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Northern Sea Route Cargo Flows and Infrastructure – Present State and Future Potential

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Sammendrag/Abstract

The report assesses the Northern Sea Route's commercial potential and economic importance, both as a transit route between Europe and Asia, and as an export route for oil, gas and other natural resources in the Russian Arctic. First, it conducts a survey of past and present Northern Sea Route (NSR) cargo flows. Then follow discussions of the route's commercial potential as a transit route, as well as of its economic importance and relevance for each of the Russian Arctic regions. These discussions are summarized by estimates of what types and volumes of NSR cargoes that can realistically be expected in the period 2000-2015. This is then followed by a survey of the status quo of the NSR infrastructure (above all the ice-breakers, ice-class cargo vessels and ports), with estimates of its future capacity. Based on the estimated future NSR cargo potential, future NSR infrastructure requirements are calculated and compared with the estimated capacity in order to identify the main, future infrastructure bottlenecks for NSR operations.

The information presented in the report is mainly compiled from data and research results that were published through the International Northern Sea Route Programme (INSROP) 1993-99, but considerable updates have been made using recent information, statistics and analyses from various sources.

Stikkord/Key Words
Northern Sea Route, Russia, Arctic, shipping

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Preface

The Northern Sea Route (NSR) is the Russian name for what is often known outside Russia as the Northeast Passage (NEP). In Europe, the term *Northeast Passage* has for centuries nurtured visions – that have never completely died out – of an adventurous shortcut that may bring about a revolution in sea trade between Europe and East Asia. In Russia, the term *Northern Sea Route* holds different connotations, and mainly evokes visions of a grand national waterway, created by the efforts of the Russian people, and mainly an internal transport corridor for bringing natural resources out, and for bringing deliveries in to the many settlements in the Russian Arctic. The Russian emphasis on the route's *internal* character is further seen from the formal Russian definition, by which the NSR is strictly confined by the Novaya Zemlya islands in the west and the Bering Strait in the east.

This report tries to assess the sea route's commercial potential and economic importance. It does so by first making a survey of past and present Northern Sea Route (NSR) cargo flows. The route's economic potential and importance, both as an international transit route and as a transport corridor to and from the Russian Arctic regions, is then discussed, before forwarding estimates of future cargo potential. An overview of the status quo of the NSR infrastructure (above all the ice-breakers, ice-class cargo vessels and ports) is also made, with estimates of its future capacity. Based on the estimated future cargo potential, future infrastructure requirements are calculated and compared with the estimated capacity in order to identify possible future bottlenecks for NSR operations.

A large portion of the information presented in this report is compiled from data and research results that were published through the International Northern Sea Route Programme (INSROP) 1993-99. The establishment of INSROP was brought about by the formal opening of the Northern Sea Route (NSR) to non-Russian vessels in 1991, and was a multi-disciplinary, international research programme with the aim of investigating all relevant aspects and consequences of international shipping on the NSR. The programme involved more than 450 researchers from 14 countries, approximately half of them from Russia.

The INSROP data has been updated and supplemented by data and analyses from various sources – the most important ones being the NSR User Conference in Oslo November 1999, and a report commissioned by the EU body Tacis in 2000 to identify the Northern Sea Route's infrastructure bottlenecks. This author is most indebted both to the many INSROP scientists who have provided much of the baseline data, as well as the Russian and Dutch scientists that participated in the Tacis project.

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1 The Northern Sea Route - Introduction and Basic Features

1.1 Why make commercial studies of the Northern Sea Route?

The first and most obvious answer to this question is the great savings in distance – and thus potentially also in time and expenses – that the route can offer for shipping between Northwest Europe and Northeast Asia/Northwest America. For some destinations, distance savings can be as high as 50% compared to the shipping lanes presently used. Some examples are showed below in table 1.1:

Table 1.1: Alternative Shipping Routes to Ports in the Pacific and Atlantic, in nautical miles[1]

	From Hamburg to:			
Shipping routes via:	Vancouver	Yokohama	Hong Kong	Singapore
NSR	6635	6920	8370	9730
Suez Canal	15377	11073	9360	8377
Cape of Good Hope	18846	14542	13109	11846
Panama Canal	8741	12420	12920	15208

Distance savings would be even greater for traffic between ports in Northern Europe (e.g. Norway and the Russian Kola Peninsula) and in the Northern Pacific area (e.g. Alaska).

Another answer – and maybe a more important one in commercial terms – is that the Northern Sea Route (NSR) may be a very convenient export corridor for Russian natural resources. Enormous reserves of various metals, oil, gas, timber and coal are located close to the shores of the Russian Arctic Ocean or along the rivers that flow into it. The transport of non-ferrous metals, timber and coal has been important in the past – oil and possibly gas seems likely to become cargoes for the not-so-distant future.

The third and final answer to the question is that it is now finally *possible* again to use the Northeast Passage. During the Soviet era, the Russian Arctic Ocean was in practical terms closed to foreign shipping. This all changed in 1991, when the Soviet Union formally opened-up the NSR to foreign vessels. During the years when the NSR was inaccessible to outsiders, huge progress in ice-breaking technology has been made, and the trend of global warming has accelerated, justifying a new, thorough investigation into the commercial merits of the NSR.

1.2 Historic development of the Northern Sea Route[2]

As European colonial powers expanded their empires and trading routes into East Asia in the 16th Century, the search for alternative, shorter seaways to Asia began in earnest. Several expeditions – mainly organized by Great Britain and the Netherlands – were sent out to the Russian Arctic to search for the route which is now known as the Northeast Passage (NEP).

1 Yuri Ivanov & Alexander Ushakov (1992): 'The Northern Sea Route – Now Open', *International Challenges*, vol. 12, no. 1, p. 19.

2 For a more detailed overview of NSR history, see for instance W. Østreng (1999): "Historical and Geopolitical Context of the Northern Sea Route" in W. Østreng (ed.): *The Natural and Societal Challenges of the Northern Sea Route. A Reference Work*. Dordrecht/Boston/London: Kluwer Academic Publishers.

These expeditions managed to map much if the western part of the NEP, but were all either wrecked or forced to return by the difficult ice conditions. Thus, it was not until 1879 that the NEP was “conquered”, when the Finnish-Swedish explorer Adolf Erik Nordenskiöld reached the Bering Strait after having carried out a full passage from Europe, spending one winter along the way.

Prior to Nordenskiöld, the Arctic shores of the Eurasian continent had already been mapped by Russian expeditions that entered the Arctic Sea by descending the great Siberian rivers such as the Ob, Yenisey, Lena and Kolyma. These Russian expeditions were not primarily organized to find a transit route, but were motivated mainly by Russian desire to extend its sovereignty further to the east and north, and to expand the profitable fur trade with local, indigenous peoples.

While Nordenskiöld’s passage trough the NEP was a great historic achievement, it was not to have any major impact on world trade patterns. In spite of his success, it was obvious that the ice conditions posed too large an obstacle to sustain commercial transit passages.

The relevance of the NEP as an international waterway was further diminished after the Russian Revolution in 1917, after which the route became practically inaccessible to non-Soviet vessels. From this time on – and especially from the 1930s – the Soviet Union gradually developed the Northern Sea Route as an internal, Russian waterway, in support of the industrial development of its Arctic resources. Industries were established in Igarka, Norilsk, Khatanga and in other areas, largely by the use of forced labour, and port facilities were constructed. In 1932, a large bureaucracy – the *Glavsevmorput* – was established to administer not only the Northern Sea Route, but all economic activities in the Russian Arctic. The Northern Sea Route was an important, integrated part of the Russian Arctic infrastructure and was used for deliveries to the many indigenous, industrial, military and scientific settlements in the Arctic, as well as an export route for timber, ores and other products. Since the 1970s, the NSR has also been used as an important supply line for the development of the oil and gas industry in NW Siberia.

NSR activity was at its peak in 1987 when 6.6 million tons of cargo was transported on the route. In this year the Soviet President Gorbachev for the first time proposed to open up the NSR to non-Soviet vessels, an initiative which was followed-up by the formal opening of the NSR to foreign vessels on 1 July 1991.

1.3 Definition of the study area

First, a distinction should be made between the *Northern Sea Route* and the *Northeast Passage*. The Northeast Passage (NEP) is a historic term for the *transit* route north of Russia linking together the Northern Atlantic and Northern Pacific Oceans. It is a somewhat abstract term without strictly defined borders or end-points. On the other hand, the Northern Sea Route (NSR) – which is the term used by Russia – is a clearly defined entity: According to official Russian definition, it stretches from the Novaya Zemlya islands in the west to the Bering Strait in the east (see figure 1.1).

Secondly, the NSR can not be thought of as one clearly defined linear *route,* but should instead be thought of as the whole *sea area* between Novaya Zemlya and the Bering Strait. Due to the highly variable and difficult ice-conditions present along most of the NSR, the optimal route choice for vessels navigating the NSR will vary. Depending on seasonal, regional and annual variations in ice-cover, vessels will sometimes have to choose routes close to the mainland, other times routes through the many archipelagos, and sometimes routes north of them.

In this report, the term "the NSR Area" is often used. This implies the Northern Sea Route + adjacent land areas. The land areas in question are those parts of Chukotka Autonomous *Okrug*, Republic of Sakha, Krasnoyarsk *Kray*, and Yamalo-Nenets Autonomous *Okrug* that face the Arctic Ocean or gravitates towards the NSR through the navigable rivers that flow into the Russian Arctic Ocean.

As Russian administration and statistics strictly adhere to the above definition of the Northern Sea Route, this report will for practical reasons mainly focus on that area. Only where relevant and possible, will the report include information on conditions in the Barents Sea and other areas outside the NSR.

The only case where an area not formally part of the NSR area has been included systematically into the study, is the case of the oil and gas regions in the Timan-Pechora Basin. The oil and gas fields in question are situated either offshore in the Pechora Sea (south-east Barents Sea) or on-land in the Nenets Autonomous *Okrug*. They have been included into the study since they are potentially very large sources of cargo generation, and because the physical environment in this area – shallow, ice-covered seas – presents the same challenges for shipping as for areas formally inside the NSR.

In the report, the terms *Eastern NSR* and *Western NSR* are also extensively used. The *Western NSR* is used to describe the part of NSR from Dikson westwards (including Dudinka and the Yenisey River), where the large majority of NSR economic activity is taking place today. The *Eastern NSR* denotes the areas between Dikson and the Bering Strait, where shipping and economic activities are very much lower than in the western part. In some of the statistics (for instance Annex A1), the terms Eastern and Western NSR are defined slightly differently, according to administrative borders: Chukotka Autonomous *Okrug* (A.O.) and the Republic of Sakha is grouped as "Eastern NSR", while Krasnoyarsk *Kray* (including Taymyr A.O.) and Yamalo-Nenets A.O. is grouped as "Western NSR". Thus, the Taymyr Peninsula east of Dikson is in the statistics part of the Western NSR, even though it should functionally be considered a part of the Eastern NSR. This inconsistency is not significant, as economic activity on the extremely barren Taymyr Peninsula is very low.

1.4 Legal, administrative and operational framework of NSR shipping

NSR activities are centrally organised through the Ministry of Transport's *Service of Marine Transport* (SMT). Different NSR players such as NSR shipping companies, NSR ports, ice-surveillance organisations etc. are integrated in the SMT system. The SMT is also responsible for organising the shipment of deliveries to the northern settlements. Russian legislation stipulate federal ownership of the main components of the NSR infrastructure: Icebreaking, emergency, salvage and hydrographic fleets, port facilities, navigational and hydrographic support for navigation safety, hydrometeorological service and radio communication facilities. These elements of the NSR are always to be under central management, even though they may be operated by others (as the state-owned NSR ice-breakers are for instance operated by Murmansk Shipping Company and Far Eastern Shipping Company).

There are plans to reorganise the SMT into a Russian stock company "RAO Sevmorput" controlled by the state, but with participation from all major players, including the shipping companies, ports and main cargo-owners such as oil companies and the Norilsk Nickel Company, as well are regional authorities. At a later stage, foreign owner interests may also be allowed. The model is based on a condition that NSR cargo volumes increase to a level where the NSR infrastructure can become self-financing. The model is partly based on a

Canadian model with the *Canarctic* company[3]. Plans have not yet materialised, partly due to opposition from some of the concerned parties. Murmansk Shipping Company has been opposed the idea as unnecessary, and also the Russian Northern Fleet has voiced strong scepticism over the security implications of such steps which would make the NSR more open to foreign interests[4].

The maintenance of NSR infrastructure is in principle to be financed by the users and *NSR fees* are in reality mandatory for all vessels entering the NSR. The fee depends on the season, on which part of the NSR is being navigated, on the vessel's size and on the nationality of its charterer (see Table 3.4). The fees cover icebreaking assistance, ice-forecasting and routing services. In the 1990s state subsidies of the Arctic transport system decreased while traffic plummeted, causing fees to increase sharply to cover running expenses for the icebreakers and other infrastructure. This caused further decrease of traffic volumes. Russian authorities have signalled increased subsidies from year 2000, aiming at reducing the fees to maximum 3-7 USD/grt, hoping thus to eventually increase traffic to 6-10 million tons per year, which would make the system self-financed.

The overall supervision of NSR affairs is entrusted to the *Northern Sea Route Administration* (NSRA), which is an integrated part of the Russian Ministry of Transport. NSRA Headquarters are located in Moscow. Its main tasks include coordination of the activities of the Marine Operations Headquarters (see next paragraph) and NSR shipping companies, contact with potential cargo-owners, processing of applications for escort and working-out of NSR fee system (in co-operation with the shipping companies).

Practical operational supervision of NSR traffic is carried out by the eastern and western *Marine Operations Headquarters* (MOHs), which are based in Pevek and Dikson respectively. The MOHs are subordinate to the NSRA, but are run by the Murmansk Shipping Company (Dikson) and the Far-Eastern Shipping Company (Pevek). A wide range of experts staff the MOHs, also including ice-monitoring experts. The dividing line of responsibility between the two MOHs are set at 125° east, i.e. just west of the Lena river mouth. In reality, when icebreakers of the Murmansk Shipping Company (MSCO) are active on the eastern NSR, they – and the ships they are escorting – are being supervised from the western MOH. The eastern MOH is only operating during the traditional navigational season, while the western MOH operates throughout the year, supervising the year-round Murmansk-Dudinka line.

All vessels sailing on the NSR must strictly follow the orders of the MOHs – in reality the vessels submit to *constant control* by the MOH throughout the entire voyage. The MOHs are responsible for pilotage, navigational support, organisation of convoys and ice-breaker assistance, and for designating optimum routes taking into consideration ice conditions and available icebreaker support. A ship is not allowed to deviate from a route without MOH permission, but revisions to this restriction and control might be considered in the future. The continued development of detailed (near) real-time ice information delivered directly to the vessel by satellite, could realistically enable vessels to execute local and tactical navigation on their own in the future[5]. Communication between the MOHs and the vessels is presently only

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3 Y.M. Ivanov, A.P. Ushakov & A.N. Yakovlev (1998): "Russian Administration of the Northern Sea Route – Central or *INSROP Working Paper*, No. 106.

4 "RAO 'Sevmorput': bit' ili nye bit'", *Polyarnaya Pravda* 29 February 2000.

5 L.W. Brigham, V.D. Grishchenko & K. Kamesaki (1999): "The Natural Environment, Ice Navigation and Ship Technology" " in W. Østreng (ed.): "The Natural and Societal Challenges of the Northern Sea Route. A Reference Work". Dordrecht/Boston/London: Kluwer Academic Publishers.

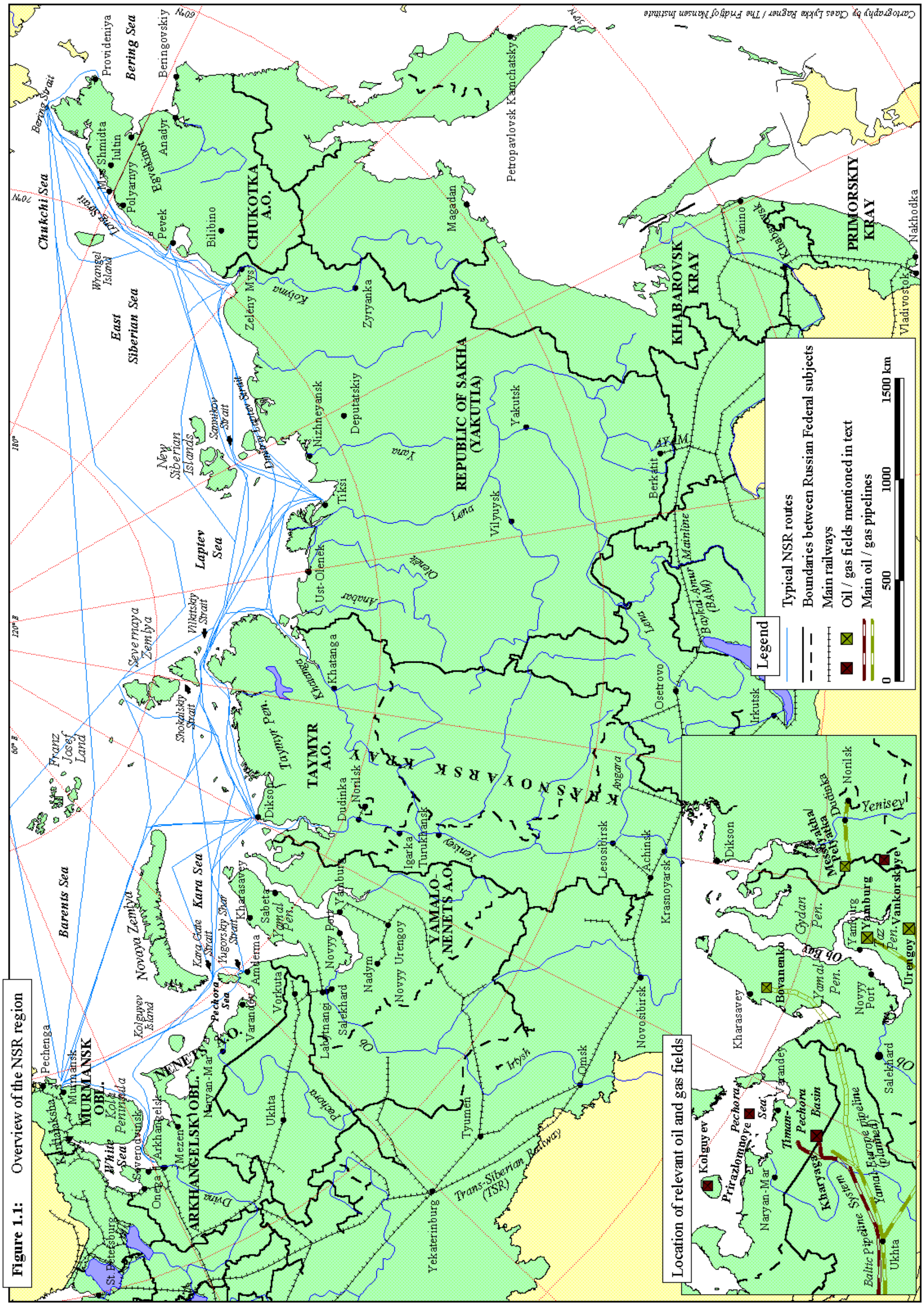

Figure 1.1: Overview of the NSR region

carried out in Russian language, which presents one of several practical obstacles to non-Russian vessels wishing to sail on the NSR.

The present Russian regime for NSR shipping (as set out in the 1991 *Regulations for Navigation on the Seaways of the NSR*[6]), are based on Article 234 of the UN Convention on the Law of the Sea, under which a coastal state has the right to unilaterally adopt and enforce laws and environmental regulations in its exclusive economic zone where ice coverage causes exceptional hazards to navigation, and where the environment is especially vulnerable[7].

The Russian regulations set out that all vessels wishing to enter the NSR (*including* all areas within Russian 200 n.m. exclusive economic zone) should notify this to the NSRA in beforehand, and also submit an application for ice-breaker escort. The application must contain information on guaranteed payment of NSR fees, and documentation of adequate insurance to cover environmental pollution damage. The vessel must also meet special ice-class requirements. There is also a range of minor technical requirements, including compatibility with the Russian ice-navigation technique of close towing, requiring increased strengthening in the bow and the ability to fasten towlines. Such requirements in fact exclude the use of vessels with bulb bow design.

If the NSRA accepts the application for ice-breaker assistance, the vessel is obliged to follow the route determined by the MOH according to ice-conditions and available ice-breaker support. Normally, one or two ice-pilots will also have to be placed onboard, depending on the ice conditions and on the crew's ice experience. By accepting a vessel for escorting, the MOH in practice also grants the vessel automatic access to any Russian internal and territorial waters that the MOH-determined route leads through. The formal command chain for lescorting is as follows: NSRA → MOH → icebreaker → ice pilot (on board the vessel) → vessel[8]. Compulsory icebreaker escort is mandated for passage through the Vilkitskiy, Dmitriy Laptev, Sannikov and Shokalskiy Straits under all circumstances.

Russia maintains the right to board any vessel even in the exclusive economic zone when there are reasons to believe that the vessel does in fact not comply with the standards and rules mandated by Russia, or when it is feared that severe natural conditions may endanger the vessel or the marine environment. Vessels on the NSR must carry out any orders and follow the routes prescribed by the MOH. The MOH may suspend navigation at any time if there are concerns regarding safe navigation or environmental protection. Ships violating any provisions of the *Regulations* can be removed from the NSR by the MOH[9].

Russia maintains that the NSR straits are internal Russian waters[10]. This, along with the present regulations demanding permission to enter even the exclusive economic zone part of the NSR and the mandatory ice-breaker escort in the central NSR straits, in effect makes it impossible for vessels to ply any NSR route without the permission of Russian authorities, or

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6 The regulations can be found in the English-language *Guide to Navigating Through the Northern Sea Route* which is available from the Ministry of Transport, Hydrographic Department, 190031 Moskovskiy Pr. 12, St. Petersburg, Russia, tel/fax +7 (812) 3103768.

7 For a further discussion of the legal status of the NSR, see: Brubaker, R. Douglas and Willy Østreng (1999): "The Northern Sea Route Regime: Exquisite Superpower Subterfuge?," *Ocean Development & International Law*, 30:299-331.

8 A. Yakovlev, G. Semanov, Y. Ivanov, A. Ushakov, S. Zubarev, M. Gavrilo, V. Khlebovich, K.A. Moe, J. Thomassen & O.W. Brude (1999): 'Legal and Environmental Evaluation of the Routes Selected for the INSROP Simulation Study', *INSROP Working Paper*, No. 128.

9 Brigham et al (1999).

10 See A.L. Kolodkin, V.Yu. Markov & A.P. Ushakov (1997): "Legal Regime of Navigation in the Russian Arctic", *INSROP Working Paper*, No. 94.

without paying NSR fees. While this may not be unreasonable – strict enforcement of environmental standards is extremely important in the Arctic, and it will indeed be difficult to use the NSR without using the Russian infrastructure – the Russian regulations are not universally accepted. On grounds of principle, the US as well as several non-Russian INSROP experts have challenged Russia's claims. In the view of the US, the NSR straits should be considered international straits, with the implication that they may be used by foreign vessels for innocent passage without notification or application to the Russian authorities. Also, Russia's right to carry out inspections in the exclusive economic zone to ensure compliance with Russian regulations is being challenged – vessels with sufficient ice-class and insurance coverage should be able to proceed without hindrance[11].

At present, this dispute is more a legal one than a real one, as Russian authorities have signalled a flexible attitude towards foreign vessels wishing to use the route, and potential foreign users of the route are likely to comply with the Russian regulations, as they will depend on Russian ice-breaker escort. The only scenarios where such legal ambiguities may have practical implications, is if the US should take a confrontational line on this issue (forbidding American ships to use the straits and trying to pressure other states to take similar actions), or if in the future foreign cargo ships with high ice-breaking capability would like to venture through the NSR without Russian ice-breaker escort (and consequently without paying ice-breaker fees). At least one INSROP author has been advocating such a scenario as the only possible solution for commercially viable transit operations[12]. However, building cargo-vessels that are able to operate independently of Russian infrastructure along the whole NSR is not commercially feasible without further *considerable* technological or climatic improvements.

1.5 The physical environment of NSR shipping

The main physical constraints to NSR shipping are the *shallow seas and straits* along most parts of the route, and above all the difficult *ice conditions*. There are signs that ice-conditions are becoming slowly lighter, possibly due to *climate change*.

1.5.1 Shallow seas

A distinct feature of the Russian Arctic is the shallowness of its seas. The shallowness creates at least three major problems for shipping:

1. *The shallowness of the straits through the New Siberian Islands seriously limits the draft and size of ships that can use the whole NSR on a regular basis.* The draft restrictions in Sannikov Strait is 12.5 m and in only 6.7 m in the Dmitriy Laptev Strait. By choosing a route north of the New Siberian Islands, this problem can be avoided, but ice-conditions are often prohibitively severe. In reality, vessels that are constructed to operate on the whole NSR on a regular basis will have to observe the 12.5 m draft restriction.
2. *The shallowness of the coastal areas force deep-draft ships to choose routes far from the coast.* This creates additional problems for larger ships, since ice conditions often are better close to the coast, where small islands and other local features may provide shelter from drifting ice.

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11 See for instance E. Gold in his review of Yakovlev et al (1999); T.R. Ramsland (1999): "Economic Evaluation of NSR *INSROP Working Paper*, No. 140; or D. Brubaker's discussion of the question in W. Østreng, A.L. Kolodkin, D. Brubaker & J.-L. Jernsletten (1999): "Military, Political, Legal and Human Affairs", in W. Østreng (ed.): *The Natural and Societal Challenges of the Northern Sea Route. A Reference Work*. Dordrecht/Boston/London: Kluwer Academic Publishers.

12 T.R. Ramsland (1999): "Economic Evaluation of NSR Commercial Shipping", *INSROP Working Paper*, No. 140.

3. *The shallowness of the coastal areas and the Arctic ports seriously limits the size of ships that can call at Russian Arctic ports.* Even with the existing standard class of Russian NSR cargo vessels – the *Norilsk (SA-15)* class vessels – the 9.0 m draft is too deep to proceed to quay in many of the NSR ports – loading/unloading will have to take place by reloading to smaller vessels, or directly onto the ice. Another serious consequence is the inability of larger ships to seek shelter and repair in emergency situations. Draft restrictions and other particulars of the individual NSR ports are described later in the chapter 6.3.

1.5.2 Ice conditions

Difficult ice-conditions often prohibit the use of the shortest route between two points, and lead to the need of expensive ice-breaker assistance. It also causes increased fuel expenses, damage to vessels, detours and reduced speeds. The ice-conditions vary greatly between the different parts of the NSR, and between seasons and years. Table 1.2 shows average percentage of ice-free regions during the summer months:

Table 1.2: Summer ice-free regions of the Russian Arctic seas (average percentage of region's total area that is ice-free)[13]

End of month	Region						
	South-western Kara Sea	**North-eastern Kara Sea**	**Western Laptev Sea**	**Eastern Laptev Sea**	**Western East Siberian Sea**	**Eastern East Siberian Sea**	**South-western Chukchi Sea**
June	17	0	10	10	0	0	27
July	40	18	24	33	10	6	57
August	85	41	45	69	31	17	75
September	95	53	51	80	49	27	85

First of all, this shows that no parts of the NSR are completely ice-free even during the most favourable summer month (September). Secondly, this indicates that the areas at each end of the NSR – the south-western Kara Sea and the south-western Chukchi Sea – have the lightest ice-conditions (along with the Eastern Laptev Sea around the Lena river mouth), with the eastern East Siberian Sea having clearly the most difficult ice conditions. This corresponds with navigational experience, where the East Siberian Sea has been seen as the most difficult sea to navigate, and also being the main bottleneck for transit navigation. Other parts of the NSR have "average" ice-conditions.

The reason for the difficult conditions in the East Siberian Sea is the mighty Ayonskiy Ice Massif, consisting of thick and hardened multiyear ice, and which often extends almost to shore even during summer due to currents and winds. See figure 1.2.

Sailing during the *winter season* (November-May), is generally much more difficult than in the summer season, due to the thicker and more dense ice-cover. An important, special feature of winter navigation is the *fast ice* – stable, immovable ice which is "clinging" to the coastline. Depending on the location of islands and sea depths, the fast ice may be extending up to 500 km from the Russian mainland. Fast ice is very difficult to pass through, and normally it is preferable to avoid it by using northerly routes. If off-shore winds prevail, one

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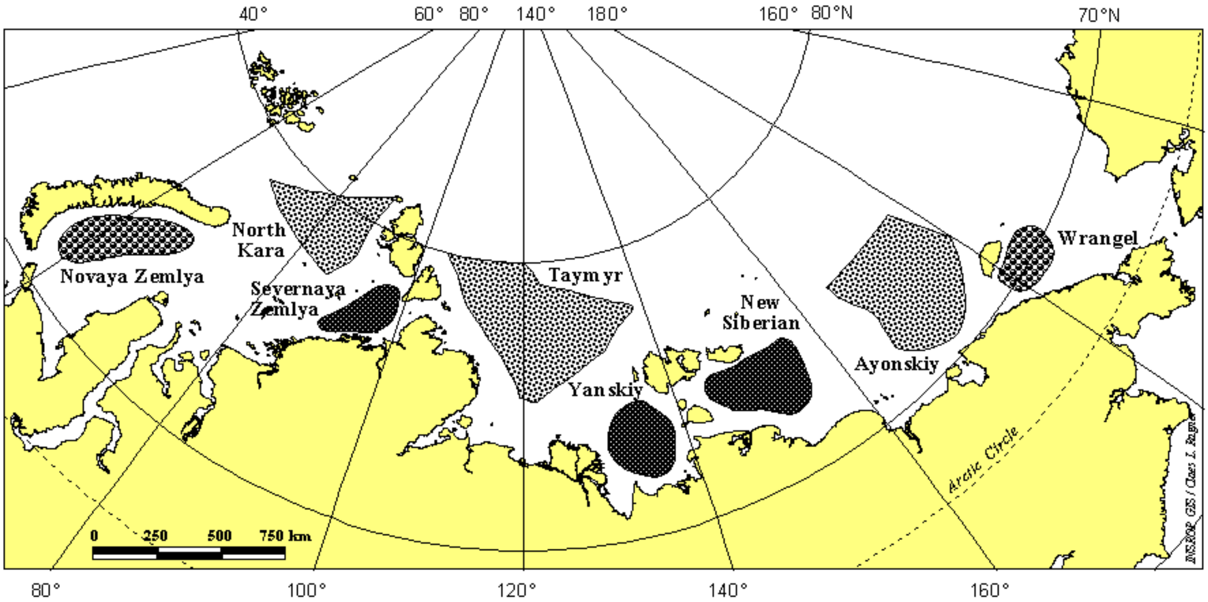
[13] S. Brestkin, A. Yulin, V. Karklin, I. Ashik, Z. Gudkovich, I. Karelin, S. Klyachkin, E. Makarov, E. Sapershtein, I. Sergeeva, V. Smolyanitskiy, K. Teitelbaum & S. Frolov (1998): "Natural Conditions along the Selected Routes", *INSROP Working Paper*, No. 121.

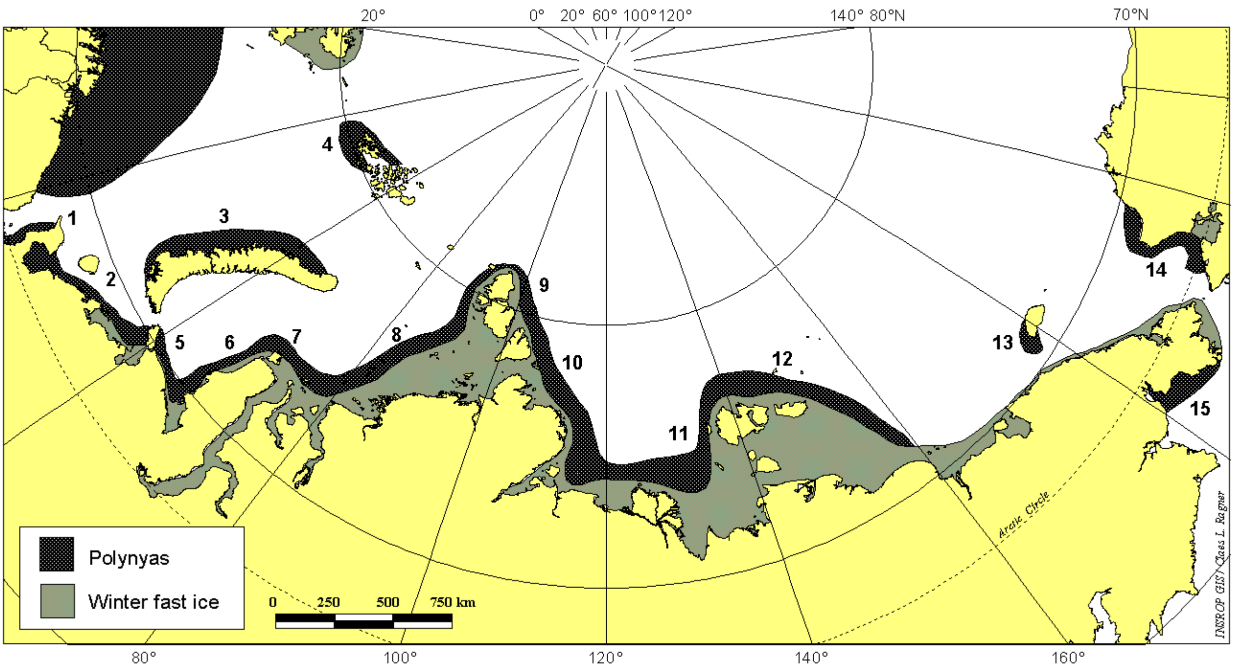
will often during winter find open leads at the edge of the fast ice – so called *polynyas*, which are very suitable for navigation. Typical location of fast ice and *polynyas* is illustrated in figure 1.3.

Figure 1.2: General locations of summer ice massifs in the Russian maritime Arctic[14].



Noted are three types of summer ice massifs: Multiyear ice from the Arctic Ocean (North Kara, Taymyr and Ayonskiy); local drift ice (Novaya Zemlya and Wrangel); and, fast ice remnants (Severnaya Zemlya, Yanskiy and New Siberian).

Figure 1.3: Regions of winter fast ice and *polynyas* in the Russian Maritime Arctic[15].



Polynyas: 1 – Cheshskaya, 2 – Pechora, 3- West Novaya Zemlya, 4 – Victoria Sea, 5 – Amderma, 6 – Yamal, 7 – Ob-Yenisey, 8 – West Severnaya Zemlya, 9 – East Severnaya Zemlya, 10 – Taymyr, 11 – Lena, 12 – New Siberian, 13 – Wrangel, 14 – Alaska, 15 - Anadyr

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14 Reproduced from Brigham et al (1999).

15 Reproduced from Brigham et al (1999).

Again, it is clear that it is the Kara Sea that offers the easiest conditions for navigation. Here, the extension of the fast ice is normally small, but the existence of *polynyas* is also relatively normal. The only areas where polynyas are not often found, are the eastern East Siberian Sea and the Chukchi Sea. This is again mainly due to currents pushing ice from the central Arctic Basin towards the coast, thus creating extremely difficult ice conditions. The fact that both Severnaya Zemlya and the New Siberian Islands normally become enveloped by the fast ice, will often force ships to choose a route north of these archipelagos, routes which may expose the ships to extremely harsh ice conditions, in addition to being a detour.

Under normal conditions, winter navigation along the eastern NSR will never be profitable, and commercial operations will be restricted to the summer season. The summer season has traditionally been defined as June-October, but technological improvements have gradually allowed an *extended* summer season, with navigation until December in years of favourable ice-conditions. Today, it is only shipping on the Dudinka-Murmansk line that operates on a year-round basis. All other transport is carried out only during summer.

1.5.3 Climatic change

While there have also recently been years of extremely difficult ice-conditions on the NSR (for instance 1998), a growing number of reliable research reports indicate that the polar ice cap is shrinking at an unprecedented rate, and some research reports indicate that the pace is dramatic. Recent research has shown that the ice thickness in the Central Arctic Ocean has been reduced by 15% per decade since 1958[16], and that the extent of multi-year ice has been reduced by 14% in the period 1978-98[17]. If these trends continue, the entire Arctic Ocean will become ice-free during summer before the end of this century. This would change fundamentally the conditions for and prospects of shipping on the NSR, even though no detailed research into this particular question has been made.

[16] Rothrock, D.A., Y. Yu, and G.A. Maykut (1999): “Thinning of the Arctic Sea-Ice Cover,” *Geophysical Research Letters*, 26, 23:3469-3472.

[17] Johannessen, O.M., E.V. Shalina, and M. Miles (1999): “Satellite Evidence for an Arctic Ice Cover in Transfor *Science*, 286:1934-1937.

2 Historic and Actual NSR Freight Flows

The annual volumes of cargo transported along the NSR have varied widely. Prior to the 1930s cargo volumes were modest, but under Stalin large programmes to exploit the Russian Arctic's natural resources were initiated, and the NSR developed into a transport corridor for import of industrial supplies and export of natural resources. The 2nd World War saw a further increase in volumes, caused by increased mining, relocation of industry and a shift to seaborne supplies to Northern Siberia in order to release capacity on the Trans-Siberian Railway (TSR) for military cargoes[18]. For a long time after the war, the general trend was a continued slow but steady growth in transport volumes, which reached a peak in 1987 with 6.58 mln tons. From then on, cargo volumes decreased sharply, and since 1996, they have hovered around 1.5-2.0 mln tons annually.

NSR overall cargo volumes for the years 1945-1999 are presented in table 2.1. In table 2.2, NSR cargo volumes for the 1990s have been broken down into the various transport directions – import, export, transit and different kinds of cabotage (internal sea transport). Data for the peak year 1987 has been included for reference. In table 2.3, a detailed breakdown of foreign trade in the 1990s is made, and in table 2.4, cargo flows through *eastern* and *western* NSR ports are compared. Figures in tables 2.1-2.4 all refer to the formal definition of the NSR, confined by Novaya Zemlya in the west and the Bering Strait in the east. A weakness with this cargo statistics is that it does not take into consideration *how long distance* the cargo is transported. A ton of cargo carried between two neighbouring ports, and a ton carried in transit, counts equally much.

2.1 Transport directions

As can be seen from table 2.2, the overall reduction of NSR cargo volumes 1987-99 has been considerable (76%), with none of the transport directions spared. Import to the region from abroad and from the Russian Pacific coast has almost halted, and transit traffic is again down to zero. The least dramatic reduction is seen on export.

2.1.1 Cabotage import from other regions of Russia

The contraction of the Russian economy in the 1990s made it impossible for the Russian State to maintain the previously high level of subsidies towards the Arctic transport system, leading to a sharp decline in non-commercial deliveries of fuel, foodstuffs and other basic commodities to the Russian Arctic settlements. In addition, the disintegration of the Soviet economic system has slowed down – or closed down – many important economic activities in the Arctic, such as mining and oilfield development. Coupled with a considerable population outflow, this has also led to a reduced need for shipping provisions to the Arctic.

Another notable trend is that while 40-50% of the deliveries previously came in from eastern Russia prior to 1994, almost all deliveries are now coming in from western Russia, i.e. mainly from Murmansk and Arkhangelsk. This trend was brought to an extreme in 1998, when only 0.6% of deliveries were brought in from eastern Russia. In 1999, this figure was 4.4%.

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[18] Bulatov, Vladimir (1997): "Historical and Current Uses of the Northern Sea Route. Part IV: The Administration of the *INSROP Working Paper*, 84.

Table 2.1: Total cargo volumes transported along the NSR, 1945-1999, million tons[19]

Year:	1945	1960	1970	1980	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Volume:	0,44	0,96	2,98	4,95	6,58	5,51	4,80	3,91	2,97	2,30	2,36	1,64	1,95	1,46	1,58

Table 2.2: Dynamics and directions of NSR cargo shipment, 1987-1999, thousand tons[20]

	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Change 1987-99
Cabotage import to NSR ports, *of which*	2943.6	2490.4	2261.6	1806.9	1413.6	795.3	829.3	635.5	703.1	455.5	645.4	-78.1 %
- from west Russian ports	1808.1	1355.1	1193.8	974.4	768.9	573.5	576.8	462.0	558.4	452.6	616.8	-65.9 %
- from east Russian ports	1135.5	1135.3	1067.8	834.5	644.7	221.8	252.5	173.5	144.7	2.9	28.6	-97.5 %
Cabotage export from NSR ports	1684.7	1556.0	1450.7	1272.2	728.5	710.3	766.0	595.2	645.4	421.7	311.3	-81.5 %
Intra-Arctic cabotage	358.6	136.2	170.0	169.7	95.3	18.3	10.8	10.0	36.2	50.5	61.3	-82.9 %
Foreign trade, *of which*:	1590.7	1212.8	745.5	456.1	520.3	636.0	655.5	383.2	560.6	530.7	562.2	-64.7 %
- import	509.8	11.8	1.9	5.3	3.0	57.1	49.5	15.6	35.6	6.6	13.0	-97.5 %
- export	1080.9	1201.0	743.6	450.8	517.3	578.9	606.0	367.6	525.0	524.1	549.2	-49.2 %
Transit	1.0	115.1	176.2	202.3	208.6	140.2	100.2	18.1	0.0	0.0	0.0	-100.0 %
Total volume of shipments	6578.6	5510.5	4804.0	3909.2	2966.3	2300.1	2361.8	1642.0	1945.2	1458.4	1580.2	-76.0 %

[19] Compiled by the author from: M. Tamvakis, A. Granberg & E. Gold (1999) "Economy and Commercial viability" in W. Østreng (ed.): "The Natural and Societal Challenges of the Northern Sea Route. A Reference Work". Dordrecht/Boston/London: Kluwer Academic Publishers, p. 225; Northern Sea Route Administration (2000), *Ob'yem arkticheskikh perevozok morskim transportom v 1996-1998 gg. (The Volume of Arctic Sea Transport 1996-1998)*. Moscow: Northern Sea Route Administration, unpublished memo, p. 1; with preliminary 1999 figures from A.G. Granberg, *personal communication*, August 2000.

[20] Ibid.

