". All of the information is highly relevant and important to INSROP. For Part 1, (Route Selection), it is not possible at this time to compare the routes with the AARI historical ice statistics. That data is to be presented to INSROP in March. However, my sources at Scott Polar and the U.S. National Ice Center can confirm in general the information (ice conditions and routes) presented in figures 1-6. Part 1 is an excellent summary that we will rely on for Chapter 2 of the INSROP integration book.

Most of Part 2 can be found in the "Guide to Navigating through the Northern Sea Route". I have in my possession a rough English translation as the English version is not yet available from the publisher. The communications information is particularly critical and the authors have provided a good summary with which I have no substantial changes. Section 2.6 is a good summary of basic ice convoying tactics; however, this section does require considerable improvement of the resulting translation from Russian. While I believe there are other techniques (on general icebreaking, convoying and river tactics in ice), I sense that 2.6 is a good review from the perspective of what is needed for ships being escorted. Again, this section needs some work on the English so that it is clear and unambiguous. I have annotated some of the wording to reflect this requirement.

Part 3 (Description of Routes) represents a large investment in time and meticulous plotting. I look forward to reviewing all the charts you have at FNI when I visit. Although it may seem obvious to many, I believe throughout the text and at the top of page 3-44 the words "Russian navigational charts" should be used. Another example is at the bottom of page 3-4: "Russian" nautical charts #20040 and 947. If for any reason other national charts were used, that fact should be noted. Since the report goes well beyond the INSROP consortium, we must be perfectly clear whose charts we are using in each INSROP paper. One sentence needs more clarification page 3-3: "we used routine 'two hands' calculation and checking procedure according to 'Recommendations for organisation of navigational service — 89". I believe I understand what was done and how things were checked, but I think other readers will require another sentence or two for complete explanation. Overall, the chartlets and tables in Part 3 are excellent and represent careful attention to detail.

Here are a number of specific comments, not including translation issues:

Part 1

- Figures 1-6 are too small for sufficient reading. I highly recommend each figure be placed on a full page (landscape). I realize much effort was used to integrate the figures into the text, but I believe they are not as helpful if not enlarged.
- Page 1-2, paragraph 8 sea bottom configuration should be bathymetry.
- Page 1-5, Table 1 Southwest Part and Southeast Part substitute region.
 change extent to length.
- Page 1-12, Figure 6 fixed ice should be fast ice.

Part 2

- Page 2-7 Anywhere there is unsteady radio communications should be changed to unreliable radio communications.
- Again, I believe Figures 2, 3, 4 and 5 are too small to be easily read.
- I cannot find anywhere in Part 2 where MOH is defined ... I suspect it is "Marine Operations Headquarters" ... where are the locations (Dikson and Pevek)?
- Section 2.6 convention in English uses icebreaking and icebreakers (each one word).

 Page 2-27 — Figure 8 — this photo is somewhat misleading as such a smooth track can only come from one of three icebreakers, Kapitan Sorokin, Kapitan Nikolayev or Mudyug (unless perhaps it is slush ice) ... most icebreaker tracks are not smooth and are quite uneven ... I recommend another photo.

