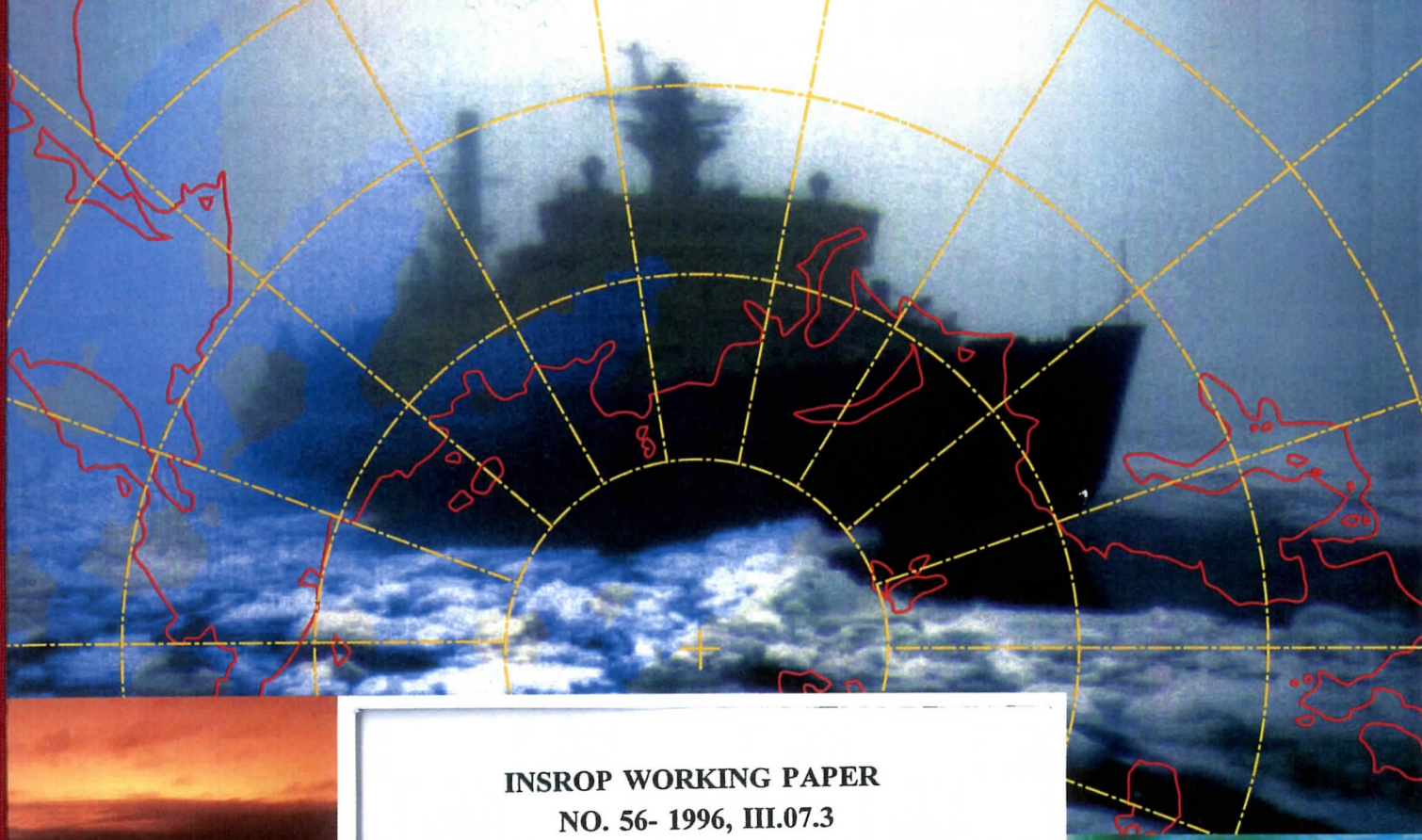

INSROP WORKING PAPER
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West Siberian Oil and the Northern Sea Route: Current Situation and Future Potential

Valery Kryukov, Arild Moe and Vladimir Shmat

INSROP International Northern Sea Route Programme

Central Marine Research & Design Institute, Russia

The Fridtjof Nansen Institute, Norway

Ship and Ocean Foundation, Japan

International Northern Sea Route Programme (INSROP)

Central Marine Research & Design Institute, Russia | The Fridtjof Nansen Institute, Norway | Ship & Ocean Foundation, Japan

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Title: **West Siberian Oil and the Northern Sea Route: Current Situation and Future Potential**

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This publication forms part of a Working Paper series from the **International Northern Sea Route Programme - INSROP**. This Working Paper has been evaluated by a reviewer and can be circulated for comments both within and outside the INSROP team, as well as be published in parallel by the researching institution. A Working Paper will in some cases be the final documentation of a technical part of a project, and it can also sometimes be published as part of a more comprehensive INSROP Report. For any comments, please contact the authors of this Working Paper.