Table 2.3: Foreign import/export to/from the NSR ports 1990-1999, thousand tons[21]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total exports, *of which*	1201.8	743.6	450.8	517.3	578.9	606.0	367.6	525.0	524.1	549.2
- timber from Igarka	711.3	448.2	247.2	296.5	297.6	272.7	42.1	53.5	39.2	?
- timber from Tiksi	147.6	47.6	67.2	95.9	42.4	19.6	–	4.7	–	?
- non-ferrous metals from Dudinka	164.1	90.7	80.3	116.7	222.8	302.4	282.6	377.6	409.7	?
- nickel matte from Dudinka	29.3	17.1	13.7	6.0	2.6	–	–	?	–	?
- sulphur from Dudinka	106.6	15.1	–	–	–	–	–	–	–	–
- gas condensate from Yenisey/Ob/Yamal	–	–	–	–	13.5	11.3	42.9	45.9	57.2	?
- coal from Sakha (Kolyma)	25.9	108.7	39.0	–	–	–	–	–	–	?
- metal scrap from Sakha/Dudinka/N.Zemlya	16.2	?	?	?	–	–	–	5.3	17.7	?
Total imports, *of which*	11.8	1.9	5.3	3.0	57.1	49.5	15.6	35.6	6.6	13.0
- coal to N. Zemlya from Poland	8.9	–	–	–	–	–	–	–	–	–
- pipes to Ob Bay / Lower Yenisey	–	–	–	3.0	1.3	–	?	?	?	?[a]
- to Dudinka	2.9	–	0.1	–	9.1	3.7	?	?	4.1	?
- to Pevek (mostly fuel)	–	–	–	–	30.5	0.9	2.2	8.4	1.8	?
- to Tiksi	–	?	?	–	?	–	4.0	–	–	?
- to Mys Shmidta (mostly fuel)	–	–	–	–	14.4	19.5	–	25.9	–	?

[a] One shipment reported Japan-Dudinka. Volume unknown.

Table 2.4: Comparison of cargo flows through ports of the western and eastern NSR, 1998, thousand tons[22]

	Western NSR[a]	Eastern NSR[a]	Whole NSR
Cabotage import to NSR ports from W. Russian ports	290.4	162.2	452.6
Cabotage import to NSR ports from E. Russian ports	0.0	2.9	2.9
Cabotage export from NSR ports to other Russian regions	418.5	3.2	421.7
Intra-Arctic cabotage	0.0	50.5	50.5
Foreign export	524.1	0.0	524.1
Foreign import	4.8	1.8	6.6
Total NSR port turnover	1237.8	220.6	1458.4

[a] *Western NSR* is here defined as the western Kara Sea, including Dikson, Dudinka and the Yenisey River. *Eastern NSR* is the stretch between Dikson and the Bering Strait.

21 Compiled by the author from Tamvakis et al. (1999): p. 226; A. Granberg, G. Kobylkovsky & V. Plaksin (1999): “Cargo-forming Potential of Sakha (Yakutia), Chukot Autonomous District and other Far-Eastern Regions for the Northern Sea Route”. *INSROP Working Paper*, No. 135, p. 12; V. Pavlenko & A. Yakovlev (1999): “Impact of the Northern Sea Route and the Lensky Riverine Steamship Line Functioning on the Socio-Economic Situation and Development of Sakha Republic (Yakutia)”. *INSROP Working Paper*, No. 149, p. 8; Annex A2; Northern (2000): p.1; Frank, Sergey O. (2000): “International Shipping on the Northern Sea Route – Russia’s Perspective,” in Claes Lykke Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers, 2000, p. 9; with preliminary 1999 figures from A.G. Granberg, *personal communication*, August 2000.

22 Aggregated by the author from annex A2.

2.1.2 Cabotage export to other regions of Russia

Cabotage export is dominated by one single trade, namely the transport of non-ferrous ores from Dudinka to Murmansk, originating from the Norilsk mines and destined for the Kola Peninsula smelter industry. Volumes have decreased steadily in the 1990s, but since 1996 this has been partly compensated by increased export of processed non-ferrous metals from Dudinka to Western Europe. The trade started in 1968 and has been carried out on a year-round basis since 1978.

2.1.3 Intra-Arctic cabotage

Intra-Arctic cabotage covers shipments along the Lena and Kolyma Rivers to points located between Khatanga and Mys Shmidta. This involves mainly cargo arriving by railway to the port of Osetrovo on the Lena River, as well as local freight (mostly coal) on the Kolyma River. Since 1994 intra-Arctic cabotage has dramatically decreased, even though a slight upturn has been seen since 1997, as modest distribution of coal from the Kolyma to locations along the eastern NSR has resumed[23].

2.1.4 Foreign import.

Import to the NSR area all but ceased in the 1990s, and now only consists of various minor, incidental deliveries. In 1997 the import consisted of 25,900 tons of deliveries to Mys Shmidta and 8,400 tons to Pevek (see table 2.3) – the majority oil products from USA and Western Europe. In 1998 and 1999, volumes were even smaller. This is most of all caused by the reduced level of industrial activities in the Russian north, not least the reduced pace of development of gas resources in the Yamalo-Nenets Autonomous *Okrug* (A.O.). In the 1980s, this trade represented several hundred thousand tons annually.

2.1.5 Foreign export.

Export is the transport direction that has dropped least 1987-1999 - “only” 49.2%. While timber export has been reduced by almost 95%, this has been partly compensated by a more than doubling of export of nickel and other non-ferrous metals via Dudinka to ports in Western Europe. In 1998, 78.2% of foreign export from NSR ports consisted of non-ferrous metals from Dudinka, while timber export only represented 7.5% (see table 2.3). The remainder of 1998 export consisted mostly of another rising cargo segment: gas condensate from the Yenisey, Ob Bay and Yamal areas (10.9%).

2.1.6 Transit

Since 1997, transit cargo volumes have returned to zero. In the Soviet era almost no commercial transit sailings took place, even though some passages were made by military vessels. Then, in 1989, transit volumes suddenly grew, due to the grossly undervalued rouble that allowed dollar-earning Russian shipowners to make substantial profits in terms of roubles, even with low freight tariffs. In 1991, 15 transits totalling 176,200 tons of cargo took place[24]. Transit traffic further increased to a peak in 1993 when 208,000 tons were carried. After 1993 freight terms gradually worsened (including a fall in the real purchasing power of

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[23] See annexes A1 and A2.

[24] A. Yakovlev, G. Semanov, Y. Ivanov, A. Ushakov, S. Zubarev, M. Gavrilo, V. Khlebovich, K.A. Moe, J. Thomassen & O.W. Brude (1999): ‘Legal and Environmental Evaluation of the Routes Selected for the INSROP Simulation Study’, *INSROP Working Paper*, No. 128.

dollar in Russia), and the number of transit sailings decreased in 1994 and 1995, and in 1996 only one transit sailing was recorded – with no further transits recorded since. The 1989-96 transits included voyages with dry bulk from Murmansk and Latvia to Japan, China and Thailand; and from China and Canada to Murmansk, the Netherlands, the UK and Spain[25]. All transits were carried out by Russian ice-class vessels of the *Norilsk* and *Dmitriy Donskoy* classes[26]. Even though this burst of NSR transit sailings was short-lived, there is no doubt that it created high expectations in Russia concerning the route's international potential.

2.1.7 Eastern NSR vs. western NSR

One important point which is not obvious from table 2.2, but which is clearly demonstrated in table 2.4, is that the lion's share of NSR cargo transport takes place on the western part, in that part of the Kara Sea which lies west of Dikson and the mouth of the Yenisey River. In 1998, ports of the western NSR had 85% of the total turnover of all NSR ports. The only important source of cargo generation east of the Yenisey in 1998 was the coal shipped out from Kolyma for local distribution along the eastern NSR[27]. In the western part there were three major sources of cargo generation: first of all non-ferrous metals and ores from Dudinka, secondly occasional transport of gas condensate from various points around the lower Yenisey, the Ob Bay and Yamal Peninsula, and thirdly timber out of Igarka[28]. All of these cargoes are believed to have been shipped westwards. Also – as mentioned above – ports in western Russia are increasingly dominating the delivery of supplies *into* the NSR area. In 1998 all provisions to western NSR ports came in from the west, and so did 97.6% of the provisions to eastern NSR ports.

2.2 NSR commodities

Russian INSROP sources have also provided NSR cargo statistics broken down into the various *commodity types.* A closer look at the main cargo categories follows.

2.2.1 Hydrocarbons

The Soviet Union/Russia has been developing oil and gas fields in the Russian Arctic for several decades. However, those fields in the Russian North already under production – both those in the European Arctic and those in Northwest Siberia – are transporting their products southwards by pipeline. Marine export out of the region has been restricted to a few yearly shipments of gas condensate from the area around the Yamal Peninsula/Ob Bay/lower Yenisey, with slowly increasing export volumes: 13,500 tons in 1994, 11,300 tons in 1995, 42,900 tons in 1996, 45,900 tons in 1997 and 57,200 tons in 1998 (see table 2.3). The most significant of recent gas condensate shipments was the transport of 10,700 tons of gas condensate made by the Finnish M/S *Uikku* from Sabeta in the Ob Bay to Rotterdam under extremely unfavourable ice conditions in April/May 1998, escorted by Russian icebreakers. This was part of the Finnish-led and partially EU (General Directorate of Transport)-financed ARCDEV project, which carried out this demonstration voyage to explore the practical and commercial feasibility of year-round marine export of gas condensate from the Yamal area to EU countries[29].

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25 Granberg, Alexander G. (1998): "The Northern Sea Route: Trends and prospects of commercial use," *Ocean & Coastal Management*, 41:175-207.

26 Isakov, N., A. Yakovlev, A. Nikulin, G. Serebryansky, and T. Patrakova (1999): "Potential Cargo Flow Analysis and *INSROP Working Paper,* 139.

27 See annex A2.

28 See annex A2

29 Details of the ARCDEV project and voyage to be found at http:\\www.arcdev.neste.com

In addition to gas condensate, minor volumes of crude oil have been transported from tiny fields in or around the Pechora Sea – formally outside the NSR and not included in the tables 2.1-2.4. The only oil field with regular production here is on Kolguyev Island, where in 1998 22,000 tons of crude oil were shipped out (Moe and Jørgensen, 2000). In 1985, a shipload of oil was transported from the Varandey field (Shabad, 1986), but it was not until August 2000 that another 10,000 tons of crude oil were exported from this area, this time as a first trial loading from the planned Varandey oil terminal with makeshift equipment (Lukoil, 2000a).

2.2.2 Non-ferrous metals and ores

In the late 1990s, non-ferrous metals and ores have been the most important NSR cargo. This trade is completely dominated by the Norilsk Nickel Company, with its industrial complex located in Norilsk in the north of Krasnoyarsk *Kray*. Presently, the Norilsk complex produces 90% of Russian nickel, 65% of Russian copper, 90% of its cobalt and 100% of its platinum. The company's revenues were reported to be USD 2.9 billion in 1999 with a retained profit of USD 1.3 billion[30]. Transport services are reported to make up approximately 5% of the product price[31]. The Company started transport of copper-nickel ore from Norilsk to its smelting industry on the Kola Peninsula in 1968 via Dudinka and Murmansk. Later nickel matte ("feinstein") transport began. Since 1978, transport has taken place year-round. The Norilsk Nickel Company also exports refined non-ferrous metals directly to Western Europe, and previously also exported sulphur. At its peak, annual NSR cargo shipments from/to the Norilsk works exceeded 2.5 mln tons[32]. In 1998, shipments from Dudinka totalled 844,329 tons, of which 787,715 tons were non-ferrous ores and metals, including nickel matte – see table 2.5. This was a slight decrease from the approximately 951,000 tons of non-ferrous ores and metals in 1997 and 831,500 tons in 1996[33]. It is believed that 1999 volumes were on the same level. Including 283,462 tons of deliveries via the NSR *to* Dudinka (but excluding 28,892 tons in transit to Khatanga), the Norilsk Nickel Company in 1998 generated a total freight flow for the NSR of 1,114,069 tons, which was 76% of the NSR freight flow that year.

Table 2.5: Cargo shipments via Dudinka port in 1998 (mainly to/from the Norilsk works), tons[34]

Shipments to Dudinka, total	**298,632**
of which:	
Dry cargo	254,570
Liquid cargo	15,170
Transit to Khatanga (dry cargo)	28,892
Shipments from Dudinka, total	**844,329**
of which:	
Non-ferrous ore	206,876
Nickel matte ("feinstein")	171,114
Non-ferrous metals (export)	409,725
Scrap metal	15,870
Other cargo	40,744
Cargo total	**1,142,961**

30 Norilsk Nickel Company 1999 Annual Report.
31 Frank (2000).
32 Tamvakis et al (1999).
33 Northern (2000).
34 Compiled from data found in annex A2.

In addition to Norilsk Nickel, there are other minor industrial complexes for extraction and concentration of ores of non-ferrous and rare metals, gold and valuable minerals in the NSR area. However, these enterprises are exporting their products southward by other means of transport, and no significant cargo volumes for the NSR have been recorded in the 1990s.

2.2.3 Timber and wood products

In the Soviet era and up until 1995, timber was the most important NSR export cargo, with Igarka on the Yenisey River as the main export port. On a smaller scale, Tiksi has been the centre of timber export from the NSR's eastern part. In addition, large-scale timber export has taken place from Arkhangelsk and other ports on the White and Barents Seas, but this is outside the formal NSR area. Igarka timber export peaked in 1976 at 1,265,000 m^3 – approximately 800,000 tons[35]. The export then stabilised at around 700-750,000 tons in the 1980s. However, as NSR fees increased in the 1990s, and as efficiency of the Trans-Siberian Railway improved, Russian timber export gradually shifted towards rail, and since 1996, annual export volumes have been only between 39-54,000 tons (see table 2.3). The situation for Tiksi has been even worse, export dropping to 19,600 tons in 1995, and since then being virtually zero. There may be some under-reporting of NSR timber transport figures, as river vessels during the ice-free summer season may venture out on the NSR, taking the cargo all the way to end destinations outside the NSR without notifying the NSRA, in order to avoid the mandatory NSR fees[36]. This is however not likely to be a significant number.

2.2.4 Dry cargo and fuel provisions to Arctic settlements

The number and population of Russia's Arctic settlements have declined dramatically in the 1990s – especially in the eastern part of the NSR – and the need for food, fuel and other provisions has declined accordingly. Settlements on or close to the Arctic coast or along the navigable lower parts of the Yenisey, Khatanga, Anabar, Olenëk, Lena, Yana, Indigirka and Kolyma Rivers are provided by way of the NSR during the short summer season. Most provisions – recent years close to 100% – is coming in from ports of Western Russia (Murmansk and Arkhangelsk). Some provisions to the Northern parts of the Sakha Republic and Chukotka Autonomous Okrug used to come in from the Russian Far East (food and fuel from Primorskiy and Khabarovsk *Krays* and coal from Beringovsky), but this traffic has almost seized since 1998. The total amounts of provisions brought into the NSR area from western Russian, eastern Russian and foreign ports were 658,400 tons in 1999, 462,100 tons in 1998, 738,700 in 1997 and 651,100 in 1996. Of this, only between 7-36,000 tons annually were imported from abroad[37].

Most fuel provisions in the 1990s were carried out by ice-classified tankers from the Nakhodka-based Primorsk Shipping Company and the Finnish Fortum (previously Neste). Tankers from the Latvian Shipping Company have also taken part in this trade. Since 1998, newbuilt tankers from Lukoil Arctic Tankers have also taken part in the deliveries. Most transport has originated from Murmansk, Arkhangelsk and Primorskiy *Kray*, but occasional deliveries directly from Western Europe and the US Pacific coast have also taken place. Fuel has represented approximately 40% of annual deliveries to the settlements, with 213,200 tons of liquid cargoes transported in 1996, 285,900 tons in 1997, and 161,700 tons in 1998[38]. Another source states that on average, tankers have made approximately 50 voyages on the

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35 Tamvakis et al. (1999).

36 A.N. Silin (CNIIMF), *personal communication*, St.Petersburg, March 2000.

37 Northern (2000); A.G. Granberg, *personal communication*, August 2000.

38 Northern (2000)

NSR each year carrying a total of about 400,000 tons of oil – of which 80% is diesel oil.[39] However this figure also includes transport out of the area of gas condensate (somewhere between 50-100,000 tons), and possibly also fuel deliveries to Arctic settlements outside the formal NSR area.

Food and other dry provisions are mainly carried into the NSR area by ships from the Murmansk Shipping Company (MSCO) and until 1997 also by the Far Eastern Shipping Company (FESCO – Vladivostok), even though small-scale direct import of grain from the USA and Western Europe has also taken place occasionally. Some local distribution is carried out by the Tiksi-based Arctic Shipping Company along the Sakha coast, and by the Arkhangelsk-based Northern Shipping Company along the coasts of the south-eastern Barents Sea and the south-western Kara Sea. Several river shipping companies also take part in the local distribution. During the 1995 navigation season, an experiment was undertaken to deliver civilian cargoes to the Yamal Peninsula by an atomic-powered submarine, but this has not been followed-up. According to statistics[40], 437,900 tons of food and other dry cargoes were transported to the NSR area in 1996, 452,800 tons in 1997 and 300,400 tons in 1998.

2.2.5 Materials for oil/gas development

In 1976 voyages to Kharasavey began with supplies for the expected development of Yamal Peninsula gas fields. In 1979 shipments from Western Europe began to Novyy Port in the Ob Bay, along with small-volume shipments of large-diameter pipes and equipment from Japan for the construction of main pipelines from Urengoy. The shipment of pipeline equipment peaked in 1988 with 432,800 tons[41], but it should be noted that in this – and other years – the volume of equipment transported in from south on the Ob River, was many times larger[42]. However, development of new fields has slowed down in the 1990s, and there have been only occasional deliveries. The latest reported delivery of pipes was from Japan to Dudinka in May 1999[43].

2.2.6 Coal

NSR cargo flows of coal have been most variable, with the 1990s seeing coal being both imported, exported and carried in different cabotage directions. Export of coal from Sakha ceased after 1992 (see table 2.3), and until 1997, the main cargo flow of coal was cabotage import from Beringovsky south of the Bering Strait to Pevek and other eastern NSR ports. Such transports totalled 187,100 tons in 1995, 141,200 tons in 1996 and 127,900 tons in 1997 (see annex A1). This traffic stopped in 1998. Instead, transport of coal from the Sakha mines at Zyryanka (shipped down the Kolyma River and out to Pevek for further local distribution) picked-up again: from 45,700 tons in 1990, it first declined to 2,600 tons in 1995 and 0 in 1996, before climbing up to 31,000 tons in 1997 (annex A1) and 46,600 tons in 1998 (annex A2). Most of the 61,300 tons carried in “intra-Arctic cabotage” in 1999 (see table 2.2) is also believed to be coal. Some coal is probably also being transported in from the west but is not distinguishable in statistics from other types of dry cargo provisions.

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39 K. Moe & G. Semanov (1999): “Environmental Assessments”, Chapter 3 in Willy Østreng (ed.): “The Challenges of the Northern sea Route. Interplay between Natural and Societal Factors”, *INSROP Working Paper*, no 167.

40 Northern (2000)

41 Tamvakis et al (1999).

42 Kryukov, Valery, Arild Moe, and Vladimir Shmat (1999): “Financing the NSR: Regional Aspects,” *INSROP Working Paper*, 146.

43 Frank (2000).

2.2.7 Passenger transport

Most passenger transport to and from the Arctic settlements now takes place by plane, even though both cargo vessels and river barges are taking passengers. However, transport of passengers is no longer an important task of NSR shipping. On the other hand, a recent innovation in NSR traffic is icebreaker cruises for foreign passengers. Recently, there have been cruises every summer from Murmansk to Franz Josef Land and the North Pole, and from Provideniya Bay along the NSR. For example, the atomic icebreaker *Yamal* (MSCO), equipped with comfortable passenger cabins, usually performs two to three 3-week cruises a season, at approximately $20,000 per foreign passenger. The specially re-equipped diesel-engine icebreaker *Kapitan Khlebnikov* (FESCO) is also used for cruises[44]. These ice-breakers are sometimes also used for scientific expeditions, in different parts of the Arctic as well as in the Antarctic. The nuclear ice-breaker *50 Let Pobedy,* which is under construction in St.Petersburg, will be outfitted to carry 141 passengers, suitable for tourist cruises as well as research expeditions[45].

2.3 Conclusions

As can be deducted from the statistics and materials presented in this chapter, NSR cargo flows seem to have stabilized during the 2nd half of the 1990s, with annual volumes between 1.4 and 2.0 mln tons. Broadly speaking – and based upon 1996-99 averages – present main cargo flows consist of approximately 850,000 tons of non-ferrous metals and ores from Dudinka to Murmansk and Western Europe, approximately 650,000 tons of supplies to the NSR settlements overwhelmingly transported out of Murmansk and Arkhangelsk (of which approximately 250,000 tons are fuel and 400,000 tons are dry cargo), approximately 50,000 tons of gas condensate export from lower Yenisey/Ob Bay/Yamal, approximately 50,000 tons of timber export from Igarka and 50,000 tons of coal distributed from Kolyma along the eastern NSR. Other cargo flows – including transit cargo flows – are non-existent or negligible at the moment.

No major developments influencing the main cargo flows have been reported since 1999, the Murmansk Shipping Company in late 2000 reported that the delivery of goods to the NSR settlements had been carried-out smoothly during the summer[46].

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[44] Tamvakis et al (1999).

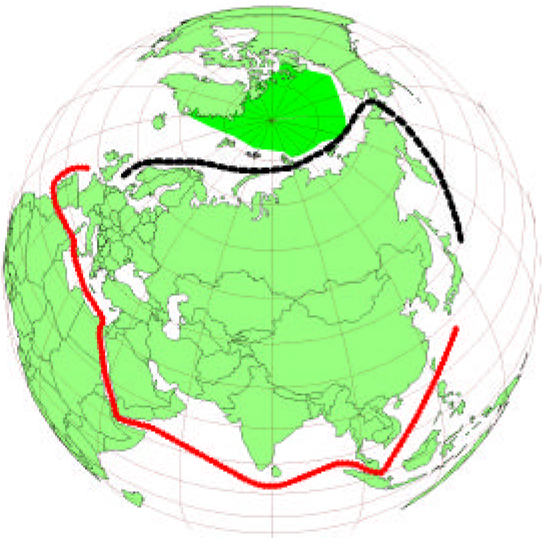
[45] Morskoy Flot (1998): Ledokol'nyy flot Rossii ("Russia's icebreaking fleet). *Morskoy Flot* 11-12: 21-23. Reported by L. Brigham (1998): "The Northern Sea Route, 1998". *Polar Record* 34 (190), pp 219-224.

[46] Reported at the MSCO WWW Homepage: *www.msco.ru*

3 Transit Traffic Potential

Outside Russia, most attention has been paid to the NSR as a potential transit route for cargoes between Western Europe and NE Asia/NW America. That the NSR is a considerably shorter route for traffic between these regions, is a geographic fact, as demonstrated in table 1.1 and figure 3.1. There is also little doubt that transport via the NSR can be *faster* for much of the year. The important question is however: Will transport via the NSR also be more *profitable* than moving cargoes via traditional and well-established routes? Finding the answer to this question was one of the main objectives of INSROP, and a large number of studies were dedicated to this topic.

Figure 3.1: Overview of the Northern Sea Route and the conventional Suez route



important “competitor” – the Suez route. Such comparisons – however incomplete – will be presented in this chapter, along with evaluations of their results and weaknesses. Comparisons with the other “competitors” – the Panama Canal and the Trans-Siberian Railway (TSR) – have not been treated by INSROP to the same detail, and are not discussed in this chapter. The importance of the Panama Canal is limited for the NSR, but the lack of a thorough comparison between the NSR and the TSR is regrettable.

In this chapter, we will first assess the transit *cargo potential*, then look into some of the main factors that determine the cost of NSR transit operations, and then go on to look at the results of NSR/Suez cost comparisons carried-out within INSROP.

3.1 Transit cargo potential

According to Tamvakis et al.[47], if the influence area of the NSR is defined as trade in both directions between Europe and the northern parts of the Far East region, and between Europe and the northern parts of the Pacific coast of North America, the latest reliable, detailed and

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47 M. Tamvakis, A. Granberg & E. Gold (1999) “Economy and Commercial viability” in
and Societal Challenges of the Northern Sea Route. A Reference Work”. Dordrecht/Boston/London: Kluwer Academic Publishers.

broad-based statistics available on seaborne trade between these areas, date back to 1987[48]. At that time, estimates indicated volumes of 21 million tonnes, whereas total world seaborne trade was estimated at 3,330-3,400 million tonnes. A more realistic cargo potential – one that included only the most relevant types of cargo – would give a total of 6.8 million tonnes eastbound and 2.8 million tonnes westbound, using the same source of statistics. However, this does not take into consideration the *seasonal* character of NSR transits with a traditional sailing season of only 4-5 summer and autumn months.

Another way of estimating the transit cargo potential is by analysing present traffic through the Suez Canal, combining statistics on country of origin and country of destination for the different cargo segments. By analysing Suez Canal statistics, Ramsland identified fabricated metals and mineral fertilisers as the two dominating NSR-relevant eastbound bulk cargoes – see tables 3.1 and 3.2[49].

Table 3.1: Southbound Suez Volumes 1994, Bulk Cargoes, NWE Export (thousand tons)

Product	Total volumes	NEW Export	Percent of total	Russian export	Percent of NEW total	NSR relevant
Fabricated Metals	32 094	16 437	51 %	7 780	47 %	Yes
Mineral Fertilisers	13 769	7 693	56 %	4 727	61 %	Yes
Cereals	11 213	4 688	42 %	0	0 %	Yes
Oil Products	9 288	2 218	24 %	178	8 %	Doubtful
Chemical Products	6 362	1 705	27 %	327	19 %	No
Cement	4 200	491	12 %	321	65 %	No
Metals & Ores	1 708	1 135	66 %	0	0 %	Yes
Sugar	1 280	993	78 %	0	0 %	No
Sum	79 914	35 360	44 %	13 333	38 %	

Table 3.2: Southbound Suez Volumes 1994, Bulk Cargoes, Far East Imports (thousand tons)

Product	Total volumes	Far East import	Percent of total	Chinese import	Percent of Far East	NSR relevant
Fabricated Metals	32 094	13 745	43 %	5 860	43 %	Yes
Mineral Fertilisers	13 769	5 837	42 %	5 306	91 %	Yes
Cereals	11 213	848	8 %	461	54 %	Yes
Oil Products	9 288	1 415	15 %	220	16 %	Doubtful
Chemical Products	6 362	414	7 %	248	60 %	No
Cement	4 200	0	0 %	0	0 %	No
Metals & Ores	1 708	326	19 %	191	59 %	Yes
Sugar	1 280	0	0 %	0	0 %	No
Sum	79 914	22 585	28 %	12 286	54 %	

[48] The only source of disaggregated seaborne statistics between maritime trade areas (rather than just countries) was the UN Maritime Transport Study. It was published annually and contained seaborne commodity trade flows for a total of 33 maritime trade areas that covered all the world. Due to its detail and scope, this publication presented data with a 3-year time lag. The publication was eventually discontinued by the UN: the last issue came out in 1990, containing detailed data for 1987.

[49] Statistics from the 1995 Suez Canal Annual yearbook. Quoted and analysed by T.R. Ramsland (1999): The Russian Fertiliser Industry. Fertilisers as a Cargo Segment on the Europe-Far Eastern Trade". *INSROP Working Paper*, No. 156.

North West Europe (NWE) is here defined as Norway, Sweden, Finland, Denmark, Russia, the Baltic Republics, Germany, Benelux, Great Britain, Ireland and France, while the Far East (FE) is defined as South Korea, China (including Hong Kong), Japan, and Taiwan.

The tables indicate that Russia is the main exporter of potential NSR transit cargoes, and that China is the main importer. The tables also seem to indicate that as much as approx. 14 million tons of fabricated metals and 6 million tons of mineral fertilisers may be NSR-relevant. However, without a more geographically detailed analysis taking into consideration exact ports of departure and destination, exact figures are difficult to assess. Also, the figures above do not take into consideration the seasonal character of the NSR. More detailed discussions on these two transit cargo segments are found in separate chapters below.

Isakov et al. have elaborated on the NSR transit potential of Russian exports (shipped out from ports in the European part of Russia, as well as the Baltic countries) to the Far East[50]. According to them, seaborne export to the Asia-Pacific from Northwest European ports amounted to 5.06 million tons in 1996, of which 2.41 million tons were exported to China, 0.89 million tons to Taiwan, 0.14 million tons to South Korea and 0.02 million tons to Japan. Of these, 3.33 million tons were exported through ports in the Baltic countries, while 0.92 million tons was exported through St.Petersburg, 0.77 million tons through Murmansk and 0.03 through Kaliningrad[51]. 98% of this export consisted of fertilisers and fabricated ferrous metals (see chapters below).

Other potential *eastbound cargoes* are less prominent. Ramsland identifies cereals and ores as relevant cargo segments, but volumes are small (see tables 3.1 and 3.2). Fish from Norway and other countries in NW Europe has been mentioned, but again suitable volumes are small.

When it comes to *westbound cargoes*, there are no obvious, large candidates, and this is a problem, since an imbalance between eastbound and westbound volumes will endanger the profitability of operations. However, according to analysis of Suez statistics[52], Chinese coal export has the potential of becoming a cargo segment, depending on world prices of that commodity. In 1997 4.03 million tons of Chinese coal passed through Suez. Bulk cargoes from the North American West Coast may also be interesting. Main products would be coal, wood products and grains. 1997 export figures from the Canadian West Coast to NW Europe includes 4.1 million tons of coal and 1 million tons of woodpulp, presently channelled through the Panama Canal. US West Coast exports are less relevant for the NSR – the most relevant cargo being grain export from Portland/Seattle to Russia and Europe[53].

There are few non-bulk candidates, as containerised cargo is not considered a suitable cargo for the NSR (see chapter below). However, according to analysis of trade statistics carried out by Ramsland[54], car import to NW Europe – especially from Japan – may be an NSR-relevant cargo (not least from a vessel-size perspective), even though the strict requirements to *regularity* will pose a major obstacle.

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50 N. Isakov, A. Yakovlev, A. Nikulin, G. Serebryansky & T. Patrakova (1999): “Potential Cargo Flow Analysis and *INSROP Working Paper*, No 139.

51 Ibid.

52 T.R. Ramsland (1999): “Cargo Analysis, North West Europe-The Far East / Canada US West Coast-NW Europe. The Potential for Transit Traffic on the Northern Sea Route”. *INSROP Working Paper*, No. 145.

53 Ibid.

54 Ibid.

Having thus got a view of the general situation concerning the NSR transit cargo potential, let us move on to a closer look at the most interesting cargo segments:

3.1.1 Ferrous metals

Russia exported approximately 20 million tons of fabricated, ferrous metals by sea in 1994, 27.2 million tons in 1995, 27.2 million tons in 1996, and 27.7 million tons in 1997[55]. In 1996 – for which detailed analysis have been made by Isakov et al. – approximately 31% (in 1997: 40%) of this was exported from the ports of NW Europe: 0.32 million tons were exported from Murmansk, 1.01 million tons were exported from St.Petersburg and other Russian Baltic ports, while 6.72 million tons were exported through the Baltic countries. Of this, 2.76 million tons were exported to the Far East and Southeast Asia (China, Japan, South Korea, Taiwan, Malaysia, Singapore, Thailand, the Philippines, Indonesia and Laos). In 1996, the four Russian metal works which are geographically most suitable for exporting via Murmansk/NSR (the Cherepovets, Novolipetsk, Nizhni Tagil and Magnitogorsk Integrated Metal Works) exported a total of 3.55 million tons to the Far East via European ports. Isakov et al. concludes from their analysis that approximately 1.7-1.9 million tons of these ferrous metals export could be diverted to the NSR (via Murmansk) during an extended summer navigation season[56].

3.1.2 Fertilisers

In 1996, Russia exported a total of 12.0 million tons of chemical and mineral fertilisers via the ports of Murmansk, St.Petersburg and Ventspils (Latvia). The Far East and Southeast Asia received 2.18 million tons of this, with China importing 1.47 million tons (see table 3.3)[57].

Table 3.3: Volumes of Transportation of Russian Chemical and Mineral Fertilisers to Southeast Asia and the Far East (tons)

Country	Ventspils	St-Petersburg	Murmansk	Total
China	702 026	30 030	741 000	**1 473 056**
Taiwan	5 017	-	-	**5 017**
Indonesia	-	40 005	-	**40 005**
Malaysia	20 051	305 270	-	**325 321**
Singapore	280 799	40 000	-	**320 799**
Japan	20 000	-	-	**20 000**
In total	**1 027 893**	**415 305**	**741 000**	**2 184 198**

Of this, 0.61 million tons were transported during the traditional NSR sailing season (July-October), and Isakov et al. estimates that as much as 0.75 million tons of this could be diverted to the NSR (via Murmansk) during an extended summer navigation season[58].

In addition to this comes a considerable potential from the presently ongoing export of fertilisers by Hydro Agri from Norway (Porsgrunn and Glomfjord) to China.

The fertiliser trade is maybe the most suited of all trades when it comes to large-scale NSR transit, both because of geography, cargo volumes, vessel sizes and not least stability. The fertiliser trade through Suez has been relatively stable in the nineties: 12-20 million tons were

55 1994 figure from *Bulletin of Foreign Commercial Information* (BFCI), No. 16 (7751), 10 February 1998. 1995, 1996 and 1997 figures from Isakov et al. (1999).

56 Isakov et al. (1999).

57 Ibid.

58 Ibid.

transported south through the Suez Canal annually1992-97, Russia's share varying from 3.9 to 7.1 million tons. China's import share has been between 3.6 and 8.3 million tons.

3.1.3Nuclear fuel

Nuclear fuel is a potential transit cargo which is very small in volume, but which potentially represents large values, and which may be politically controversial. The nuclear fuel in question is reprocessed Japanese nuclear fuels and vitrified high-level radioactive waste from reprocessing plants in Great Britain and France to be transported back to nuclear power plants in Japan. According to information obtained during the NSR User Conference in November 1999, representatives of Japanese and British nuclear fuel industries have discussed this option with Russian authorities. Russian transport authorities have expressed support for the scheme (which would offer significant income and employment for the Russian ice-breakers), and it is believed that Japan is presently investigating the feasibility of this option[59].

Apart from a more than 50% reduction in sailing distance compared to presently used routes, the usage of the NSR has other, very clear advantages from the point of view of the nuclear fuel industry. Along the routes used so far, there has been very strong opposition by coastal states concerned with the nuclear fuel's extreme toxicity and its potential weapons utility. The transports that have taken place to date have often chosen very long routes trying to minimise the number of countries whose waters they pass through. By using the NSR, the number of nations involved would be restricted to only Norway, Russia and the US (Alaska). In the case of nuclear cargoes, the present high NSR tariffs are unlikely to be considered a major obstacle. To fulfil current plans of the Japanese nuclear industry, it is estimated that 3-4 shipments of nuclear waste and highly sensitive reprocessed nuclear fuel eastwards and up to 5-6 shipments of less sensitive spent nuclear fuel westwards are required per year. The reprocessed fuel must be transported in 2-vessel convoys for security reasons, and calculations (see annex C2) indicate that at least 3 NSR transits could be made during the summer season, two eastwards and 1 westwards. Even though recent communications from British and Japanese sources indicate that the reported discussions have not led to any immediate plans for preparing such transports on the NSR, the transport of nuclear fuels still has a potential of becoming one of the first regular NSR transit cargoes. It is believed that the fesibility of this option is presently being investigated in Japan. There are however a whole range of legal and practical problems that need to be addressed before any such traffic can take place, and even if these problems are solved, traffic is not likely to come underway before well beyond 2005.

3.1.4Cargoes not suitable for NSR transit

INSROP research has also shown what types of cargoes that are *not* suitable for NSR transit. As ice conditions are unpredictable, frequent delays are unavoidable even with ice-breaker escort. This in practice prohibits liner operations with *containerised cargoes*, as such traffic operates on very strict time schedules. Other problems especially affecting container traffic is the risk of freezing damage to sensitive cargoes, as well as the fact that there are no ports with substantial turnover of containers between Japan and Murmansk. Also – as will be further discussed below – there are serious size limitations for vessels travelling on the NSR, in reality limiting transit vessels to approximately 50,000 dwt. This is far smaller than vessels able to use existing, traditional routes. In practice, this rules out profitable transit transport of several bulk cargoes, most notably *oil*.

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59 See Sawhill, Steven G., and Claes L. Ragner, "Nuclear cargoes: A radiant future for the Northern Sea Route?," *in prep*.

3.1.5 Conclusions – transit cargo potential

To sum up the chapter on future, potential NSR transit freight flows, the following, main conclusions can be drawn:

The two most promising large-volume cargoes for NSR transit are ferrous metals and chemical/mineral fertilisers, both eastbound cargoes. The freight flow of these two products from Europe to East Asia has been relatively stable throughout the 1990s. Another potential cargo – albeit in only very small volumes – is Japanese nuclear waste/fuel. It is Russia that has the largest export potential for NSR transit cargoes, and China that has the largest import potential. Potential *westbound* cargoes are more difficult to identify than *eastbound* cargoes, and volumes seem to be smaller.

In terms of *overall* volumes, several estimates have been forwarded by different sources. Based on present cargo flows between Europe and the north Pacific Region, eastbound NSR transit cargo *potential* is 2-3 million tons by a modest estimate, and 6-8 million tons by an optimistic estimate, while westbound NSR transit cargo potential is less than 1 million tons by a modest estimate, and 2-4 million tons by an optimistic estimate. One of the more moderate estimates – possibly also indicative of Russian policy goals – has been forwarded by the Northern Sea Route Administration, in which the annual volume of transit cargoes is expected to reach 300,000-500,000 tons before the year 2005, with the ultimate goal of eventually realising most of the NSR's transit potential with 5-6 million tons of eastbound cargo and 2-3 million tons of westbound cargo[60]. This estimate may be as good as any other, but whether or not any of the *potential* cargo flows will ever be transformed into actual cargo flows, will all depend on the transport economy of transit operations. This will be discussed in the following sections.

3.2 Basic factors for commercial NSR transit traffic

All European ports facing the Atlantic, Baltic and Arctic Oceans, all ports in East Asia north of Hong Kong, and all ports in Northwest America from Portland northwards are considered to be of relevance for NSR transit. INSROP transit studies and calculations were however based on the Hamburg-Yokohama stretch, which is 11,100 nm by the traditional Suez route, but only 6900 nm by the NSR. This is also comparable to the distances between Murmansk and relevant Chinese ports. Of this, the NSR proper is approximately 2550 nm, measured along a standard, coastal summer route, assuming favourable ice conditions.

The main factors that influence the cost of NSR transit operations are briefly presented below.

3.2.1 NSR tariffs

All vessels using the NSR must pay NSR fees to cover the expenses of the NSR infrastructure. Under the present Russian tariff system, fees depend on the vessel's ice-class, its gross register ton (grt), the season, the charterer's nationality and on which parts of the NSR are being navigated. NSR fees do not depend on the number of days of ice-breaker escort. The present system for calculating NSR fees for non-Russian charterers are presented in table 3.4.

[60] Y. Ivanov, A. Ushakov & A. Yakovlev (1998): "Russian Administration of the Northern sea Route – Central or *INSROP Working Paper*, No. 106..

Table 3.4: Calculation of NSR fees for foreign and Russian vessels charted by foreign companies[61]

Ice class of vessel	Gross registered tonnage (grt)		NSR fees (USD/grt)		
	From	To	Summer (July-October)		Winter
			Entire NSR	Part of NSR	
Ice-breaker	5001	6000	7.26	4.36	6.53
	10001	11000	6.58	3.95	5.92
	19001	20000	5.49	3.29	4.94
ULA	5001	6000	9.98	6.49	9.73
	10001	11000	9.04	5.88	8.82
	19001	20000	7.54	4.90	7.36
UL	5001	6000	18.15	11.80	17.70
	10001	11000	16.44	10.68	16.03
	19001	20000	13.72	8.92	13.37
L1	5001	6000	22.69	15.88	23.82
	10001	11000	20.55	14.38	21.58
	19001	20000	17.15	12.00	18.00

The above mentioned fees include costs for icebreaking assistance (which is by far the largest component of the NSR fee), ice-forecasting and route recommendation services (based on ice-monitoring by satellites and other means). Only the fee for the two mandatory on-board ice-pilots will have to be added. At USD 672 per day[62], this will normally amount to USD 7-10,000 pr. transit. The above fee system does not apply to *Russian* charterers, for whom no official fee system has been published.

Nor has any information on the system of NSR fees for vessels larger than 20,000 grt been published, except that "vessels exceeding 20,000 grt and with beam exceeding 26 m, are led for extra fees depending on technical conditions of the vessel, seasons of the year, region of sailing, ice conditions etc."[63] The most relevant of the Russian cargo vessels (the *Norilsk (SA-15)* vessels with ULA ice-class) are only 16,500 grt. According to this system, the chartering of a *Norilsk* class vessel for a transit run, would incur an NSR fee of *at least* USD 124,410 (+ ice pilot fee).

The present fee system is a result of what happened in beginning of the 1990s, when both cargo volumes and state subsidies declined rapidly, forcing the Murmansk Shipping Company (MSCO) and other ice-breaker operators to increase fees, leading to a further decrease in traffic. However, Russian authorities have informed that a new system of ice-breaker fees is under consideration. Different figures have been mentioned[64], but all have been in the range of 3-7 USD/grt. According to the informed opinion of the main Russian INSROP partner

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61 A. Yakovlev, G. Semanov, Y. Ivanov, A. Ushakov, S. Zubarev, M. Gavrilo, V. Khlebovich, K.A. Moe, J. Thomassen & O.W. Brude (1999): 'Legal and Environmental Evaluation of the Routes Selected for the INSROP Simulation Study', *INSROP Working Paper*, No. 128.