Part 3

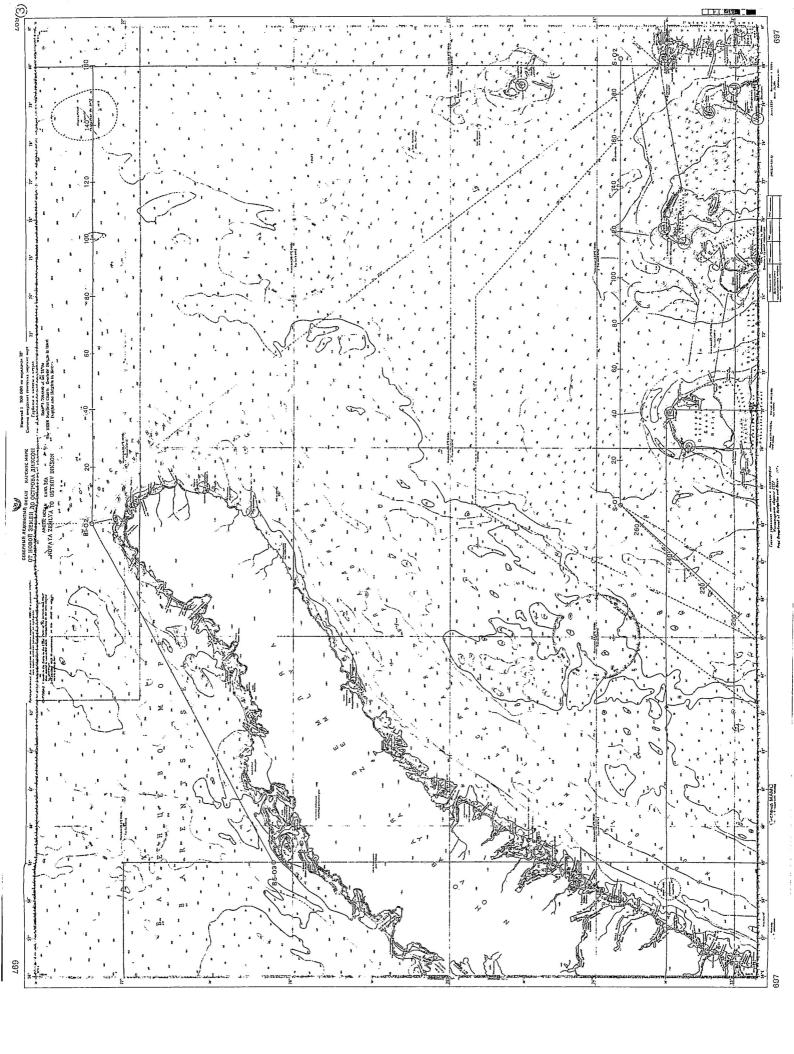
- Throughout draught is used ... other INSROP reports use draft (U.S. spelling) ... which should it be?
- Page 3-10 I recommend lines across the page or some other way to separate the information for each B route.

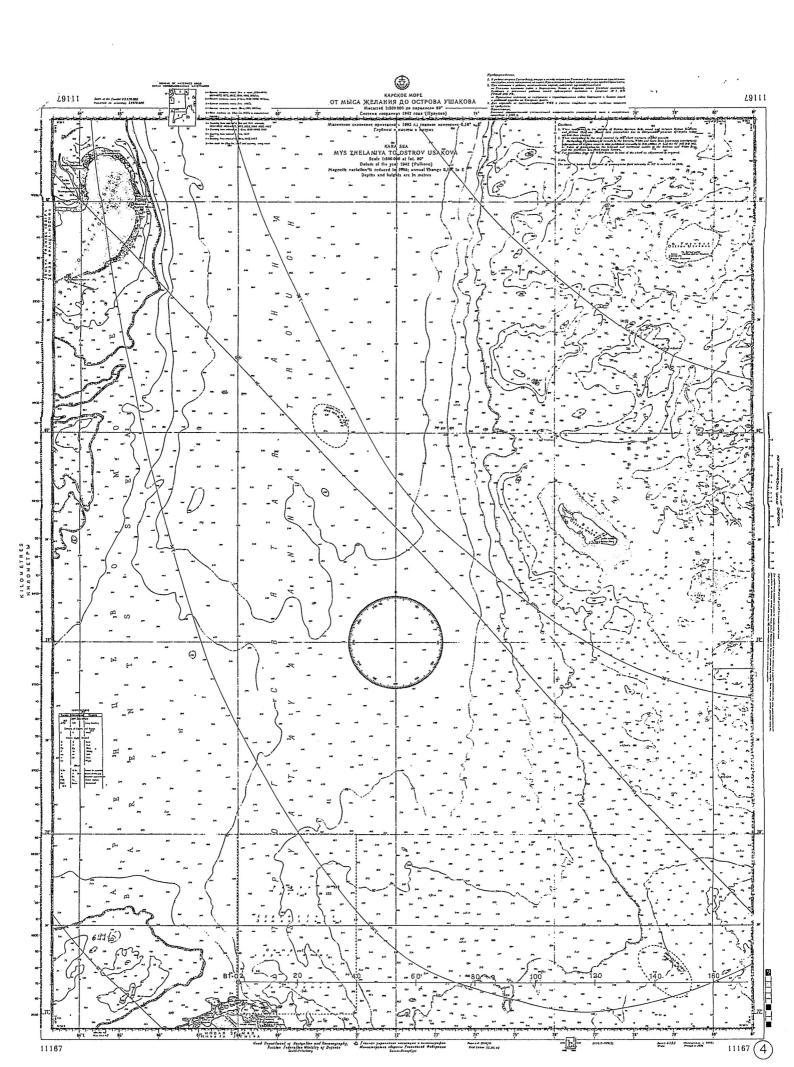
Overall, the report contains solid and key information. With some of the above changes and a thorough editing of the English, it should be published as an INSROP report. I have annotated the draft with additional changes to the translation.