FOREWORD - INSROP WORKING PAPER

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

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

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

The complete series of publications may be obtained from the Fridtjof Nansen Institute.

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West Siberian Oil and the Northern Sea Route: Current situation and future potential[1]

Introduction

One of the ongoing focuses of interest in global transport is the Northern Sea Route and the possibility of increased ship traffic and commerce along this route. This would open up new links between Europe and North East Asia as well as the Western part of the American continent. But the route would also help the economic growth of adjacent areas. For many of these regions, remote and under-developed as they are, good transport links are the key to attracting industry, opening up local natural resources and getting them to potential markets and customers[2].

This paper will discuss links between the Northern Sea Route and the development of oil and gas in the northern regions of Western Siberia and Krasnoyarsk krai (Northern Ob-Yenisei).

1. The Northern Ob-Yenisei: land and resources

1.1 Main oil and gas areas

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[1] Acknowledgements:
The authors are grateful for the assistance of Rune Castberg in preparing the maps and for the comments from Trond Ramsland and two reviewers to a draft version of the report which was submitted for publication in *'Polar Geography and Geology'*. The parallel publication of the report as an INSROP Working Paper is in understanding with the editor of the journal.

[2] These issues are explored in a series of publications from the International Northern Sea Route Programme.

Several oil and gas areas can be identified within the region[3] described as the Northern Ob-Yenisei. These are quite distinctive in terms of their geographic location, concentration of resources and even the extent to which their geology has been studied. These factors in turn affect possible approaches to how the NSR can be opened up.

The areas involved are:

1. The Arctic parts of Tyumen oblast[4] (the Yamal and Gydan peninsulas),

2. The Far North of Tyumen (the raions of Nadym, Pur, Taz and Krasnoselkup - all located within Yamal-Nenets autonomous *okrug*),

3. The North West of Tyumen (the raions Oktyabrsk, Beloyarsk and Khanty-Mansi - all located within Khanty-Mansiysk autonomous *okrug*),

4. The Far North of Krasnoyarsk krai (raions on the left bank of the Yenisei contiguous to Tyumen).

1.2 Oil and gas condensate: an estimate of reserves

An evaluation as of January 1994 gave surveyed (proven) and preliminarily explored (probable) recoverable reserves of oil in Tyumen as 21 billion tonnes (ABC1 + C2, Russian classification) and reserves of condensate as more than 1.5 billion tonnes (Table 1). 13.5 bn tonnes are proven oil reserves. About 8.75 bill. tonnes of the total reserves are to be found in just over 170 fields in the Tyumen raions mentioned above. More than half of the reserves lie within the Yamal-Nenets autonomous okrug. The richest fields are in the raions of Pur (in Yamal-Nenets autonomous okrug) and

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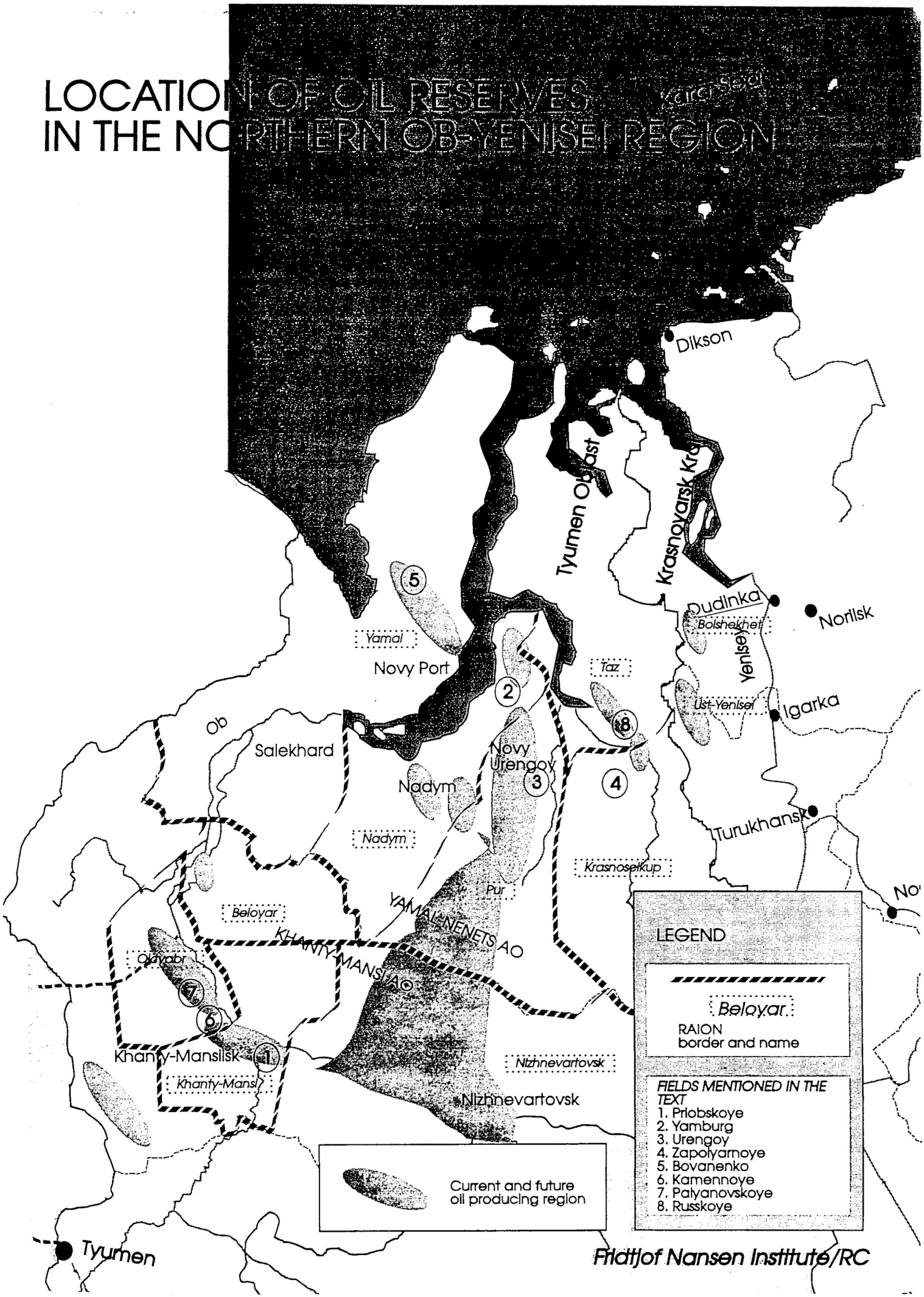
[3] The term "region" is used as a general term referring to a more or less specified area in the context. The use of the Russian word "raion" refers to the administrative subdivisions of oblasts and okrugs.