62 Ibid.

63 Ibid.

64 Speeches during the NSR User Conference, November 1999, by the Russian Minister of Transport Sergey O. Frank, The Head of the Ministry's Marine Policy Dept. Nikolay Matushenko, the Director of the Central Marine Research and Design Institute (CNIIMF) Vsevolod I. Peresypkin and the Director of Murmansk Shipping Company Vyacheslav Ruksha, all published in C.L. Ragner, (ed.) (2000): *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

CNIIMF (Central Marine Research and Design Institute), future ice-breaker charges are not going to exceed 5 USD/grt. CNIIMF furthermore foresees that the fee for 25-50,000 dwt vessels with high ice-class will not exceed 4 USD/grt[65]. This also indicates that chartering a *Norilsk* class vessel for a transit run, would in the future incur an NSR fee of USD 66,000-82,500 per voyage (+ ice pilot fee).

While almost all interested parties in Russian domestic, Arctic sea trade (the Norilsk Nickel Company etc.), have signalled that a tariff of USD 5 per ton would be attractive for them, this low tariff would only be attractive for the ice-breaker operator if cargo turnover climbs to 6-10 mln tons or above. Whether USD 5 per ton will be low enough for international transit operations, is further discussed below in chapter 3.3.

As for the “competition”, the system for calculating Suez Canal tariffs is well known[66]. It can be mentioned that for a vessel with the particulars corresponding to a *Norilsk* class vessel (16,500 gross register ton, 11,000 net register ton), the total Suez Canal Transit costs amounts to approximately USD 98,000 (at October 2000 exchange rates). However, it must be mentioned that the Suez Canal Authority (SCA) has had a very competitive pricing policy, offering special tariff reductions up to 80% for ships that can document that other routes will otherwise be more profitable[67]. Based on such historic experience, one can expect that it is likely that the SCA – in face of real competition from the NSR – will offer reduced tariffs also to bulk vessels between NW Europe and NE Asia.

Finally, there is one more side to the tariff question that needs discussion, namely the perspective of the ice-breaker *operators*. One major problem for the NSR is the difficulty of creating a balanced tariff system that would secure profitable operations for both the cargo owners and the ice-breaker operators at the same time. Tacis[68] made an analysis of the economy of ice-breaker operations. Assuming a transit cargo volume of 1 mln tons per year, assuming synergy effects by escorting simultaneously transit vessels and vessels delivering provisions to the NSR settlements, and assuming a high tariff of USD 10 per ton of cargo (which would render transit traffic utterly unprofitable for cargo owners), the study still concluded that less than 1/3 of the ice-breakers’ running costs could be recovered. The study further showed that even with a tariff system more differentiated than today (with for instance USD 3 per ton of hydrocarbons from the Pechora Sea, and USD 15 per ton of non-ferrous ores/metals from Dudinka) hydrocarbons will yield far larger profits for the ice-breaker operator than non-ferrous metals, with the escort of non-ferrous metals actually generating large deficits unless synergies can be obtained by simultaneously escorting large volumes of hydrocarbons from the Kara Sea.

From this study, it can be concluded that regular transit traffic with “ordinary”, commercial cargoes is difficult to imagine without heavy losses/subsidies on the part of Russia. Export of hydrocarbons – especially form the Pechora Sea – is maybe the only NSR cargo that can be tariffed in such a way that both cargo owners and ice-breaker operators can run profitably. In order for the Dudinka trade of non-ferrous metals/ores to become profitable for the ice-breaker operators, tariffs must either be extremely high, or synergies with hydrocarbon exports must be realized.

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65 Yakovlev et al (1999).

66 See for instance http://www.lethsuez.com/tariff.htm

67 See for instance http://www.lethsuez.com/rebates.htm

68 Tacis North-West Regional Transport Development Project (2000): *Northern Sea Route, Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

3.2.2 NSR ice-insurance premiums

All vessels sailing the NSR must also have sufficient insurance to cover possible damage to the marine environment. However, it is difficult to assess what the ice-premiums will be for vessels travelling on the NSR, since there have so far been so few cases of NSR vessels being put on the international marine insurance market. The only figures that have been published are from the "Russian P&I POOL", which is open to all vessels that are not otherwise covered. Table 3.5 shows the Russian P&I POOL's *approximate* tariffs for *one-year* protection and indemnity (P&I) insurance for vessels on the NSR (defined as the sea-lanes between Murmansk and Dutch Harbor in Alaska):

Table 3.5: Approximate tariffs of civil liability insurance (P&I) for vessels using Murmansk - the NSR - Dutch Harbor seaway (annual rate)[69]

Type of vessels: / Degree of coverage:	Tankers	Dry cargo vessels	Other vessels
Responsibility for pollution only	USD 4.55/grt	USD 1.65/grt	USD 1.40/grt
Standard packet of risk	USD 9.10/grt	USD 8.10/grt	USD 7.00/grt

Yakovlev et al. stresses that these figures are approximate, and that P&I insurance quotations will vary for any individual vessel or a group of vessels. For instance, the model above does not take into consideration the vessel's ice-class. However, this indicates that a *Norilsk (SA-15)* class dry cargo vessel will be sufficiently P&I insured for the NSR for an annual sum of USD 133,650. If the vessel moves outside the Murmansk-Dutch Harbor stretch, additional ordinary P&I insurance for these stretches will come in addition.

Special hull & machinery (H&M) insurance for the NSR is also available from Russian insurers. Yakovlev et al has received the following quotation, based on the vessels' ice-class:

Table 3.6: Approximate H&M insurance tariffs for vessels on the NSR (annual rate, pro rata in % of the insurance sum)[70]

Type of vessel: / Ice-class:	L1	UL	ULA
Bulker/container carrier	0.92-2.29	0.78-1.95	0.63-1.60
Tanker	1.03-2.63	0.90-2.24	0.74-1.84

The approximate quotations above are for a bulker/container carrier of cost from USD 60 mln and a tanker of cost USD 75 mln. Actual quotations will be based on a case-by-case basis, depending on the individual vessel. If requested, H&M insurance is also available on a per-voyage basis.

3.2.3 Vessel size

The standard NSR cargo vessels of today are of the Russian *Norilsk (SA-15)* class. These vessels are 19,900 dwt. INSROP research on suitable NSR ship design, shows that under present NSR conditions and with present technology, the absolute maximum size of NSR transit vessels is approximately *50,000 dwt* – more or less corresponding to socalled "Handymax" vessels. The main constraints are depth (maximum draft 12.5 m due to the 13 m depth of Sannikov Strait), and breadth as vessels need to be able to follow behind ice-breakers (absolute maximum beam is 30 m – 2 m wider than the largest Russian *Arktika*-class ice-

[69] Reported by Yakovlev et al (1999), but based on a 1997 document "Suggestions on the Insurance of Marine Risks on the NSR. Reference" prepared by the St. Petersburg branch of the Milinsure company.

[70] Ibid.

. St.Petersburg: Krylov Shipbuilding Research Institute.

[72] Ramsland, Trond R. and Svein Hedels (1996): “The NSR Transit Study (Part IV): The Economics of the NSR. A Feasibility Study of the Northern Sea Route as an Alternative to the International Shipping Market,” *INSROP Working Paper*, 59.

3.3 Cost comparison for NSR-Suez transit shipping

The INSROP Simulation Study[73] was the final and most ambitious of INSROP's attempts to compare NSR transit operations with the traditional Suez route. It consisted of the following main components:

- Detailed, technical drawings of new, hypothetical bulk/container cargo ships especially adapted for NSR transit operations were made. In additions a hypothetical equally-sized *conventional* vessel was used to compare NSR operations with ongoing, conventional Suez route operations.
- A pair of probable NSR summer transit routes was selected, and detailed, historic ice data 1957-1990 for these routes were collected, and used for speed simulations.
- All main input economic variables were collected/calculated (building costs, capital costs, icebreaker fees, Suez Canal fees, insurance fees, port dues, fuel expenses, operational expenses, etc.).
- Total costs for the various ships, routes and seasons were calculated and compared with the standard Suez route. Costs were calculated on both a monthly basis (Monthly Voyage Simulation) and on an annual basis (Annual Serial Voyage Simulation).
- All relevant legal and environmental data, as well as historic, operational data of the Russian *Norilsk (SA-15)* ice-class fleet, was collected and used to calibrate input data and results.

The three hypothetical NSR ships were a 25,000 dwt state-of-the-art bulk/container vessel with "high" ice-class, a 40,000 dwt bulk/container vessel built on similar principles, and a 50,000 dwt bulk vessel with "medium" ice-class. The 50,000 dwt vessel had less ice-breaking capabilities, but was designed for optimal cargo carrying capacity and optimal performance in open water. The hypothetical *conventional* vessel used for simulation of ongoing, conventional Suez route operations was a 50,900 dwt Handymax vessel. See table 3.7 for further description of the vessels.

3.3.1 Results

Not surprisingly, the *INSROP Simulation Study* identified capital cost as the major cost component. This favours larger ships, and favours ships with lower ice-class, due to their considerably lower construction cost. Therefore, of the three vessels investigated, the larger and faster 50,000 dwt cargo ship with less ice-class was clearly the most commercially rational vessel to use. The lower ice-class would mean more days of ice-breaker escort and higher ice-breaker fees, but as long as the present system of *flat* ice-breaking fees is in effect (only depending on ice-class and grt and *not* on the number of *days* of ice-breaker escort), the extra ice-breaker fees are more than outweighed by smaller capital costs and other, favourable factors.

However, it was also recognised that certain reductions in the present NSR tariff rates would be absolutely necessary, and the study proposed a tariff reduction of 26%, meaning that maximum NSR fees would be approximately USD 5/grt.

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[73] The project consisted of 8 Work Packages, producing 9 INSROP Working papers. The final simulations were carried out by Work Package 8, and final results and conclusions published in: K. Kamesaki, S. Kishi & Y. Yamauchi (1999): "Simulation of NSR Shipping based on Year-round and Seasonal Operation Scenarios", *INSROP Working Paper*, No. 164.

Table 3.7: Description of the various hypothetical vessels used in the INSROP Simulations Study[74].

	25,000 dwt ice-class vessel	**40,000 dwt ice-class vessel**	**50,000 dwt ice-class vessel**	**50,900 dwt *conventional* vessel**	**Notes**
Technical specifications					
Cargo type	Dry bulk / containers	Dry bulk / containers	Dry bulk	Dry bulk / containers	
Length.o.a.	199.9 m	206.5 m	252.0 m	n.a.	
Beam	25.1 m	27.5 m	30.0 m	n.a.	
Draft	9.0 m	12.5 m	12.5 m	n.a.	
Gross tonnage	21,000 grt	22,600 grt	31,000 grt	28,000 grt	
Displacement	35,700 tons	52,000 MT	70,960 MT	n.a.	
Cargo capacity	21,500 tons	36,000 t / 1671 TEU	47,000 tons	47,000 tons	
Number of propellers	2	2	1	1	
Shaft power	24,000 kW	28,000 kW	18,375 kW	11,000 kW	
Speed in open water	14.5 knots	14.5 knots	17.0 knots	15.0 knots	
Ice-class	High (ULA?)	High (ULA?)	Moderate (UL?)	None	
Ice-breaking capability	1.85 m at 1.0 m/sec	1.85 m at 1.0 m/sec	1.2 m at 1.5 m/sec	None	
Crew	24 persons	24 persons	25 persons	25 persons	
Design developed by:	Kværner Masa-Yards (Finland)[75]	Kværner Masa-Yards (Finland)[76]	Ship & Ocean Foundation (Japan)	NKK Corporation (Japan)	
Economic specifications					
Construction costs	USD 57 mln	USD 66 mln	USD 30 mln	USD 22 mln	
Capital costs	USD 6.45 mln p.a.	USD 7.46 mln p.a.	USD 3.39 mln p.a.	USD 2.49 mln p.a.	1
Extrapolated/assumed NSR fee, July-October	USD 7.36/5.45 per grt	USD 7.11/5.26 per grt	USD 6.83/5.05 per grt	n.a.	2
Extrapolated/assumed NSR fee, November-June	USD 7.14/5.28 per grt	USD 6.89/5.10 per grt	USD 6.56/4.86 per grt	n.a.	2
Ice pilot fees	USD 672 pr. NSR day	USD 672 pr. NSR day	USD 672 pr. NSR day	n.a.	
Suez Canal transit fee	USD 122,000 per time	USD 127,000 per time	USD 139,000 per time	USD 139,000 time	
Crewing cost	USD 1,537,000 p.a.	USD 1,537,000 p.a.	USD 1,599,000 p.a.	USD 1,599,000 p.a.	
NSR Insurance	USD 10/grt p.a. USD 210,000 p.a.	USD 10/grt p.a. USD 226,000 p.a.	USD 10/grt p.a. USD 310,000 p.a.	n.a.	3
Suez Insurance	USD 5.7/grt p.a. USD 119,700 p.a.	USD 5.5/grt p.a. USD 124,300 p.a.	USD 4.8/grt p.a. USD 148,800 p.a.	USD 134,000 p.a.	4
Maintenance costs	USD 473,000 p.a.	USD 493,000 p.a.	USD 560,000 p.a.	USD 560,000 p.a.	5
Fuel	USD 91/ton	USD 91/ton	USD 91/ton	USD 1,032,000 p.a.	6
Hamburg port dues (6 d)	USD 78,200 per stop	USD 84,200 per stop	USD 113,100 per stop	USD 526,884 p.a.	7
Yokohama port dues (6 d)	USD 44,500 per stop	USD 47,400 per stop	USD 59,700 per stop	USD 278,116 p.a.	7

Notes:
1. Repayment over 15 years at a 7% interest rate per year.
2. *Extrapolated NSR fees* are extrapolated from existing NSR fees as reported in table 3.4. Ice-breaker fee for the 50,000 dwt vessel increased by 10% due to lower ice performance. *Assumed NSR fees* are calculated by reducing the extrapolated fees by 26%.
3. Includes P&I insurance of approx. USD 8/grt as indicated in table 3.5. H&M insurance is difficult to decide exactly, due to the lack of relevant damage statistics, but according to Kamesaki et al., it is likely to be somewhere in the range of USD 1.0-2.9/grt, and therefore 2.0 is chosen as an average figure.
4. Suez insurance rates are well-known, and based on actual market rates.
5. Maintenance costs include repairs, replenishment of parts and stocks, lubrication oils and other miscellaneous expenses. Based on average actual costs observed in similar, 5-year old existing vessels.
6. Fuel prices based on a 5-year average 1994-98. Fuel consumption will vary greatly with ice conditions, but a rule of thumb is that when operating in ice, a vessel will use 2-3 times as much fuel as in open water.
7. Assuming dry bulk cargo.

Maximum profits were reached by switching between the NSR and the Suez route according to prevailing ice-conditions (which would require accurate, long-term ice forecast). Under the condition of an NSR fee reduced by 26%, and by using detailed 1980-89 monthly ice data for simulating speeds and for choosing between the NSR and Suez routes, maximum profits for the modelled 50,000 dwt bulk carrier would have be reached by using the NSR in average 9.0 times per year, and the Suez route on average 1.2 times per year. The results are shown in table 3.8.

74 Summarised from Kamesaki et al. (1999)

75 A.-C. Forsén, J. Kivelä & E. Ranki (1998): "Design of the NSR Service Ships", *INSROP Working Paper*, No 120.

76 Ibid.

Table 3.8: Average annual freight expenses for a 50,000 dwt moderate ice-class dry bulk cargo vessel, compared to a corresponding conventional 50,900 dwt vessel plying the Suez route. Average annual figures based on 1980-1989 ice conditions[77].

		50,000 dwt ice-class vessel	**50,900 dwt ordinary vessel**
	Cargo tonnage:	47,000 tons	47,000 tons
NSR	NSR voyages:	9.0 pr year	0
	Total NSR voyage days:	322 days (*)	0
	Total cargo transported via the NSR:	423,090 tons	0
	Total NSR costs:	USD 8,857,100	0
	NSR freight cost:	USD 20.93 per ton	0
Suez	Suez voyages:	1.2 pr year	9.3 pr year
	Total Suez voyage days:	43 days (*)	365 days (*)
	Total cargo transported via the Suez route:	56,400 tons	437,752 tons
	Total Suez route costs:	USD 1,267,200	USD 7.913,000
	Suez route freight cost:	USD 22.47 per ton	USD 18.1 per ton
Total (NSR + Suez)	Total annual transported cargo:	479,490 tons	437,752 tons
	Total annual costs:	USD 10,124,300	USD 7.913,000
	Annual average freight cost:	**USD 21.11 per ton.**	**USD 18.1 per ton**

* Including port days (3 days for loading, 3 days for unloading)

In spite of the reduced NSR tariff, the results are not very encouraging. Running costs on a per trip basis are lower with the NSR ship, but when capital costs are counted, the per ton costs are higher for the NSR vessel (USD 21.1 vs. USD 18.1 per ton of cargo). Even though the NSR ship carries larger volumes per year (479,490 vs. 437,752 tons), and thus will earn a higher annual income, the freight rate will have to be as high as USD 52.75 per ton for the NSR ship to be the most profitable of the two. However, the average Handymax freight rates between NW Europe and the Far East are only USD 19.60 according to 1997-98 figures collected by Ramsland[78], even though individual, very NSR-relevant shipments were observed to obtain higher freight rates (for instance 30000 tons of fertilisers from Murmansk and S. China at USD 34.00 per ton and 50,000 tons of potash from Ventspils to China at USD 25.00 per ton[79]).

Figure 3.2 shows that it is only in the month of September – when NSR transit conditions are the most favourable – that a freight cost per ton equal to the conventional Suez vessel's 18.1 USD/ton can be achieved. At the same time, figure 3.2 also shows that for 8 months (June-December), the NSR will be faster than the 39.2 days (including port/canal days) that the conventional vessel uses on the Suez route. Cost calculations showed that in some instances the NSR would still be chosen over the Suez route, *even* when the Suez route would be one or a few days faster. This was caused by the considerably lower fuel expenses for the much shorter NSR route.

The overall results of the INSROP Simulation Study, to a large degree confirmed the results of an earlier, separate INSROP study. That study, using a slightly different methodology, concluded that the increase in operational income and free cash flow would not produce an acceptable return on the increased capital costs necessary to finance the building of a suitable ice-class cargo vessel[80].

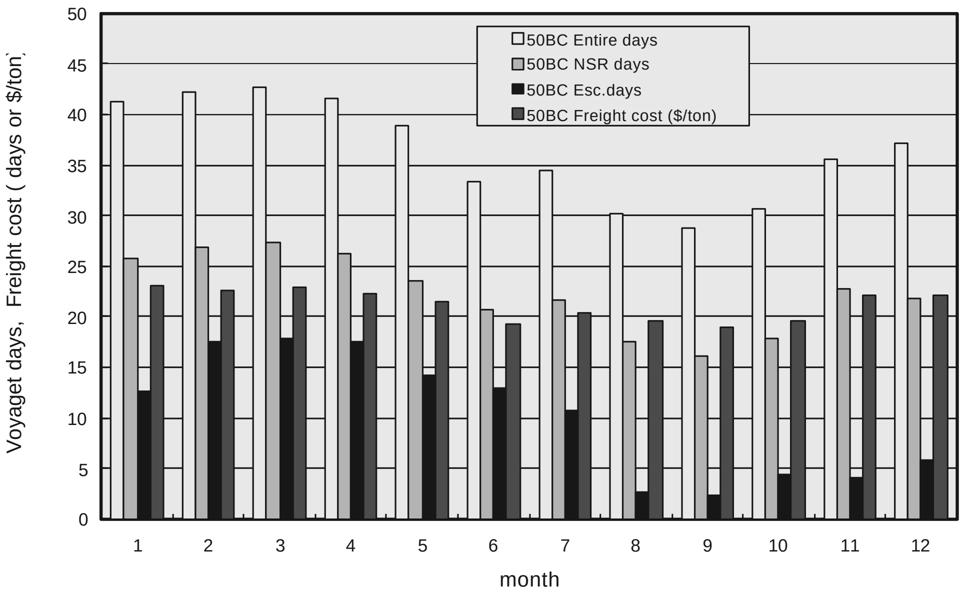
[77] Summarised from Kamesaki et al (1999).

[78] T.R. Ramsland (1999): "Economic Evaluation of NSR Commercial Shipping", *INSROP Working Paper*, No.140.

[79] Ibid.

[80] Ramsland and Hedels (1996).

Figure 3.2: Number of voyage days for a 50,000 dwt moderate ice-class dry bulk cargo vessel, including number of days within the NSR area and number of ice-breaker escort days; freight costs[81].



However, when considering the results of the INSROP Simulation Study, the model has some weaknesses that should be noted:

- *Ship size:* A beam of 30 m (2 m wider than the largest, Russian ice-breakers), may cause several disadvantages not included in the model, such as more easily getting stuck in the ice even during ice-breaker escort, which may lead to both lower transit speeds and higher ice-breaker fees. On the other hand, if the ship is made slightly narrower, cargo-capacity and profitability will be correspondingly reduced. Another problem is that the model did not take into consideration that even larger vessels than 50,900 dwt could be used as an alternative for transport along the Suez route.
- *NSR transit speeds:* The model only uses strictly defined NSR routes – in reality route choices will vary according to actual ice conditions, and if a more favourable alternative is found (e.g. a large lead in the ice), the vessel will change course and choose the fastest alternative. Actual NSR transit speeds obtained by cargo vessels of the Murmansk Shipping Company 1992-93, are 9.1 knots in the period July-February[82], while the model calculated average speeds between 8 and 9 knots for the same period. On the other hand a 30-meter beam may lead to lower speeds than calculated under ice-breaker escort. Furthermore, no “standby- time” has been included (waiting for the ice-breaker to arrive when you’ve become stuck in ice, waiting for a convoy to depart etc.), which is a very optimistic assumption.
- *NSR tariffs:* 5 USD/grt has been used, but signals from Russian authorities may well indicate even lower tariffs. On the other hand, if the modelled vessel fails to meet ULA ice-class, ice-premiums may be higher. Also, in new, future NSR tariff systems, the fees may vary according to the number of escort *days*, which will have additional negative effects for a ship with lower ice-class.
- *Insurance costs:* Calculations are based on the existing, very scarce information about NSR insurance premiums. The indicated premiums are in turn based on very scarce

[81] Kamesaki et al (1999).

[82] Ibid.

statistical material. If and when more detailed information on ice conditions, accident statistics etc. becomes available, it is likely that insurance premiums will become lower.

- *Crew:* NSR navigation requires special skills. The smaller *Norilsk* vlass vessels have a 39-person crew. In comparison, the crew estimate of 25 persons for the hypothetical ice-going 50,000 dwt vessel may seem small.

These model weaknesses point in both directions, and if taken into consideration, it is not obvious whether they will improve or worsen NSR's freight costs compared to Suez freight costs.

3.3.2 Possible remedies

Assuming that the model weaknesses mentioned above – if corrected – will still leave the NSR with a USD 3 disadvantage per ton of cargo compared to standard Suez operations, what are the actions that can be taken to improve the NSR's position vs. Suez? From the Russian perspective, the most significant action that can be taken is to further lower transit fees. Russia has signalled that NSR fees *may* become even lower than 5 USD/grt, and a state investment program in the Arctic transport system is announced[83], but it is doubtful whether Russia has the economic strength or the political will to carry-out the necessary investments and to subsidise the NSR tariffs sufficiently much and sufficiently long for the cargo-volumes to increase to a level where the NSR infrastructure could conceiveably become self-financed. Furthermore, Russia should do every effort to keep-up a smooth-running NSR infrastructure, including high technical standards, adoption of practices more in line with international practices, and a stable legal and administrative framework.

Other possible remedies, such as considerable changes in the price of new-buildings, of international interest rates, and of international freight rates, are not within Russia's power to change.

Icebreaking technology has gradually developed during the last Century, and new, very interesting concepts have been introduced recently. However, without further considerable progress – both in technical capacities and in price – this will hardly be sufficient to render transit operations profitable under present conditions.

The most "promising" development in favour of NSR transit operations, may actually be the continuation of the observed trend of a diminishing Polar ice cap, probably caused by global warming. There is overwhelming scientific evidence that the Arctic ice cover has diminished over the last decades[84].

Another theoretical "rescue" for the NSR, is if chronic political problems should arise in the Middle East or elsewhere along the Suez route, jeopardizing safe and efficient operations along the Suez route, and thus improving the NSR's comparative position.

[83] For instance by the Russian Minister of Transport during the Northern Sea Route User Conference, November 1999: Frank, Sergey O. (2000): "International Shipping on the Northern Sea Route – Russia's Perspective," in C.L. Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers, 2000.

[84] See for instance O.M. Johannessen, M.W. Miles, H. Drange, G. Evensen, K. A. Lisæter and S. Sandven (2000): "Arctic Sea Ice Reduction – Implications for the Northern Sea Route" in C.L. Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers, 2000.

3.4 Conclusions

While realizing that the models used have significant weaknesses, it is still possible to draw some general conclusions based on the material presented above, referring to the standard stretch Hamburg-Yokohama:

- When building and capital costs are excluded, using the NSR can be profitable compared to Suez under current market conditions both on a trip-to-trip basis as well as on an annual basis. The condition is that a smooth-running NSR infrastructure is in place, including high-quality short and long-term ice forecasts (to facilitate optimal route choices – both between Suez and the NSR, and within the NSR), and a guaranteed availability of ice-breakers when needed, to avoid delays.
- When building and capital costs *are* included, the margins for profitable NSR transit operations disappear, and under the present market conditions, NSR transit operations will not be profitable.
- If NSR transit operations are ever to become profitable, it is clear that NSR-specific expenses must be lowered. INSROP researchers proposed to reduce NSR fees by 26% to 5 USD/grt, but this alone is not sufficient. Reduction of insurance ice-premiums would also be important. However, *if Suez Canal Fees are lowered to meet the NSR competition, the prospects of profitable NSR operations will be very small, no matter how much NSR fees are reduced.*
- Present Russian ice-class vessels are too small to compete on the ordinary NW Europe-Far East market – the *Norilsk (SA-15)* class bulkers are only 19,900 dwt while most of the NE-Europe-Far East bulk trade takes place with 25-75,000 dwt vessels. It can thus only compete for occasional small-size cargoes or between ports where the distance savings are even greater than between Hamburg-Yokohama.
- In order to realise maximum NSR potential, new, larger purpose-built “NSR-max” vessels should be used. NSR-max would imply a Handymax sized vessel with a 12.5 m draft, 28-30 m beam and close to 50,000 dwt. While ice-class is important, it seems preferable to keep the ice-class moderate in order to keep capital costs down and in order to improve open-water performance and cargo capacity. If, in the future, Russia should build larger ice-breaker or improved ice-conditions would allow regular passage of vessels north of the New Siberian islands (to avoid the shallow Sannikov Strait), indices of NSR transit operations would be considerably improved.

The overall conclusion therefore seems to be that for a commercial investor, it is very difficult under present market conditions to justify the building of dedicated NSR transit vessels. This not only applies for the Hamburg-Yokohama stretch – INSROP was not able to identify any other realistic scenarios for ordinary commercial cargoes where it would be more profitable to invest in NSR vessels than in ordinary vessels to be used through Suez. And this is a conclusion that is reached even without having included into the calculations two very significant factors: the cost of political risk of dealing with Russia, and the likelihood of the Suez Canal Authority to offer rebates to counter the competition. The conclusion will be difficult to alter without very radical changes of the basic market conditions, such as for instance: a further considerable reduction of the Arctic ice cap; a very substantial reduction of NSR fees; the appearance of so-far unidentified, geographically very suited cargo flows (for instance between Alaska and Northern Scandinavia), or; chronic, serious problems along the Suez route due to political unrest. With no such dramatic developments immediately in view, NSR transit traffic can only be expected in ad-hoc cases using existing Russian vessels, or for very particular cargoes for which normal transport economy considerations do not apply. Nuclear waste/fuel in transit between Japan and Europe is so far the only identified potential cargo in this category, even though this is also still highly speculative.

4 The NSR's Significance for the Economic Development of the Russian Arctic

Inside Russia, the main focus with regard to the NSR is its economic significance for the Arctic regions from Murmansk in the west to Chukotka in the east. The NSR has been an important corridor for carrying-in supplies to the Russian Arctic regions, and for carrying-out parts of their vast natural resources, thus contributing to the economic growth both of the Arctic regions and of Russia as a whole.

The NSR's role differs for the various Arctic regions, and in this chapter, we will look at the NSR from a regional viewpoint, i.e. we will discuss the NSR's importance for the economy of each of the Federal subjects along the route. From the east, they are: Chukotka Autonomous *Okrug*, the Republic of Sakha (Yakutia), Krasnoyarsk *Kray* (incorporating Taymyr Autonomous *Okrug*), Yamalo-Nenets Autonomous *Okrug* and Nenets Autonomous *Okrug*. We will also briefly discuss the NSR's importance for Arkhangelsk *Oblast* and Murmansk *Oblast*, since the port cities of Murmansk and Arkhangelsk are the main bases for marine activities along the NSR.

4.1 Chukotka Autonomous *Okrug*

4.1.1 Geography and infrastructure

Chukotka A.O. is situated in the very far north-eastern corner of the Russian Federation. The *Okrug* is divided into two main parts: The northern part facing the Arctic Ocean, and the eastern part facing the Bering Sea. The whole of Chukotka A.O. is extremely dependent on seaborne supplies. No roads connecting the *Okrug* to southern parts of Russia exist, and along the northern coast there are no navigable rivers.

The economy of the whole Chukotka A.O. is in a state of deep crisis, with serious shortage of supplies – especially to remote towns and villages – and the population has been dwindling rapidly since 1990. From 1990, the total population dropped by 49% to 85,000 inhabitants 1 January 2000[85]. The *Okrug* is heavily dependent on federal subsidies.

Most economic activities take part in the eastern part, in the capital Anadyr and around the ports of Beringovsky, Egvekinot and Provideniya – the first one being an important coal exporting port, and the latter being considered the eastern gateway to the NSR.

It is however the more sparsely populated *northern* part of Chukotka which is of interest to the NSR. Here, economic activity is focused around the two seaports of Mys Shmidta and Pevek, and the inland gold mining town of Bilibino. The Marine Operations Headquarters for the eastern part of the NSR is located in Pevek.

The main indices of economic development in Chukotka A.O. are presented in table 4.1.

[85] Goskomstat Rossii, *Estimation of number of de-facto and de-jure population on the subjects of Russian Federation on January 1, 2000*. At www.gks.ru.

Table 4.1: Indices of the economic development of the Chukotka A.O., 1985-1996[86]

Indices	Unit	1985	1990	1995	1996
Population	thousand persons %	155 100.6	154 100	91 59.1	85 55.2
Incl. Urban	thousand persons %	112 100.9	111 100	64 57.7	60 54.1
Rural	thousand persons %	43 100	43 100	27 62.8	25 58.8
Industry *	billion roubles %	0.7 77.8	0.9 100.0	0.2 22.2	0.1 11.1
Investments *	billion roubles %	0.45 80.4	0.56 100	0.02 3.6	0.02 3.6
Electric power	billion kWh %	no data	1.0 100.0	0.45 45.0	0.43 43.0
Bituminous coal	million tons %	1.03 79.3	1.3 100.0	0.88 67.7	0.56 43.1
Natural gas	million m^3 %	-	-	-	-
Oil	Thousand tons	-	-	-	-

* In 1990 prices

4.1.2 Probable future cargoes

There are presently no areas of substantial cargo generation in the northern part of Chukotka. In both Pevek and Mys Shmidta, incoming cargoes dominate, with some goods being transshipped at Pevek and taken further along to other points along the NSR coast. In 1996, these two ports had a total turnover of 234,500 (of which at least 98% incoming), in 1997 this was 252,700 tons (at least 97% incoming) and in 1998 84,113 tons (97% incoming)[87].

The incoming cargoes consist of fuel supplies from western Russia, food from both western Russia, from the Primorskiy area and from the USA, and probably some minor industrial supplies. In addition, small volumes are moved by NSR to Zelëny Mys (in Sakha) and then by road to the Bilibino area.

With no *new* realistic cargo-generating projects identified in Chukotka A.O.[88], the only cargo flows for the NSR seem to be *incoming* cargoes.

4.1.3 Less probable cargo sources

Gold is the most important mineral mined in northern Chukotka. The centre is at Bilibino, but mining also takes place at Iultin and Polyarnyy. However, these mines only produce very small cargo volumes – or none at all – for the NSR. Other minerals and metals are mined in the *Okrug*: Tungsten (at Iultin), tin (in Pevek area), silver, wolfram and mercury. But their cargo-forming potential for the NSR is minuscule.

86 Statistics from: *Russian Regions*, vol. 1, 2, Goskomstat, M., 1997; *Russian Statistical Yearbook*, Goskomstat, M., 1997. Referred by A. Granberg, G. Kobylkovsky & V. Plaksin (1999): "Cargo-forming Potential of Sakha (Yakutia), Chukot Autonomous District and other Far-Eastern Regions for the Northern Sea Route". *INSROP Working Paper*, No. 135.

87 See Granberg et al (1999), pp.11-12 (reproduced in annex A1); *ibid.*, p.13; and annex A2.

88 Castberg, Rune, Arild Moe, and Anne Berteig (1998): "Economic Development in Northern Siberia and the Russian Far *INSROP Working Paper*, 117.

4.1.4 What difference can the NSR make for Chukotka A.O.?

No other part of the NSR area is as dependent on the NSR as the northern coast of Chukotka A.O. In Chukotka, the NSR is a vital supply line, necessary to sustain present economic activities and local settlements. Apart from air transport, no alternatives exist. The small mining communities around Bilibino and Pevek are dependant on the NSR for their food, fuel and industrial supplies, and many of the local settlements (of which a large portion is inhabited by the indigenous Chukchi people), would disappear without NSR supplies. Due to insufficient supplies in the 1990s, many settlements have already been depopulated. With fuels now having to be transported all the way from western Russia during the short summer season, supplies have become even more unreliable. In 1998, for instance, winter fuel didn't arrive to Pevek until 28 November[89].

As the northern coast of Chukotka A.O. has few commercially extractable natural resources apart from those already extracted, well-functioning NSR operations are *not* important for a further economic *development* of the region. NSR exports from this area are minuscule, and will continue to be so. The role of a well-functioning NSR will be to bring in essential supplies to the area, in order to *stabilise* the local economy and *prevent further decline* of population and activities. This can not be done without heavy government subsidies.

4.2 Republic of Sakha (Yakutia)

4.2.1 Geography and infrastructure

The Republic of Sakha has an almost 2000 kilometre coastline towards the Arctic Ocean, but it is the Lena River which is the main transport corridor of the Republic. Sakha's largest seaport Tiksi is located at the mouth of the Lena, and connects Lena with the NSR and thereby with other smaller, navigable rivers in the Republic: The Kolyma, Indigirka, Yana, Olenëk and Anabar rivers. Approximately 1500 km upstream the Lena lies the capital of Yakutsk, which is connected with the rest of Russia through an all-year road. Further 1500 km upstream, Lena connects with the Baykal-Amur Mainline railway (BAM) at Osetrovo in Irkutsk *Oblast*.

Osetrovo is the main port of transhipment between railway and river barges of goods to and from the Sakha Republic. The main cargo flow moves along the Lena river on barges, with on-/off-loading at Yakutsk and many other points along the river. In the 1980s and early 1990s, relatively large cargo volumes were moved further on to Tiksi where they were transhipped to sea vessels and taken via the NSR to the mouths of the Kolyma, Indigirka, Yana, Olenëk and Anabar rivers (see annex A1, "Intra-Arctic Coasting"). However, transhipment at Tiksi has been reduced sharply – it has become much more common that river vessels take the cargoes all the way from Lena along the NSR and up the other rivers to the final destinations (see table 4.3).

No railroad or all-year roads exist in the northern part of Sakha. This area is thus very dependent on rivers, the NSR and winter roads for cargo transport.

Cargo flows in the Republic may be somewhat changed *if* the planned Amur-Yakut Railway (AYAM) is completed. This almost 1000 km. railway would connect Yakutsk with BAM, and considerably improve the Republic's import/export capacity. One consequence would be a

89 Brigham, Lawson W. (2000): "The Northern Sea Route, 1998," *Polar Record*, 36, 196:19-24.

much improved connection with the ports and industrial/agricultural areas of the Khabarovsk and Primorskiy *Krays*. Many of the deliveries so far carried out to the eastern NSR area have originated in this area, but with AYAM in place, more supplies – also for northern Sakha – are likely to be shifted towards transport by railway + river (+sea from Tiksi). Construction of the AYAM has reached Berkatit[90], and 7-800 km remain to Yakutsk. Due to lack of funds, the construction is however progressing very slowly, and even optimistic estimates do not foresee a completion of this railway *before* 2005[91].

Sakha is by far the largest subject of the Russian Federation, and on its territory there are enormous deposits of various valuable minerals, in addition to very large timber resources in the southern part. The population contracted by 11% in the 1990s to 988,600 inhabitants in 2000[92]. Of these, only 39,800 live in administrative regions bordering on the Arctic Ocean[93].

However, as population in the coastal areas is sparse, since this part of the NSR has the most severe ice-conditions, and because distances to the main loading ports (Vladivostok, Nakhodka, Vanino, Osetrovo) are very large, the use of the NSR for import, export and internal transport remains relatively limited. There are only two seaports in the republic: Tiksi and Zelëny Mys (even though loading/unloading to shore or river barges takes place at several other points along the coast).

The main indices of economic development in Sakha are presented in table 4.2.

Table 4.2: Indices of the economic development of the Republic of Sakha (Yakutia), 1985-1996[94]

Indices	Unit	1985	1990	1995	1996
Population	thousand persons %	1013 91.3	1109 100	1023 92.2	1016 91.6
Incl. Urban	thousand persons %	669 90.7	738 100	658 89.8	654 88.7
Rural	thousand persons %	344 92.7	371 100	365 99.0	362 97.6
Industry *	billion roubles %	3.0 75.0	4.0 100.0	3.2 80.0	1.5 37.5
Investments *	billion roubles %	3.0 71.4	4.2 100	0.5 11.9	0.5 11.9
Electric power	billion kWh %	no data	8.7 100.0	6.9 79.3	7.4 85.1
Bituminous coal	million tons %	14.1 81.5	17.3 100.0	11.9 68.8	10.8 62.4
Natural gas	million m^3 %	1.0 66.6	1.5 100.0	1.65 110.0	1.6 106.7
Oil	Thousand tons	-	no data	166	198

* In 1990 prices

90 V. Pavlenko & A. Yakovlev (1999): "Impact of the Northern Sea Route and the Lensky Riverine Steamship Line Functioning on the Socio-Economic Situation and Development of Sakha Republic (Yakutia)". *INSROP Working Paper*, No. 149.

91 Castberg et al. (1998).

92 Goskomstat Rossii (2000).

93 Granberg et al. (1999).

94 Statistics from: *Russian Regions*, vol. 1, 2, Goskomstat, M., 1997; *Russian Statistical Yearbook*, Goskomstat, M., 1997. Referred by Granberg et al (1999).

4.2.2 Probable future NSR cargoes

Incoming cargoes are still likely to be dominant for Sakha in some years to come. The latest comparable figures available show that in 1997, sea vessel delivered 132,100 tons of goods to Sakha's Arctic ports and rivers, while river vessels delivered additional 415,600 tons – see table 4.3. In 1998, sea vessels delivered only 89,055 tons[95] – the volume of cargoes delivered by river vessels is not known.

Table 4.3: Volumes of goods delivered by sea and river transport to the Arctic zone of the Sakha Republic (Yakutia) in 1997, thousand tons[96].

Destinations	Volumes of goods delivered by marine transport (NSR)	Volumes of goods delivered by river transport
Port of Tiksi	117.6	63.0
Yana river	-	225.6
Indigirka river	-	48.9
Kolyma river	14.5	27.6
Olenëk river	-	3.4
Anabar river	-	16.1
Other regions	-	31.0
In total	**132.1**	**415.6**

The most realistic sources of *outgoing* NSR cargo in Sakha is still timber and coal, even though their future potential is very uncertain.

Timber export via Tiksi has all but seized mainly due to high transport costs, which in turn is due to high NSR tariffs. Timber export has been almost completely shifted towards railway. At its peak in 1989, export via the NSR was 195,400 tons. A scenario with higher timber prices and considerably lower NSR tariffs may eventually revive the export. Under such conditions, an "optimistic scenario" forecast by Granberg et al.[97], estimates maximum potential of timber export via Tiksi at 60,000 tons in 2005 and 130,000 tons in 2015.

Concerning coal, the Sakha Republic's geological reserves are estimated at 400 billion tons of bituminous and brown coal[98]. The largest reserves are in the central part of the Republic, around and to the west of Yakutsk. The development of these reserves is however closely linked with river transport and the future extension of the AYAM railway to Yakutsk. The only coal mine significant for the NSR is located in Zyryanka on the Kolyma river, which has probable reserves of 30 billion tons[99]. In the 1980s and beginning of the 1990s, volumes as large as 186,500 tons (1985) were transported down the Kolyma river for distribution via Zelëny Mys and the NSR to settlements along the coast and rivers between Tiksi and Pevek (see detailed statistics in annex A1). This role was later largely taken over by coal transport from Beringovskiy in eastern Chukotka. When that traffic decreased in 1997 and seized in 1998, the distribution of Zyryanka coal again increased, and volumes between 30-50,000 tons were moved along the eastern NSR in 1997 and 1998. 1989-92 minor export from Zyryanka

95 Annex A2.

96 V. Pavlenko & A. Yakovlev (1999): "Impact of the Northern Sea Route and the Lensky Riverine Steamship Line Functioning on the Socio-Economic Situation and Development of Sakha Republic (Yakutia)". *INSROP Working Paper*, No. 149. Marine transport statistics originally from Soyuzmorniiproekt (1998), and river transport statistics from River Transport Service (1998).

97 Granberg et al. (1999).

98 Ibid.

99 *Gornaya Entsiklopediya*, Moscow: Sovyetskaya Entsiklopediya, 1986. Reported by Castberg et al. (1998).

to abroad took place for a few years (reaching 35,500 tons in 1989), but due to the prevailing crisis in the Russian coal industry as well as the situation in the world coal market, large scale development of this source in the foreseeable future does not look realistic[100]. If Zyryanka continues to provide cargoes for the NSR, it will be for the local market. An “optimistic scenario” forecast by Granberg et al.[101], estimates maximum potential of coal export via Zelëny Mys and the NSR at 50,000 tons in 2005 and 70,000 tons in 2015.