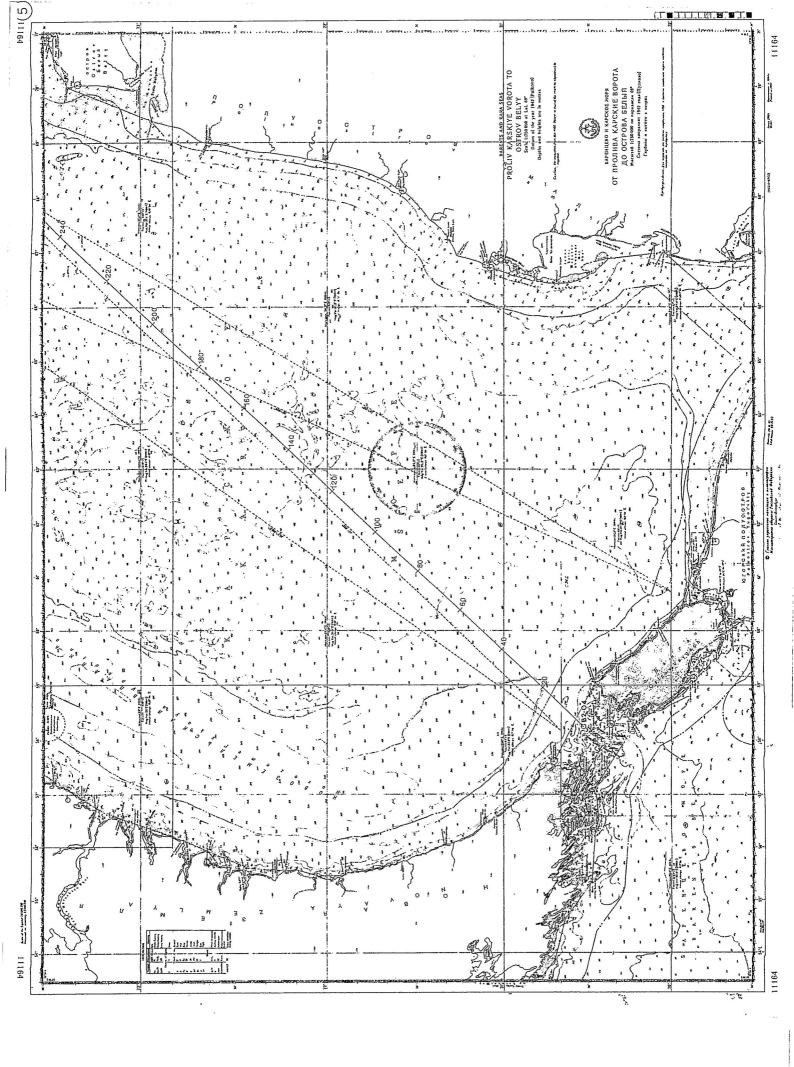
Respectfully,

Lawson W. Brigham

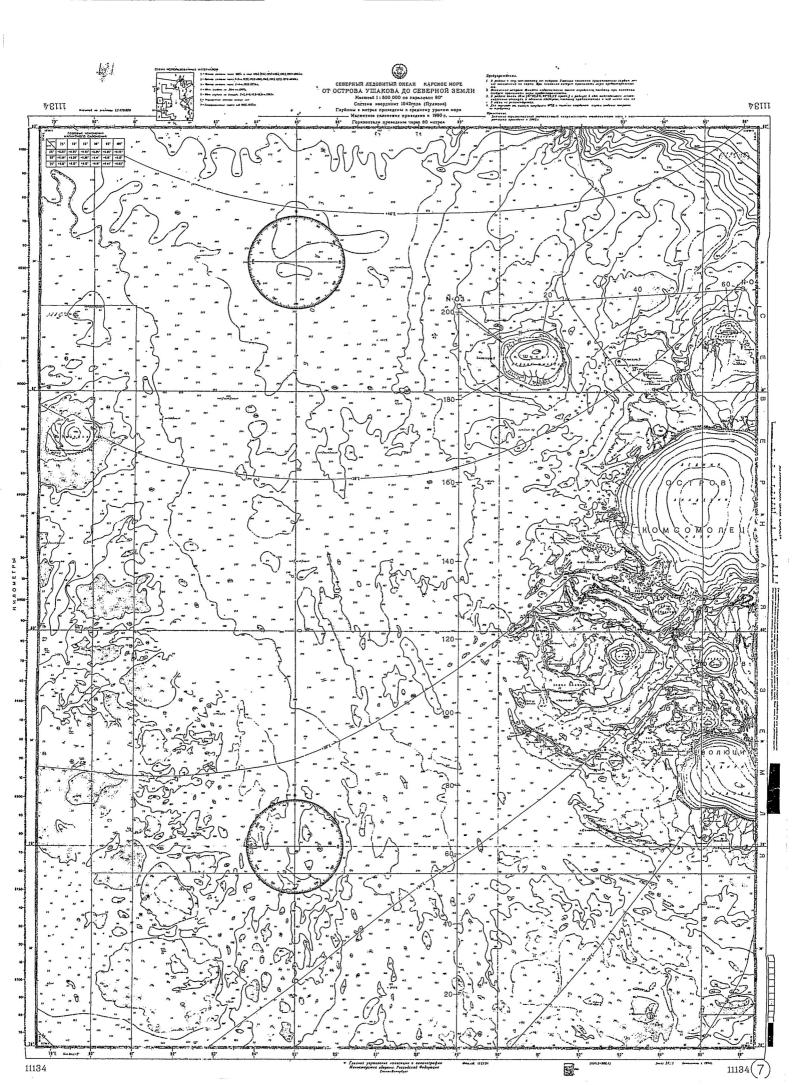
Captain, U.S. Coast Guard (Ret.) Scott Polar Research Institute