4.2.3 Less probable cargo sources

The Sakha Republic has very large and diverse reserves of natural resources, even though the large majority of these resources are deemed to be commercially non-recoverable as their extraction and transport will be too expensive due mainly to the harsh climate and the regions’ remoteness. Alexander Granberg has summed-up the main features of the Republic’s natural resources, and states:

> It is rich in mineral resources: diamonds, non-ferrous and valuable metals, rare-earth metals, zeolite, and others, all of them with the potential to bring in substantial foreign currency earnings and lead the way to the development of the entire region.
>
> In diamonds, for instance, the Northeast accounts for 82% of Russian reserves, with the diamond-bearing areas stretching in western Sakha (Yakutia) from the mid-reaches of the Lena River to the shores of the Arctic Ocean. Reserves of precious metals in the Northeast make up 30-35% of the Russian total. A large gold-bearing belt (1000 km long by 200 km wide) has been found in the Yano-Kolymskiy Arctic zone, while the Chukotka belt (…) is the second largest gold-bearing area in all Russia. There are significant reserves of tungsten and tin, as well as silver, mercury, antimony and other composites. The Tomtorskoye deposit is rich in rare metals such as yttrium, scandium, niobium, samarium, europium and several others[102].

Most of these resources are not exploited. On the contrary, the trend is towards lower activity:

> The economy of the region is experiencing hard times at present. Most its mining and processing enterprises (including the tin enterprise Deputatskiy), as well as coal mines have become unprofitable. Some of them are closed, others have reduced their output significantly. The traditional sectors of the indigenous peoples (especially reindeer breeding) are also in a depressed state.
>
> With a few exceptions, there are no opportunities for extending the mining and processing of raw materials in the Arctic area of Sakha (Yakutia) at present. More probable are the development of Zyryanovskiy coal basin (with transportation of coal to Chukotka A.O. and Magadan *Oblast*) and preparation for commercial mining of local diamonds[103].

This largely conforms with conclusions reached by other INSROP researchers[104], who have not been able to identify any potential, profitable mining projects in Sakha that may create new large-scale cargo flows for the NSR. The most realistic future cargo-generating projects in the Republic (such as the development of the South Yakutian coal basin, or the Chara-Tokko and Aldan iron deposits, all in Southeast Sakha), are located much closer to the BAM than to the NSR, and will therefore certainly be exported by rail.

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[100] Castberg et al. (1998)

[101] Granberg et al. (1999)

[102] Ibid.

[103] M. Tamvakis, A. Granberg & E. Gold (1999) “Economy and Commercial viability” in W. Østreng (ed.): “The Natural and Societal Challenges of the Northern Sea Route. A Reference Work”. Dordrecht/Boston/London: Kluwer Academic Publishers

[104] For instance: N. Isakov, A. Yakovlev, A. Nikulin, G. Serebryansky & T. Patrakova (1999): “Potential Cargo Flow Analysis and Economic Evaluation for the Simulation Study”. *INSROP Working Paper*, No 139; and Castberg et al (1998).

There are also important mines of gold and diamonds, making up a large part of the Republic's income, but they do not provide bulk volumes for the NSR, with air being a more rational mean of export. The tin mines that opened in Deputatskiy (close to the Yana river) in 1986, exported its products via the NSR to Tiksi and on to the Lena, but production has proven unprofitable, and has been halted.

Sakha is also rich in oil and gas reserves, both in the south of the Republic, in the central Vilyuysk region (which presently provides the capital Yakutsk with gas) and in the lowlands that stretches along the entire Sakha coastline. However, if developed, the southern and central fields are likely to be exported by pipeline, and what concerns the potential northern reserves (which are estimated to be at least 3.2 billion tons of recoverable hydrocarbons in the East Siberian Sea and 3.3 billion tons in the Laptev Sea[105]), geographic and climatic factors almost make commercially development unthinkable, probably for all future.

4.2.4 What difference can the NSR make for the Republic of Sakha?

Southern and central areas of Sakha are relatively well supplied by rail, road and river transport on the Lena and its tributaries, and it is only the northern coast and communities along the Kolyma, Indigirka, Yana, Olenëk and Anabar rivers which are dependant on supplies via the NSR. The reduction in supplies brought in on the NSR has meant hardship for many local communities, including communities of the Yakut, Evenk, Even, Chukchi and Yukagir indigenous peoples. Compared to northern Chukotka, the situation is nevertheless better. One reason is the Lena river fleet, which under light ice conditions is able to proceed from the Lena mouth via the Laptev and East Siberian seas to unload supplies to the settlements along the coast and along the navigable rivers. The other reason is the *relatively* good economy of the Republic (due to its gold, diamond and other mineral resources), allowing the Sakha government to organise its own supply operations to compensate for the lack of deliveries organised by the central Russian government. It can therefore be concluded that while a well-functioning NSR is important for supplying the northern areas of Sakha, it is less crucial than for instance in Chukotka A.O. Even so, import to the region has seriously diminished in the 1990s, and caused depopulation and decreased economic activities. This situation would no-doubt be alleviated if NSR operations were to function better.

Even though most of Sakha's export is well serviced by air, pipeline and river/rail transport, well-functioning, reliable and cheaper Northern Sea Route operations could mean improved conditions for some of the economic sectors in the region. As has been showed above, timber export might be revived, and coal distribution from Zelëny Mys to settlements along the Sakha and Chukotka coast may have a chance to increase moderately.

4.3 Krasnoyarsk *Kray* (including Taymyr Autonomous *Okrug*)

4.3.1 Geography and infrastructure

Krasnoyarsk *Kray* is centred on the Yenisey river. The lower part of the river is relatively deep, and allows access to Dudinka for seagoing vessels up to 15-20,000 dwt, while vessels up to 14,200 are able to proceed to Igarka. From Igarka only ships under 5000 dwt are able to proceed, and most of the river transport therefore takes place by river barges up to

[105] A. Granberg (1995): "The significance of the NSR for Regional Development in Arctic areas of Russia". *INSROP Working Paper*, No. 19.

Lesosibirsk, which is the end point of a sideline of the Trans-Siberian Railway (TSR). Goods are either transhipped to rail here, or further up at the city of Krasnoyarsk.

The southern part of the *Kray* is relatively well connected to the rest of Russia by railway and roads, but in the northern part, transport by river and the NSR is dominant.

Krasnoyarsk *Kray* also incorporates Taymyr Autonomous *Okrug* with its 43,700 inhabitants[106], which includes the vast Taymyr Peninsula with the small seaport of Khatanga in the east and the seaports of Dikson and Dudinka in the west. Dudinka is connected with an approximately 50 km railway to the large mining city of Norilsk (155,000 inhabitants in 1996). Norilsk is administratively *not* a part of Taymyr A.O. (even through it is surrounded by it), but is directly subordinated to the *Kray* administration. Norilsk, with its nickel and copper mines, is the largest cargo generator for the NSR, with year-round transport from Dudinka to Murmansk and Western Europe.

It is only the northern part of the *Kray* – Taymyr A.O., Norilsk plus the areas along the Yenisey river up past Igarka to Turukhansk – which is directly relevant for the NSR. Of the *Kray*'s 3.05 million inhabitants[107], approximately 330,000 live in this area[108]. The south of the *Kray* can be reached via the Yenisey, but for this area, railway will normally be a more practical and economic mean of transport for getting supplies in and products out.

A large portion of the supplies to Norilsk comes in by river. Exact river cargo volumes statistics have not been collected by INSROP, but river transport volumes in the *Kray* are many times greater than sea transport volumes to/from Krasnoyarsk *Kray*.

4.3.2 Probable future cargoes

The northern part of Krasnoyarsk *Kray* is very rich in non-ferrous metals. The largest deposits are located – and under production – in Norilsk. Reserves are still very large and easily-available, and production is likely to remain stable. From Norilsk, nickel, copper, cobalt, and platinum – both ores and refined products – are shipped out via Dudinka, most by the NSR to the Kola Peninsula and Western Europe, and some southwards by the Yenisey The turnover of Dudinka's sea-port in 1998 was 1.14 mln tons[109]. Statistics Recent statistics for Dudinka's river-port are not available, but traditionally, river volumes have been larger than NSR volumes when also inbound volumes are counted[110]. The last years, there seems to have been a balance between these two routes, but future developments in NSR tariffs, river transport tariffs and TSR tariffs may change this. However, as much of Norilsk's export is destined to the nickel smelting plants at Kola Peninsula (which is also owned by the Norilsk Nickel Company), large-volume NSR export is likely to continue.

Hydrocarbons relevant for the NSR have been found in two parts of the *Kray*: west of Dudinka (Messoyakha/Solenin/Pelyatka) and north-west of Turukhansk. The Messoyakha/ Solenin fields are already under production, providing gas to Norilsk through a pipeline. The neighbouring Pelyakta field is planned to become online towards the end of 2000[111]. A few

[106] Goskomstat Rossii (2000)

[107] Goskomstat Rossii (2000)

[108] Tamvakis et al (1999).

[109] Annex A2

[110] See Ramsland, Trond R. (1996): "The Northern Sea Route and the Rivers Ob-Irtysh and Yenisey," *INSROP Working Paper*, No. 44.

[111] Norilsk Nickel (2000): "Tests success for Pelyatka gas condensate deposit pipeline," *Press Release*, Norilsk Nickel's WWW homepage www.nornik.ru, 18 July 2000.

tens of thousand tons of gas condensate from these fields are also exported every year via Dudinka and the NSR. No further, major developments relevant for the NSR are expected in these fields which mainly contain gas.

The Turukhansk fields are more promising, with the Vankorskoye field being most suited for exploitation. Along with the 3 neighbouring fields of Lodochnoye, Tagul and Suzun, reserves here are estimated at 363 mln tons of oil, 219 bcm of gas and 3.6 mln tons of gas condensate. Russian authorities have agreed to let Vankorskoye be developed on a production sharing basis, with Shell and Anglo-Siberian Oil (ASO) as main foreign partners. ASO estimates the field to hold 150 mln tons of oil and 68 bcm of gas (Anglo, 2000). The drilling of the first three wells was planned to start in 2000, and depending on the results, it would be decided whether to link the field with the main oil pipeline network 500 km to the south-west, or to build a 730 km pipeline northwards and build a terminal at the deep-water port of Dikson (Shell, 2000a). ASO has stated that marine transport is the preferred option (Anglo, 2000). Marine transport of *gas* is not considered. Development has been planned to start in 2002, but it has recently been reported that Shell is considering pulling-out of the project, casting doubts on its future (Shell, 2000b). Under a very optimistic scenario, Bandman et al. estimate that oil extraction from the Turukhansk fields is likely to reach 14 mln tons annually by 2005, 14.5 mln tons by 2010 and 18 mln tons by 2015, generating oil and gas condensate cargo flows for the NSR of approximately 9.0 million tons in 2005, 12.6 million tons by 2010 and 13.5 million tons by 2015[112]. However, it already seems obvious that such volumes can not be realized as early as indicated, with production not likely to start up before 2005 under any circumstances.

The development of these oil fields is likely to cause considerable import cargo flows of pipes and other equipment. The majority of equipment is likely to be transported via railway to Lesosibirsk/Krasnoyarsk and then down the Yenisey by river barges, but some large-size equipment – most notably pipes – are not suited for railway transport, and will likely be imported by the NSR from Japan and Western Europe. Bandman et al also estimated that import of pipes and other equipment via the NSR may reach 140,000 tons annually during the most intense phase of development[113]. Main points of unloading will be Dudinka, Dikson and Igarka.

Igarka hosts a large timber processing complex, which at its peak in the late 70’s could saw 800,000 m^3 annually, in addition to loading of up to 1.3 mln m^3 unprocessed timber on seagoing vessels for export (0.3 mln m^3 from local forests, 1.0 mln m^3 transported from upper Yenisey[114]). The port activity at Igarka has however now dropped to only 40-60,000 tons annually, as timber transport out of the region has been diverted towards the south and the TSR. According to Bandman et al., Federal programmes are being implemented to support the timber industry in Igarka and elsewhere in Siberia, and export volumes as high as 1.5 million tons may be expected for the NSR by the year 2015[115]. However, this depends more than anything else on NSR tariffs and world prices, and depending on the development of these factors, large-scale exports from Igarka may or may not resume. However, Igarka as a timber exporter will be at a disadvantage compared to especially Arkhangelsk, which can accommodate larger ships, which is closer to the western markets and also has a longer ice-free season. Therefore, large volumes of timber export from Igarka should not be expected.

112 M.K. Bandman, V.V. Vorobieva, T.N. Yesikova, V.D. Ionova & B.V. Robinson (1999): “The Cargo Generating Potential of the Angaro-Yenisey Region for the Northern Sea Route”. *INSROP Working Paper*, No. 137.

113 Ibid.

114 Tamvakis et al (1999).

115 Bandman et al (1999).

4.3.3 Less probable cargo sources

Apart from the deposits of non-ferrous metals at Norilsk, other large deposits are confirmed in northern parts of the *Kray*, but with the still huge and easily mineable reserves at Norilsk, the exploitation of other deposits are not being considered.

Previously, at Norilsk, sulphur was also produced and transported by sea in volumes up to approximately 200,000 tons[116], but this traffic completely disappeared from 1992. According to Alexander Granberg, there is a potential of reviving this production, with an NSR cargo potential of 0.5-1.5 mln tons annually[117].

The only industrial output from the Taymyr A.O. is coal (55,000 tons were mined in 1995), but none of this has been exported by the NSR[118]. Enormous coal reserves have been confirmed in the Taymyr coal basin, but location and the present level of coal demand does not make production probable in the foreseeable future.

Very large reserves of mineral fertilisers (apatite and phosphor fertilisers) are located between Norilsk and Khatanga in the Mimecha-Kotuy region. It has been said that these reserves could replace the Kola Peninsula deposits, where reserves are becoming smaller and the quality of the mined fertilisers is decreasing. The development of apatite mining at Mimecha-Kotuy would necessitate the construction of a railway link to Igarka or Norilsk. Optimistic estimates by Bandman et al., say that export could start around 2015 with annual transport volumes for the NSR of 0.75-1.5 mln tons of export and 0.3-0.5 mln tons of inbound supplies.

The southern part of Krasnoyarsk *Kray* is heavily industrialised. In theory, supplies to the industry and the 4-5 million people in the vicinity of the upper Yenisey, could be brought in via the NSR and the Yenisey, and the industrial end-products could likewise be exported by the same route. In reality, the Trans-Siberian Railway seems to be winning the battle over this cargo. TSR operations have been running relatively smoothly the last few years, with costs, capacity and efficiency outperforming the NSR alternative. NSR has several drawbacks, including a limited navigation season and the need to tranship goods at least twice (between rail, river vessels and sea vessels). In addition, NSR tariffs are presently very uncompetitive. If the tariffs were considerably reduced, some goods have been mentioned as potential cargoes, such as alumina import directly from abroad to the aluminium plants of southern Siberia (Bratsk, Krasnoyarsk, Sayan and Novokuznetsk). The Siberian plants are only able to provide a small portion of its raw materials from domestic sources, and some of the imports have been coming through Murmansk and western Russian ports. Import over Murmansk has been consistently high in the late 1990s with 1,065,400 tons in 1994, 792,400 tons in 1995, 1,007,900 tons in 1996 and 1,161,100 tons in 1997[119]. A potential of 400,000 tons of alumina import per year is suggested by Bandman et al[120], with a similar figure for export of processed aluminium to NW Europe. The same authors refer to possible exports of lead and zinc (20,000 tons via the NSR by 2010), and magnesial products (200-350,000 tons per year). Coal from Kuznets is also forwarded as a potential cargo of up to 500,000 tons per year.

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[116] See Granberg, Alexander G. (1997): "Selected Studies in Regional Economic Development along the Northern Sea *INSROP Working Paper*, 74.

[117] A. Granberg (1998): "The Northern Sea Route: Trends and prospects of commercial use". *Ocean & Coastal Management* 41 (1998), 175-207.

[118] Tamvakis et al (1999).

[119] Tacis North-West Regional Transport Development Project (1998): *Port Traffic Forecasting for the Port of Murmansk. Draft Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

[120] Bandman et al (1999).

4.3.4 What difference can the NSR make for Krasnoyarsk **Kray?**

There are two circumstances that make the Krasnoyarsk *Kray* unique with regard to the NSR. First, it is the existence of a major industrial complex – the Norilsk/Dudinka complex – which uses the NSR for large-scale imports and exports. Second, it is the position of the Yenisey river as the only river along the NSR deep enough to accommodate sea vessels – ships up to 15-20,000 dwt can go to Dudinka, and ships up to 5000 dwt can continue another 1300 km upstream to Lesosibirsk.

As has been indicated above, if reliability and prices of NSR operations are kept at reasonable levels, the flows of non-ferrous metal ores and metals from Norilsk to the Kola Peninsula (and beyond) are likely to continue, benefiting industrial activities in both these regions. A collapse in NSR infrastructure, or too high prices of its use, may have negative impact on the industrial activity at Norilsk, which in turn may have negative impact on the nickel smelting activities on Kola Peninsula.

As has also been indicated above, the access via Yenisey to the enormous timber resources in central Siberia, and the access to the industrial heartland of southern Eastern Siberia, has the potential of generating NSR cargo flows, *depending on price and efficiency of the two competing transport modes*: The TSR and the NSR. If NSR/Yenisey shipping operations were to be streamlined, tariffs were to be slashed considerably, and if the TSR were to run into problems in the future, the NSR may become an important route for industrial import and export to southern Krasnoyarsk. However, it must be admitted that at present, the NSR does not provide real competition to TSR for transport to/from the industrial areas in southern Krasnoyarsk.

Nevertheless, for all economic activities in Krasnoyarsk – both in northern, central and southern sectors – having two competing transport alternatives is a favourable position.

As for the oil and gas industry which is slowly about to develop in the northern part of the *Kray*, well-functioning NSR operations may be crucial. If direct, marine export to markets in Western Europe may be established at reasonable prices, the *Kray* may obtain better conditions than it would through export via the monopolised oil and gas pipeline systems. For some of the fields, volumes may be too small to justify the building of new, long pipelines, but if located close to the coast or the Yenisey, the fields may be exploited and their resources exported by tankers. Such export is presently taking place in small scale with gas condensate from the Messoyakha fields. However, at present, only small tankers of 10-20,000 dwt take part in such export. Without building new terminals to accommodate larger tankers, it will be difficult to realise the potentials. The best alternative seems to be Dikson, with its deep harbour, supplied thorough a local pipeline system.

In order to develop fields in Krasnoyarsk *Kray*, large amounts of supplies are necessary, with much of the pipes and technical equipment coming in from Japan and Western Europe. If especially pipes could be brought in by the NSR, it would greatly facilitate development operations. The need to transport pipes is not confined to the short summer season, so year-round availability of ice-strengthened bulk ships and strong icebreakers are essential.

For Krasnoyarsk *Kray*, the NSR's importance as a supply route for food, fuel and other commodities for northern settlements is not as essential as for the regions further east. The main reason is that almost the whole *Kray* can be reached through an alternative route: the Yenisey. The only notable exception is the northern and eastern parts of the Taymyr Peninsula. However, the northern coast of the peninsula is not inhabited (except a few, small polar stations), and thus, the only part of Krasnoyarsk *Kray* which is vitally dependant on the NSR for supplies, is the area centred on the port of Khatanga in the east. Apart from those employed in the port, only small numbers of Dolgan and Nganasan indigenous people inhabit this area.

To sum up: The NSR has a much larger potential for assisting the economic development of Krasnoyarsk *Kray* than it has for the regions further east. At the same time, the NSR is less important for supplying local settlements. For northern parts of the *Kray*, well-functioning and reasonably-priced NSR operations will contribute to the development of hydrocarbon reserves, as well as to secure continued cargo flows between Norilsk and the Kola Peninsula and beyond. For central and southern parts of the *Kray*, the NSR may under certain conditions offer an alternative transport route to the Trans-Siberian Railway.

4.4 Yamalo-Nenets Autonomous *Okrug*

4.4.1 Geography and infrastructure

The Yamalo-Nenets Autonomous *Okrug* (YaNAO) – which is formally subordinated to the Tyumen *Oblast* – is centred around the lower reaches of the Ob river and around Ob Bay. It includes the Yamal, Taz and Gydan Peninsulas, all of which have large reserves of hydrocarbons. Population was 503,900 in 2000[121]. The Ob river is shallow – maximum draft is 3 m – and seagoing vessels are therefore not able to enter the Ob river. River vessels, on the other hand, are able to take cargoes from Ob river out into Ob Bay, where they can be transhipped to larger vessels at for instance Novyy Port (draft: 7 m). Other ports accessible for seagoing vessels are Yamburg in the Ob Bay and Kharasavey on the west coast of Yamal Peninsula. Several other points are used for loading/unloading, but ships will have to be anchored offshore, and (un)loaded by smaller vessels or by pipeline.

Two railway lines enter YaNAO: A line from the Russian “heartland” in south-west reaches Labytnangi on the western shore of the Ob, right across from the YaNAO capital of Salekhard. The importance of this railway could be even increased if plans to complete a side track to Arkhangelsk materialise – that would provide a convenient export/import channel for goods to and from the northern Urals – including northern YaNAO. From Labytnangi, the railway continues north towards the Yamal Peninsula gas fields, but construction has been more or less halted halfway.

The other railway line enters YaNAO from the south, and links major oil/gas fields in the *Okrug*’s southern part (around Novyy Urengoy and Yamburg) with the Trans-Siberian Railroad. The railway ends at Yamburg on the Ob Bay, but it does not appear that Yamburg is much used for transhipments.

With about 90% of Russia’s gas production taking place within its borders, YaNAO is already today the world’s greatest producing region of natural gas, with numerous fields under production in the southern and central parts of the *Okrug*, the largest fields being the super-giants of Urengoy and Yamburg. All the producing oil and gas fields in YaNAO are connected to the integrated Russian pipeline network.

In contrast with this, most of the Yamal and Gydan peninsulas have no on-land transport facilities at all, except a few winter roads. These areas – sparsely populated by reindeer

[121] Goskomstat Rossii (2000)

herding Nenets indigenous peoples – are dependant on the NSR for many of their supplies, while the southern parts of YaNAO is much better connected to the rest of Russia.

4.4.2 Probable, future cargoes

Today, the only export going out of YaNAO via the NSR is a few annual loads of gas condensate from different locations around the Ob Bay and the Yamal Peninsula, with annual volumes probably around 50,000 tons. Often, the highly valuable gas condensate is a by-product when extracting oil or gas, and as the development of new oil and gas fields slowly moves northward in the *Okrug*, the transport of gas condensate is likely to continue with gradually increasing volumes. Some licence holders are reportedly assessing the feasibility of developing coastal fields and exporting their gas condensate by sea[122], but no major projects have so far been reported to have moved beyond this. The EU – through its ARCDEV project (1998-2000) – has been looking especially into the prospects of regular, marine, large-scale export of gas condensate from YaNAO. A follow-up project to ARCDEV has been announced by the EU for 2001-2004[123]. The potential for marine export of gas condensate from YaNAO and the northern Krasnoyarsk *Kray* has been estimated to 3-5 million tons per year[124] – a moderate estimate for just YaNAO would be somewhere between 1 and 3 mln tons pr. year, some time after 2015.

On the Yamal Peninsula enormous gas reserves of approximately 10 tcm have been confirmed, with 4.3 tcm in the giant Bovanenko field alone[125]. Potential output has been estimated by Gazprom to up to 83 bcm annually[126]. Large-scale export of these resources in the form of liquefied natural gas (LNG) by ice-classified tankers have been investigated, and detailed logistic solutions have been proposed[127]. LNG export would require the building of a large port terminal and a gas liquefaction plant – or a methanol plant – at Kharasavey on the western shore of the Yamal Peninsula. It would also require the construction of local pipelines to the nearby giant Bovanenko gas field and/or other nearby on- and off-shore gas fields. A technical feasibility study of this alternative has assessed the export capacity of such an LNG plant/port terminal complex to be 21.6 mln tons per year[128].

The main alternative though, seems to be to connect the Yamal Peninsula to the existing gas pipeline network with a more than 1000 km pipeline south-west to Ukhta, and thereby completing the "Yamal-Europe Pipeline" by feeding Yamal gas into the new pipeline corridor already built through Belarus and Poland. A final decision concerning the transport mode of Yamal gas is not believed to have been taken, even though recent official documents[129] seems to assume that the pipeline will be built, while the LNG alternative is hardly mentioned.

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[122] Arild Moe, the Fridtjof Nansen Institute, *personal communication*, October 2000.

[123] See "Task Descriptions, Key Action 'Sustainable Mobility and Intermodality', Thematic Programme 'Competitive and Sustainable Growth', 5th Framework Programme", 3rd Call for Proposals (6 June 2000) available at the European Commission's Community Research & Development Information Service (CORDIS) internet server: *www.cordis.lu/growth/calls/200002.htm*

[124] Isakov et al (1999).

[125] J. Estrada, A. Moe & K.D. Martinsen (1995): *The Development of European Gas Markets.* Chichester: John Wiley & Sons.

[126] Tamvakis et al. (1999)

[127] Isakov, N.A., E.G. Logvinovich, F.A. Moreynis, A.E. Nikulin, N.V. Popovich, A.N. Silin, N.N. Stenin, I.L. Sverdlov, and V.A. Erashov (1997): "Seaborne Exports of Gas from Yamal," *INSROP Working Paper, No.* 86.

[128] Isakov et al (1999).

[129] e.g. Gazprom (2000): *Annual Report 1999*. Moscow: Gazprom.

Several studies have compared the two alternatives, but conclusions as to which one is commercially preferable differ[130]. It seems clear, though, that profitable seaborne export will at least require substantial reductions in tax levels, NSR tariffs and insurance premiums[131]. However, it is not obvious that one transport option rules out the other, as pipelines would mainly cater to European markets, while the higher-priced LNG – if exported – would have North America and possibly East Asia as main markets. It has been said that Gazprom's general development plan for Yamal considers sea transport of LNG from gas fields on and off the western coast of Yamal, while gas from Bovanenko will be taken out by pipeline[132].

Depending on future gas demand and prices, it is also very uncertain *when* the Yamal reserves will be developed. No gas is being produced at the moment, even though there have already been activities on the peninsula related to hydrocarbons development for about 3 decades. Gazprom almost completely halted its development projects on Yamal in 1996, and is reported not to intend to resume development before 2005 at the very earliest[133]. Gazprom has itself reported that production at the Bovanenko field will start in 2010[134] and even in the most optimistic case, no production can be expected before this. However, LNG export can not be ruled out, and if it takes place, volumes will be considerable – figures of 5-21 mln tons have been suggested[135].

Other large gas fields also exist in the area. After test drilling in the Ob Bay during the summer 2000, Gazprom announced the find of a 600 bcm gas field, and already estimated production drilling to start in 2007, a statement being viewed with scepticism by many observers[136]. However, if exploited, the gas is likely to be channelled into the existing pipeline network.

Even though most of the hydrocarbon reserves that have been identified in the northern part of YaNAO consist of natural gas, considerable reserves of *oil* are also present. Economic calculations carried out by Kryukov et al. show that for average oil fields of the northern YaNAO, marine export is likely to be less costly than connecting the fields to the existing oil pipeline network, in spite of higher technological and financial risk[137]. The same study compared commerciability between the use of smaller and larger oil tankers (40,000 dwt vs. 80,000), and between exporting only crude oil or constructing a refinery plant that would secure a mix of crude oil export and export of up to 3 mln tons of refined oil products. Results showed that construction and usage of larger tankers would yield larger profits, and that the construction of a refinery plant would also increase profitability of marine export.

Proven and probable oil reserves in YaNAO were 4463 mln tons (including gas condensate) in 1994, with an annual production of 46 mln tons in the southern part[138] – all of which was

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130 Kryukov, Valery, Anatoli Tokarev, and Vladimir Shmat (1998: "Analysis and Evaluation of Economic Conditions and Energy Prospects Implementation of the Yamalo-Nenets Autonomous Okrug," *INSROP Working Paper*, 102; Isakov et al. (1999).

131 Kryukov et al. (1998).

132 A.N. Silin (CNIIMF), *personal communication*, St.Petersburg, March 2000.

133 Deutsche Morgan Grenfell (1998): *Gazprom: Emerging Europe Oil and Gas (Shareholder's Report from 12 December 1997, updated 9 July 1998)*. London: Morgan Grenfell & Co.

134 Gazprom (1999): *Annual Report 1998*. Moscow: Gazprom.

135 Isakov et al. (1999); A.N. Silin, personal communication. (2000).

136 "Gazprom to step up development of Arctic gas find," *Energy24*, September 19, 2000.

137 Kryukov et al. (1998).

138 V. Kryukov, A. Moe & V. Shmat (1996): "West Siberian Oil and the Northern Sea Route: Current Situation and Future *INSROP Working Paper*, No. 56.

transported by pipeline. However, several factors – such as capacity problems in the existing pipeline network and the distant and dispersed location of many of the undeveloped oil fields – makes seaborne export a realistic alternative for future. No estimates of potential oil export volumes by the NSR has been forwarded within INSROP, and at present no particular projects are under development, but there is no doubt that the potential is equal to at least several mln tons per year.

The largest volumes of good transported into YaNAO by the NSR so far, has been deliveries of pipes and other technical equipment for the development of oil and gas fields. Maximum volumes in the past was almost 500,000 tons per year, but it must be noted that far larger volumes were transported into the *Okrug* from the south on the Ob[139]. If the Yamal Peninsula gas reserves were to be developed, the total volume of deliveries may well increase to "old" levels, but it is likely that the portion of deliveries that will be carried via the NSR will be smaller, since the Yamal railway and all-year road will then have been completed[140].

Deliveries of food and other goods to the local communities along the YaNAO coast, is likely to continue, but volumes are small. Even for indigenous settlements in the far north of the *Okrug*, most deliveries are coming in by land, from the south.

4.4.3 Less probable cargo sources

In connection with the construction of new refineries in the area, or in connection with the development of large oil and gas fields, there is also the possibility of utilizing the by-product liquefied petroleum gas (LPG), which is presently being burnt off. This would require a liquefaction plant somewhere along the YaNAO coast. Novyy Port has been mentioned as a possible location. The economic viability of such a project is however still questionable[141]. Potential volumes are estimated by Russian experts to be up to 1 mln tons[142].

Apart from hydrocarbons, YaNAO has few natural reserves. Fish resources in the Kara Sea and in the Ob River (sturgeon) is of local importance, and so is production of reindeer meat, but none of these create significant cargo volumes for the NSR.

The Ob River also represents very little NSR cargo potential. In contrast to the Yenisey River, the Ob River cannot be navigated by sea vessels, which complicates transhipment operations. Secondly, the regions bordering on the Ob/Irtysh river system has a much better developed railway and road system than many of the regions bordering on the Yenisey river. Thirdly, a glimpse at the map will reveal that the distances that can be saved to NW Europe destinations by using the NSR rather than railway are much smaller from the Ob region than from the Yenisey region.

4.4.4 What difference can the NSR make for Yamalo-Nenets A.O.?

In the YaNAO, the NSR is likely to play a very important role in the development of local hydrocarbon resources in the north of the *Okrug*. There is a clear potential for marine transport of at least gas condensate and oil, to be exported westwards by ice-class tankers, with icebreaker escort most of the year. The profitability of such operations depends largely on the size of tariffs levied, and on the ability to maintain stable, reliable operations. If such

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139 Kryukov, Valery, Arild Moe, and Vladimir Shmat (1999): "Financing the NSR: Regional Aspects," *INSROP Working Paper*, 146.

140 Kryukov et al. (1999)

141 See Tamvakis et al (1999).

142 A.N. Silin, *Personal communication,* St.Petersburg, March 2000.

NSR operations can not be established, the likely result is that fewer fields in the northernmost part of the *Okrug* will be developed and exploited. If NSR tariffs are reduced, along with other fiscal measures and a lowering of marine insurance premiums, it is also possible to imagine that the marine transport of Yamal Peninsula gas also becomes a realistic alternative, in the form of methanol or LNG. It will be in the interest of both YaNAO and importing countries to see large parts of the hydrocarbon reserves exported by sea, to avoid the dependence on the present oil and gas pipeline monopolies, to increase flexibility in export volumes and destinations, and to encourage competition between different transport alternatives.

When developing fields, the NSR will also be essential in providing large-size equipment, especially pipes from Japan and Western Europe. Without this opportunity, development of the northern fields will be more costly and time-consuming.

Apart from deliveries to small communities on the northernmost parts of the Yamal and Gydan peninsulas (mainly of the Nenets indigenous people), the NSR does not have a large role to play in delivering fuel, food and consumer goods to local settlements in YaNAO. Most such needs are filled by river, rail and road traffic from the south.

4.5 Nenets Autonomous *Okrug*

4.5.1 Geography and infrastructure

The Nenets A.O. is formally a part of Arkhangelsk *Oblast*, and stretches 2-300 km inland from the Barents Sea coast between the White Sea entrance and Novaya Zemlya. The *Okrug* had 45,200 inhabitants in 2000[143]. Most of the area is only connected to the rest of Russia by winter roads, and consequently shipping plays a relatively important role in import and export of products. The capital Naryan-Mar is the only port of any size in the *Okrug*, with timber as the traditional export product. The port of Amderma is located in the extreme east of the *Okrug*, and functions mainly as a support base for NSR operations. A new port – to be used for the development and export of local oil resources – is projected around Varandey on the Pechora Sea.

Only the easternmost corner of the *Okrug* (around Amderma) is formally part of the NSR area, but the south-eastern corner of the Barents Sea is functionally similar to the NSR (shallow seas that are ice-covered much of the year), and large volumes of hydrocarbon export is expected within few years.

4.5.2 Probable, future cargoes

The *Okrug* is rich in hydrocarbons – especially in oil, and especially in the eastern part. In the south of the *Okrug*, several fields (mainly oil fields) are under production, and oil is exported southwards by pipeline. Resources in the northern part are not yet exploited, except for a tiny oil field on the Kolguyev Island. According to separate estimates by Gazprom and Norsk Hydro[144], there may be 275-400 mln tons of extractable offshore oil reserves in the Pechora Sea, which – if exploited – are likely to be exported by sea. In addition comes possible sea export from fields onshore, close to the coast. Several offshore and onshore fields in the north of Nenets A.O. are being considered for development.

[143] Goskomstat Rossii (2000).

[144] Moe, Arild and Anne-Krsitin Jørgensen (2000): “Offshore Mineral Development in the Russian Barents Sea,” *Post-Soviet Geography and Economics*, 41, 2:98-133.

Development has come furthest at the Prirazlomnoye oil field, located 57 km offshore in the Pechora Sea. For this field, the construction of an ice-resistant production platform has been initiated at the Sevmashpredpriyatie Shipyards in Severodvinsk, close to Arkhangelsk. The works were reported to be 25% completed in late 1999[145]. In 1998, the field was estimated to start production in 2002[146], but work has since been halted due to financial problems. Australian partners withdrew from the project in 1999, and were replaced later that year by German Wintershall. Wintershall has now stated that the field could start yielding oil by 2003 in a "best-case scenario"[147]. Other observers estimate that Prirazlomnoye is not likely to be able to start production before around 2005[148]. According to the field's Russian licence holder Rosshelf, the oil will be exported by sea, with Rotterdam as final destination for the crude oil[149]. Different sources have put the field's extractable oil reserves at 65-100 mln tons to be exploited over 20.5 years, with peak annual production of 6.0-8.0 mln tons to be reached a few years after start-up[150]. Operations will take place year-round, with ice-breaker assistance during winter, and possibly with reloading of the cargo at the Kola Peninsula.

On shore, Lukoil seems to have made a final decision to build the long-planned oil terminal at Varandey. Makeshift loading equipment capable of handling 1 mln tons per year has been installed, and a first trial loading was carried out in August 2000[151]. Also, the fact that Lukoil is presently building-up its own 10 vessel ice-class tanker fleet, stating that it is to be used for export purposes[152], strongly points to the company's intent to develop this export route. Lukoil – and several other companies – have announced plans to develop a large number of fields in Timan-Pechora[153]. While the southern fields no doubt will be connected to existing pipelines and the Baltic Pipeline System, Lukoil clearly intends to channel the export from some of the northern fields via the Varandey terminal. It has been reported that the terminal will have a loading capacity of 5.0-6.5 mln tons of oil when its first stage has been completed by the end of 2005[154]. In a later stage, the terminal's capacity is to be increased further to 15 mln tons[155].

However, the development of fields in the area has stalled as necessary foreign investments are being withheld awaiting the approval of Russian authorities to develop fields under production-sharing agreements (PSAs).

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145 M. Basarygin, V. Kuznetsov, Y. Simonov & Y. Soldatov (2000): "Marine Transport System for Oil Export from the Prirazlomnoye Oil Field in Barents Sea" in in C.L. Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

146 Gazprom, as reported by Reuters News Service – Eastern Europe on 24 September 1998.

147 "Wintershall and Gazprom to develop Prirazlomnoye through joint venture," *NewsBase*, June 13, 2000.

148 Moe & Jørgensen (2000).

149 Basarygin et al (2000).

150 Basarygin et al. (2000); "Wintershall and Gazprom…" (2000); Nikitin, B.A., V.S. Vovk et al. (1999): "Podgotovka syrevov bazy na arkticheskom shelfe (Development of the Raw Material Base of the Arctic Shelf)," *Gazovaya promyshlennost'*, 1:20-23.

151 Lukoil (2000): "First Timan-Pechora's Oil comes from Varandey Terminal," *Press Release*, August 21, 2000.

152 Lukoil Arctic Tanker Internet Homepage: *www.lukoil-at.spb.ru*

153 Lukoil (2000): "Lukoil Board of Directors approved a program to develop oil in Russian North," *Press Release*, April 25, 2000; "Gazprom to draft proposals to Arktikmorneftegazrazvedka," *Vedomosti*, September 7, 2000.

154 "New crude oil export terminal in Barents Sea ready in mid-2000," *Reuters*, November 12, 1999; Murmansk Shipping Company (1999): *Annual Report 1998*.

155 "New crude oil..." (1999)

Timber has been an important export cargo from Naryan-Mar, however volumes have decreased. Recent statistics are not available, but timber export from Naryan-Mar decreased from 23,200 tons in 1992 to 6,400 tons in 1994.

As the coastal area of Nenets A.O. only has road connection with the rest of Russia through *zimniki* winter roads, delivery of goods by marine transport is important for the settlements along the coast. Statistics have not been collected by INSROP.

4.5.3 What difference can the NSR make for Nenets A.O.?

In the same way as for Yamalo-Nenets A.O., sea transport will play a very important role for the development of hydrocarbon resources in the Nenets A.O., especially oil resources offshore and in the coastal areas. Transport schemes have reportedly already been decided upon for the first offshore oil field Prirazlomnoye, with export by purpose-built ice-breaking tankers, accompanied parts of the year by icebreakers. The development of an oil export terminal at nearby Varandey also seems to have been decided. The availability of ice-breakers, and the tariff on its use, will be important, but not as important as for regions further east due to the relatively light ice-conditions. With marine export, Nenets A.O. is likely to be able to exploit more of its hydrocarbon resources than if all export were to take place by pipeline. The local authorities have shown strong interest in developing the marine export option, as this will lessen its dependence on the oil pipeline monopoly Transneft and on neighbouring southern regions, and instead forge direct contacts with foreign countries and transporters.

As the coastal areas are without all-year roads, marine transport will also continue to be important for deliveries of food, fuel and other supplies to the coastal communities (including settlements of indigenous Nenets and Komi people), as well as industrial supplies to the oil industry. The modest timber export out of Naryan-Mar is also dependent on marine transport during the ice-free summer season.

4.6 Murmansk and Arkhangelsk *Oblasti*

The port cities of Murmansk and Arkhangelsk are also dependent on the NSR in the sense that NSR-related activities form a substantial part of the cities’ employment and revenue. *Arkhangelsk* used to be the staging point for NSR activities, with most of the fuel and provisions for NSR settlements shipped out from Arkhangelsk’s seaport every summer. The Arkhangelsk-based Northern Shipping Company (NSC) also used to dominate the timber transport out of Igarka. Still, cargoes are moved from Arkhangelsk to the NSR every summer, but port cargo statistics indicate that volumes have been well below 200,000 throughout the 2nd half of the 1990s[156]. Arkhangelsk’s role as the hub for NSR activities has long ago been taken over by *Murmansk*. All of Russia’s nuclear ice-breakers – and many of the diesel ones – have been based in Murmansk, the home port of their operator MSCO. MSCO also has the largest fleet of ice-class cargo vessels, and completely dominates the dry cargo traffic on the NSR. Lukoil Arctic Tanker (LAT) has also established a base just outside Murmansk, from which it carries oil products to the NSR settlements. Furthermore, nickel ore from Norilsk is unloaded at Murmansk and taken by rail to the Kola Peninsula smelting complexes. A rough estimate indicates that cargoes to and from the NSR in the late 1990s represented around 10% of the port’s turnover (which has been steadily increasing since 1995, reaching 8.1 mln tons in

[156] Tacis North-West Regional Transport Development Project (1999): *Port Traffic Forecasting for the Port of Arkhangelsk. Draft Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

1998) [157]. Murmansk is also the most likely export port if transit of mineral fertilizers and fabricated metals should ever get underway.

In the deep fjord at Pechenga west of Murmansk there are also plans to construct a transhipment port for oil from the Pechora Sea[158]. Oil would be taken by smaller ice-class tankers from the field, and reloaded here to large tankers that would take the oil to the markets. Some other support functions, both related to oil field development and to the increased sea traffic through the Barents Sea, are also likely to be located in Murmansk.

Without NSR operations, both Arkhangelsk, and in particular Murmansk, would face very serious consequences for economy and employment.

4.7 Conclusions

The discussions of this chapter have shown that the NSR plays a different role for the different regions along the route. In some areas, the NSR is a *necessity* without which many settlements cannot exist, while in other parts of the NSR area, the NSR is mainly an *opportunity* which may offer comparative advantages to other, available transport routes.

This very clearly has an east-west dimension, with the easternmost region – Chukotka A.O. – being extremely dependant on the NSR for survival of its northern parts, with Sakha being somewhat less dependant because of alternative import/export routes by river, with Krasnoyarsk *Kray* being able to use the NSR for export of non-ferrous metals and potentially as an alternative to the Trans-Siberian Railway, and the westernmost regions being able to use the NSR to develop oil and gas reserves which would else not have been commercially recoverable.

Therefore, there is no doubt that if one talks about the NSR as a mean to promote the *economic development* of the northern part of Asian Russia, focus has to be on the western part, where large volumes of hydrocarbons, non-ferrous metals and possibly timber will be exported westwards. This also implies that NSR operations can be carried out on a more-or-less commercial basis in the western part of the NSR area, while NSR operations in the eastern part can not become profitable in itself, but must rely on the authorities' capability and will to subsidise the supplying of local settlements.

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157 Brodin, Alf (2000): "Ports in Transition in Countries in Transition. The changing situation for ports in Russia and the Baltic states in times of geopolitical and economic transition," *CHOROS Report*, 2000:1. Gothenburg: Department of Human and Economic Geography, Gothenburg University, 2000; Tacis North-West Regional Transport Development Project (1998): *Port Traffic Forecasting for the Port of Murmansk. Draft Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

158 See Moe and Jørgensen (2000); Basarygin et al. (2000)

5 Forecasting of Future NSR Cargo Flows, 2000 - 2015

When discussing future NSR freight flows, caution is necessary. Many have tried to forecast future NSR freight flows, but most of the forecasts can be considered as little more than mere guesses, often expressions of wishful thinking. Even careful forecasts based upon actual statistics, trends and plans, are extremely uncertain, as the future of most activities in the Russian Arctic is basically dependent on the development of the highly unpredictable Russian economical and political situation.

The NSR area certainly abounds in natural resources – enormous deposits are located onshore or offshore in the Russian Arctic. Optimistic cargo forecasts often point to this almost endless list of natural resources, but the often extremely harsh environment in which they are located, along with the general difficult economic and political situation in Russia, make the exploitation of most of these resources very improbable in the short or medium term, or even in the long term.

In chapter 3, the NSR's potential as a corridor for transit cargoes was discussed, and in chapter 4, a survey was made of the route's past, present and potential future role in the economies of the NSR regions. In this chapter, an effort will be made to summarize and conclude those discussions, by offering overall estimates of the types and volumes of cargo that can realistically be expected on the NSR up to 2015. While largely based on cargo potential estimates referenced earlier in the report, some adjustments are made in this chapter to take into account delays and unexpected problems that past experience shows must be expected. Still, figures will have a very large margin of error, especially when it comes to oil and gas-related activities. Estimates of significant, potential cargo flows are summarized in table 5.1. Cargo flows not listed in table 5.1 are considered by this author either to have a too insignificant potential (<25,000 tons per year), or to be too unrealistic.

5.1 Hydrocarbons

Based on the regional presentations above, the following summary can be made of the most important NSR-relevant developments in the oil and gas sector:

- The Prirazlomnoye field in the Pechora Sea is on a slow track towards realization, and is still likely to be the first field to produce large volumes of hydrocarbons for marine transport, even though the indicated "best case scenario" with production start in 2003 might easily be several years delayed, based on previous experience. Different, but mostly consistent reports of the field's properties and production plans have been presented, and makes it possible to estimate what the field will mean in terms of NSR cargo potential and required infrastructure. At full production, annual volumes are expected to be 6-8 mln tons, to be reached a few years after upstart. A few years after that, output volumes will start to decrease.
- Lukoil is likely to continue the construction of the Varandey oil terminal. Simultaneously, Lukoil, Gazprom and other Russian and foreign companies have stated plans to develop coastal fields in the northern Nenets A.O. that can be connected to the terminal. So far, projects are only developing very slowly, due to lack of necessary investments. During 2000, the terminal will apparently be developed to a preliminary capacity of approximately 1 million ton, even though this capacity is not likely to be used, since no fields in the area have been fully developed yet. The terminal is planned to be ready by the end of 2005, and to have a capacity of approx. 5 mln tons, with throughput capacity possibly increased further to 15 mln tons at a later stage.

- For the Vankorskoye oil field, it has been stated that marine export via Dikson is the preferred logistic option, and – although still uncertain – it is assumed that this option will eventually be chosen. The project may, however, be seriously hurt if Shell decides to pull out. Taking this into consideration – as well as the need to lay 730 km of pipeline and to construct an oil terminal – start-up of production cannot be expected until late in the decade, even under the best conditions. Existing estimates of production volumes are still few and unreliable. The only available estimates are by Bandman et al., but actual production is likely to be much later and considerably lower than their estimates of 9.0 mln tons in 2005, 12.6 mln tons in 2010 and 13.5 mln tons in 2015.
- For the export of Yamal Peninsula gas, most factors seem to weigh in favour of a pipeline solution, at least for the largest and earliest fields. Gas production at Yamal is in all cases still years into the future, with 2010 as the earliest estimate. At a later stage, the building of a natural gas liquefaction plant at the Yamal Peninsula with subsequent marine export of LNG cannot be ruled out, even though prospects are highly uncertain. If built, available estimates indicate that the capacity of a liquefaction plant at Kharasavey will be in the range of 5-21 mln tons per year. Apart from Yamal, other gas development projects also exist in the Russian Arctic, but marine export does not seem to be considered an alternative for these.
- Marine export of gas condensate will no doubt continue and increase as new oil and gas fields come under production in various regions of the Russian Arctic. Even for gas fields where the gas is transported out by pipeline, the condensate may well be exported by sea. As most relevant projects are still in the planning stage, no drastic development is expected, but rather a stable, moderate growth from the present level of 50-100,000 tons.

The projects are believed to be realized in the chronological order as listed in above, except for gas condensate export, which is already taking place. In addition, the tiny Kolguyev field will continue production (at around 20,000 tons per year), and it is not impossible to imagine the development of some oil-fields in YaNAO. However, as no concrete projects seems to exist at this moment, this is how taken into consideration in the estimates in table 5.1.

5.2 Non-ferrous metals and ores

There are no indications that the present production level of non-ferrous ores and metals to be transported from Dudinka to the Kola Peninsula and Western Europe (approximately 750-950,000 tons), will decrease in the foreseeable future. During the Northern Sea Route User Conference in November 1999, the Deputy General Director of the Norilsk Nickel Company told the Conference that they have no plans to reduce their transport volumes of bulk ores from to the Kola Peninsula or refined products to Rotterdam. On the contrary, it was stated that Norilsk Nickel is indeed interested in increasing the exports in the near-term if the transportation tariffs are reduced. Nevertheless, high NSR tariffs and uncertainty over future availability of ice-breaker assistance and suitable cargo vessels, causes worries for the company. For the time being, it has indicated that it will focus more on transportation in the summer season in order to minimise costly ice-breaker assistance. Norilsk Nickel is also reported to be investigating other alternative transport modes, such as by submarines. With the company being dependent on a steady flow of ores from its mines at Norilsk to its smelting plants at Kola, it has very strong incentives for solving its logistic problems. With the NSR clearly being the most convenient transport route, it seems reasonable to expect that the company will somehow be able to maintain a stable NSR transport flow also in the future.

5.3 Timber and wood products

In recent years only 40-60,000 tons of timber and wood products have been transported annually on the NSR. Larger volumes are being exported from the European part of the Russian north, even though these volumes have also been drastically reduced over the last decade. (249,400 tons of timber and wood products were exported from Arkhangelsk in 1997[159].) Isakov et al.[160], estimate the total potential foreign export volumes from all North Russian timber ports (including Arkhangelsk) to be 1.3-1.9 mln tons, based on the production potential of the existing Russian timber industry. Actual export potential is probably considerably lower, both overall and in particular for the NSR. International economic trends must take much of the blame for the downturn of Russian timber export in general, but the almost complete halt in timber export from Igarka and Tiksi is more than anything else caused by the high level of NSR tariffs, leaving the NSR uncompetitive compared to the Trans-Siberian Railway and Arkhangelsk. Economic estimates show that in the ice-free season, export of saw-timber via the port of Igarka would have been less expensive than transport by railway to the sea ports of European Russia, if transport costs had not included the mandatory NSR fee[161]. The same source reports that the federal programme of social-economic development of Igarka till the year 2005 envisages an increase in export saw-timber production from 126,000 m^3 (1995) to 400,000 m^3 by 2000, but there are no reports indicating that such an increase is likely to be materialising. Nor are there any signals that Russian authorities are contemplating to exempt summer transport of timber from NSR fees, and even if that was to happen, Arkhangelsk would still maintain a comparative advantage over Igarka. With no indications that basic conditions for the timber trade are about to change, no substantial increase in NSR timber trade is expected.

5.4 Provisions and fuel to Arctic settlements

The level of import to NSR ports (both from other Russian ports and from abroad) is not expected to change dramatically from the relatively stable level of the late 1990s of 450-750,000 tons per year. This level seems to balance the absolute minimum needs of the northern settlements and the maximum capacity of the strained Russian State economy to carry out these mostly unprofitable supplies. The need for supplies to the Russian Arctic has decreased since the beginning of the 1990s due to decreased population as well as to the overall decrease in economic activities. There are no indications that this situation is going to change dramatically. If Russian budgets for supplying the northern territories should be enlarged, there is probably a potential for slightly increased transport to some areas along the easternmost parts of the NSR (especially in Chukotka A.O.) where no transport alternatives to the NSR exist. In recent years, communities in these areas have reportedly not been receiving sufficient supplies of food, energy and other necessities. The increase of imports represented by an improvement of deliveries to such communities may however be offset by a continued decline in overall population figures.

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[159] Tacis North-West Regional Transport Development Project (1999): *Port Traffic Forecasting for the Port of Arkhangelsk. Draft Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

[160] For instance: N. Isakov, A. Yakovlev, A. Nikulin, G. Serebryansky & T. Patrakova (1999): "Potential Cargo Flow Analysis and Economic Evaluation for the Simulation Study". *INSROP Working Paper*, No 139..

[161] Granberg, Alexander G. (1997): "Selected Studies in Regional Economic Development along the Northern Sea Route," *INSROP Working Paper*, No. 74.

The role of foreign imports is likely to continue to be modest. Occasional deliveries of grain and foodstuffs may continue from both the US West Coast and from Western Europe, while there is little reason to expect any import of foreign oil products, as the new, ice-strengthened fleet of Lukoil Arctic Tanker is likely to take over and dominate fuel deliveries to the Russian Arctic.

The conclusion is that the present level of provisions and fuel to the arctic settlements is likely to continue, with approximately 40% of the cargo being oil products and the rest being food and other dry cargoes. These volumes may increase somewhat when and if large-scale oil and gas development in the western NSR area gets underway. The great majority of supplies will be provided from Murmansk and Arkhangelsk, even though some coal, fuel and food may be transported from the east also in the future.

5.5 Materials for oil and gas development

Depending on the pace of development of oil and gas fields, delivery of pipes and other technical equipment from Japan, Europe and other areas may again increase, especially if the Yamal gas fields are to be developed. However, most of this will continue to be delivered by river and other transport means, and with the existence of the Yamal railway and all-year road, the NSR is likely to play a smaller role in the future than in the past, even though *pipes* from Japan and Europe will still be well suited for seaborne transport. Therefore, future NSR volumes are estimated considerably lower than the up to 500,000 annual tons as seen in the 1980s. Equipment from Japan is likely to be imported along the eastern NSR during the summer season.

No other large-scale industrial imports are foreseen in the near future, even though considerably reduced NSR tariffs may facilitate import and export of industrial raw materials and products via the Yenisey to/from central part of Asian Russia

5.6 Coal

There is disagreement over the prospects of NSR coal export from the Zyryanka mines on the Kolyma River. Granberg et al.[162] expect resumption of the high coal export levels of the 1980s provided that the Russian economy stabilises, that growth rates in the output of local industries will be moderate, and that the projected railroad connecting Yakutsk with BAM will be finished. Other experts[163] are more pessimistic, due to the fact that relatively high costs of extraction and transport from these remote locations are not likely to make these products competitive on the international market with the present price level. Until considerable changes are seen in the basic conditions for the coal trade, coal export can not be expected, and it is unlikely that volumes for the NSR will dramatically surpass the present level of approximately 50,000 tons internally distributed along the eastern NSR.

5.7 Transit cargoes

INSROP's investigation of the NSR's transit potential did not give any reasons to expect an imminent resumption of the NSR transit operations that ground to a halt in 1996. In spite of

[162] A. Granberg, G. Kobylkovsky & V. Plaksin (1999): "Cargo-forming Potential of Sakha (Yakutia), Chukot Autonomous District and other Far-Eastern Regions for the Northern Sea Route". *INSROP Working Paper*, No. 135.

[163] Castberg, Rune, Arild Moe, and Anne Berteig (1998): "Economic Development in Northern Siberia and the Russian Far East: Implications for the Northern Sea Route," *INSROP Working Paper*, 117.

the existence of a cargo base of at least several million tons of fertilizers and metals and other cargoes that are presently transported between relevant regions, the transport economy of NSR transit operations seems to preclude regular, large-scale transit operations under present market conditions.

The improvement of sailing conditions due to global warming and reduced ice cover can, however, not be excluded. On the contrary, recent research has indicated that the Arctic ice-cap is diminishing at an unprecedented rate. However dramatic, it is still doubtful whether this would make a distinct difference from a commercial viewpoint in the 15-year period investigated in this article, as it would probably take longer than that to *substantially* reduce the dependence on ice-breaker assistance.

Based on INSROP results, it may also be difficult to envisage a sufficient reduction in NSR fees. Even the approx. 26% reduction from present levels that has been recommended by researchers[164] and which *in principle* also seems to have been accepted by Russian authorities as a goal[165], does not appear sufficient to make *transit* operations profitable. Already with the present fees, transit operations would be very unprofitable for the ice-breaker operators[166], and a further fee reduction would just increase deficits, unless very large convoys can be organized.

Therefore, with no signals of radical changes in the basic conditions for NSR shipping in the short term, transit volumes are expected to be zero – or close to zero – in the whole period up to 2015. The only identified cargo that might have a commercial potential, is Japanese nuclear waste/fuel to and from reprocessing plants in the UK and France. Even this is speculative, and volumes will under all circumstances be minuscule (maximum 3-4 transits per season – see annex C2). Based on available information, no other regular NSR transit cargoes are expected within 2015, even though occasional transits may take place with existing Russian vessels.

5.8 Conclusion

For the next few years, there are no reasons to expect a dramatic change in NSR cargo flows in either direction from the recent level of between 1.4-2.0 mln tons annually. According to signals from the Norilsk Nickel Company, transport of non-ferrous ores and metals and other products from Dudinka to the Kola Peninsula and Western Europe will continue as until now, and this will therefore continue to be the main NSR cargo for the time being. Furthermore, the deliveries of food, fuel and other provisions to the Russian arctic settlements seem to have stabilised. Finally, there are neither any indications of an imminent revival of large-scale timber export from the NSR area, nor any obvious new sources of other dry cargo generation.

However, when it comes to marine export of hydrocarbons, the Russian Arctic is almost certain to see a very large increase in marine cargo volumes, and in 3-5 years, volumes will surpass the volume of non-ferrous ores and metals, if developments proceed according to announced plans.

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164 K. Kamesaki, S. Kishi & Y. Yamauchi (1999): "Simulation of NSR Shipping based on Year-round and Seasonal *INSROP Working Paper*, No. 164.

165 See: Frank, Sergey O. (2000): "International Shipping on the Northern Sea Route – Russia's Perspective," in C.L. Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers, 2000.

166 See: Tacis North-West Regional Transport Development Project (2000): *Northern Sea Route, Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

In table 5.1, estimates of future cargo flows are presented for the years 2005, 2010 and 2015. Taking into consideration the high degree of uncertainty involved, the table first presents the *range* of possible volumes, largely based on the most pessimistic and optimistic estimates taken from INSROP and other sources. Then, an *exact* volume figure follows, representing what this author, to the best of his judgement, considers to be the most realistic estimate. These figures are used further in chapter 6 as a basis for calculation of the future, required capacity of the NSR infrastructure.

Overall NSR cargo volumes for 2005 are estimated at between 1.30 and 14.20 mln tons, with 5.00 mln tons considered by this author as the most realistic level, with oil export from Prirazlomnoye and Varandey expected to have started up, although not yet having reached full capacity.

Overall cargo volumes for 2010 are estimated at between 8.45 and 41.15 mln tons, with 13.50 mln tons considered to represent the most realistic level. By this time, oil export from both Prirazlomnoye and Varandey is expected to have reached full capacity.

For 2015, overall cargo volumes have been estimated at between 8.75 and 62.55 mln tons, with this author considering 20.00 mln tons to be the most probable approximate estimate. By this time, marine export of oil from Vankorskoye via Dikson is expected to have started, throughput capacity at Varandey is expected to have been further increased, while export from Prirazlomnoye is expected to be gradually decreasing.

The “basic” NSR cargo flows, i.e. all flows excluding export of hydrocarbons and transit traffic, is estimated by this author to remain relatively stable for the whole period, probably at somewhere between 1.8-2.0 mln tons per year. Apart from a few occasional transit sailing by existing Russian vessels, and maybe a few annual sailings of Japanese nuclear waste/fuel from towards the end of the decade, no transit traffic is expected.

To put these conclusions and estimates in perspective, here are some of the existing overall estimates that have been forwarded by other experts:

- Isakov et al. have presented the most optimistic figures, saying that even when transit traffic and oil export is excluded, the demand for NSR shipments is likely to increase to maximum 6 million tonnes. This figure includes delivery of cargoes to support the development of new oil and gas fields, oil supplies to the Arctic settlements (1 mln t), shipments to and from the mines and metallurgical industry at Norilsk (2.5 mln t), timber export (700-750,000 t), and shipments in the eastern sector of the NSR (up to 2,100,000 t).[167]
- Kryukov et al. estimated that future “basic” NSR cargo flows will amount to minimum 2.9 million tons, transit traffic and hydrocarbons export not included. With hydrocarbons included, non-transit cargo volumes are estimated to lie between 13.6 and 77.0 million tons when all relevant fields have been developed[168].
- INSROP’s final report (which tried to summarise all main INSROP results and conclusion) projects annual flows of nearly 4 million tons in 2005-2010, *not including* oil export[169].

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[167] Isakov, N., G. Serebryansky, A. Parfenov, T. Patrakova, and N. Sadofieva (1997): “Regional Port Development Along *INSROP Working Paper*, No. 87

[168] V. Kryukov, A. Moe & V. Shmat (1999): “Financing the NSR: Regional Aspects”. *INSROP Working Paper*, No. 146.

[169] W. Østreng (1999) “The Multiple Realities of the Northern Sea Route: Geographical Hot Spots and Cool Spots of Navigation” in W. Østreng (ed.): “The Natural and Societal Challenges of the Northern Sea Route. A Reference Work”. Dordrecht/Boston/London: Kluwer Academic Publishers.

- The Central Marine Research and Design Institute (CNIIMF) in St.Petersburg (who was INSROP's key Russian partner), has made a relatively modest estimate of the cargo potential of the NSR by 2015-2020: 25-30 million tons of crude oil export from the Timan-Pechora Basin and the West Siberian Basin; 15-20 million tons of LNG from the Yamal Peninsula; 1-3 million tons of gas condensate from the West Siberian Basin; Up to 2 million tons of goods and mineral fertilisers; More than 1 million tons of non-ferrous ores and metals and other products from the Norilsk Nickel Industrial Complex; Some export of ferrous metals and timber[170].
- Finally, the Russian Minister of Transport Mr. Sergei Frank presented the following sober forecast during the *Northern Sea Route User Conference* in November 1999: 1.5 million tons in 2000, 4 million tons in 2005, 12 million tons in 2010 and 50 million tons in 2020[171].

It is clear that compared to most other sources, the overall estimates presented in this current report are relatively moderate.

[170] Peresypkin, Vsevolod I. (2000): "Introduction to Northern Sea Route History and INSROP's Background," in Claes Lykke Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

[171] Frank (2000).

Table 5.1: Overview of estimated Northern Sea Route cargo potential and main logistic arrangements (*incl.* transport of hydrocarbons from the Pechora Sea) 2005-2015, million tons.

Type of cargo	**1996-99 average cargo volumes**	**Possible range (pessimistic-optimistic estimates)**			**Most probable estimate (used for further calculations)**			**Main types of cargo vessels previewed (dwt)**	**Principal sailing season / NSR sector**	**Ice-breaker assistance required? Season / sector**
		2005	2010	2015	2005	2010	2015			
Hydrocarbons (export westwards)	0.05	0.10 -11.30	7.20 -38.10	7.50 -59.50	3.20	11.50	18.00		Year-round / West	Winter / West
- Prirazlomnoye crude oil	–	0.00 - 6.00	2.00 - 8.00	2.00 - 6.00	2.00	6.00	4.00	60,000 tankers		
- Varandey crude oil	–	0.00 - 5.00	5.00 -15.00	5.00 -15.00	1.00	5.00	8.00	60,000/20,000 tankers		
- YaNAO LNG	–	–	–	0.00 -20.00	0.00	0.00	0.00	–		
- Dikson crude oil	–	–	0.00 -12.60	0.00 -13.50	0.00	0.00	5.00	60,000 tankers		
- Gas condensate	0.05	0.10 - 0.30	0.20 - 2.50	0.50 - 5.00	0.20	0.50	1.00	20,000 tankers		
Non-ferrous metals/ores (Dudinka westwards)	0.85	0.60 - 1.20	0.60 - 1.20	0.60 - 1.20	0.90	0.90	0.90	20,000 dcv	Year-round / West	Winter / West
Timber/wood products (Igarka westwards)	0.05	0.00 - 0.10	0.00 - 0.10	0.00 - 0.10	0.05	0.05	0.05	10,000 dcv/barges	Summer / West	Normally not
Deliveries to the settlements (mostly from Murmansk/Arkhangelsk)	**0.65**	0.60 - 1.35	0.65 - 1.50	0.65 - 1.50	0.80	1.00	1.00		Year-round / West	Winter / West
- Fuel	**0.25**	0.20 - 0.35	0.20 - 0.40	0.20 - 0.40	0.25	0.30	0.30	20,000 tankers	Summer / Whole	Summer / East
- *Excluding Dudinka line*[c]	***0.20***				*0.20*	*0.20*	*0.20*			
- Dry cargo	0.40	0.35 - 0.50	0.35 - 0.60	0.35 - 0.60	0.40	0.45	0.45	20,000 dcv		
- *Excluding Dudinka line*[c]	***0.15***				*0.15*	*0.15*	*0.15*			
- Oil industry equipment	0.00	0.05 - 0.50	0.10 - 0.50	0.10 - 0.50	0.15	0.25	0.25	20,000 dcv		
- *Excluding Dudinka line*[c]	*0.00*				*0.05*	*0.05*	*0.05*			
Coal (internal cabotage, eastern NSR)	0.05	0.00 - 0.10	0.00 - 0.10	0.00 - 0.10	0.05	0.05	0.05	20,000 dcv/barges	Summer / East	Summer / East
Transit cargo	–	0.00 - 0-05	0.00 - 0.05[a]	0.00 - 0.05[a]	–	0.00[b]	0.00[b]		Summer / Whole	Summer / East
- Nuclear fuel/waste	–	–	3-4 transits	3-4 transits	–	3 transits	3 transits	Specialized vessels		
- Other transit cargoes	–	0.00 - 0.05	0.00 - 0.05	0.00 - 0.05	–	–	–	–		
Other cargoes (misc. import/export)	0.00	0.00 - 0.10	0.00 - 0.10	0.00 - 0.10	0.00	0.00	0.00	–	–	–
Total	**1.65**	**1.30 -14.20**	**8.45-41.15**[a]	**8.75-62.55**[a]	**5.00**	**13.50**[b]	**20.00**[b]			

[a] Including 3-4 transits of vessels carrying nuclear fuel/waste (cargo *weight* insignificant)
[b] Including 3 transits of vessels carrying nuclear fuel/waste (cargo *weight* insignificant)
[c] The "Dudinka line" refers to the year-round line between Murmansk and Dudinka, and includes all cargoes transported to Dudinka on return trips of vessels that carry non-ferrous metals and ores as well as gas condensate from Dudinka. It also includes deliveries to the oil industry that can be dropped off along the way to Dudinka, especially at the Yamal Peninsula and at Dikson.
Note: While "–" denotes non-existent cargo-flows, "0.00" is used for cargo flows that are too small to be considered "significant" (i.e. < 25,000 tons).
dcv = dry cargo vessels

6 The NSR Infrastructure: Status, Outlook and Future Requirements

Having looked at the cargo potential of the Northern Sea Route, we now turn our attention to the NSR infrastructure and its capacity. Today, the existing NSR infrastructure is more than capable of handling all the cargoes that are offered for transport. But with large projects underway to develop oil fields in the Russian Arctic, the potential cargo base is expected to increase many-fold, so a natural question is: What about the future? In this chapter we will survey the status quo for the most important components of the NSR infrastructure: the ice-class cargo vessels, the ice-breakers and the ports, also including brief discussions of other components such as communication systems, navigational aids, ice-forecasting and emergency facilities. The capacity of the main infrastructure components will be predicted up to 2015. Furthermore, based on the cargo potential figures estimated in chapter 5, future capacity requirements will be estimated. Finally, a comparison will be made of the *available capacity* and *required capacity* in order to identify future bottlenecks.

6.1 The NSR cargo fleet

6.7.1 The shipping companies

The *Murmansk Shipping Company (MSCO)* is by far the largest shipping company on the NSR, controlling the largest number of ice-class vessels and an overwhelming part of NSR dry cargo transport, including the Dudinka trade of non-ferrous metals and ores. MSCO's ice-breakers now also carry out almost all of the escorting along the NSR. MSCO is also running the Marine Operations Headquarters (MOH) for the western part of NSR (located in Dikson). In 1998, MSCO carried 924,935 tons of dry cargo on the NSR, which was 63% of all NSR cargoes that year (and 75% of all *dry* cargoes)[172].

At the end of 1999, MSCO's dry bulk/container cargo fleet was composed of 27 vessels totalling 510,900 dwt., of which 24 vessels (478,700 dwt) had ULA or UL ice-class. This also includes the state-owned 33,980 dwt nuclear-powered LASH (container-ship) *Sevmorput*. In addition, MSCO controls another 16 vessels totalling 470,700 dwt through the affiliated Malta-registered "NB Shipping", including 10 ULA and UL ice-class vessels (195,000 dwt). The average age of MSCO vessels was 18.3 years (16.0 years if the vessels of the affiliated company are counted). The newest ice-class vessel is from 1990. Recent new-buildings only include conventional bluewater vessels[173].

Since 1978, MSCO has been running the year-round service between Murmansk and Dudinka carrying outbound non-ferrous ores and metals to Murmansk and Western Europe, as well as inbound supplies for the industrial complex at Norilsk. MSCO also transpoorts most of the supplies to settlements along the western parts of the NSR, and also used to handle most of the transit transportation[174]. MSCO is organised as a joint stock company, and since 1998, the Russian oil company Lukoil has a controlling 50.2% share of the company stocks[175], through its recently created affiliate *Lukoil Arctic Tanker (LAT)*. This investment, along with LAT's

172 See annex A2.

173 Information mainly taken from Murmansk Shipping Company's 1998 and 1999 Annual Reports.

174 Y. Ivanov, A. Ushakov & A. Yakovlev (1998): "Current Use of the Northern Sea Route", *INSROP Working Paper*, no. 96.

175 MSCO 1998 Annual Report

building-up of its own 10-vessel fleet of ice-strengthened tankers (to be completed in 2001), is seen as a signal of that company's intention to take over oil supplies to Russian Arctic settlements, and to use marine transport for the export of oil and gas condensate from Russian fields in the Arctic. This is likely to shape the future development also of MSCO, gearing it towards the escort of Lukoil tankers exporting hydrocarbons via the planned Varandey terminal in the Pechora Sea.

The *Far Eastern Shipping Company (FESCO)* is based in Vladivostok and used to be the "number 2" shipping company on the NSR. Until the mid-1990s, it provided the majority of dry cargo transportation in the Eastern NSR region. It carried out deliveries to settlements on the northern coasts of Chukotka Autonomous *Okrug* and the Sakha Republic from the ports of Primorskiy *Kray*, Vanino, Magadan and Beringovskiy (coal). In addition, FESCO carried out timber export from the port of Tiksi to Japan and moved containers from the ports of the Eastern NSR region and Magadan to Primorskiy *Kray* ports[176]. However, as was shown in table 2.2, since 1998, there have been virtually no deliveries to the NSR area from eastern Russia, and the ice-class fleet of FESCO now mainly operates along the Russian Pacific coast. During the summer season, FESCO is still responsible for running the Marine Operations Headquarters (MOH) for the eastern part of NSR, which is located onboard a FESCO ice-breaker in Pevek. The Far Eastern Shipping Company is a Joint Stock Company.

By 1 January 1996, FESCO owned 19 dry bulk/container vessels of ULA or UL ice-class, totalling approximately 205,000 dwt., in addition to 20 specialised UL ice-class timber carriers[177]. No updated figures have been provided by INSROP, but there is reason to believe that a great number of these ships have been disengaged since 1996. FESCO has been building several new ships during the 1990s – all believed to be conventional non-ice-class vessels – and the average age of its cargo vessels dropped from 17 years in 1995 to 15.4 years in 1998[178].

In addition, FESCO operates Russia's second-largest ice-breaker fleet (after MSCO), which consists of four large diesel-electric ice-breakers. However, their appearance on the NSR seems to have become more seldom as MSCO has taken over most escorting along the NSR.

The Primorsk Shipping Company (PRISCO) is based in Nakhodka, and has since its establishment in 1971 provided transportation of oil products in bulk to the ports of Eastern Russia (including the eastern NSR) from the hub ports of Vladivostok, Nakhodka and Arkhangelsk. Tankers of the *Partizansk* type have delivered oil products from heavy tankers to the bar of the Kolyma river and to the port of Mys Shmidta[179]. However, since the late 1990s, oil deliveries from the west has completely taken over in the entire NSR area, and PRISCO's ice-class tanker fleet no longer carries in oil products from the east. As partner in the Russian-Finnish joint venture *Arctic Shipping Service*, it is however still engaged in oil deliveries from the *west*, and in the export of small quantities of gas condensate from the lower Yenisey/Ob Bay/Yamal areas *westwards*[180]. However, PRISCO's role in the Arctic has gradually diminished, and it has instead turned itself towards the international market. Nevertheless, PRISCO states that it intends to continue to be active in the Russian ice-class market. It is building new vessels especially for the export of oil from the Sakhalin fields, but

176 Ivanov, Yury M., Alexander P. Ushakov, and Anatoly N. Yakovlev (1998): "Current Use of the Northern Sea Route," *INSROP Working Paper*, No. 96.

177 Ibid.

178 FESCO President Viktor M. Miskov in the FESCO 1998 Annual Report.

179 PRISCO 1998 Annual Report.

180 Ibid.

PRISCO is also hoping to capture a share of the future crude oil transport from the fields in the Barents and Kara seas. PRISCO cargo statistics show that while the company between 1994 and 1999 gradually increased its annual overall cargo volume from 5,671,000 tons to 8,430,000 tons, internal cargo transport between Russian ports plummeted from 1,250,000 tons to only 309,000 tons in 1998, to rebound again to 604,000 tons in 1999[181].

At the end of 1999, PRISCO's fleet consisted of 45 ships of totally 714,000 dwt (44 tankers and 1 dry cargo vessel). Among these are 25 UL ice-class tankers totalling approximately 270,000 dwt. The average age of PRISCO's vessels is 12,2 years. Since 1992, PRISCO has been a privately controlled Joint Stock Company.[182]

The Northern Shipping Company (NSC) is based in Arkhangelsk, and has mainly been engaged in timber transport out of Igarka and Arkhangelsk, in addition to carrying supplies to settlements on the coasts of the south-west Kara Sea and the Laptev Sea. The company also operates a container line between Arkhangelsk and Dudinka[183], and also has a small portion of the non-ferrous metals transport from Dudinka to Western Europe. With the overall decrease in timber export, the company's cargo base has seriously deteriorated.

The Arctic Shipping Company (ASC) is based in Tiksi, and is mainly involved in internal transport between Arctic coastal ports. This includes cargo delivery from Tiksi to the Khatanga Gulf and points on the Laptev Sea, as well as coal delivery from the port of Zelëny Mys (on the Kolyma river) to the port of Pevek, return from Pevek to Zelëny Mys with other various cargoes. The shallow-draft fleet of the ASC takes cargoes from large deep-draft vessels in the Khatanga Gulf, in the region of Tiksi and of the bar of the Kolyma river, and moves them to destinations where the depths are less than 4-5 m. ASC is the only NSR shipping company which still has the status of being a State shipping company[184].

Non-Russian shipping companies have also been active on the NSR, above all Latvian and Finnish companies. Tankers of the *Latvian Shipping Company* have been active in NSR shipping since the dismantling of the Soviet Union, and in 1993 the joint Russian-Finnish company *Arctic Shipping Service* (ASS) started operation on the NSR. ASS tankers (including the two *Fortum*-owned tankers *Lunni* and *Uikku*) have transported a significant share of petroleum products from Arkhangelsk/Murmansk to points along most of the Russian Arctic. This involvement is however likely to decrease and possibly disappear with the appearance of Lukoil Arctic Tanker. Foreign tankers have also taken part in the gas condensate export. Occasionally, foreign vessels have also been delivering dry cargoes to Dudinka and Tiksi, and exporting metals from Dudinka and timber from Igarka. In 1995 foreign ships transported 221,900 tons, of which 139,000 tons of liquid cargoes, or 62% of the total volume of all liquid cargo shipments[185]. This figure has probably diminished since.

Finally, there are the river transport companies. Barges from the *Lena River Steamship Line* regularly venture out onto the NSR, delivering goods directly to destinations along the Sakha coast or up along the other navigable rivers. The *Yenisey River Shipping Company* must also

181 PRISCO 1998 and 1999 Annual Reports.

182 PRISCO 1999 Annual Report.

183 Ivanov et al (1998)

184 Ibid.

185 M. Tamvakis, A. Granberg & E. Gold (1999) "Economy and Commercial viability" in W. Østreng (ed.): "The Natural and Societal Challenges of the Northern Sea Route. A Reference Work". Dordrecht/Boston/London: Kluwer Academic Publishers.

be mentioned as it directly competes with the marine shipping companies for cargoes to/from Dudinka and Igarka, sometimes during summer probably also taking cargoes out via the NSR.

6.7.2 Present state

The 1990s have seen a dramatic reduction in the Russian fleet of ice-class cargo vessels. In 1993, the Arctic fleet owned by the five Russian “Arctic” shipping companies (MSCO, NSC, ASC, FESCO and PRISCO), totalled 373 vessels of high and medium ice classes. In 1994 this figure was 218, in 1995 it had become 197, and in 1996 it reached 153. Out of those 153 vessels available in 1996, only 55 were actually used during that year’s NSR navigation season, even though it is not clear whether this was due to their technical state or to the lack of cargo. Of the 55 vessels, 21 were timber carriers, 15 were bulk carriers, 11 were multi-purpose carriers, 6 were tankers and there was one refrigerator ship and one lighter. In addition, another 20 ships of other Russian and foreign companies were involved in shipping along the NSR that year (total 202,000 dwt)[186]. It is believed that many of these ships were tankers of Latvian and Finnish companies.

The number of vessels diminished further to 150 in the beginning of 1997, the latest year for which INSROP collected systematic information. Details on the 1997 fleet are presented in table 6.1.

Table 6.1: Composition of the fleet of ULA, UL and L1 ice-class vessels in Russian Arctic shipping companies (as of 1 January 1997)[187]

Ice class	Average age	No. of ships	Tonnage
***ULA*, total**	**12.0 years**	**16**	**159,200**
of which:	under 5 years	–	–
	6-10 years	8	61,600
	11-15 years	8	97,600
	16-20 years	–	–
	above 20 years	–	–
***UL*, total**	**14.5 years**	**92**	**744,400**
of which:	under 5 years	9	31,700
	6-10 years	24	106,800
	11-15 years	12	133,600
	16-20 years	25	306,100
	above 20 years	22	166,200
***L1*, total**	**19.4 years**	**42**	**295,100**
of which::	under 5 years	–	–
	6-10 years	6	25,600
	11-15 years	2	500
	16-20 years	8	92,000
	above 20 years	26	177,000
TOTAL:	**15.2 years**	**150**	**1,198,700**
of which:	under 5 years	9	31,700
	6-10 years	38	194,000
	11-15 years	22	231,700
	16-20 years	33	398,100
	above 20 years	48	343,200

Statistics is grouped by degree of ice-class, with ULA being the highest ice-class in the Russian Maritime Register of Shipping. UL is the second-highest, followed by L1, L2 and L3 (see chapter 3.2.4 for a brief description of the ice-classes).

186 Tamvakis et al (1999).

187 Presented by Tamvakis et al (1999). Based on *Soyuzmorniiproekt* data.

The statistics show that in 1997, the NSR fleet totalled 1,198,700 dwt and the 150 vessels were on average 15.2 years old, with 1/3 of them already above 20 years of age. The fleet is believed to have shrunk further since then, with Tamvakis et al.[188] forecasting that "not more than 55 ice class transport ships will be able to operate in the Arctic by the year 2000, later also these ships will be disengaged in mass. … Urgent measures are necessary for building new ships of the required specialisation; otherwise, in the near future the Arctic fleet will not be able to handle even the current volumes of shipments."

While not systematic, the overview below should give a fairly good picture of the NSR fleet as of late 1999. The list contains the most relevant types of ULA/UL ice class (or equivalent) cargo vessels capable of operating on the whole NSR. The information is mainly based on the shipping companies' 1999 Annual Reports. A more comprehensive overview of the NSR fleet – including technical specifications – is presented in annex B1.

- *Norilsk (SA-15)* class: 19,900 dwt. ULA dry bulk/container vessels built 1982-87. At least 13 vessels believed to be in operation, 7 owned/controlled by MSCO and 6 by FESCO.
- *Dmitriy Donskoy* and *Mikhail Strekalovskiy* classes: Approx. 19,500 dwt UL dry bulk vessels built 1977-82. At least 27 vessels believed to be in operation, 25 owned/controlled by MSCO and 2 by FESCO.
- *Vitus Bering* class: 9,200 dwt ULA RORO vessels built 1986-89. 5 vessels believed to be in operation, all owned by FESCO.
- *Samotlor* class: 17,200 dwt UL tankers built 1975-78. 12 vessels believed to be in operation, all owned by PRISCO.
- *Ventspils* class: 6,300 dwt UL tankers built 1983-86. At least 10 vessels believed to be in operation, 5 owned by PRISCO and 5 by LSC.
- *Partizansk* class: 2,800 dwt UL tankers built 1988-90. At least 10 believed to be in operation, 9 owned by PRISCO and 1 by NSC.
- *Astrakhan* class: 20,000 dwt UL tankers built 2000-01. 5 to be in operation by the end of 2001, all owned by LAT.
- *Lunni* class: 15,700 dwt 1A Super ice-class (DNV classification, approximately equal to Russian UL ice-class) tankers built 1993-95. 2 vessels in operation, both owned by Finnish Fortum.
- *Sevmorput* class: 34,000 dwt UL nuclear-powered lighter built in 1988. 1 vessel exists, operated by MSCO.

In addition come vessels of lower ice-class, most notably LAT's 5 16,000 dwt *Perm* class tankers of L1 ice-class, which are only allowed to operate on the western NSR. NSC's fleet of smaller timber carriers is also not included in the list.

6.7.3 The future

The above fleet is sufficient to cover present needs, but a large number of the vessels are old, and will inevitably be decommissioned within a few years. The only company known to be building new ice-class tonnage, is LAT with its new 10-vessel tanker fleet of the *Astrakhan* and *Perm* classes totalling 180,000 dwt upon its completion in 2001. These vessels will suffice to handle present levels of fuel supplies to the NSR settlements (200-250,000 tons) and gas condensate export (approximately 50,000 tons), and these vessels – along with three new, larger vessels (reportedly between 30-60,000 dwt) that LAT is planning to build – are also said to be sufficient to handle up to 10 mln tons of oil export from Varandey, to be

[188] Tamvakis et al. (1999, p. 264)

reloaded to larger tankers at the Kola Peninsula[189]. For Prirazlomnoye, it is planned to use two purpose-built 60,000 dwt tankers with UL ice-class that can carry up to 6-8 million tons annually, also this to be reloaded at Kola[190]. For export of Vankorskoye oil via a new terminal at Dikson, no fleet plan has been announced, but if the tankers are to rely on assistance from the existing class of ice-breakers, sizes above 60,000 dwt are difficult to imagine.

To estimate the minimum, future need of tankers, we will for convenience assume that all operators (also LAT at Varandey) will choose to use a standard, new class of 60,000 dwt UL tankers for *all* large oil export operations exceeding 1 mln tons per year (i.e. operations out of Prirazlomnoye, Dikson *and* Varandey). It is further assumed that existing classes of vessels of 16-20,000 dwt are used for all export of gas condensate and inbound deliveries of fuel. This means that in order to transport the liquid cargoes estimated in table 5.1, at least one 60,000 dwt tanker will be required to handle the 3 mln tons of oil from Prirazlomnoye and Varandey in 2005, four will be needed in 2010 and if oil export from Dikson gets underway as expected, at least eight 60,000 dwt tankers will be needed in 2015. LAT's present fleet will be able to handle all expected volumes of gas condensate and fuel. (See annex C1 for details on how these figures were calculated.)

Several Russian companies such as Lukoil, Sovcomflot and Gazprom are reported to be planning to build new, larger ice-class tankers, with indicated sizes in the range of 30-100,000 dwt[191]. However, with actual field production still at least 4-5 years away, none of them have yet been reported to have started construction or concluded building contracts. But as these ice-class tankers will be part of integrated logistic systems, they will no doubt be built when and if commercially based large-scale marine oil export materialize. On the other hand, Finnish Fortum has already ordered for delivery in 2002 two 106,000 dwt tankers of high ice-class capable of operating *independently* (i.e. without the assistance of ice-breakers) in ice-covered areas without the hard multi-year ice – such as the Pechora Sea and western Kara Sea[192]. Even though they are mainly for Baltic use they may also signal what future NSR tankers may look like.