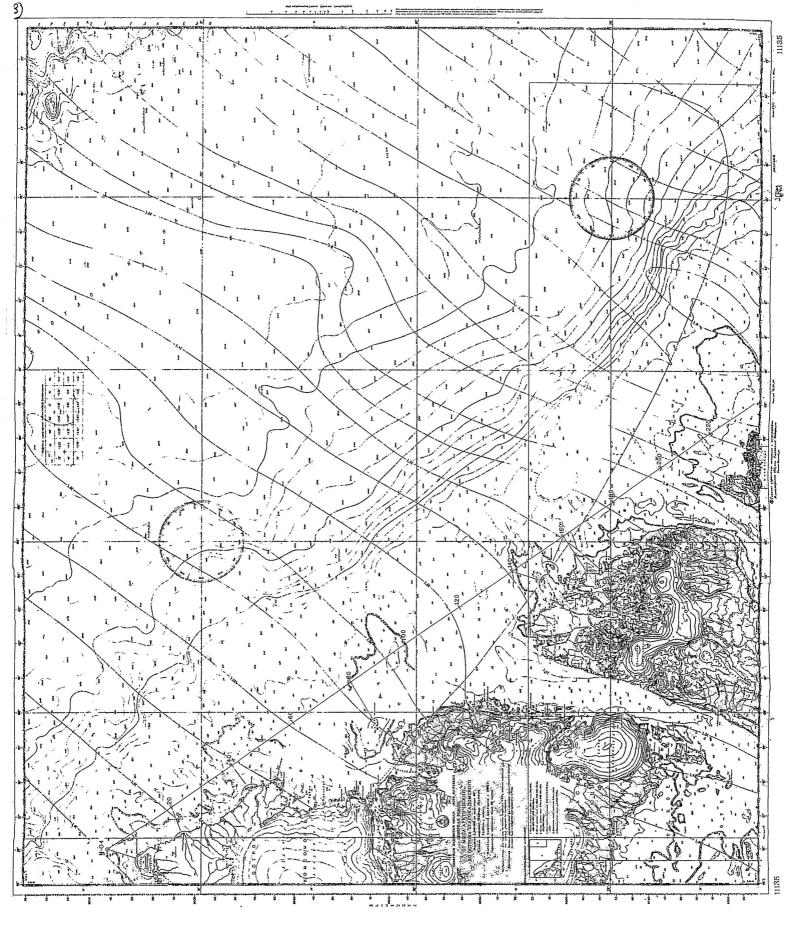


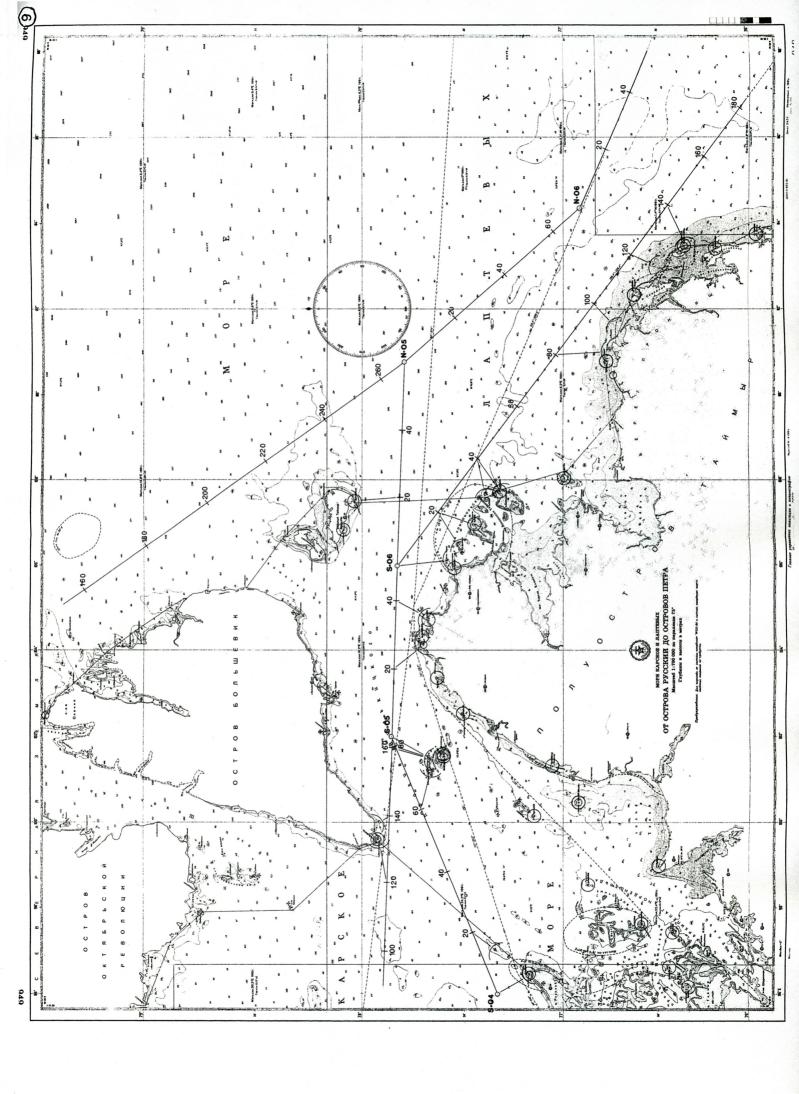