As for dry cargo transport, the approximately 850,000 tons of non-ferrous metals and ores that are presently taken out from Dudinka annually, are mainly transported on vessels of the *Norilsk*, *Mikhail Strekalovskiy* and *Dmitriy Donskoy* classes. Average load per vessel is approximately 15,000 tons, meaning that around 60 annual voyages are required. Approximately 10 vessels are reportedly being used for this trade[193]. On their return to Dudinka, these vessels also carry in the estimated 250,000 tons of various dry cargoes that are needed to sustain the industry and population of the Norilsk complex. The same classes of vessels are used during summer to transport food and other supplies to the eastern NSR settlements, as well as for coal transport. When Dudinka is exempted, inbound dry cargoes to the NSR area amount to approximately 150,000 tons per year, with an additional

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189 Murmansk Shipping Company 1998 Annual Report; Frank, Sergey O. (2000): "International Shipping on the Northern Sea Route – Russia's Perspective," in C.L. Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

190 M. Basarygin, V. Kuznetsov, Y. Simonov & Y. Soldatov (2000): "Marine Transport System for Oil Export from the Prirazlomnoye Oil Field in Barents Sea" in in C.L. Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

191 Frank (2000); Peresypkin, Vsevolod I. (2000): "Introduction to Northern Sea Route History and INSROP's Background," in Claes Lykke Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers; MSCO 1998 Annual Report.

192 Fortum (2000): "Two new-generation crude oil carriers to join Fortum Fleet," *Press release*, June 30, 2000.

193 Tacis North-West Regional Transport Development Project (2000): *Northern Sea Route, Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

approximately 50,000 tons of internally distributed cargoes, mostly coal. This must be carried during the 4-6 month summer season. It has been estimated that still an *additional* 5 vessels are needed to take care of summer transport of the present magnitude[194]. This leads to the conclusion that 15 dry cargo vessels of present classes are needed to sustain the present levels of NSR dry cargo traffic (except the approximately 50,000 tons of timber export from Igarka that is taken by NSC timber carriers during summer). According to the forecasts in table 5.1, *dry cargo* traffic on the Dudinka line will only increase moderately in the period up to 2015 (from 1.10 mln tons now to 1.25 mln tons in 2005 and 1.40 mln tons in 2010 and 2015). Most of the increase is in eastbound cargoes, for which there is considerable free capacity. For other destinations, i.e. for summer transportation, dry cargo volumes will increase from 0.20 mln tons today to 0.25 mln tons in 2005, 2010 and 2015 (again exempting timber cargo). This also includes a few annual deliveries of pipes from Japan via the eastern NSR. With such volumes, assuming continued year-round traffic on the Dudinka line, but also assuming that some of the vessels used for the Dudinka trade can be used to supply other settlements during summer, a 15-vessel fleet is likely to be able to handle all expected flows of dry cargo.

As of the beginning of 2000, there were 40 known vessels of the relevant classes believed to be in operation, being 12-23 years of age (see annex B2 for a list of vessels). Assuming 25-year life spans, the fleet will have been reduced to 21 vessels by 2007 and 12 vessels by 2008. Since there are other parts of Russia also requiring the service of these vessels (Russian Pacific coast, White Sea etc.), a critical lack of dry cargo vessels could hit the NSR as early as 2005-06, unless new vessels enter the fleet.

The prospects of building new dry cargo vessels are bleaker than for new tankers. Not only because their usage to a larger extent is non-commercial (most notably the delivery of provisions to the Arctic settlements organized by cash-strapped Russian authorities), but also because they generally operate in waters where much heavier ice-breaker assistance is needed, making transport operations considerably more complicated and expensive. Alarmingly, the latest available annual reports from MSCO, FESCO or any other of the NSR shipping companies, do not indicate that any new shipbuilding programs of ice-class vessels are underway in these companies. Russian authorities have recently announced the *Program for the Revival of the Merchant Marine of Russia for 2001-2005*, where the building of four new dry cargo vessels is planned[195]. There are, however, reasons to view plans with scepticism, not least because under the previous such program (1993-2000), only ten out of 76 planned ice-class vessels were built (the ten LAT tankers), due to lack of funding. The only large-scale commercial user of the dry cargo vessels is the Norilsk Nickel Company, and even though this highly profitable company has the financial capability of constructing their own vessels, they may still face the problem of future lack of ice-breaker availability (see below), for which investments of a different magnitude are required. This may be the reason for Norilsk Nickel's announced plans to acquire up to three decommissioned *Typhoon* submarines from the Russian navy, and to outfit them for cargo transport between Dudinka and Murmansk. The refurbishment of one such submarine would require investments of approximately USD 80 mln, and would only be able to carry 12,000 tons of cargo[196]. In comparison, the construction of a vessel similar to the *Norilsk* class at a Russian wharf will costs an estimated USD 20 mln[197], and its cargo carrying capacity is higher. But such a submarine would – according to

194 Tacis (2000)

195 Matushenko, Nikolay I. (2000): "Russian Federation Policy in the Development of the Arctic Shipping," in V.E. Spiro and B.P. Polonsky, eds., *ICETECH '2000 Proceedings*. St.Petersburg: Krylov Shipbuilding Research Institute.

196 Nilsen, Thomas (2000): "Typhoon conversion?: Navy sub for metal transport in Arctic," *www.bellona.no* (Bellona internet homepage), September 10, 2000.

197 Tacis (2000)

Norilsk Nickel – be able to break its own channel in the ice on the Yenisey River, and upon reaching the sea, it would proceed towards Murmansk submerged under the ice. On the other hand, Norilsk Nickel's insistence on such plans may also be mainly rhetoric, in an attempt to reduce the level of NSR fees that it must pay.

Since regular transit operations with ordinary cargoes are not expected, the building of especially suited "NSR-max" cargo vessels of approximately 50,000 dwt is not required or expected. However, if transport of nuclear fuel/waste was to materialize, at least two new small but highly specialised vessels with the required ice-class and nuclear safety class would be needed (see annex C2). Vessels are likely to be financed by the countries involved.

6.2 The ice-breakers

6.2.1 Existing fleet

After the 56 MW *Sibir* nuclear ice-breaker was decommissioned in 1999, there are today 13 major ice-breakers of 16-56 MW in operation in Russia: four of the 56 MW nuclear *Arktika* class, two of the shallow-draft 33 MW nuclear *Taymyr* class, three of the 27 MW diesel-electric *Yermak* class and four of the 16 MW diesel-electric *Kapitan Sorokin* class. They have been listed in table 6.2. In addition there are several small ice-breakers of 9 MW or less, mainly used for port operations.

Table 6.2: Major active Russian Polar Icebreakers[198]

Name	Year Completed	Megawatt (MW)	Status/Operations	Operator
		Nuclear icebreakers		
***Arktika* class**				
Arktika	1975	56	Was scheduled 2000 for retirement, but is now being refurbished for prolonged service.	MSCO
Rossia	1985	56	NSR Operations	MSCO
Sovietskiy Soyuz	1990	56	NSR Operations	MSCO
Yamal	1993	56	NSR Operations	MSCO
Taymyr class				
*Taymyr**	1989	33	River & Coastal NSR Operations	MSCO
*Vaygach**	1990	33	River & Coastal NSR Operations	MSCO
		Diesel-electric ice-breakers		
***Yermak* class**				
Yermak	1974	27	Scheduled 2000 Retirement	FESCO
Admiral Makarov	1975	27	NSR Operations (Far East)	FESCO
Krasin	1976	27	NSR Operations (Far East)	FESCO
Kapitan Sorokin class				
*Kapitan Sorokin**	1977	16	Baltic Duty (Port of St. Petersburg)	?
*Kapitan Nikolayev**	1978	16	Modified Bow, Coastal Arctic Operations	MSCO
*Kapitan Dranitsyn**	1980	16	Polar Tourist Voyages	MSCO
*Kapitan Khlebnikov**	1981	16	Polar Tourist Voyages	FESCO

* Shallow-draft designs (7–8 m draft), suitable for operations for instance on the Yenisey River and the Ob Bay.

198 Adapted from L.W. Brigham, V.D. Grishchenko & K. Kamesaki (1999): "The Natural Environment, Ice Navigation and Ship Technology" " in W. Østreng (ed.): "The Natural and Societal Challenges of the Northern Sea Route. A Reference Work". Dordrecht/Boston/London: Kluwer Academic Publishers.

Of these 13, one (the *Kapitan Sorokin*) is permanently stationed in St.Petersburg for Baltic operations. The four diesel-electric ice-breakers owned by the Vladivostok-based FESCO are also seen less and less on the NSR as they are mostly engaged in Pacific Coast operations, in addition to Antarctic expeditions and tourist cruises. The remaining eight are operated by MSCO and based in Murmansk. This includes all of Russia's six state-owned nuclear ice-breakers that are leased to MSCO under an agreement that was recently prolonged by 10 years[199].

Due to the more than 75% reduction of NSR cargo volumes since 1987, the existing ice-breaker fleet is more than sufficient to accommodate all present NSR transport needs.

6.2.2 Future available *fleet*

Historic records show that the average life cycle of large Russian ice-breakers has been approx. 25 years, with 30 years as maximum. It was reported in 1998 that the two oldest active ice-breakers – the *Arktika* (built 1975) and the *Yermak* (1974) – were scheduled for retirement in 2000[200]. Since then, a program to re-equip the existing nuclear ice-breakers with the purpose of prolonging their lifetime up to 30 and maybe even 35 years has been embarked on (Peresypkin, 2000; Korolev, 2000), and may help keep at least the *Arktika* in service a few more years. But even so, these two vessels will soon approach the end of their service life. So will all the other five remaining diesel-electric ice-breakers, which were already 19-25 years old in 2000.

To replace the outgoing ice-breakers, only one new ice-breaker is presently under construction, the *50 Let Pobedy* ("*50 Years of Victory*" – formerly also known as the *Ural*). This ice-breaker will be of the 56 MW nuclear *Arktika* class. Building started at the Baltic Shipyards in St.Petersburg in 1985[201], but due to inadequate funding, construction has been proceeding very slowly, with many interruptions. In 1998, the vessel was reported to be 67.2 % completed, needing further 34 months' of work to be launched, provided that necessary funding is provided[202]. Total construction costs for the vessel is approximately USD 250 mln, with USD 75 mln reportedly still missing in 1998[203]. At the Northern Sea Route User Conference in November 1999, the Russian Transport Minister reconfirmed Russia's intention of completing the vessel, indicating launch in 2002. However, according to recent reports, the authorities only earmarked USD 3.5 million annually from year 2000 for the continued construction[204], indicating that it is certainly several years before this ice-breaker will be in service.

Russian research and design institutions – in co-operation with experts from Finland and Germany – have already carried-out a feasibility study for the development of a new generation of icebreakers. The basic designs for such new classes of ice-breakers have apparently been ready for more than five years. According to the St.Petersburg-based Central

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199 Ischenko, Aleksey (2000): "Neftyanye prioritety Murmana (Oil priorities for Murmansk)," *Polyarnaya Pravda*, September 5, 2000.

200 Ivanov et al (1998).

201 Brigham, Lawson W. (1999): "Soviet-Russian Polar Icebreakers: Changing Fortunes," *U.S. Naval Institute Proceedings*, 125, 1: 89-90.

202 Morskoy Flot (1998): Ledokol'nyy flot Rossii ("Russia's icebreaking fleet). *Morskoy Flot* 11-12: 21-23. Reported by L. Brigham (1998): "The Northern Sea Route, 1998". *Polar Record* 34 (190), pp 219-224.

203 Kudrik, Igor (2000): "New icebreaker might enter service in three years," *www.bellona.no* (Bellona internet homepage), February 3, 2000.

204 Ibid.

Marine Research and Design Institute (CNIIMF), the following types of new generation icebreakers should be examined[205]:

- A universal ice-breaker with two draft modes of operation with 60 MW power, for support of navigation in the western area of the Arctic Region. Such an ice-breaker would be able to operate both in the sea, in the shallow shelf areas, and in river estuaries.
- A lead icebreaker with the power of 100 MW to ensure year-round navigation on the NSR, including escorting large capacity cargo vessels along high-latitude routes (north of all the archipelagos). Such an ice-breaker would also be used as a rescue ship. Such ice-breakers will have almost double the strength of today's largest ice-breakers, the 56 MW Arktika-class ice-breakers.
- In addition, construction of a new line of 25 MW diesel-electrical icebreakers is being considered, as well as new port icebreakers.

The 60 MW nuclear ice-breaker is an especially interesting concept. With its wide 32.2 m beam and shallow 8.5 m minimum draft, it would be very versatile and able to replace both *Arktika* and shallow-draft *Taymyr* class ice-breakers and accommodate considerably larger cargo vessels[206].

According to CNIIMF, work has already commenced on a feasibility study for the construction of four new nuclear-powered ice-breakers. However, there are no indications that Russia is yet able to move plans beyond the planning stage towards implementation. Nor are there reliable reports of plans to build more ice-breakers of existing classes, except for the *50 Let Pobedy*.

However, the announced programme of re-equipping the existing nuclear icebreakers with the purpose of prolonging their lifetime by several years, seems to be proceeding[207]. According to MSCO, a 10-year extension of the life of the six nuclear ice-breakers will require the relatively modest investment of approximately USD 100 mln[208] (compared to USD 250 mln for the construction of one new Arktika-class ice-breaker). Such a solution will no doubt pose increased operational as well as environmental risks, but may be the only way for Russia to uphold its ice-breaker capacity until state finances allow the building of new ice-breakers.

With this programme in mind, 30-year life spans are optimistically assumed for all the ice-breakers. Further assuming that the *50 Let Pobedy* will finally be put into service in 2005, the existing and planned ice-breaker fleet is likely to develop as follows:

- 2000: 4 *Arktika* class, 2 *Taymyr* class, 3 *Yermak* class, 4 *Kapitan Sorokin* class
- 2005: 4 *Arktika* class (the *Arktika* will have been replaced by the *50 Let Pobedy*), 2 *Taymyr* class, 1 *Yermak* class, 4 *Kapitan Sorokin* class
- 2010: 4 *Arktika* class, 2 *Taymyr* class, 1 *Kapitan Sorokin* class.
- 2015: 4 *Arktika* class, 1 *Taymyr* class
- 2020: 3 *Arktika* class
- 2025: 1 *Arktika* class (the *50 Let Podedy*)

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205 Peresypkin, Vsevolod I. (2000): "Introduction to Northern Sea Route History and INSROP's Background," in Claes Lykke Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

206 Peresypkin, Vsevolod I. and Loly G. Tsoy (2000): "Arctic Icebreakers of Russia. State and Outlook of the Development," in V.E. Spiro and B.P. Polonsky, eds., *ICETECH '2000 Proceedings*. St.Petersburg: Krylov Shipbuilding Research Institute.

207 Peresypkin (2000); Korolev, Andrey (2000): "Life time for nuclear ice-breakers prolonged," *www.bellona.no* (Bellona internet homepage), May 22, 2000.

208 "V ozhidanii starta" (1998): *Neftegazovaya Vertikal*, 9-10, pp 72-74. Reported in V. Kryukov, A. Moe & V. Shmat (1999): "Financing the NSR: Regional Aspects", *INSROP Working Paper*, No. 146.

It should be kept in mind that not all of these will be available for NSR operations, with some resources inevitably having to be allocated also to the Baltic, the Pacific Coast and other areas.

Above, it was stated that the *50 Let Pobedy* was 67.2% ready in 1998, needing another 34 months to be completed. From this, it can be deduced that the construction of a new *Arktika*-class ice-breaker is likely to take approximately 10 years *provided that the necessary funds are available*. Furthermore, according to an interview with MSCO's former Director V. Ruksha, even if the State starts providing sufficient funds in the 2001 year budget towards the creation of a *new* generation of ice-breakers, the ice-breakers will not become operative until year 2017[209]. Based on past experience and the general economic situation in Russia, it does not seem likely that the Russian State is able as yet to commit necessary funds to rejuvenating its ice-breaker fleet. Smaller diesel-electric ice-breakers can be built faster and at lower prices, but will not be particularly suited for operations along the eastern NSR with its more difficult ice-conditions, nor for the escort of large tankers. This indicates that an inevitable, gradual decline of Russian ice-breaking capacity will take place over the next 10 years, with replacements not entering the fleet before 2010 at the very earliest. Even this is just a theoretical possibility – in reality the process of renewing the ice-breaker fleet is likely to take much longer, if it will at all happen.

6.2.3Future required *fleet*

According to MSCO, 2 *Arktika* and 2 *Taymyr* class ice-breakers are needed during winter to maintain the year-round Murmansk-Dudinka line at a level of up to 1.4 mln tons of cargo annually[210]. Furthermore, MSCO claims that its present fleet will be capable of escorting annually up to 10 mln tons of hydrocarbons from future fields in ice-covered parts of the Kara and Barents Seas, as well as 3 mln tons of cargoes to/from the Yenisey River and eastern NSR (including transit trade and the year-round Dudinka trade). This scheme will employ all its 8 major ice-breakers – 2 *Arktika*-class and the 2 relatively old diesel-electric ice-breakers for the hydrocarbons export, and 2 *Arktika*-class and the 2 shallow-draft *Taymyr*-class ice-breakers for the escort of ships on the Yenisey River and the eastern NSR (Murmansk, 1999). If such a capacity to escort totally 13 mln tons of cargo annually can be sustained, it will certainly be sufficient for several years to come. Even if the old diesel-electric ice-breakers were to disappear, the capacity would still be sufficient to accommodate the 5.0 mln tons of cargoes that have been estimated for 2005.

Assessing the number and type of ice-breakers needed in the future is however complicated, as it not only depends on cargo volumes, but also on season, routes, cargo vessel sizes etc. Nevertheless, assuming that 60,000 dwt tankers will be used for almost all oil export from Prirazlomnoye, Varandey and Dikson and 20,000 dwt cargo vessels will be used for the export of non-ferrous metals and gas condensate, and assuming that all these cargo-flows will be year-round, calculations indicate that the *minimum* need of ice-breakers during the *winter season* will be 4-5 *Taymyr*/*Arktika* class nuclear ice-breakers (or equivalent) in 2005, 5-6 in 2010 and 7-8 in 2015, to accommodate the cargo flows projected in table 5.1. For commercial operations such as oil export, cargo vessels can not afford long delays, and this has been taken into consideration when calculating the number of required ice-breakers. This also implies that every cargo vessel will normally be escorted by a dedicated ice-breaker (to avoid loosing time awaiting the formation of a convoy). See annex D for details on the calculation of required number of ice-breakers.

209 "RAO 'Sevmorput': bit' ili nye bit'", *Polyarnaya Pravda* 29 February 2000.

210 Ibid.

For *summer operations*, 20,000 dwt tankers and dry cargo vessels are assumed used for all deliveries to and within the eastern NSR and for the import of pipes and other oil industry equipment from Japan (3-4 shiploads per summer). In addition, 3 annual transit convoys with nuclear cargoes on board special vessels are assumed. It is further assumed that convoys will generally consist of one ice-breaker and two cargo vessels. Under these conditions, *minimum* need of ice-breakers for the summer season will be 4 *Taymyr*/*Arktika* class nuclear ice-breakers (or equivalent) for the whole period 2005-2015. For most summer operations, convoying is assumed, with one ice-breaker escorting on average two cargo vessels when delivering supplies to the eastern NSR settlements. See annex D for further details on how calculations were made.

6.2.4 Conclusions

At one point or another – probably somewhere around 2010 – the need for ice-breaker services is bound to surpass the available resources. Problems may also occur earlier, if technical or funding problems should force any of the ice-breakers into dock for extended periods.

Capacity problems are likely to occur first during the winter season, when it is the large bulk cargoes (oil and non-ferrous ores/metals) that are in need of ice-breaker escort. With ice-breaker services in short supply, the relatively uncomplicated oil transport is likely to capture most of the available capacity. Such a prediction is further supported by the 1998 acquirement by Lukoil of a controlling stake in MSCO. The Norilsk Nickel Company – needing 4 nuclear ice-breakers to uphold a cargo flow far smaller than the oil volumes – have good reasons to be worried about future access to ice-breaking services.

As for the supply of NSR settlements – and for transit traffic – this is carried out during the summer season, and does therefore not “compete” with the oil industry. Ice-breaker capacity seems to be sufficient up until around 2015, after which the situation may turn dramatic.

If the Russian State is not able to finance the building of larger ice-breakers, the most realistic option will be that the oil and gas industry will construct ice-breakers themselves. Such ice-breakers are likely to be adapted to the special needs of the oil industry. This means wider designs than today (to accommodate larger tankers), but probably shallower and with less ice-breaking capabilities than the largest existing ice-breakers, since the Pechora and western Kara Seas (including Ob Bay) are shallow and have significantly lighter ice-conditions than parts of the eastern NSR. The disadvantage is that such ice-breakers will be less suited for operations along the eastern NSR, jeopardizing future deliveries to the NSR settlements as well as the possibilities for establishing large-scale transit operations. The other obvious option for the oil industry is to build large tankers similar to the two new Fortum tankers with high ice-class capable of operating independently in first-year ice. However, construction costs of such tankers are staggering, believed to be more than double of normal tankers.

6.3 NSR seaports

Within the NSR area, there is still only one seaport that is permanently open to calls of foreign vessels, namely the old timber port of Igarka. In the vicinity of the NSR, there are a few more ports with the same status, namely Murmansk, Arkhangelsk, Kandalaksha, Onega, Mezen and Naryan-Mar on the Barents and White Sea coasts, and Provideniya on the Bering Sea coast. In addition, Russian authorities have been issuing annual Government Orders in which an increasing number of Arctic ports and points have been made accessible for the duration of one sailing season. For the 1997 sailing season, 48 ports/points were temporarily opened, and for the 1998 sailing season, all these plus another 23 ports/point were opened[211]. These 71 ports were:

Amderma, Anadyr, Anabar, Bely, Bely Nos, Beringovsky, Vaygach, Varandey, Viktoria, Vilkitskiy, Vitino (Kandalakshsky Bay), Vostochnaya Litsa, Geiberga, Golomyanny, Greham-Bell, Dikson, Dudinka, Zhelaniya, Zimovochnaya, Indiga, Indigirka, Iondayahka, Isachenko, Kanin Nos, Karataika, Karmakuly, Koyda, Kolguev, Kolyma, Leskino, Mokhnatkina Pakhta, Maly Taimyr, Menshikova, Minina, Nagurskaya, Nikolaya, Noviy Port, Pankrat'eva, Pevek, Peschany, Pravdy, Preobrazheniya, Ponoy, Rudolfa, Russkaya Gavan, Russkiy, Ruchyi, Ryveem, Sabetta, Seyakha, Solnechnaya, Sredny, Sterligova, Sop-Karga, Talatakhard, Tambey, Tiksi, Uedineniya, Ust-Kara, Khatanga, Kharasavey, Kheysa, Fedorova, Chelyuskin, Chernoe, Shavor, Mys Shmidta, Shoyna, Egvekinot, Eklips and Yana. Their location has been marked on the map in figure 6.1.

All major NSR ports are found on this list – the only relevant port missing being the small oil port of Yamburg in the Ob Bay. It is not known how many ports/points that were opened for the 1999 or 2000 sailing seasons, but it is not believed to have been less than in 1998. Most of the ports/points are small, including many polar stations, meteorological stations and indigenous settlements. The reason for most of them to be opened for foreign vessels is to receive fuel deliveries from the foreign tankers operating on the NSR. According to the NSRA, the number of points opened for foreign vessels may be reduced as Russian tankers take over more of the deliveries. On the other hand, there are plans to make a larger number of the ports open to foreign vessels on a permanent basis[212]. However, so far it is not known that any other NSR ports except Igarka have been opened permanently.

Loading and unloading of cargo takes place at a great number of places along the NSR. The majority of these locations, however, have no port facilities – and many places the water is too shallow for larger vessel to approach the coast. At such locations, cargo is either loaded/unloaded directly from/on the ice (where trucks will move the cargo between the ship and the settlement), or moved to/from the shore by smaller vessels or by floating pipelines.

There are a number of important ports along the NSR with facilities and equipment to accommodate seagoing vessels. Amderma, Dikson, Dudinka, Igarka, Khatanga, Tiksi, Zelëny Mys, Pevek and Mys Shmidta are the “old” NSR ports. In addition, some relatively new seaports have been established in the oil and gas producing regions of northern YaNAO: Kharasavey, Novyy Port and Yamburg. Only Dudinka and Zelëny Mys are reported to be in a satisfactory state, with the technical state of the other ports gradually deteriorating due to lack of upkeep and investments[213]. A serious lack of port ice-breakers has also been reported for most NSR ports.

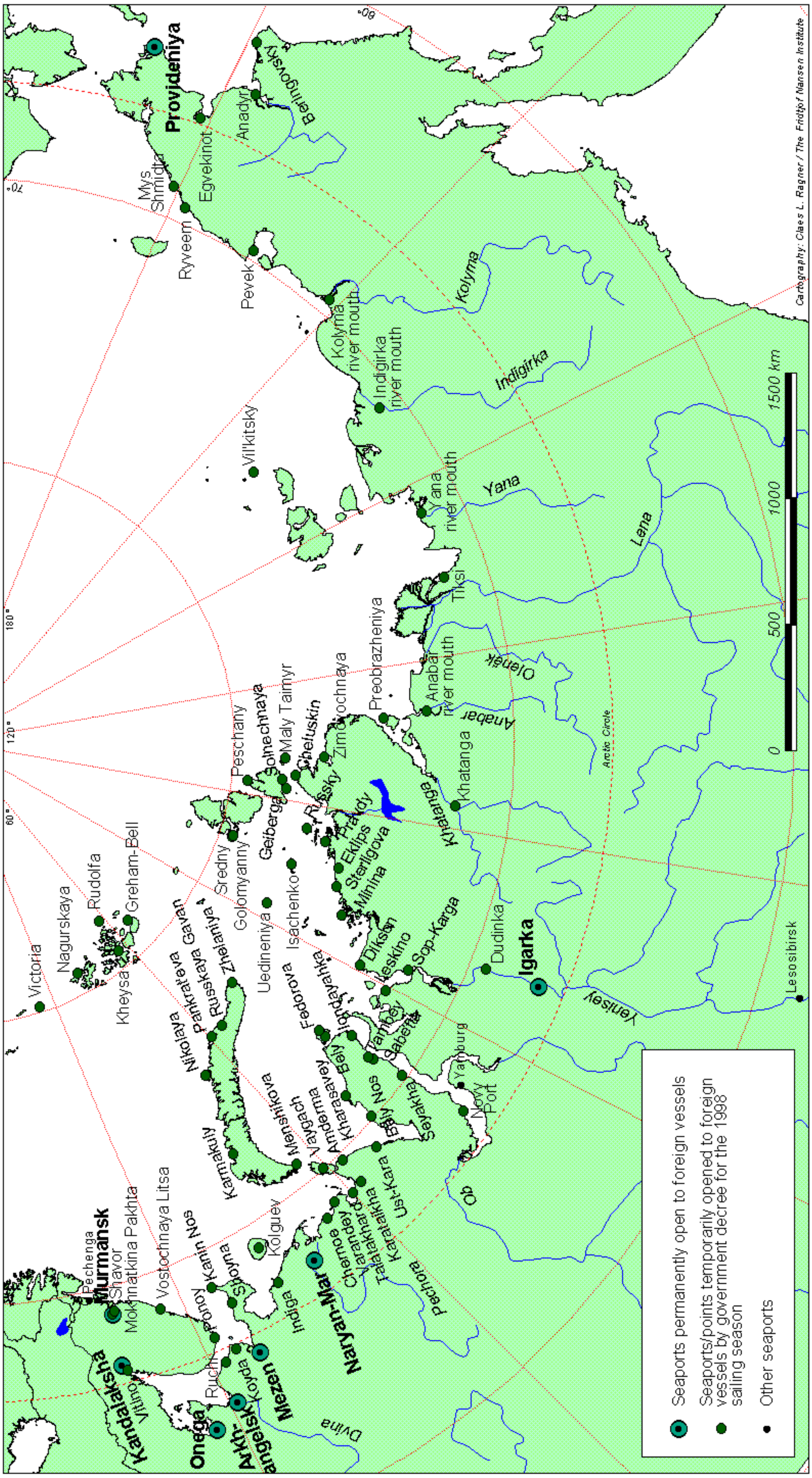
Outside the NSR there are also three ports of great importance for the NSR. First of all, there are the two western NSR gateways of Murmansk and Arkhangelsk, where most of the deliveries to the NSR ports originate. At the eastern end of the NSR lies Provideniya. With its deep, sheltered harbour – ice-free for most of the year – it has traditionally been the NSR’s eastern gateway, even though also this port has seen traffic drop dramatically in the 1990s.

[211] *Pravitel’stvo Rossiyskoy Federatsii Rasporyazheniye No 958-r*. (Government Order of the Russian Federation No. 958-r) 17 July 1998.

[212] A.P. Ushakov, Deputy Head of the Northern Sea Route Administration, *Personal communication*, December 1998.

[213] Tamvakis et al. (1999)

Figure 6.1: NSR seaports and points open to foreign vessels.



Murmansk port had a 1998 turnover of 8,100,000 tons[214], of which an estimated 550-850,000 tons were NSR-related. In Arkhangelsk turnover was a modest 1,100,000 tons, with NSR-related cargoes accounting for less than 200,000 tons[215]. Dudinka seaport handled 1,143,000 tons in 1998 (annex A2), making it the largest port within the NSR proper. Pevek is the 2nd largest NSR port, handling 82,960 tons in 1998 (and as much as 205,800 tons in 1997)[216]. All other NSR ports have had turnovers in the late 1990s considerably below 100,000 tons every year.

Details of each of these ports are presented below, ports being listed from west towards east[217].

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[214] Brodin, Alf (2000): "Ports in Transition in Countries in Transition. The changing situation for ports in Russia and the Baltic states in times of geopolitical and economic transition," *CHOROS Report*, 2000:1. Gothenburg: Department of Human and Economic Geography, Gothenburg University.

[215] Tacis North-West Regional Transport Development Project (1999): *Port Traffic Forecasting for the Port of Arkhangelsk. Draft Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

[216] A. Granberg, G. Kobylkovsky & V. Plaksin (1999): "Cargo-forming Potential of Sakha (Yakutia), Chukot Autonomous District and other Far-Eastern Regions for the Northern Sea Route". *INSROP Working Paper*, No. 135.

[217] The data on the different ports have been collected from a range of sources – the most important ones listed below. Often, port information from the different sources have been inconsistent and conflicting – in these cases the author has tried to apply the best of his judgement when choosing which data to emphasise. Main sources:

- N. Isakov, G. Serebryansky, A. Parfenov, T. Patrakova & N. Sadofieva (1997): "Regional Port Development Along the *INSROP Working Paper*, No 87.
- Y. Ivanov, A. Ushakov & A. Yakovlev (1998): "Current Use of the Northern Sea Route", *INSROP Working Paper*, no. 96.
- A. Baskin, A. Buzuyev, E. Yakshevich et al. (1998): "Operational Aspects. Volume 3 - 1995 project work", *INSROP Working Paper*, No. 101.
- A. Granberg, G. Kobylkovsky & V. Plaksin (1999): "Cargo-forming Potential of Sakha (Yakutia), Chukot Autonomous District and other Far-Eastern Regions for the Northern Sea Route". *INSROP Working Paper*, No. 135.
- M. Tamvakis, A. Granberg & E. Gold (1999) "Economy and Commercial viability" in W. Østreng (ed.): "The Natural and Societal Challenges of the Northern Sea Route. A Reference Work". Dordrecht/Boston/ London: Kluwer Academic Publishers.
- L.W. Brigham, V.D. Grishchenko & K. Kamesaki (1999): "The Natural Environment, Ice Navigation and Ship *The Natural and Societal Challenges of the Northern Sea Route. A Reference Work*. Dordrecht/Boston/London: Kluwer Academic Publishers.
- Northern Sea Route Administration (2000): *Ob'yem arkticheskikh perevozok morskim transportom v 1996-1998 gg*. (The Volume of Arctic Sea Transport 1996-1998). Moscow: Northern Sea Route Administration, unpublished memo.
- Soyuzmorniiproekt (1999*): Morskie perevozki gruzov po trasse SMP. Vypolnennie sudami parokhodstv i flotom drugikh vedomstv i kompaniy v 1998 godu* (Sea Transport of Cargoes on the NSR. Carried out by Ships from Shipping Companies and the Fleet of Other Authorities and Companies in 1998). Moscow: Soyuzmorniiproekt, unpublished memo.
- A. Reid (2000): "Chukotka and Abramovich on the eve of the gubernatorial elections", *Russian Regional Report*, Vol. 5, No. 41, 08 November 2000.
- Lloyd's Ports of the World 1996, Lloyd's of London Press Ltd.
- Maps and charts

For the sections concerning Murmansk and Arkhangelsk, information from the following additional sources have been used:

- A.-K. Jørgensen, C.L. Ragner & W. Østreng (1998): Infrastructure in the European Arctic: Challenges for Norway. *FNI Report*, No 14.
- A. Brodin (1998): "The Future of Murmansk, Arkhangelsk and Other Western NSR Ports in a Regional Perspective.", *INSROP Working Paper*, No. 116.
- A. Brodin (2000): Ports in Transition in Countries in Transition. The changing situation for ports in Russia and the Baltic states in times of geopolitical and economic transition. *CHOROS Report* 2000:1. Gothenburg: Department of Human and Economic Geography, Gothenburg University.
- Tacis North-West Regional Transport Development Project (1999): *Port Traffic Forecasting for the Port of Arkhangelsk. Draft Final Report.* St.Petersburg: Tacis North-West Regional Transport Development Project.
- Tacis North-West Regional Transport Development Project (1998): *Port Traffic Forecasting for the Port of Murmansk. Draft Final Report*. St.Petersburg: Tacis North-West Regional Transport Development Project.

6.3.1 Murmansk

The port of Murmansk is the largest in the Russian north, and fills both important national and local functions such as export/import of general cargo from/to the Russian “heartland” and export of minerals from the Kola Peninsula mining industry. In addition, Murmansk has traditionally been an important fishery port.

And Murmansk is essential with regard to the NSR. It’s NSR relevance is dual: Firstly, most deliveries to the NSR settlements during the summer season originate in Murmansk: Food, equipment and general cargo are loaded onto MSCO cargo ships in the Murmansk Commercial Sea Port (MCS), and fuel products for the NSR are loaded onto tankers at the Mokhnatkina Pakhta oil terminal close to Murmansk. Secondly, Murmansk is the end terminal of the Dudinka-Murmansk line which is operated year-round by MSCO cargo vessels and ice-breakers, transporting non-ferrous ore from the Norilsk mines to the non-ferrous metallurgical industry on the Kola Peninsula.

In the future, Murmansk may also become the main transhipment port for NSR transit cargo, such as fertilisers and ferrous metals.

The main port operator in Murmansk is the Murmansk Commercial Sea Port (MCS), operating 16 berths. Other operators are JSC Agrosfera (operating one berth for the export of fertilisers) and Lukoil Arctic Tanker (operating the oil port of Mokhnatkina Pakhta). The Fishing Port is also under separate operation.

The throughput of Murmansk peaked in 1989 with 8.8 mln tons, and decreased steadily to a low of 4.1 mln tons in 1993. Since then, the throughput level has recovered to 7.1 mln tons in 1997 (including 6.6 mln tons handled by the Commercial Sea Port), and 8.1 mln tons in 1998. MCS maximum capacity is approximately 9.0 mln tons.

Table 6.3: The seaport of Murmansk

Latitude / Longitude:	69°00'N / 33°04'E
Average Sailing Season:	Year-round
Port status for foreign vessels:	Open permanently
Maximum ship size:	44,750 dwt.
Maximum ship length:	202 m
Maximum ship draft:	16 m
Airport:	Yes (Murmashi).
Other connecting infrastructure:	Railway; Year-round roads.
Owner / operator:	Main operator: JSC Commercial Sea Port of Murmansk.
Ice conditions:	Ice free year-round. Temporary freezing in port in severe winters. Some drift ice in mild winters.
Turnover / capacity information:	Max turnover: 8.8 mln tons (1989); 1998 turnover: 8.1 mln tons. Cargoes to/from NSR presently 0.55-0.85 mln tons. Maximum capacity: 9.0 mln tons.
Loading Facilities:	20 berths, including deep water berths; 3.8 km quays; Facilities for bulk, ore (apatite, iron), tanker, timber, metals, container, ro/ro, bagged cement and fish; 25,500 m^2 storehouses, 60,000 m^2 open storage area; 40 t portal cranes, 90 t floating cranes.
Service facilities:	Pilotage (compulsory); Harbour ice breaker assistance; Fresh water; Ship repairs up to 30,000 dwt.; Berthing towage (compulsory).
Other comment:	All year round traffic to Dudinka. Western starting point of NSR traffic. Icebreaker base.

NSR cargoes presently represent approximately 10% of port turnover. In 1997, an estimated 450,000 tons were cabotage import (non-ferrous ore concentrate and nickel matte ("feinstein")) from Dudinka, while somewhere between 2-400,000 tons of deliveries (including fuel) were transported from Murmansk/Mokhnatkina Pakhta to the NSR area. In 1998, the cabotage import from the NSR area was reduced to an estimated 380,000 tons (non-ferrous ore concentrate and nickel matte) from Dudinka, while an estimated 150-350,000 tons of deliveries (including fuel) were transported from Murmansk/Mokhnatkina Pakhta to the NSR area.

The main limiting factor for the port of Murmansk is its inability to accommodate vessels larger than 45,000 dwt, most of the berths being designed for vessels around 10,000 dwt. Increasing the port's ability to accommodate larger ships is important also for the NSR, as vessels of approximately 50,000 dwt are considered optimal for NSR transit traffic, with potentially even larger vessels later if ice-breaking technology improves and if larger ice-breakers enter operation.

6.3.2 Arkhangelsk

Arkhangelsk is traditionally a large port for export of timber, but this export has been severely reduced in the nineties. Arkhangelsk was traditionally also the most important gateway for transport to the Russian Arctic. This position has now clearly been lost to Murmansk, even though considerable traffic takes place during the summer season even now. Arkhangelsk's main problem is that ice-breaker escort is needed large parts of the year (normally October-May), which is a serious drawback compared to Murmansk. Other drawbacks include the shallow harbour (maximum draft 9 m compared to Murmansk's 16 m), and a maximum size of ships of approximately 20,000 dwt. This situation is gradually aggravated by the large volumes of sediments carried and deposited by the river Dvina every year. Plans to increase the entrance channel to 10.2 m (enabling vessels up to approximately 25,000 dwt to enter), are lacking funds. It is therefore not reasonable to expect Arkhangelsk to become a prominent transhipment port for NSR transit traffic – if such traffic ever gets started – even though it will retain a position as a supply base to the Russian Arctic.

The throughput of Arkhangelsk peaked in 1989 with 6.1 mln tons, and decreased dramatically to a low of 0.65 mln tons in 1996, with a slow recovery to 0.8 mln tons in 1997 and 1.1 mln tons in 1998. Of this, only 194,000 tons were cabotage, and it is not clear how much of this was to ports in the White Sea and Barents Sea, and how much was to NSR ports. The main port operator in Arkhangelsk is the Arkhangelsk Sea Commercial Port (ASCP), even though some saw mills operate their own berths.

Table 6.4: The seaport of Arkhangelsk.

Latitude / Longitude:	64°33'N / 40°37'E
Average Sailing Season:	01.05 - 01.11 (year-round with ice breaking assistance).
Port Status for Foreign Vessels:	Open permanently.
Maximum Ship Size:	19,240 dwt.
Maximum Ship Length:	162 m
Maximum Ship Draft:	9 m
Airport:	Yes (Talagi)
Other Connecting Infrastructure:	Railway; Roads; Dvina River; White Sea-Baltic Canal.
Owner / Operator:	Main operator: JSC Arkhangelsk Sea Commercial Port (ASCP)
Ice Conditions:	Ice covered from end October – mid May.
Turnover / Capacity Information:	Max turnover: 6.1 mln tons (1989); 1998 turnover: 1.1 mln tons.. NSR relevant cargoes presently under 0.20 mln tons.
Loading Facilities:	35 berths; Facilities for container, bulk, fish and tanker; Storehouses, open storage areas, cold storehouses; 32 t portal cranes, 50 t floating cranes.
Service Facilities:	Pilotage (compulsory); Harbour ice breaker assistance; Fresh water; Ship repairs up to 7000 dwt.; Berthing towage.
Other Comments:	Western starting point of NSR traffic. A main port for deliveries to NSR settlements. River Dvina needs frequent dredging. Home port of the Northern Shipping Company NSC.

6.3.3 Amderma

Amderma is strategically located just south of the Yugorskiy Shar Strait. Its main function is as a radio communication centre for the SE Barents Sea and the SW Kara Sea. Apart from supplies to nearby villages, it has virtually no cargo throughput potential. The port is operated by local authorities.

Table 6.5: The seaport of Amderma.

Average Sailing Season:	Unknown
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	Unknown
Airport:	Yes
Other Connecting Infrastructure:	No
Owner / Operator:	Reportedly handed over from State control, probably to the Nenets A.O.
Ice Conditions:	Ice covered in winter. Details unknown.
Turnover / Capacity Information:	1998 turnover: 394 tons
Loading Facilities:	Vessels may be unloaded only on roadstead.
Service Facilities:	Fuel and provisions only in emergencies.
Other Comments:	Hospital, postal service, telegraph and telephone line. Communication centre for the SW Kara Sea/SE Barents Sea.

6.3.4 Kharasavey

The port of Kharasavey is located on the west coast of the Yamal Peninsula. It was built in connection with the upstart of oil and gas field developments in the area in the 1970s. It has so far mainly been used for import of equipment (for drilling and construction of pipelines, railways and roads), which started from 1976, and peaked in 1988 with 102,000 tons. A channel of 5 m depth was dug in the middle of the 1990s, which allows seagoing river barges access to the shore during the summer season. The port is located close to the giant Bovanenko gas field, and it will be the end point of railway and year-round road tracks that have been built half-way up the Peninsula. Little port statistics have been found, but in 1998 the only cargo recorded was an export shipload of 9287 tons of gas condensate. Inbound cargoes are likely to be very few, as there is very little oil and gas field development going on presently at the Yamal Peninsula. If and when such activities restart, Kharasavey is again likely to become an import centre of technical equipment. If marine export of liquefied natural gas (LNG) or methanol will ever take place from the Yamal Peninsula, Kharasavey is the likely export terminal. Such developments would require further deepening and enlargement of the port. Port owner/operator is unknown, but Gazprom is likely to be a major stake-holder in the port.

6.3.5 Novyy Port

Novyy Port is another port that has been developed in connection with the development of oil and gas fields on the Yamal Peninsula. From 1979 until the early 1990s, it was a major port for import of large-diameter pipes and equipment from Western Europe and Japan. Supply of oil and gas equipment to the Yamal Peninsula peaked in 1988 with 432,800 tonnes. Novyy Port may be used for transshipment between river barges from the Ob River and smaller seagoing vessels. Statistics is scarce, but present port activity is believed to be very low. In 1998, the port had a recorded turnover of only 724 tons. If oil and gas fields in the area are eventually developed, Novyy Port has been mentioned as a suitable location for a liquefied petroleum gas (LPG) plant, producing for marine export. Draft restrictions in the port is 7 m. Port owner/operator is unknown, but Gazprom is likely to be a major stake-holder in the port. Novyy Port is also a local centre for reindeer-herding indigenous Nenets people.

6.3.6 Yamburg

This new port is constructed just south of Grdiny Point in the Ob Bay. A channel with a depth of 5.5 m leads to the port. The port is equipped with floating and motor cranes, and hospital facilities are available. The port is mainly servicing the nearby oil and gas fields – a railway track connects the port with the giant gas fields of Yamburg and Noviy Urengoy, but apparently the port is not used for transhipment. Port owner/operator is unknown, but Gazprom is likely to be a major stake-holder in the port. No data of port turnover has been found.

6.3.7 Dikson

Dikson is situated in the south-eastern Kara Sea near the entrance to the Gulf of Yenisey. Vessels with maximum permitted draft of 11m may enter; the inner roadstead provides a good anchorage. Lifting capability of port unloading equipment is maximum 8 tons. Roadstead boats may assist vessels while berthing and entering the port. Only minor repairs may be carried out. During navigation, a rescue team is based in Dikson, as well as a radio navigational equipment repair group. Fresh water may be obtained. Dikson has an airport, hospital, radio relay line to Dudinka, and radio aids to navigation. The port is owned and operated by the Norilsk Nickel Company. The western Marine Operations Headquarters is also located in Dikson, operated by Murmansk Shipping Company. Previously, Dikson has been used as an import and transhipment port to settlements and polar stations in the area, but its cargo throughput is now very small. Due to its relatively deep and protected harbour (15 m water depths are located at reasonable distance offshore), Dikson has been mentioned as a suitable location for a new oil export terminal for oil and gas condensate from the Vankorskoye and neighbouring fields. Dikson has also been mentioned as a suitable bunker port if NSR transit operations get underway.

Table 6.6: The seaport of Dikson.

Latitude / Longitude:	73°31'N / 80°28'E
Average Sailing Season:	Unknown
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	11 m
Airport:	Yes
Other Connecting Infrastructure:	No
Owner / Operator:	RAO Norilsk Nickel
Ice Conditions:	Ice covered in winter. Details unknown.
Turnover / Capacity Information:	Maximum turnover 100,000 tons (1987). 1998 turnover: 2568 tons.
Loading Facilities:	8 t cranes.
Service Facilities:	Berthing towage; Minor repairs; Fresh water.
Other Comments:	Base for the western Marine Operations Headquarters.

6.3.8 Dudinka

The port of Dudinka is situated on the Yenisey River approximately 370 km from the mouth of the river. There is both a sea-vessel port and a river-vessel port. Dudinka's main function is to export non-ferrous metals and ores from the Norilsk industrial complex located 50 km. to the east, and to import supplies to the city. Up to ten vessels may berth at the same time. The port is equipped with gantry cranes, tug assistance, repair facilities and diving assistance. Fresh water may be taken from the river in places indicated by medical authorities, and provisions may be obtained. An airport, hospital, postal service and telegraph are situated in Norilsk, as well as the terminus of the Dudinka–Norilsk railroad. The port is operated by the Norilsk Nickel Company, and it is reported to be one of the few NSR ports in satisfactory technical condition. The export of goods from Dudinka to Murmansk takes place year-round (with a 1-2 months pause in the spring when the ice on the Yenisey breaks) with assistance of MSCO ice-breakers when needed. It has been reported that the maximum draft of the port is 11.5 m with ships up to approx. 20,000 dwt being able to call.

Table 6.7: The seaport of Dudinka.

Latitude / Longitude	69°25'N / 86°16'E
Average Sailing Season:	Year-round, except 1-2 months in the spring when the ice on Yenisey breaks.
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 unknown.
Maximum Ship Size:	Approximately 20,000 dwt
Maximum Ship Length:	Unknown
Maximum Ship Draft:	11.5 m
Airport:	Yes (in Norilsk, 70 km away).
Other Connecting Infrastructure:	Railway to Norilsk. Yenisey River.
Owner / Operator:	RAO Norilsk Nickel.
Ice Conditions:	Yenisey freezes in winter. Details unknown.
Turnover / Capacity Information:	Max turnover: approx. 2.5 mln tons. 1998: 1,143,000 tons.
Loading Facilities:	Gantry cranes.
Service Facilities:	Berthing towage; Minor repairs; Divers; Provisions.
Other Comments:	Located 370 km upstream the Yenisey River. Year-round export of Norilsk Nickel to Murmansk (5 days).

6.3.9 Igarka

Igarka is one of the oldest sea and river ports of the north of Russia, and is situated 640 km south of the mouth of the Yenisey River. It is owned and operated by the Igarka Woodworking Integrated Plant, and its main purpose has been to load and tranship timber and wood products both from the Igarka plant and from the upper reaches of Yenisey. Igarka was a bustling port in the 1970s and 1980s, reaching a cargo turnover figure of approximately 0.8 mln tons in 1976. Foreign exports have also been considerable. Traffic has dropped sharply recent years and has only been around 40-60,000 tons annually in the late 1990s. Nevertheless, Igarka is still today the only NSR port open for foreign vessels on a permanent basis. Depths alongside berths are 10-11 m, allowing access to ships up to 14,2000 dwt. The port is equipped with gantry and floating cranes. Minor repairs are available, and fresh water may be taken from the river. Hospital and postal facilities are available, and an airport is situated 1.5 km away. Most of the export out of Igarka has traditionally taken place by ships of the Northern Shipping Company.

Table 6.8: The seaport of Igarka.

Latitude / Longitude:	67°27'N / 86°36'E
Average Sailing Season:	01.07 - 30.10 (110-115 days, up to 165 days with icebreaker assistance).
Port Status for Foreign Vessels:	Open permanently.
Maximum Ship Size:	14,200 dwt.
Maximum Ship Length:	152 m
Maximum Ship Draft:	7.3 m
Airport:	Yes
Other Connecting Infrastructure:	Yenisey River transport (mainly from Lesosibirsk).
Owner / Operator:	Igarka Woodworking Integrated Plant.
Ice Conditions:	Yenisey freezes in winter. Details unknown.
Turnover / Capacity Information:	Max turnover: approx. 0.8 mln tons (1976). 1998: 39,211 tons.
Loading Facilities:	12 berths, mainly for timber; Port cranes at berth, mobile cranes and 5t floating cranes available; Warehouses and covered sheds available.
Service Facilities:	Pilotage (compulsory) available to early December; Fresh water from river; Bunkers not guaranteed; Berthing towage (compulsory); Minor repairs.
Other Comments:	Located 640 km upstream the Yenisey River. Transhipment of logs/timber from river barges.

6.3.10 Khatanga

The port of Khatanga is situated 180 km from the mouth of the Khatanga River, which flows into the south-west Laptev Sea. Pilotage is provided by pilots of Khatanga Hydrobase. Depths in the port are 3.5–8 m. Unloading equipment includes 3–8 ton gantry cranes and one floating crane. Tug assistance is available, and divers may be called from the port of Tiksi. Only minor repairs can be undertaken. A hospital, postal service and airport facilities are available. The port is owned by the State. Used as a base for ice-breakers operating in the area.

Table 6.9: The seaport of Khatanga.

Latitude / Longitude:	70°56'N / 102°29'E
Average Sailing Season:	Unknown
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 Unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	8 m
Airport:	Yes
Other Connecting Infrastructure:	Winter roads
Owner / Operator:	Russian Federation.
Ice Conditions:	River and estuary freezes in winter. Details unknown. Spring floods when river ice breaks.
Turnover / Capacity Information:	1998 turnover: 47,030 (includes an unidentified volume of cargoes to other points around the Khatanga Bay).
Loading Facilities:	Shallow water berths for small sea vessels; No warehouses; Open storage (in flood prone areas); 5 t floating cranes, caterpillar cranes.
Service Facilities:	Disposal of solid garbage not polluted with oil; Emergency repairs; Berthing towage.
Other Comments:	Located 180 km upstream the Khatanga River. Icebreaker base.

6.3.11 Tiksi

Tiksi is situated in the southern Laptev Sea near the mouth of the Lena River. Depths are 9-10 m at the roadstead and approximately 5 m in the inner harbour. The port is equipped with 25-ton gantry cranes. Repair facilities, bunkers and other provisions are available. Diving service, navigational equipment repairs and navigational information are provided by Hydrobase. There are hospital, postal service, telegraph and airport facilities in Tiksi. The port is the home-port of the Arctic Shipping Company, and it has been transferred from State control to the jurisdiction of the Sakha Republic (Yakutia). A large part of the activity consists of transhipment between sea vessels and river barges going up the Lena and Yana rivers. Tiksi is home of the Arctic Shipping Company.

Table 6.10: The seaport of Tiksi.

Latitude / Longitude:	71°39'N / 128°48'E
Average Sailing Season:	July-October (95-105 days).
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 Unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	9-10 m at the roadstead, approx. 5 m in the inner harbour.
Airport:	Yes
Other Connecting Infrastructure:	Lena River
Owner / Operator:	Republic of Sakha (Yakutia).
Ice Conditions:	Ice covered in winter. Details unknown.
Turnover / Capacity Information:	Maximum turnover above 0.7 mln tons (late 1980s). 1998: 40,155 tons.
Loading Facilities:	Piers and petroleum berth; 25 t gantry cranes.
Service Facilities:	Harbour pilotage (compulsory); Berthing and icy condition towage; Fresh water; Bunker; Disposal of waste, bilge and ballast waters (but not faeces waters); Minor repairs; Diving.
Other Comments:	Transhipment between sea-vessels and river barges. Home port of the Arctic Shipping Company.

6.3.12 Zelëny Mys

Zelëny Mys is situated 130 km upstream the Kolyma River. Pilotage to the port is compulsory, and the port has the means for roadstead discharge. Medical assistance and postal service are available. An airport is situated in the town of Cherskiy, which has bus service with the port. Zelëny Mys is reported to be one of the few NSR ports in relatively satisfactory technical condition. It has been reported that the Russian Federation has relinquished its ownership of the port to local authorities, probably meaning the port is now operated by the Republic of Sakha (Yakutia). The port is used for import of deliveries to settlements along the Kolyma River and in the Bilibino district, and for the export and distribution of coal from Zyryanka (upstream Kolyma).

Table 6.11: The seaport of Zelëny Mys.

Latitude / Longitude:	68°47'N / 161°22'E
Average Sailing Season:	05.07 - 05.10 (85 days). Kolyma river navigation: over 100 days.
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 Unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	Sand bar at river mouth limits ship drafts to 4.3 m.
Airport:	Yes (Chersky)
Other Connecting Infrastructure:	Kolyma River; Winter Road (November - May) to Bilibino.
Owner / Operator:	Unknown
Ice Conditions:	Ice covered in winter. Details unknown.
Turnover / Capacity Information:	Maximum turnover above 0.55 mln tons (late 1980s). 1998: 69,621 (includes all cargoes to/from the Kolyma river).
Loading Facilities:	Loading and tanker berths; 6 moorings of bankhead construction (totally 607 m); Warehouses and open cargo storage areas; 5-40 t portal cranes, 20 t gantry cranes, 25-30.5 t gantry cranes for containers, 5-35 t floating cranes, 10-25 t jib cranes.
Service Facilities:	Pilotage (compulsory); Disposal of solid garbage; Berthing towage (compulsory).
Other Comments:	Located 130 km upstream the Kolyma River.

6.3.13 Pevek

The port of Pevek is situated near the town of Pevek (population: 10,000), administrative centre of the Chaunsky region in Chukotka. There are hospital, postal service, bank and airport facilities in Pevek. The port is still under Federal control, owned by the Ministry of Transport. Pevek also hosts the eastern Marine Operations Headquarters, operated by the Far Eastern Shipping Company (FESCO), and located onboard one of FESCO’s ice-breakers stationed in Pevek. A rescue team is located in Pevek during the navigation season.

Table 6.12: The seaport of Pevek.

Latitude / Longitude:	69°42'N / 170°15'E
Average Sailing Season:	15.06 - 25.10 (115-120 days).
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 Unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	10.25 m
Airport:	Yes
Other Connecting Infrastructure:	Approx. 150 km year-round roads to neighbouring settlements. Winter road to Bilibino.
Owner / Operator:	Administered by the Russian Federation's Ministry of Transport.
Ice Conditions:	Ice covered in winter. Details unknown.
Turnover / Capacity Information:	Maximum turnover 0.66 mln tons (1988). 1997: 205,800 tons. 1998: 82,960 tons.
Loading Facilities:	Cargo and tanker berths; Metal warehouses and open cargo storage areas; 5-40 t portal cranes, 25 t caterpillar cranes.
Service Facilities:	Pilotage; Berth towage; Disposal of solid garbage not polluted with oil. Bunkers, supplies, repairs.
Other Comments:	Deep water anchorage available. Base for the western Marine Operations Headquarters.

Pevek is today the most important of the ports of the eastern NSR, both as a cargo import/reloading port for western Chukotka and Eastern Sakha, and as a centre of NSR infrastructure as it has bunker, supply and repair facilities for NSR cargo vessels and ice-breakers.

6.3.14 Mys Shmidta

Mys Shmidta's main function is as an import harbour for deliveries to the local settlements, including several settlements of indigenous Chukchis. As the various local mining and non-ferrous metallurgical enterprises have stopped or almost stopped their production, very little export now goes out of the port.

Table 6.13: The seaport of Mys Shmidta.

Latitude / Longitude:	68°56'N / 179°27'W
Average Sailing Season:	July-September (85-100 days).
Port Status for Foreign Vessels:	Open 1998 by annual decree. 1999/2000 Unknown.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	Shallow. Exact measures unknown.
Airport:	No
Other Connecting Infrastructure:	No
Owner / Operator:	Russian corporation Almazzoloto.
Ice Conditions:	Ice covered in winter. Details unknown.
Turnover / Capacity Information:	Maximum turnover approx. 0.3 mln tons (late 1980s). 1997: 46,900 tons. 1998: 1153 tons
Loading Facilities:	Most cargo is taken from ship to the moorings by small port vessels.
Service Facilities:	Unknown.
Other Comments:	Very poor technical state of port facilities.

6.3.15 Provideniya

The port of Provideniya is situated in the deep and well-protected Provideniya Bay on the Chukotka Peninsula. Overall depths in the bay are 30–35 m, and near the berths, 9 m. The port is marked by leading lines. Medical and tug assistance are available and the Provideniya Hydrobase provides navigation information. Provideniya has been considered the eastern gateway to the NSR, being the eastern start point for westbound convoys, but traffic has seriously deminished during the 1990s. Population has reportedly been halved to 2,500 inhabitants during the past decade, and the port is down from 1,500 to 90 employees. The port's dockside cranes were being dismantled for transportation to St. Petersburg in 2000.

Table 6.14: The seaport of Provideniya.

Latitude / Longitude:	64°25'N / 173°14'W
Average Sailing Season:	05.05 – 05.01 (225 days, including 45 days with icebreaker assistance).
Port Status for Foreign Vessels:	Open permanently.
Maximum Ship Size:	Unknown
Maximum Ship Length:	Unknown
Maximum Ship Draft:	+20 m
Airport:	Yes
Other Connecting Infrastructure:	No
Owner / Operator:	Unknown
Ice Conditions:	Frozen November - May.
Turnover / Capacity Information:	Capacity: 0.4 mln tons. Maximum turnover 213,800 tons (1990). 1997: 37,100.
Loading Facilities:	Cargo and auxiliary berths; Tanker berth; Warehouses and open storage areas available; 5-40 t portal cranes, 16-25 t caterpillar cranes. (Some cranes reportedly being dismantled in 2000).
Service Facilities:	Pilotage (compulsory); Fresh water; Bunker; Disposal of polluted water; Berthing towage; Minor repairs; Divers.
Other Comments:	Eastern starting point for NSR convoys. Poor technical state of port facilities.

6.3.16 Other ports

In addition to those ports mentioned above, there are a few other existing and planned ports that are of some relevance to the NSR, now or in the future. Again proceeding from west towards east, these are:

- *Pechenga*. There have been long-time plans to build a large civilian container and oil/gas port in the sheltered, deep and ice-free Pechenga Fjord close to the Norwegian border. If built, its main relevance for the NSR will be as a transhipment port for oil and gas from the Pechora and Kara seas. While on-land facilities may be constructed in the future, it seems probable that this harbour will initially be used for *direct* transhipment of the oil/gas from smaller ice-class tankers to larger conventional tankers. Such a scheme for the export of oil from the Prirazlomnoye field in the Pechora Sea is being favoured by its operator Rosshelf/Gazprom, and would require very little investment in port facilities[218].
- *Varandey*. For the oil fields that are planned to be developed in the coastal zone of the Nenets Autonomous *Okrug*, an export terminal is planned at Varandey on the Pechora Sea coast. Varandey is favourable due to its proximity to the many relatively small fields in question. Several companies have been involved in the plans for such a terminal, including the Lukoil and the Norwegian Norsk Hydro. Varandey's drawback is its shallow waters, which will only allow access to smaller vessels (< 60,000 dwt). In August 2000, an experimental run was carried out at Varandey in which a Lukoil tanker loaded approximately 10,000 tons of crude oil with the use of a 4 km. floating pipeline. Capacity is planned to be expanded to approx. 1 mln tons by the end of 2000, and to approx. 6 mln tons by 2005.
- *Lesosibirsk*. This port approximately 1800 km upstream Yenisey, is also accessible for small sea-vessels up to approximately 5000 dwt, even though in reality the large majority of the port's cargo is moved on river barges.

6.3.17 Conclusions / future development

The present network of ports seems to cover the basic needs of NSR settlements and enterprises. Capacity and equipment of most of the ports have been rapidly deteriorating in the 1990s and may delay loading/unloading operations, but all of them are believed to still be operating below full capacity, and it is clearly not the ports that have been the bottleneck causing the reduction in NSR cargo flows since 1987. The only NSR port of major economic importance – Dudinka – seems to be maintained at a relatively good standard by the Norilsk Nickel Company.

Except for hydrocarbons, no dramatic increase of NSR cargoes is expected in the next 15 years, and for most existing ports, only moderate investments will be necessary. The bulk of investments in the NSR port infrastructure in the years to come will be in building oil terminals and other installations necessary for the development of the oil and gas industry in Northwest Russia. The following port developments are the most probable: A new off-shore or on-shore crude oil transhipment port at Pechenga (Kola Peninsula); a new crude oil export terminal at Varandey, an LNG/methanol plant and export terminal at Kharasavey; a crude oil export terminal at Dikson, and possibly; an LPG plant and export terminal at Novyy Port. Apart from makeshift equipment in place in Varandey, none of these facilities have yet been built, but these are all projects being contemplated by the large Russian oil and gas companies

[218] Basarygin, Mikhail Yu, Vyacheslav P. Kuznetsov, Yury A. Simonov, and Yury I. Soldatov (2000): "Marine Transport System for Oil Export from the Prirazlomnoye Oil Field in Barents Sea," in Claes Lykke Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

Lukoil and Gazprom, in co-operation with foreign oil companies and local Russian authorities.

6.4 Ice-information and ice-forecasting

Efficient and commercial viable use of the NSR is extremely dependent upon accurate and expedient ice information and ice forecasts. One can divide the need for accurate ice information into 4 categories:

- Accurate databanks of *historic ice-data* are important for investors and ship owners in order to assess whether to invest in NSR vessels and in that case what type of ice-class vessel to construct. “What kind of ice-conditions is it necessary to prepare for?”, “How large are the risks of ice damage?” etc.
- Accurate *long-term ice-forecasts* (2-3 months) are necessary for long-term planning of vessel movements. Knowing approximately when the ice will break in the spring, when it will freeze in the autumn, and which parts of the NSR are likely to see difficult or easy ice conditions, is essential information for ship owners when deciding how to position their cargo vessels and ice-breakers and when to start NSR voyages. It will also be important for any future transit operations, determining from which date until which date in that particular year the NSR will be more suitable than the Suez route.
- Accurate *short-term ice-forecasts* (one week) are necessary for route planning - whether to go north or south of the archipelagos, whether one needs ice-breaker assistance or not etc.
- (Near) *real-time ice information* is necessary for efficient day-to-day tactical navigation. Are there any *polynyas* (open leads) nearby? Are there any icebergs nearby? Where can one find areas of low ice density? Is there any way to get around an area of ice-ridges? etc

The main responsibility for mapping and forecasting of NSR ice conditions is entrusted to the federal Arctic and Antarctic Research Institute (AARI), based in St.Petersburg. AARI has already collected and analysed NSR ice-data for more than 70 years. Based on analysis of ice data collected from a wide and diversified network of ice observation sources (Russian and non-Russian satellites, aircraft, polar stations, automatic ice drift buoys and ice-breakers) the following products are offered:

- Continuously updated databases of historic ice conditions.
- Short-term weather and ice forecasts for 7-8 days.
- Long-term weather and ice forecasts for 2-3 months.
- Specialised ice-forecasts (dates of freezing, dates of break-up of fast ice etc.)
- Biweekly composite ice charts of all Arctic seas.
- Operative photo maps from the satellite images.
- Sea ice dynamic charts.
- Synoptic charts of the Arctic.

Most of these products are ECDIS-compatible.

Generally, ice information from the different sources are sent to AARI’s Sever Centre in St.Petersburg where it is analysed and then relayed to the vessels via the Marine Operation Headquarters. Regional ice centres at Dikson, Tiksi and Pevek (closely connected with the MOHs) also take part in the collection, analysis and relaying of ice information.

6.4.1 Satellite monitoring

Ice-data collected by satellites is today the most important source of ice-information. At present, a range of satellites is employed for ice-monitoring purposes, including Russian satellites Okean-01, Resurs and Meteor-3, and non-Russian ERS (EU), NOAA (US) and

RADARSAT (Canadian) satellites. The European Space Agency (ESA)'s ENVISAT ASAR is scheduled to become operational in year 2000.

INSROP research and practical experience has showed that an optimal NSR ice monitoring system is obtained with the joint use of Russian Okean side-looking radar (SLR) data and ERS/RADARSAT synthetic aperture radar (SAR) data. However, if non-Russian users are to employ Russian satellite data, significant improvements will be necessary. Investment in improved communications can lead to much greater use. Also, ERS/RADARSAT SAR data should become more available to Russian users, but a host of technical, financial and organisational issues must be resolved to enable this[219].

The most detailed data obtainable today comes from ERS/RADARSAT SAR data, which is available with a resolution of up to 100 m. Data with such high resolution, is highly useful for day-to-day tactical ice navigation. The orbits of existing satellites pass over every part of the NSR on a daily basis, but due to lack of receiving facilities, SAR ice-data for the central part of the NSR (most of the Laptev Sea), is not obtainable today. The SAR receiving station in Tromsø (Norway) is only able to receive signals from satellites as far east as Severnaya Zemlya, and the receiving station in Fairbanks (Alaska) is only able to receive signals from satellites as far west as the New Siberian Islands. In order to cover the whole NSR, the European Space Agency (ESA) is going to build a new SAR receiving station in the Russian Arctic to cover the gap. A decision has now been made by ESA and the Russian State Committee for the North to locate the station in Tiksi in the Sakha Republic[220]. It is not known when this station will enter operation, but when it does, one bottleneck for efficient NSR ice navigation will have been removed.

Another bottleneck in the system for providing NSR vessels with the necessary ice-information, is the capacity of the available communication systems, as it now takes more than 6 hours to transfer one SAR data image to the vessels. Automatic ice classification (of SAR images) and enhanced computer processing may reduce image receipt aboard ship to 2–3 hours. The transmission of SAR images in compressed format should also become more routine in the future[221].

6.5 Communication and navigational aids

Communication between vessels and the Marine Operations Headquarters is maintained both by radio and by satellite.

6.5.1 Satellite communication

Two satellite communication systems can support NSR operations today – the International INMARSAT system and Russia's OCEAN system. The NSR is partially covered by two INMARSAT geostationary satellites; gaps in coverage occur in the Laptev Sea and north of Severnaya Zemlya. INMARSAT is used to transmit digital ice data and forecasts to the vessels. The system architecture of OCEAN is similar to INMARSAT, but OCEAN is better in covering the eastern Laptev Sea. However, few of the INMARSAT ship receivers are compatible with the OCEAN system, and critical communication gaps will remain along the NSR with these two systems[222].

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[219] Brigham et al (1999).

[220] Stanley Morris, EU Joint Research Centre, *Personal communication*, March 2000.

[221] Brigham et al (1999).

[222] Ibid.

INSROP Working Paper, 128.

226 Can be ordered from Ministry of Transport, Hydrographic Department, 190031 Moskovskiy Pr. 12, St. Petersburg, Russia, tel/fax +7 (812) 3103768.

large-scale charts of all relevant straits and other especially important areas. The process of declassifying charts has been very dynamic, and it is expected that a great number of additional charts will be published within the next years. However, the current available Russian paper charts are already sufficient for coastal navigation and higher-latitude routes along whole of the NSR. Approximately 90 of the charts have now also been published in bilingual Russian-English editions. Overview of the available charts can be found in *Chart Catalogue 7107* issued by the Department of Navigation and Hydrography of the Ministry of Defence (HDNO)[227].

Concerning digital navigation charts, most of the NSR is also sufficiently covered: By 1999, 300 electronic charts had already been published, all believed to be consistent with the ECDIS (Electronic Chart Display Information System) format[228].

6.5.5 NSR Navigation guide

In 1996, a pilot with detailed navigational descriptions and instructions for all parts of the NSR was published. It is the called *Guide to Navigating Through the Northern Sea Route* (NR 415 IB), and is a translation of the original Russian-language NSR navigational guide[229].

Apart from detailed route descriptions, the *Guide* also includes a detailed reference section on the 'Practice of Navigation in Ice'. Topics covered here are icebreaker escort (icebreaker-assisted navigation), convoy composition and tactics, icebreaker method for creating channels, and techniques to protect propellers when manoeuvring in ice. Additional sections review specific procedures for operating in land fast ice, drifting ice and during independent navigation (without icebreaker escort). Instructions are also provided for the escort of ships in late autumn and winter during the most difficult and hazardous conditions. The Regulations and ice navigation reference section contain indispensable information for all ships planning NSR voyages[230].

6.5.6 Coastal navigation aids[231]

The coast of the Russian Arctic is relatively low and flat, which makes it difficult to detect with radar. Thus, it has been necessary to equip the NSR with high-accuracy positioning systems. An efficient network of coastal aids to navigation has been developed, including radio beacons, lighted landmarks and lighthouses, sea daymarks, radar responder beacons, passive radar reflectors and buoyancy obstruction beacons. Floating buoys have very limited use on the NSR due to the brief open water season; those that are used adhere to the international IALA system found in European waters. There are 47 radio beacons in operation today along the NSR, 17 of which are manned. All have ranges of 100–150 nm; work is continuing on a new radio beacon with a 300 nm-range. The NSR coast, particularly in dangerous areas, is well-equipped with navigational markers: 30 radio responder beacons and more than 700 passive radar reflectors are deployed (most are combined with lighted landmarks and sea daymarks). Radar beacons are deployed mainly in river estuaries and their approaches; these operate year-round. One thousand buoyant obstruction beacons are deployed along the NSR for operation during the summer navigation season. All aids to

[227] Ibid.

[228] Electronic Charts can be ordered through Morintech, Prospekt Kima 6, 199155 St.Petersburg, Russia, e-mail: ntm@morintech.spb.su, tel./fax:+7 (812) 3254048.

[229] The *Guide to Navigating Through the Northern Sea Route* can be ordered from Ministry of Transport, Hydrographic Department, 190031 Moskovskiy Pr. 12, St. Petersburg, Russia, tel/fax +7 (812) 3103768.

[230] Brigham et al (1999).

[231] This entire section has been adapted from Brigham et al (1999).

navigation are shown on the nautical charts, and their characteristics are given in the Guide to Navigation Through the Northern Sea Route. In unmanned facilities, an atomic power battery employed since 1975 powers the system (400 are in operation today).

6.5.7 Satellite navigation[232]

GPS, the Global Positioning System (NAVSTAR satellite system), is provided to civilian users to determine positions within at least 100 m with 95% accuracy. This system is likely to continue to be the world's most reliable navigation aid in the future. Many international companies manufacture receivers for NAVSTAR/GPS. Russia also operates a similar satellite navigation system employing the satellite GLONASS; this system has the same accuracy as GPS. However, fewer receivers are available, and ships on the NSR are more likely to carry GPS. For higher accuracy with GPS, a differential mode (DGPS) has been recently introduced, providing an accuracy to within 10 meters with 95% accuracy. Today four DGPS stations are in operation – three on the Kara Sea coast and one on the Yenisey. They ensure high-accuracy positioning in the Kara Gate Strait, Vilkitskiy Strait, the Yenisey River up beyond Igarka, and most of the Kara Sea. The plan is for all coastal areas of the Russian Arctic to be covered by DGPS, with eight other stations to be deployed in the eastern part of the NSR after year 2000.

6.6 Accident preparedness: search & rescue, repair facilities

If a vessel should face an emergency situation while being on the NSR, what infrastructure is in place to assist?

6.6.1 Search & rescue operations

Search & Rescue operations are directed by the MOH, with dedicated salvage and repair teams stationed onboard ice-class salvage tugs in Dikson and Pevek, as well as onboard the ice-breakers. If a ship becomes stuck in ice with danger of being sunk or having to pass the whole winter in ice, ice-breakers will be routed to the vessel, even though they may be several thousand kilometres away, and may use many days to reach the vessel.

The NSR regions are covered by the Global Sea Salvage Distress System - GSSDS. According to a 1997 decision by the federal government, emergency radio stations keeping watch on distress and salvage frequencies will be established in the ports of Murmansk, Arkhangelsk, Tiksi, Pevek, Mys Shmidta and Provideniya. A COSPAS-SARSAT system station (determining the position and nationality of vessels, aircraft and other mobile objects in distress) is to be located in the port of Arkhangelsk[233].

6.6.2 Ship repair facilities

Ship repair facilities are very limited and very scattered along the NSR. The following NSR ports have been reported to have some facilities (se section on "Ports" above):

Dikson: Facilities available for minor repairs.
Dudinka: Facilities available for minor repairs.
Igarka: Facilities available for minor repairs.
Khatanga: Minor emergency repairs possible.

[232] This section has been adapted from Brigham et al (1999), with some additional material taken from A.P. Ushakov (2000): "The Real Face of Northern Sea Route Shipping," in Claes Lykke Ragner, ed., *The 21st Century – Turning Point for the Northern Sea Route?* Dordrecht/Boston/ London: Kluwer Academic Publishers.

[233] Y.M. Ivanov, A.P. Ushakov & A.N. Yakovlev (1998): "Russian Administration of the Northern Sea Route – Central or *INSROP Working Paper*, No. 106.

Tiksi: Facilities available for minor repairs.
Pevek: Repair facilities available.
Provideniya: Facilities available for minor repairs.

It is not mentioned how large ships the repair facilities in these ports may accommodate. In emergency cases when damaged vessels are unable to reach port, icebreakers may provide limited help such as carrying-out divers' examination and very light repairs, and providing bunkers and fresh water.

This indicates that only facilities for minor repairs are available within the NSR area. Large vessels and serious damages can not be satisfactorily repaired in the NSR ports, and vessels will have to proceed to shipyards outside the NSR area to be repaired.

At the *western end* of the NSR area, the port of Murmansk is reported to have repair facilities capable of taking vessels up to 30,000 dwt, and Arkhangelsk has facilities to accommodate vessels up to 7000 dwt. In addition to this, there are several military shipyards in the area which may be able to repair larger vessels, but their exact capacities has not been investigated by INSROP, nor is it clear to which degree civilian or non-Russian vessels will be able to use their facilities.

At the *eastern end* of the NSR are, the situation is even less clear as data on repair facilities along the Russian Pacific coast or in Alaska have not been collected in the INSROP programme.

6.6.3 Conclusion – search & rescue

While the above information may be incomplete, it nevertheless indicates that a vessel in distress, may have difficulties receiving the needed assistance with rescue teams and ice-breakers hours or days away, and suitable repair facilities thousand of kilometres away. This may cause large delays and large extra expenses, as well as considerable danger to the vessel and its crew. With the long distances, low traffic volume and the lack of deep-water harbours, it may be difficult to develop the needed infrastructure.

6.7 Conclusion: What are the NSR infrastructure bottlenecks?

An increasingly unavoidable lack of ice-breaker capacity is clearly the largest future, infrastructure bottleneck for the NSR. Expected capacity will not be sufficient to handle expected cargo volumes, and without improvement of Russian State finances, one can not expect sufficient investments into the building of new ice-breakers. With the construction time of new, nuclear ice-breakers estimated at approximately 10 years even under ideal conditions, the outlook is worrisome. Problems will first appear during winter, when ice-breaker demand is highest, with the bulk cargoes of hydrocarbons and non-ferrous metals/ores both requiring escort. Later, the ability to escort deliveries to the Arctic settlements during the summer may also be endangered.

The shortcomings of other parts of the NSR infrastructure only represent minor problems compared to the ice-breakers. The largest of these minor problems is a possible, future lack of suitable dry cargo vessels of high ice-class, capable of both carrying non-ferrous metals and ores from Dudinka year-round, as well as to operate on the whole NSR during summer. The fleet is ageing, and no concrete plans to build replacements have been reported. Capacity may become insufficient from around 2007-2008.

The ports are not major bottlenecks in the NSR infrastructure. Even though capacity has been seriously damaged by a decaying technical state, the low overall economic activity of the Russian Arctic has led to very little transport demand, and apart from Dudinka, only very small volumes need to be handled by the existing ports. However, some new ports will need to be established in order to handle future oil export: Varandey and probably also Pechenga, Dikson, Kharasavey and other ports along the coasts of the oil-producing regions.

Some other, very minor infrastructure problems also exist, such as the low transfer capacity of the INMARSAT communication system, which makes efficient tactical ice-navigation difficult, as it does not allow near real-time transmission of digitized ice-information to the vessels.

7 Overall Conclusions

The review of potential NSR cargo flows concluded that the level of traditional NSR cargoes - non-ferrous metals and ores, timber, coal and deliveries to Arctic settlements – is likely to remain stable at around 1.5-2.0 mln tons annually. Only one significant new source of cargo for the future can be expected, namely hydrocarbons from various locations around the Pechora Sea and later also around the western Kara Seas, with realistic potentials of up to approximately 20 mln tons by 2015. Gas condensate and crude oil are the most realistic cargoes, with LNG a possibility beyond 2015. The transport economy of transit operations between Europe and the North Pacific/East Asia is clearly unprofitable under present conditions – NSR fees are too high for the cargo owners, and too low for the ice-breaker operators – and no *regular* transit operations are expected before within 2015, with a possible exception of very small volumes of Japanese nuclear fuel and waste in transit to/from Europe.

The Russian Arctic tanker fleet is being rejuvenated, and larger tankers are likely to be constructed when large-scale oil production starts up. The dry cargo fleet is, however, ageing, with no concrete reports of newbuildings underway. Without replacements, transport of non-ferrous metals and ores from Dudinka may face a major crisis as early as around 2005-6, and later the capacity may not even be sufficient to carry out the few annual cargo shipments of fuel, food and other commodities to the Arctic settlements.

At present there is considerable ice-breaker over-capacity. With old ice-breakers being decommissioned, and NSR cargo volumes increasing, it is, however, expected that a critical point will be reached around 2010, when cargo volumes will amount to an estimated 10-15 mln tons. This is likely to hurt especially the transport of non-ferrous metals/ores from Dudinka, which will be fighting a hard – and probably loosing – battle with the oil industry for *winter* escort. The Norilsk Nickel Company will probably need to find alternative logistic solutions. Only one major new ice-breaker will enter into operation before 2010, and with the construction of new, nuclear ice-breakers estimated to take *at least* 10 years, unless work commences within a few years, a crisis will extend to the whole NSR, as also *summer* ice-breaker capacity will become insufficient around 2015, further jeopardising deliveries to the Arctic settlements.

Lack of ice-breaking capacity is probably the greatest future bottleneck for NSR operations, with Russian State finances not likely to allow for the very large investments required, equivalent of several billion USD. For the oil industry, this may be solved by it building its own, especially adapted ice-breakers, or by embarking on the construction of new classes of large ice-breaking tankers capable of operating without ice-breaker support in first-year ice. This would still leave the rest of the NSR without adequate ice-breaker capacity, and the lack of commercial potential combined with the weak state finances does not create an optimistic outlook for the eastern NSR. No longer just a joke: the NSR's most realistic hope of "rescue" may come from the observed trend of a diminishing Arctic ice-cap, which – if continued – will offer drastically different conditions for NSR shipping within a few decades.

ANNEX A: DETAILED NSR CARGO STATISTICS

A1: CARGO TRANSPORT BY SEA VESSELS IN THE REPUBLIC OF SAKHA (YAKUTIA) AND NORTHERN CHUKOTKA 1985-1997

A2: NORTHERN SEA ROUTE CARGO STATISTICS 1998

ANNEX A1

CARGO TRANSPORT BY SEA VESSELS IN THE REPUBLIC OF SAKHA (YAKUTIA) AND NORTHERN CHUKOTKA 1985-1997 (thousand tons)[234]

	1985	**1990**	**1995**	**1996**	**1997**	**Maximum transportation volume – year**
I. Coastal trade from the West of Russia, total	463.5	248.9	68.9	165.2	187.8	468.8 – 1987.
incl. in tanks	236.1	110.4	65.8	158.3	182.2	236.1 – 1985
Includes per Regions						
to Tiksi, total	285.7	168.2	0.5	47.1	117.6	384.0 – 1987
incl. in tanks	131.6	102.2	-	47.1	117.6	189.8 – 1987
to Indigirka, total	30.1	1.1	-	14.2	-	30.1 – 1985
incl. in tanks	28.6	-	-	14.2	-	28.6 – 1985
to Kolyma, total	95.0	38.3	28.6	9.4	14.5	95.0 – 1985
incl. in tanks	60.3	6.2	28.6	9.4	14.5	60.3 – 1985
to Pevek, total	42.3	30.3	37.2	59.3	45.0	59.3 – 1996
incl. in tanks	15.6	-	37.2	56.5	40.6	56.5 – 1996
to Mys Shmidta, total	3.1	2.9	-	31.1	9.5	31.1 – 1996
incl. in tanks	-	-	-	31.1	9.5	31.1 – 1996
to other small ports, total	7.3	8.1	2.6	4.1	1.2	8.1 – 1990
incl. in tanks	-	2.0	-	-	-	3.2 – 1987
II. Coastal trade from the East of Russia, total	1110.7	1135.3	252.5	173.5	144.7	1152.3 – 1989
incl. coal	239.7	272.3	187.1	141.2	127.9	272.3 – 1990
incl. in tanks	419.0	466.9	49.5	24.7	10.1	467.6 – 1991
Includes per Regions						
to Mys Shmidta, total	258.7	239.5	52.4	11.8	9.5	272.3 – 1986
incl. coal	22.8	10.0	-	-	-	27.7 – 1987
incl. in tanks	151.6	145.4	46.4	10.1	8.5	154.6 – 1991
to Pevek, total	427.7	458.7	177.1	126.2	116.8	474.4 – 1988
incl. coal	196.3	238.1	172.1	124.9	114.6	238.1 – 1990
incl. in tanks	102.8	125.8	2.6	-	-	125.8 – 1990
to Kolyma, total	287.7	325.7	3.6	16.7	1.5	331.0 – 1991
incl. in tanks	150.2	181.8	-	14.6	-	200.0 – 1991
to Indigirka, total	7.2	6.6	0.9	1.4	-	7.8 – 1989
to Tiksi-Yana, total	78.5	52.8	0.1	-	-	107.0 – 1986
incl. in tanks	-	-	-	-	-	30.7 – 1986
to other small ports, total	50.9	52.0	18.4	17.4	16.9	52.0 – 1990
incl. coal	20.6	24.2	15.0	16.3	13.3	24.2 – 1990
incl. in tanks	14.4	13.9	0.5	-	1.6	14.4 – 1985

[234] From A. Granberg, G. Kobylkovsky & V. Plaksin (1999): “Cargo-forming Potential of Sakha (Yakutia), Chukot Autonomous District and other Far-Eastern Regions for the Northern Sea Route”. *INSROP Working Paper*, No. 135. Based on Soyuzmorniiproekt data. Sea transport by river vessels *not* included.