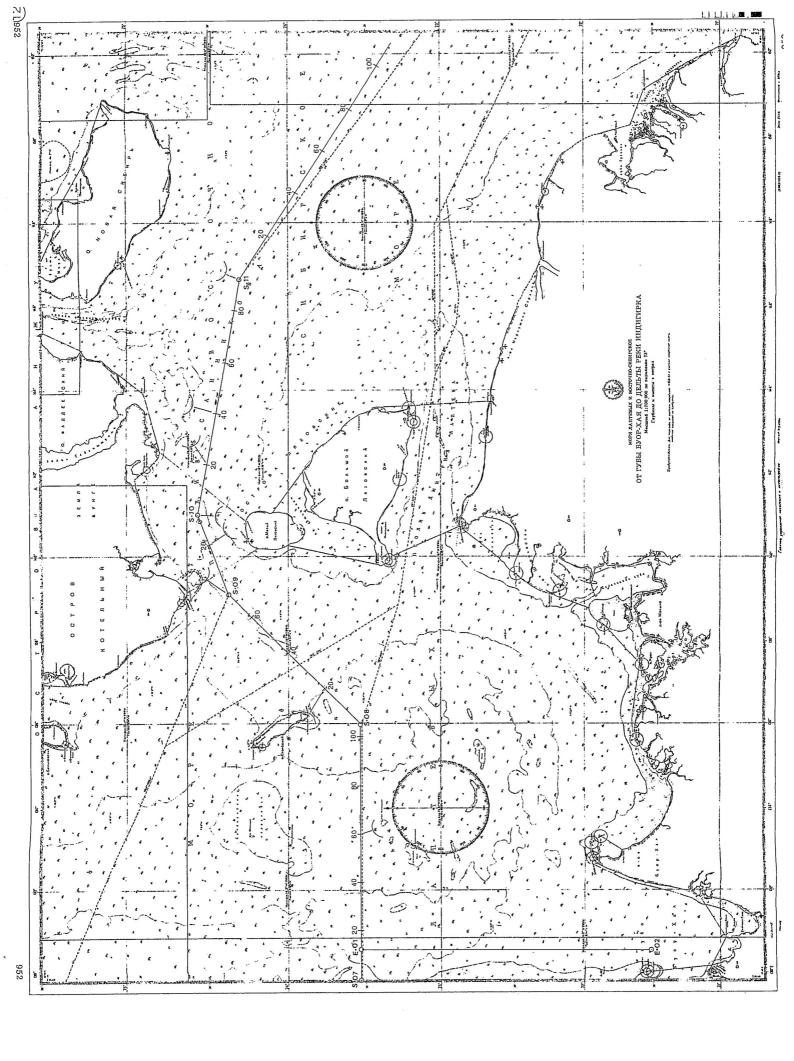


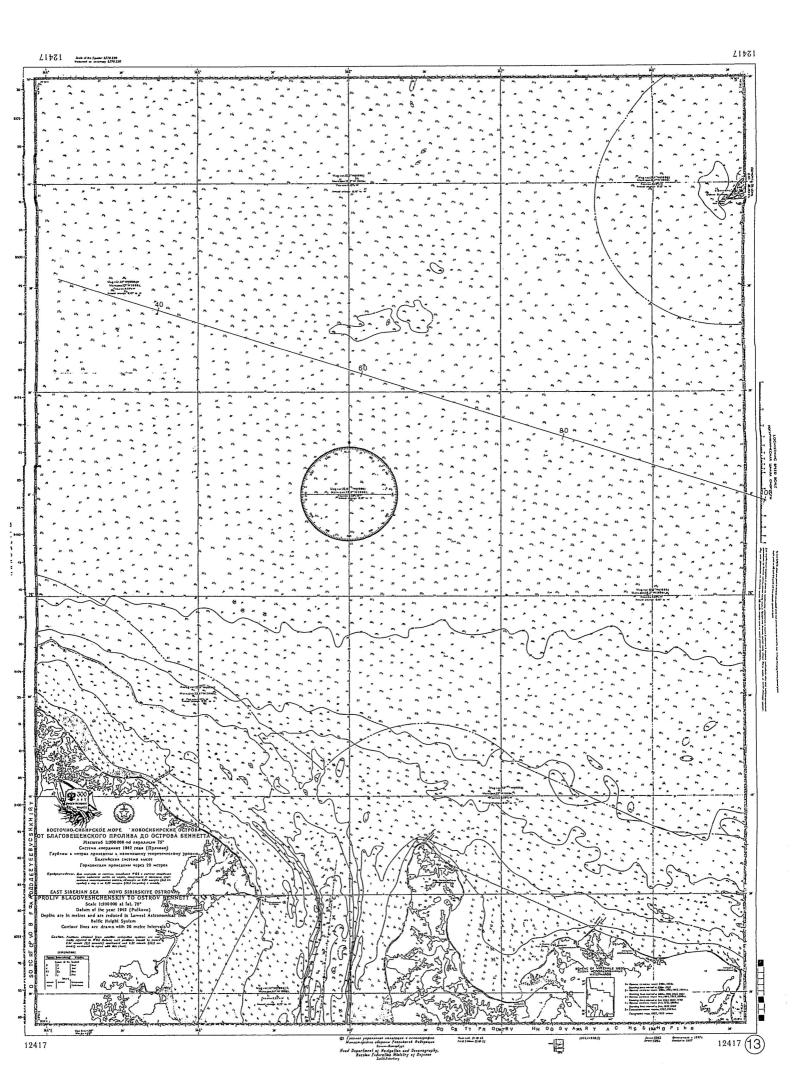