Table (continued)	1985	1990	1995	1996	1997	Max transportation volume - year
III. Intra-arctic Coasting, total	411.8	136.2	10.8	10.0	36.2	423.9 – 1986
incl. coal	186.5	45.7	2.6	-	31.0	186.5 – 1985
incl. in tanks	58.7	12.2	2.5	4.0	4.8	58.7 – 1985
Tiksi-Khatanga-Anabar, total	23.1	29.7	2.5	-	-	30.2 – 1991
incl. in tanks	19.9	10.5	2.2	-	-	19.9 – 1985
to Tiksi-Yana, total	59.7	-	-	-	-	69.7 – 1987
incl. in tanks	15.4	-	-	-	-	15.4 – 1985
Tiksi-Indigirka, total	10.7	4.4	-	-	-	13.4 – 1986
Tiksi-Kolyma, total	37.6	18.4	0.1	-	-	58.2 – 1987
Tiksi-Pevek, dry cargo, total	23.1	7.2	-	-	-	24.0 – 1986
Tiksi-Mys Shmidta, total	20.3	8.4	-	-	-	20.3 – 1985
Tiksi-other sm. ports total.	42.5	12.1	0.4	6.1	-	42.5 – 1985
incl. in tanks	23.4	2.4	0.4	0.1	-	23.4 – 1985
Kolyma-Pevek, coal	50.7	45.9	-	-	31.0	58.8 – 1986
Kolyma-Indigirka, coal	17.3	-	-	-	-	22.7 – 1986
Kolyma-Yana, coal	118.5	-	-	-	-	118.5 – 1985
Between other small ports of Russian East Arctic, total	8.3	10.1	7.7	3.9	5.2	30.4 – 1987
incl. in tanks	-	-	-	3.9	4.8	–
IV. Coastal trade to the ports of Russia, total	39.8	68.4	21.1	5.9	10.8	77.0 – 1991
incl. to Russian Far East	35.0	66.4	8.6	4.4	6.3	72.1 – 1991
V. Exportation, total	112.2	189.7	19.6	-	10.0	252.9 – 1989
incl. coal from Kolyma	-	25.9	-	-	-	35.5 – 1989
incl. timber from Tiksi	89.9	147.6	19.6	-	4.7	195.6 – 1989
incl. metal scrap	22.3	16.2	-	-	5.3	22.3 – 1985
VI. Importation, total	-	-	20.4	6.2	34.3	34.3 – 1997
incl. in tanks	-	-	16.0	-	27.2	27.2 – 1997
incl. imports to Pevek	-	-	0.9	2.2	8.4	8.4 – 1997
incl. imports to Mys Shmidta	-	-	19.5	-	25.9	25.9 – 1997
incl. imports to Tiksi	-	-	-	4.0	-	4.0 – 1995
Total NSR Freight Transport	2138.0	1778.5	393.3	403.8	423.8	–
incl. coal	426.2	343.9	189.7	141.2	158.7	–
incl. in tanks	713.8	589.5	133.8	187.0	224.3	–

ANNEX A2

NORTHERN SEA ROUTE CARGO STATISTICS 1998.

OVERALL VOLUMES AND VOLUMES CARRIED BY THE MURMANSK SHIPPING COMPANY AND THE NORTHERN SHIPPING COMPANY, (tons) [235]

	TOTAL	MSCO	NSC
TOTAL NSR CARGO VOLUME	**1,458,397**	**924,935**	**124,454**
- including liquid cargoes	222,667	0	0
- including dry cargoes	1,235,730	924,935	124,454
1, Cabotage import from western Russian ports	**452,563**	**255,628**	**32,626**
- including liquid cargoes	161,717	0	0
- to Novaya Zemlya	*16,778*		
- to Amderma	*0*		
- to Franz Josef Land	*0*		
- to Dudinka	*15,170*		
- to Dikson	*2,237*		
- to Khatanga Bay	*13,577*		
- to Tiksi	*34,859*		
- to the Yana	*13,809*		
- to the Indigirka	*14,491*		
- to the Kolyma	*23,021*		
- to Pevek	*27,775*		
- to pr. pp Arktiki	*0*		
- including dry cargoes	290,846	255,628	32,626
- to Dudinka	*250,512*	*222,926*	*27,339*
- to Amderma	*342*		*87*
- to Novaya Zemlya	*5,200*		*5,200*
- to Dikson	*145*		
- to Khatanga from Dudinka	*28,892*	*28,892*	
- to Tiksi	*1,545*		
- to Pevek	*3,810*	*3,810*	
- to pr. pp Arktiki	*400*		
2, Cabotage import from eastern Russian ports	**2,874**	**0**	**0**
- including dry cargoes	2,874		
- to Mys Shmidta	*612*		
- to Pevek	*932*		
- to the Kolyma	*1,330*		
3, Intra-Arctic Cabotage	**50,537**	**186**	**0**
- including liquid cargoes	3,751		
- Tiksi-Khatanga	*3,751*		
- including dry cargoes	46,786		
- Kolyma-Pevek, coal	*46,600*		
- Pevek-Dikson, general cargo	*186*	*186*	

[235] Soyuzmorniiproekt (1999): *Morskie perevozki gruzov po trasse SMP. Vypolnennie sudami parokhodstv i flotom drugikh vedomstv i kompaniy v 1998 godu (Sea Transport of Cargoes on the NSR. Carried out by Ships from Shipping Companies and the Fleet of Other Authorities and Companies in 1998).* Moscow: Soyuzmorniiproekt, unpublished memo.

4, Cabotage export to other Russian ports	**421,697**	**416,312**	**3,322**
- including liquid cargoes	0		
- *Yamal gas condensate*	*0*		
- *Ob Bay gas condensate*	*0*		
- including dry cargoes	421,697	416,312	3,322
- to the west	***419,634***	***416,312***	***3,322***
- *from Dudinka*	*418,450*	*415,180*	*3,270*
- including ores	*206,876*	*206,876*	
- including refined metals	*0*		
- including feinstein	*171,114*	*171,114*	
- other goods	*40,460*	*37,190*	*3,270*
- *from Amderma*	*52*		*52*
- *from Khatanga*	*810*	*810*	
- *from Pevek*	*322*	*322*	
- to the east	***2,063***		
- *from Pevek*	*1,522*		
- *from Mys Shmidta*	*541*		
5, Transit	**0**	**0**	**0**
6, Foreign export	**524,131**	**248,666**	**86,786**
- including liquid cargoes	57,199		
- *Ob Bay gas condensate*	*47,912*		
- *Kharasavey gas condensate*	*9,287*		
- including dry cargoes	466,932	248,666	86,786
- *including refined metals from Dudinka*	*409,725*	*248,556*	*29,863*
- *including other goods from Dudinka*	*284*	*110*	
- *including Scrap metal from Dudinka*	*15,870*		*15,870*
- *including Scrap metal from Novaya Zemlya*	*1,842*		*1,842*
- *including Timber from Igarka*	*39,211*		*39,211*
7, Foreign import	**6595**	**4143**	**1720**
- including dry cargoes	6595	4143	1720
- *to Dudinka*	*4058*	*1606*	*1720*
- *to Novyy Port*	*724*	*724*	
- *to Pevek*	*1813*	*1813*	

ANNEX B: OVERVIEW OF THE NORTHERN SEA ROUTE CARGO FLEET

B1: PRINCIPAL PARTICULARS FOR MAIN CLASSES OF HIGH ICE-CLASS (ULA OR UL) VESSELS OPERATING ON THE NSR.

B2: OVERVIEW OF THE NSR DRY CARGO FLEET OF THE *NORILSK (SA-15)*, *DMITRIY DONSKOY*, AND *MIKHAIL STREKALOVSKIY* CLASSES.

ANNEX B1

PRINCIPAL PARTICULARS FOR MAIN CLASSES OF HIGH ICE-CLASS (ULA OR UL) VESSELS OPERATING ON THE NSR.

Name of Ship Class	***Samotlor***	***Dmitriy Donskoy***	***Mikhail Strekalovskiy***	***Norilsk (SA-15)***	***Ventspils***	***Sevmorput***	***Partizansk***	***Vitus Bering***	***Ivan Papanin***	***Kapitan Sakharov***	***Sestroretsk***	***Astrakhan***	***Lunni* (modified)**
Register name	RR	RR	RR	RR	RR	RR	RR	RR	RR	RR	RR	RR	DNV
Ice class	UL	UL	UL	ULA	UL	UL	UL	ULA	ULA	UL	UL	UL	1A Super
Operator + No. of ships believed to be in operation[1]	PRISCO: 12	MSCO: 13	MSCO: 5 (+7) FESCO: 2	MSCO: 4 (+3) FESCO: 6	PRISCO: 5 LSC: 5	MSCO: 1	PRISCO: 9 NSC: 1	FESCO: 5	MSCO: 1	FESCO: 3 NSC: 1	FESCO: 3	LAT: 5	Fortum: 2
Country	Russia	Russia	Russia	Russia	Russia / Latvia	Russia	Russia	Russia	Russia	Russia	Russia	Russia	Finland
Vessel type	Tanker	Cargo	Cargo	Cargo	Tanker	Lash / lighter	Tanker	RORO	RORO	Container	Container	Tanker	Tanker
Year construction completed	1975-78	1977-81	1981-82	1982-87	1983-86	1988	1988-90	1986-89	1990	ND	ND	2000-01	1993–95
Dimensions													
L_{OA}(m)	160.0	162.1	162.1	174.0	113.0	260.3	97.4	159.8	166.3	ND	ND	155,6	164.4
L_{BP}(m)	148.0	154.9	154.8	159.6	105.3	228.8	90.1	142.4	ND	ND	ND	ND	150.0
B(m)	23.0	22.9	22.9	24.0	17.1	31.6	14.2	22.1	22.6	ND	ND	24.5	22.2
D(m)	12.9	13.5	13.5	15.2	8.5	18.3	6.5	12.0	ND	ND	ND	ND	12.0
d(m)	9.2	9.9	9.9	9.0	7.2	11.7	4.9	8.5	9.0	ND	ND	9.8	9.5
Cargo capacity (tonnes)[2]	15,000	15,850	15,850	15,7000 (10,345)	ND	22,200	5,300	6,200	6,200	3,800	3,800	19,100	12,000
Gross tonnage (tonnes)	13,204	13,481	13,520	16,500	5,154	38,226	2,968	13,514	ND	ND	ND	ND	10,936
Displacement (tonnes)[2]	24,570	27,340	27,340	31,200 (25,900)	9,400	54,380	4,855	18,900	ND	ND	ND	ND	ND
Dead-weight (tonnes)[2]	17,200	19,885	19,252	19,942 (14,700)	6,297	33,980	2,833	9,200	10,150	ND	ND	20,000	15,748
Propulsion													
Total power (MW)	8.5	8.2	8.2	15.4	4.4	29.4	2.9	11.5	13.2	ND	ND	8.6	13.8
Machinery	Diesel Direct drive	Diesel Direct drive	Diesel Direct drive	Diesel Direct drive	Diesel Direct drive	Nuclear Turbo electric	Diesel Direct drive	Diesel ND	Diesel ND	Diesel ND	Diesel ND	Diesel ND	Diesel Azipod
Nozzle(s)	No	No	No	No	No	Yes	ND	Yes	ND	ND	ND	ND	No
Performance													
In open water (knots)	15.7	15.2	15.2	18.1	15.2	20.8	13.5	16.4	14.0	ND	ND	13.3	14.5
In ice (knots)	ND	ND	ND	2kn in 1.0m	ND	ND	ND	2kn in 0.9m	ND	ND	ND	ND	2Kn in 1.0m

Note: In addition to these vessels, a substantial UL class timber fleet is in existence. By 01.01.1996, this consisted of at least 47 vessels (NSC: 39; FESCO: 8) of different classes, with cargo capacity between 2100-6500 dwt.

[1] All FESCO and NSC figures based on 1996 data, and some of the vessels have probably been decommissioned since. MSCO and PRISCO figures based on 1998 data. LSC, LAT and Fortum figures based on 2000 data. As for MSCO figures, vessels controlled by its affiliate "NB Shipping Malta" are included in brackets.

[2] Cargo capacity, displacement and dead-weight are given at "standard" (loadline) figures. However, when operating in Arctic waters, actual figures are lower. Arctic figures for the *Norilsk (SA-15)* class have been included in brackets. Arctic figures for other classes have not been found.

Abbreviations: RR: Russian Maritime Register of Shipping; DNV: Det Norske Veritas; PRISCO: Primorsk Shipping Company; MSCO: Murmansk Shipping Company; FESCO: Far Eastern Shipping Company; LSC: Latvian Shipping Company; NSC: Northern Shipping Company; L_{OA}: Overall length; B: Breadth; D: Depth; d: Draft; MW: Megawatt; ND: No data

Sources: This table has been adapted from L.W. Brigham, V.D. Grishchenko & K. Kamesaki (1999): "The Natural Environment, Ice Navigation and Ship Technology" in W. Østreng (ed.): *The Natural and Societal Challenges of the Northern Sea Route. A Reference Work.* Dordrecht/Boston/London: Kluwer Academic Publishers. Their information was based on the following original sources:

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ANNEX B2

OVERVIEW OF THE NSR DRY CARGO FLEET OF THE *NORILSK (SA-15)*, *DMITRIY DONSKOY*, AND *MIKHAIL STREKALOVSKIY* CLASSES

CLASS/Name of vessel:	**Owner:**	**Year built:**	**Decommission expected within[1]:**
***NORILSK (SA-15)* CLASS (ULA)**			
Norilsk	NB Shipping[2]	1982	**2007**
Nizhneyansk	*FESCO*	*1983*	*Scrapped?*
Bratsk	*FESCO*	*1983*	*Scrapped?*
Okha	*Sakhalin SCo*	*1983*	*Scrapped?*
Kemerovo	*Sakhalin SCo*	*1983*	*Scrapped?*
Tiksi	*MSCO*	*1983*	*Scrapped?*
Amderma	FESCO	1983	**2008**
Igarka	FESCO	1983	**2008**
Kola	MSCO	1983	**2008**
Arkhangelsk	NB Shipping[2]	1983	**2008**
Monchegorsk	NB Shipping[2]	1983	**2008**
Nikel	*MSCO*	*1984*	*Scrapped?*
Kandalaksha	MSCO	1984	**2009**
Anadyr	FESCO	1984	**2009**
Anatoly Kolesnichenko	FESCO	1985	**2010**
Kapitan Man	FESCO	1985	**2010**
Vasiliy Burkhanov	FESCO	1986	**2011**
Yuriy Arshenevskiy	MSCO	1986	**2011**
Kapitan Danilikin	MSCO	1987	**2012**
***DMITRIY DONSKOY* CLASS (UL)**			
Dmitriy Donskoy	MSCO	1977	**2002**
Pyotr Velikiy	MSCO	1978	**2003**
Dmitriy Posharskiy	MSCO	1978	**2003**
Alexandr Nevskiy	MSCO	1978	**2003**
Admiral Ushakov	MSCO	1979	**2004**
Alexandr Suvorov	MSCO	1979	**2004**
Mikhail Kutuzov	MSCO	1979	**2004**
Kuzma Minin	MSCO	1980	**2005**
Stepan Razin	MSCO	1980	**2005**
Emelyan Pugachev	MSCO	1980	**2005**
Yuriy Dolgorukiy	MSCO	1980	**2005**
Ivan Bogun	MSCO	1981	**2006**
Ivan Susanin	MSCO	1981	**2006**
***MIKHAIL STREKALOVSKIY* CLASS (UL)**			
Mikhail Strekalovskiy	MSCO	1981	**2006**
Pavel Vavilov	MSCO	1981	**2006**
Kapitan Chukhchin	MSCO	1981	**2006**
Viktor Tkachev	MSCO	1981	**2006**
Ivan Makaryin	FESCO	1981	**2006**

Kapitan Tsirul	FESCO	1981	**2006**
Kapitan Sviridov	MSCO	1982	**2007**
Kapitan Bocheck	NB Shipping[2]	1982 ?	**2007 ?**
Kapitan Vodenko	NB Shipping[2]	1982 ?	**2007 ?**
Tim Bak	NB Shipping[2]	1982 ?	**2007 ?**
Kapitan Vakula	NB Shipping[2]	1982 ?	**2007 ?**
Kapitan Kudlay	NB Shipping[2]	1982 ?	**2007 ?**
Kapitan Nazaryev	NB Shipping[2]	1982 ?	**2007 ?**
Anatoliy Lyapidevskiy	NB Shipping[2]	1982 ?	**2007 ?**

Abbreviations: MSCO: Murmansk Shipping Company; FESCO: Far-Eastern Shipping Company
Notes: [1] Assuming 25-year life time
[2] NB Shipping is a Malta-registered affiliate of the Murmansk Shipping Company
Sources: Mainly the shipping companies' Annual Reports in the period 1996-99.

Number of Remaining Vessels (assuming 25-year life time)**:**

2000: **40**
2001: **40**
2002: **40**
2003: **39**
2004: **36**
2005: **33**
2006: **29**
2007: **21**
2008: **12**
2009: **7**
2010: **5**
2011: **3**
2012: **1**
2013: **0**

ANNEX C: ANALYSIS OF FUTURE NEED FOR NSR CARGO VESSELS

C1: ANALYSIS OF FUTURE NEED FOR NSR TANKERS.

C2: ANALYSIS OF FUTURE NEED FOR SPECIALIZED CARGO VESSELS FOR THE TRANSPORT OF NUCLEAR CARGOES ON THE NSR.

ANNEX C1

ANALYSIS OF FUTURE NEED FOR NSR TANKERS

Prirazlomnoye crude oil: By 60,000 t tankers to reloading in the Pechenga Fjord, year-round.

- Average distance from Prirazlomnoye to Pechenga Fjord: 600 nm (10% added from shortest line, to account for deviations when avoiding areas with especially difficult ice-conditions)
- Average speed in open water: 14 knots / Average speed in ice: 10 knots
- Annual average ice-cover along route: 25%

= Average speed: 13.0 knots
= Average time in sea, one way: 46 hours

- Loading/unloading: 2 days each.

= 1 round trip takes approximately 7.8 days
= Number of annual round trips possible: 46

2005 cargo volume: 2.0 mln tons = 34 annual roundtrips = 1 x 60,000 t tanker needed
2010 cargo volume: 6.0 mln tons = 100 annual roundtrips = 2-3 x 60,000 t tankers needed
2015 cargo volume: 4.0 mln tons = 67 annual roundtrips = 2 x 60,000 t tankers needed

Varandey crude oil: By 20,000 t tankers (in 2005) and 60,000 t tankers (in 2010 and 2015) to reloading in the Pechenga Fjord, year-round.

- Average distance from Varandey to Pechenga Fjord: 640 nm (10% added from shortest line, to account for deviations when avoiding areas with especially difficult ice-conditions)
- Average speed in open water: 14 knots / Average speed in ice: 10 knots
- Annual average ice-cover along route: 30%

= Average speed: 12.8 knots
= Average time in sea, one way: 50 hours

- Loading/unloading: 1 day each for 20,000 t tanker / 2 days each for 60,000 t tanker

= 1 round trip takes approximately 6.2 days for 20,000 t vessel / 8.2 days for 60,000 t vessel
= Number of annual round trips possible: 58 for 20,000 t vessel / 44 for 60,000 t vessel

2005 cargo volume: 1.0 mln tons = 50 annual roundtrips = 1 x 20,000 t tanker needed
2010 cargo volume: 5.0 mln tons = 84 annual roundtrips = 2 x 60,000 t tankers needed
2015 cargo volume: 8.0 mln tons = 134 annual roundtrips = 3-4 x 60,000 t tankers needed

Dikson crude oil: By 60,000 t tankers to reloading in the Pechenga Fjord, year round.

- Average distance from Dikson to Pechenga Fjord: 1150 nm (10% added from shortest line, to account for deviations when avoiding areas with especially difficult ice-conditions)
- Average speed in open water: 14 knots / Average speed in ice: 9 knots
- Annual average ice-cover along route: 50%

= Average speed: 11.5 knots
= Average time in sea, one way: 100 hours

- Loading/unloading: 2 days each.

= 1 round trip takes approximately 12.3 days
= Number of annual round trips possible: 29

2005 cargo volume: 0.0 mln tons
2010 cargo volume: 0.0 mln tons
2015 cargo volume: 5.0 mln tons = 67 annual roundtrips = 3 x 60,000 t tankers needed

Gas condensate: By 20,000 t tankers from Kharasavey, Ob Bay, Dudinka and other ports around the Kara Sea, directly to Rotterdam, year-round.

- Average distance from loading point to Rotterdam: 2690 nm (Dikson chosen as representative loading point, route south of Novaya Zemlya chosen as standard export route. 5% added from shortest line, to account for deviations when avoiding areas with especially difficult ice-conditions)
- Average speed in open water: 14 knots / Average speed in ice: 9 knots
- Annual average ice-cover along route: 20%

= Average speed: 13.0 knots
= Average time in sea, one way: 207 hours

- Loading/unloading: 2 days each

= 1 round trip takes approximately 21.2 days
= Number of annual round trips possible: 17

2005 cargo volume: 0.2 mln tons = 10 annual roundtrips = 1 x 20,000 t tanker needed
2010 cargo volume: 0.5 mln tons = 25 annual roundtrips = 2 x 20,000 t tankers needed
2015 cargo volume: 1.0 mln tons = 50 annual roundtrips = 3 x 20,000 t tankers needed

Fuel Provisions: By 20,000 t tankers from Murmansk/Arkhangelsk to various destinations along the NSR

Fuel deliveries can be divided into two: Deliveries to Dudinka and other destinations on the way (such as Dikson etc), and deliveries to other locations, mainly along the eastern NSR.

Fuel deliveries on the “Dudinka line” can be carried out year-round, transported in by tankers that transport out gas condensate, and no dedicated vessels are required. Volumes are expected ad 0.05 mln tons in 2005 and 0.10 mln tons in 2010 and 2015.

Fuel deliveries to the eastern NSR must be carried out during summer. The traditional season is 4 month. Volumes are expected to be 0.20 mln tons annually in the whole period 2005-2015. This means 10 shiploads per summer. Compared to other types of hydrocarbon transport, fuel deliveries are more difficult to estimate. However, assuming Zelëny Mys /Kolyma) as an “average” destination, average distance from Murmansk is 3000 nm (having added 20% for deviation in order to avoid areas with difficult ice conditions). A vessel might have to call at several ports, so a total of 6 days are assumed to be port days per round trip. Average summer speeds are estimated at 10 knots. This indicates that one round trip is on average 31 days, enabling 3-4 round trips per summer season. This further indicates that 3, probably **4 x 20,000 t tankers** are required during the summer season to provide sufficient fuel to the NSR settlements.

Possible Synergies:

- By coordinating operations at Prirazlomnoye and Varandey, the need of 60,000 t tankers may be reduced by one in 2010 and 2015.
- Tankers carrying out gas condensate can also on their return legs take part in the transport of fuel to Dudinka/Dikson etc in winter and eastern NSR settlements in summer. Thus, no dedicated fuel carriers will be needed in the winter, and one tanker may be "saved" during summer.

Total estimated minimum need of tankers:

2005: 1 x 60,000 t + 2 x 20,000 t (+ 3-4 x 20,000 t during summer only)
2010: 4 x 60,000 t + 2 x 20,000 t (+ 3-4 x 20,000 t during summer only)
2015: 8 x 60,000 t + 3 x 20,000 t (+ 3-4 x 20,000 t during summer only)

ANNEX C2

ANALYSIS OF FUTURE NEED FOR SPECIALIZED CARGO VESSELS FOR THE TRANSPORT OF NUCLEAR CARGOES ON THE NSR

- Annual transport need: 1-2 shiploads of reprocessed MOX fuel Europe --> Japan. 1-2 shiploads of nuclear waste Europe --> Japan. 5-6 shiploads of spent nuclear fuel Japan --> Europe.
- 2 vessel convoys is mandatory for security reasons while transporting MOX fuel. 2-vessel convoys also assumed when transporting waste and spent fuel.
- Annual cycle starts in Europe 1 July.
- Speed assumed for open water: 14 knots. Speed assumed for the NSR: 9 knots
- Size of future vessels is assumed to be similar to the existing vessels (3775 dwt).

Annual cycle

Loading MOX Europe: 4 days	1 July
Atlantic: 1800 nm / 14 knots = 6 days	
NSR: 2550 nm / 9 knots = 12 days	
Pacific: 2450 nm / 14 knots = 7 days	
Unloading MOX Japan: 4 days	2 August
Loading spent fuel Japan: 4 days	3 August
Pacific: 2450 nm / 14 knots = 7 days	
NSR: 2550 nm / 9 knots = 12 days	
Atlantic: 1800 nm / 14 knots = 6 days	
Unloading spent fuel Europe: 4 days	4 September
Loading nuclear waste Europe: 4 days	5 September
Atlantic: 1800 nm / 14 knots = 6 days	
NSR: 2550 nm / 9 knots = 12 days	
Pacific: 2450 nm / 14 knots = 7 days	
Unloading nuclear waste Japan: 4 days	7 October

= during a 4-month summer season, the following can be transported via the NSR:

- 2 shiploads of MOX Europe --> Japan
- 2 shiploads of nuclear waste Europe --> Japan
- 2 shiploads of spent fuel Japan --> Europe

Remaining 3-4 shiploads of spent fuel can be transported Japan --> Europe during winter via traditional routes.

Conclusions:

- **Even with large error margin, 3 NSR transits with 2-vessel convoys can be made during a 4-month summer season (2 eastwards, 1 westwards).**
- **All of the most sensitive material (MOX and nuclear waste) can be transported via the NSR in summer, in addition to some spent nuclear fuel. The remaining nuclear fuel can be transported via traditional routes during winter.**
- **2 cargo vessels will be sufficient for the entire trade.**

ANNEX D: ANALYSIS OF FUTURE NEED FOR ICE-BREAKERS ON THE NSR

ANNEX D

ANALYSIS OF FUTURE NEED FOR ICE-BREAKERS ON THE NSR

Basic assumptions for the calculations:

- Only the use of the following existing classes of ice-breakers is considered: 56 MW nuclear *Arktika* class, 33 MW shallow-draft nuclear *Taymyr* class, 16 MW shallow-draft diesel *Kapitan Sorokin* class.
- It is assumed that in the Kara Sea in winter, 56 MW nuclear ice-breakers are preferable.
- It is assumed that 33 MW nuclear ice-breakers are preferable on the Yenisey and on the Ob Bay.
- It is assumed that 33 MW nuclear ice-breakers are preferable to escort tankers from ports in the Pechora Sea.
- It is assumed that 16 MW diesel ice-breakers are able to handle all other ice-breaking of 20,000 dwt vessels in the Pechora Sea, and that they can substitute 33 MW nuclear ice-breakers under light ice conditions.
- Winter season lasts 8 months, summer season is 4 months.
- For all export of crude oil (except the initial phase of export from the Varandey terminal) tankers of 60,000 t dead-weight/cargo capacity are used. For all other transport of hydrocarbons, tankers of 20,000 t dead-weight/cargo capacity are assumed. All transport of dry cargoes are assumed to take place on 20,000 dwt dry cargo vessels (with average cargo capacity of 15,000 t).
- It is assumed that convoys with on average 2 cargo vessels are used systematically for deliveries to the NSR settlements during summer and for the transit of nuclear cargoes. For other, mostly commercial cargoes, every cargo vessel will be escorted by a dedicated ice-breaker, to avoid delays.

WINTER ICE-BREAKER NEED
= Escort of Oil and Non-Ferrous Metals/Ores on the Western NSR

Winter 2005

The following freight flows requiring ice-breaker assistance are previewed (annual volumes):

- 2.0 mln tons of crude oil from offshore Prirazlomnoye (Pechora Sea) westwards.
- 1.0 mln tons of crude oil from Varandey (Pechora Sea) westwards.
- 0.2 mln tons of gas condensate from Kara Sea ports (Kharasavey, Ob Bay, Dudinka etc.) westwards.
- 0.9 mln tons of non-ferrous metals/ores from Dudinka (Yenisey) westwards.

2.0 million tons of crude oil from Prirazlomnoye, year-round.
Ship's cargo capacity: 60,000 t
Number of voyages: 34
= One departure every 10-11 days.
Vessels will normally need 1-2 day escorting during winter conditions.
= ice-breaker roundtrip is 2-4 days.
= **1 x 33 MW** nuclear ice-breaker is sufficient for all ice-breaking operations.

1.0 million tons of crude oil from Varandey, year-round.
Ship's cargo capacity: 20,000 t (in this initial phase – later it will be 60,000 t)

Number of voyages: 50
= One departure every 7-8 days.
Vessels will normally need 1-2 day escorting during winter conditions.
= ice-breaker roundtrip is 2-4 days.
= **1 x 16 MW** diesel-electric ice-breaker is sufficient for all ice-breaking operations.
NB: If a 60,000 t tanker had been used instead of 20,000 tankers, the number of annual voyages would have been 17, meaning one departure every 21-22 days, and one 33 MW nuclear ice-breaker would have been required for escort.

0.2 mln tons of gas condensate from Kharasavey, Ob Bay, Dudinka etc., year-round.
Difficult to estimate exact ice-breaker need since transports will be irregular. However, assuming transport by vessels of 20,000 t cargo capacity from "somewhere" in the Kara Sea, the following can be deduced:
Number of voyages: 10
= One departure every 36-37 days.
Vessels will normally need 3-5 day escorting during winter conditions.
Ice-breaker roundtrip 6-10 days
= **1 x 56 MW** nuclear ice-breaker will be sufficient

0.9 mln tons of non-ferrous metals/ores from Dudinka, year-round.
Ship's cargo capacity: 15,000 t
Number of voyages: 60 voyages
= one departure every 6 days
Vessels will normally need 4-6 days escorting during winter conditions (1-2 days on Yenisey and 3-5 days on Kara/Pechora Sea)
= **2 x 56 MW** (Kara + Pechora Seas) + **1-2 x 33 MW** nuclear (on the Yenisey)

TOTAL (with only dedicated ice-breakers escorting only one cargo vessel): **3 x 56 MW + 2-3 x 33 MW + 1 x 16 MW.**

POSSIBLE SYNERGIES:

- All traffic on the Yenisey (non-ferrous metals and gas condensate) can be handled by the 2 x 33 MW ice-breakers presently handling the non-ferrous trade.
- If gas condensate transport can be concentrated in the summer, or if winter transports can be escorted by 56 MW ice-breakers escorting the non-ferrous metals/ores from Dudinka, one 56 MW ice-breaker can be "saved"
- All traffic from Varandey and Prirazlomnoye can be handled by one 33 MW ice-breaker.

The following ice-breakers are therefore needed:

1 x 33 MW dedicated ice-breaker for Prirazlomnoye and Varandey export
2 x 56 MW dedicated ice-breakers constantly escorting non-ferrous metals/ores (and gas condensate) between Dikson and the ice-edge.
1-2 x 33 MW ice-breakers on the Yenisey, occasionally on the Ob Bay.

= Minimum total need for 2005 winter season:
2 x 56 MW nuclear ice-breakers
2-3 x 33 MW nuclear ice-breakers

However: Extreme weather will cause delays. If no spare ice-breakers are available, breakdowns will also lead to delays if they occur in the late winter.

Winter 2010

The following freight flows requiring ice-breaker assistance are previewed (annual volumes):

- 6.0 mln tons of crude oil from offshore Prirazlomnoye (Pechora Sea) westwards.
- 5.0 mln tons of crude oil from Varandey (Pechora Sea) westwards.
- 0.5 mln tons of gas condensate from Kara Sea ports (Kharasavey, Ob Bay, Dudinka etc.) westwards.
- 0.9 mln tons of non-ferrous metals/ores from Dudinka (Yenisey) westwards.

6.0 million tons of crude oil from Prirazlomnoye, year-round.
Ship’s cargo capacity: 60,000 t
Number of voyages: 100
= One departure every 3-4 days.
Vessels will normally need 1-2 day escorting during winter conditions.
= ice-breaker roundtrip is 2-4 days.
= **1 x 33 MW** nuclear ice-breaker is sufficient for all ice-breaking operations.

5.0 million tons of crude oil from Varandey, year-round.
Ship’s cargo capacity: 60,000 t
Number of voyages: 84
= One departure every 4-5 days.
Vessels will normally need 1-2 day escorting during winter conditions.
= ice-breaker roundtrip is 2-4 days.
= **1 x 33 MW** nuclear ice-breaker is sufficient for all ice-breaking operations.

0.5 mln tons of gas condensate from Kharasavey, Ob Bay, Dudinka etc., year-round.
Difficult to estimate exact ice-breaker need since transports will be irregular. However, assuming transport by vessels of 20,000 t cargo capacity from “somewhere” in the Kara Sea, the following can be deduced:
Number of voyages: 25
= One departure every 14-15 days.
Vessels will normally need 3-5 day escorting during winter conditions.
Ice-breaker roundtrip 6-10 days
= **1 x 56 MW** nuclear ice-breaker will be sufficient

0.9 mln tons of non-ferrous metals/ores from Dudinka, year-round.
Ship’s cargo capacity: 15,000 t
Number of voyages: 60 voyages
= one departure every 6 days
Vessels will normally need 4-6 days escorting during winter conditions (1-2 days on Yenisey and 3-5 days on Kara/Pechora Sea)
= **2 x 56 MW** (Kara + Pechora Seas) + **1-2 x 33 MW** nuclear (on the Yenisey)

TOTAL (with only dedicated ice-breakers escorting only one cargo vessel): **3 x 56 MW + 3-4 x 33 MW**

POSSIBLE SYNERGIES:

- All traffic on the Yenisey (non-ferrous metals and gas condensate) can be handled by the 2 x 33 MW ice-breakers presently handling the non-ferrous trade.

- If gas condensate transport can be concentrated in the summer, or if winter transports can be escorted by 56 MW ice-breakers escorting the non-ferrous metals/ores from Dudinka, one 56 MW ice-breaker can be “saved”

The following ice-breakers are therefore needed:

1 x 33 MW dedicated ice-breaker for Prirazlomnoye export
1 x 33 MW dedicated ice-breaker for Varandey export
2 x 56 MW dedicated ice-breakers constantly escorting non-ferrous metals/ores (and gas condensate) between Dikson and the ice-edge.
1-2 x 33 MW ice-breakers on the Yenisey, occasionally on the Ob Bay.

= Minimum total need for 2010 winter season:
2 x 56 MW nuclear ice-breakers
3-4 x 33 MW nuclear ice-breakers

However: Extreme weather will cause delays. If no spare ice-breakers are available, breakdowns will also lead to delays if they occur in the late winter.

Winter 2015

The following freight flows requiring ice-breaker assistance are previewed (annual volumes):

- 4.0 mln tons of crude oil from offshore Prirazlomnoye (Pechora Sea) westwards.
- 8.0 mln tons of crude oil from Varandey (Pechora Sea) westwards.
- 5.0 mln tons of crude oil from Dikson (Kara Sea) westwards.
- 1.0 mln mln tons of gas condensate from Kara Sea ports (Kharasavey, Ob Bay, Dudinka etc.) westwards.
- 0.9 mln tons of non-ferrous metals/ores from Dudinka (Yenisey) westwards.

4.0 million tons of crude oil from Prirazlomnoye, year-round.
Ship’s cargo capacity: 60,000 t
Number of voyages: 67
= One departure every 5-6 days.
Vessels will normally need 1-2 day escorting during winter conditions.
= ice-breaker roundtrip is 2-4 days.
= **1 x 33 MW** nuclear ice-breaker is sufficient for all ice-breaking operations.

8.0 million tons of crude oil from Varandey, year-round.
Ship’s cargo capacity: 60,000 t
Number of voyages: 133
= One departure every 2.5-3 days.
Vessels will normally need 1-2 day escorting during winter conditions.
= ice-breaker roundtrip is 2-4 days.
= **1-2 x 33 MW** nuclear ice-breakers are sufficient for all ice-breaking operations.

5.0 million tons of crude oil from Dikson, year round
Ship’s cargo capacity: 60,000 t
Number of voyages: 84
= One departure every 4-5 days.

Vessels will normally need 3-5 day escorting during winter conditions.
= ice-breaker roundtrip is 6-10 days.
= **2 x 56 MW** nuclear ice-breaker are sufficient for all ice-breaking operations.

1.0 mln tons of gas condensate from Kharasavey, Ob Bay, Dudinka etc., year-round.
Difficult to estimate exact ice-breaker need since transports will be irregular. However, assuming transport by vessels of 20,000 t cargo capacity from "somewhere" in the Kara Sea, the following can be deduced:
Number of voyages: 50
= One departure every 7-8 days.
Vessels will normally need 3-5 days escorting during winter conditions.
Ice-breaker roundtrip 6-10 days
= **1 x 56 MW** nuclear ice-breaker (+ maybe **1 x 16 MW** in the Pechora Sea)

0.9 mln tons of non-ferrous metals/ores from Dudinka, year-round.
Ship's cargo capacity: 15,000 t
Number of voyages: 60 voyages
= one departure every 6 days
Vessels will normally need 4-6 days escorting during winter conditions (1-2 days on Yenisey and 3-5 days on Kara/Pechora Sea)
= **2 x 56 MW** (Kara + Pechora Seas) + **1-2 x 33 MW** nuclear (on the Yenisey)

TOTAL (with only dedicated ice-breakers escorting only one cargo vessel): **5 x 56 MW + 4-5 x 33 MW + 1 x 16 MW.**

POSSIBLE SYNERGIES:

- By coordinating escorting to and from Prirazlomnoye and nearby Varandey, it should be possible to escort all forecasted oil volumes out of these ports with 2 x 33 MW ice-breakers.
- All traffic on the Yenisey (non-ferrous metals and gas condensate) can be handled by the 2 x 33 MW ice-breakers presently handling the non-ferrous trade.
- If gas condensate transport can be concentrated in the summer, or if winter transports can be escorted by 56 MW ice-breakers escorting the non-ferrous metals/ores from Dudinka, one 56 MW ice-breaker can be "saved"

The following ice-breakers are therefore needed:

2 x 33 MW dedicated ice-breakers for Prirazlomnoye and Varandey export
4 x 56 MW ice-breakers constantly escorting non-ferrous metals/ores and crude oil (and gas condensate) between Dikson and the ice-edge.
1-2 x 33 MW ice-breakers on the Yenisey, occasionally on the Ob Bay.

= Minimum total need for 2015 winter season:
4 x 56 MW nuclear ice-breakers
3-4 x 33 MW nuclear ice-breakers

However: Extreme weather will cause delays. With no spare ice-breakers available, breakdowns will also lead to delays if they occur in the late winter.

SUMMER ICE-BREAKER NEED
= Escort of Supplies to the Arctic Settlements and Transit Traffic on the Eastern NSR

In periods of high volumes, MSCO has used a “zone system” for escort along the NSR in the summer, with one 56 MW ice-breaker has passed on the cargo vessels to the next ice-breaker in the chain. Each ice-breaker has covered approximately 1000-1200 km of the NSR. Under difficult ice-conditions, this system has required 5 x 56 MW + 1 x 33 MW ice-breakers. Under light ice-conditions, 3 x 56 MW + 2 X 33 MW ice-breakers have been sufficient.

This system can not easily be implemented any more, since there is only 4 x 56 MW and 2 x 33 MW icebreakers available (provided that all existing ice-breakers are out and working simultaneously). With transport volumes sharply reduced compared to the 1980s, it may not be the most rational system either.

By giving each ice-breaker a larger area of responsibility, the number of ships that can be escorted during one season decreases.

With low level of traffic, the most rational organization of summer escort along the eastern NSR is probably a convoy system with one dedicated ice-breaker that in principle follows the convoy all the way. Such a system should at least be feasible for supplies coming from Murmansk/Arkhangelsk, even though it may be more difficult to efficiently organize convoys for internal transport and for import coming from the east.

Assuming that a convoy system is in place for deliveries from Murmansk/Arkhangelsk to eastern NSR, and assuming that such convoys on average consist of one ice-breaker and two cargo-vessels, the following results are obtained:

Summer – both 2005, 2010 and 2015

The following freight flows requiring ice-breaker assistance are previewed (annual volumes):

- 0.20 million tons of fuel delivered from Murmansk/Arkhangelsk to settlements along the eastern NSR.
- 0.15 mln tons of dry cargo delivered from Murmansk/Arkhangelsk to settlements along the eastern NSR.
- 3 convoys (6 shiploads) of nuclear fuel/waste in transit (2 eastwards, 1 westwards)
- 0.05 million tons (3 shiploads) of pipes from Japan to western NSR
- 0.05 million tons of coal and other dry cargo transported internally along eastern NSR

0.20 million tons of fuel and 0.15 million tons of dry cargo to Eastern NSR settlements.
We assume the following:

- One *average* roundtrip from Kara Sea to destination(s) is 20 days for the ice-breaker.
- All traffic to be carried-out during the traditional summer season, i.e. 120 days.

= Approximately 10 shiploads of fuel and 10 shiploads of dry cargo will be required during the summer.
= 1 ice-breaker can make 6 roundtrips during one summer.
= Approximately 10 ice-breaker roundtrips are needed to escort 10 convoys.
= At least 2 x 56 MW ice-breakers are needed.

3 transits convoys with nuclear fuel/waste
2 eastbound and 1 westbound transit convoys per summer (two cargo vessels per convoy)
Ice-breaker assistance will be needed for on average 10 days per transit.
= 1 dedicated 56 MW ice-breaker will be required for the nuclear fuel.

0.05 million tons of coal and other dry cargo transported internally along eastern NSR
3-4 roundtrips along the eastern NSR distributing cargo from Kolyma, Pevek and Tiksi to various locations.
= 1 dedicated 56 MW ice-breaker will be required for internal transport.

3 shiploads of pipes from Japan to western NSR
3 eastbound sailings through the eastern NSR every summer
Ice-breaker assistance will be needed for on average 10 days per transit.
= 1 dedicated 56 MW ice-breaker will be required for pipe import.

TOTAL (with only dedicated ice-breakers escorting cargo vessel): **5 x 56 MW**

POSSIBLE SYNERGIES:

The previewed transit, internal and import cargo flows do not one-by-one provide full-time employment for an ice-breaker. Good traffic coordination should at least be able to reduce the need by one ice-breaker.

= Minimum total need for summer season 2005-2015:
4 x 56 MW nuclear ice-breakers (some can be substituted by 33 MW nuclear ice-breakers under light conditions)

CONCLUSION:

The need of ice-breaker assistance will in the future be greatest during the winter season, with **at least 4-5 nuclear 33 MW *Taymyr*/56 MW *Arktika* class ice-breakers required in 2005, 5-6 in 2010 and 7-8 in 2015.** *Arktika* class ice-breakers will be preferable for the escort of large tankers and for the escort in difficult ice-conditions in the Kara Sea in winter and along the eastern NSR in summer. The shallow-draft *Taymyr* class ice-breakers are preferable on the Yenisey river and on the Ob Bay, and may also be better suited than Arktika in the shallow Pechora Sea and for vessel along the eastern NSR that need to approach an ice-covered shore. *Taymyr* class ice-breakers may be substituted by shallow-draft, diesel-electric 16 MW *Kapitan Sorokin* ice-breakers under light ice-conditions when escorting smaller vessels.