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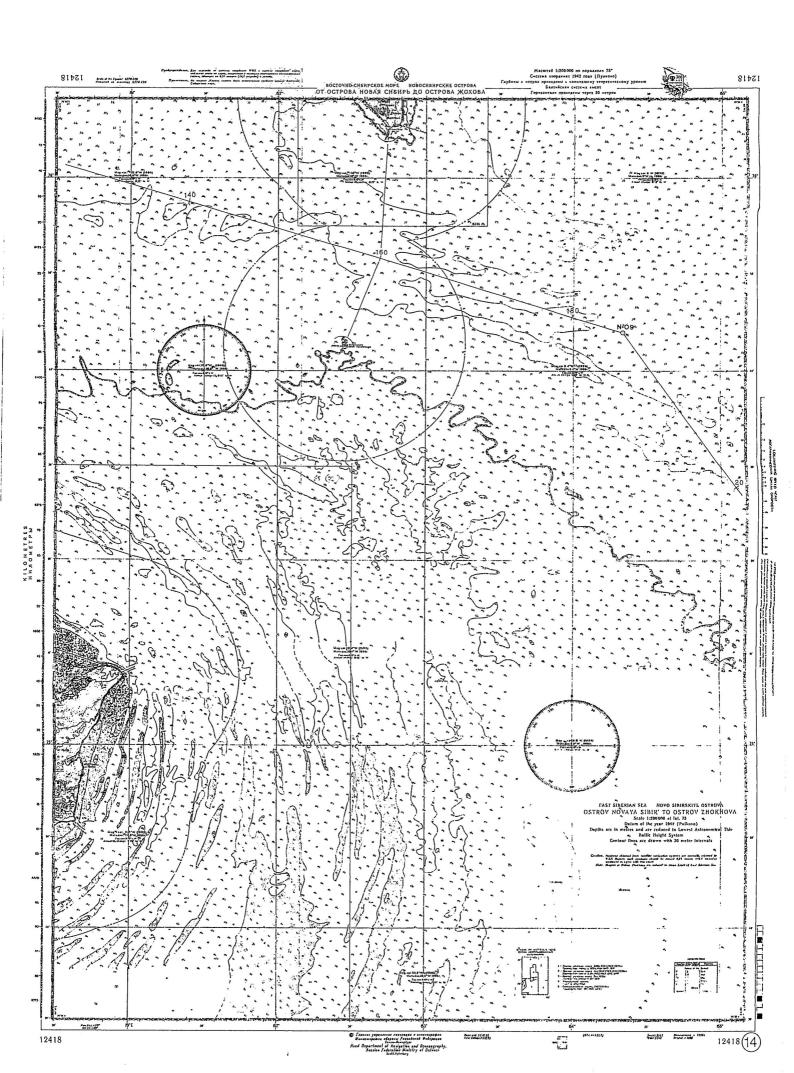


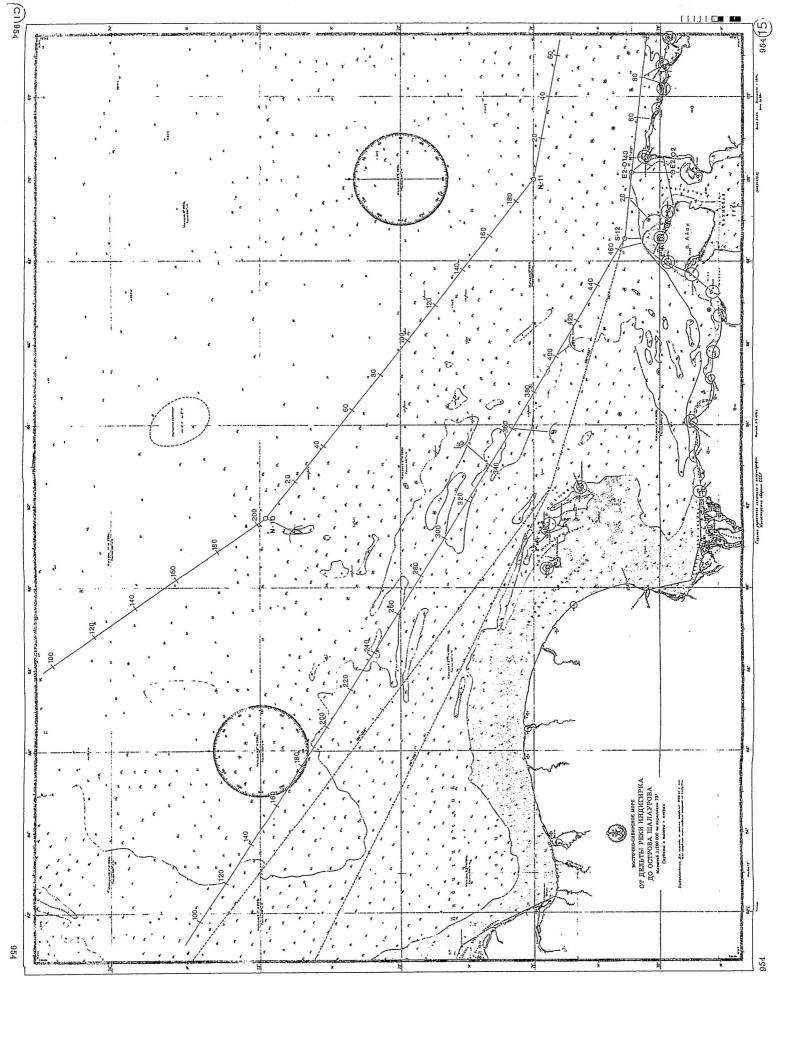


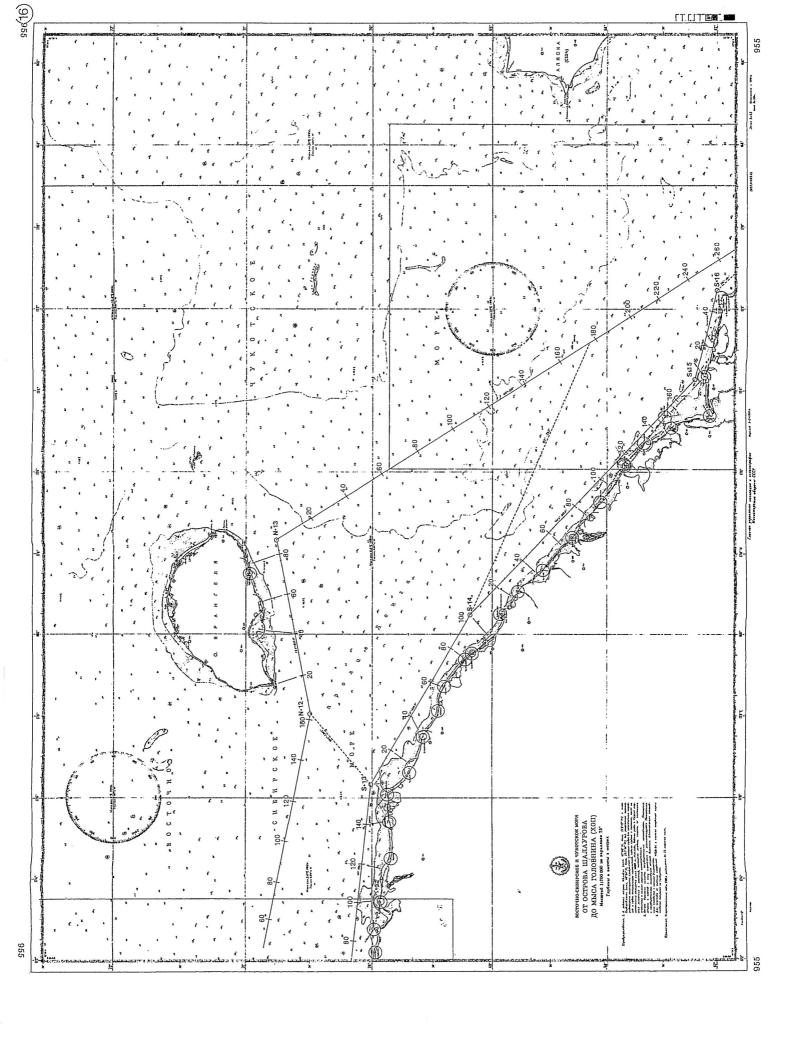












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The three main cooperating institutions of INSROP



Ship & Ocean Foundation (SOF), Tokyo, Japan.

SOF was established in 1975 as a non-profit organization to advance modernization and rationalization of Japan's shipbuilding and related industries, and to give assistance to non-profit organizations associated with these industries. SOF is provided with operation funds by the Sasakawa Foundation, the world's largest foundation operated with revenue from motorboat racing. An integral part of SOF, the Tsukuba Institute, carries out experimental research into ocean environment protection and ocean development.



Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia.

CNIIMF was founded in 1929. The institute's research focus is applied and technological with four main goals: the improvment of merchant fleet efficiency; shipping safety; technical development of the merchant fleet; and design support for future fleet development. CNIIMF was a Russian state institution up to 1993, when it was converted into a stockholding company.



The Fridtjof Nansen Institute (FNI), Lysaker, Norway.

FNI was founded in 1958 and is based at Polhøgda, the home of Fridtjof Nansen, famous Norwegian polar explorer, scientist, humanist and statesman. The institute spesializes in applied social science research, with special focus on international resource and environmental management. In addition to INSROP, the research is organized in six integrated programmes. Typical of FNI research is a multidisciplinary approach, entailing extensive cooperation with other research institutions both at home and abroad. The INSROP Secretariat is located at FNI.