[4] Tyumen oblast is here mainly referred to as a geographical area. In political terms the autonomous okrugs Yamal-Nenets and Khanty-Mansiisk are more important, even if they are formally part of the oblast. Both okrugs and oblasts are subjects of the Russian Federation.


LOCATION OF OIL RESERVES
IN THE NORTHERN OB-YENISEI REGION
Kara Sea
Dikson
Tyumen Oblast
Krasnoyarsk Kray
Dudinka
Norilsk
Bolshekhet
Yenisey
Yamal
Novy Port
Taz
Ust-Yenisei
Igarka
Ob
Salekhard
Novy Urengoy
Nadym
Turukhansk
Krasnoselkup
Pur
Beloyar
YAMALO-NENETS AO
KHANTY-MANSIA
Oktyabr
Khanty-Mansiisk
Nizhnevartovsk
Tyumen
LEGEND
Beloyar
RAION border and name
FIELDS MENTIONED IN THE TEXT
1. Priobskoye
2. Yamburg
3. Urengoy
4. Zapolyarnoye
5. Bovanenko
6. Kamennoye
7. Palyanovskoye
8. Russkoye
Current and future oil producing region
Fridtjof Nansen Institute/RC

Oktyabrsk (in Khanty-Mansiisk autonomous okrug). Each area offers around 2.5 billion tonnes. Production is underway in parts of the major Priobskoye oil basin in Khanty-Mansiisk with reserves of 850 million tonnes. The fields in the Yamal-Nenets autonomous okrug hold nearly 98% of available condensate in Tyumen, notably at the Urengoy group of fields and at Yamburg, Zapolyarnoe and Bovanenko.

Table 1: Proven and probable reserves in Tyumen oblast, 1.1.1994

Region	Number of fields	Reserves and resources (million tonnes)
Yamal-Nenets AO	133	4462.5
Krasnoselkupski raion	18	299.7
Nadym raion	17	389.2
Pur raion	77	2495.6
Taz raion	13	902.7
Yamal raion	8	375.3
Khanty-Mansi AO	295	16448.6
Khanty-Mansi raion	25	1612.4
Oktyabrski raion	10	2592.6
Beloyarski raion	7	83.1
Others	253	12160.5
Southern Tyumen	8	119.2
TOTAL	436	21030.3
of this, proven reserves		13545.3*

Source: Tyumen Oblast Statistics Committee, * Tankaev, 1995.

Krasnoyarsk krai is thought to hold a total of around 565 million tonnes of recoverable oil and condensate (161 million tonnes already proven), with 274 million tonnes (101 million tonnes proven) found mainly in the northern raions bordering on Tyumen, within the Yenisei-Khatanga and Pur-Taz oil and gas areas (Table 2). Some dozen oil and condensate fields have been surveyed here, and are ready for full-scale development.

Table 2: Proven and probable reserves of oil and gas condensate in Krasnoyarsk krai as at 1.1.1992.

	Proven reserves	Probable reserves	Total reserves
Krasnoyarsk, total	161.4	403.4	564.8
condensate	27.7	34.9	62.6
oil	133.7	368.5	502.2
Of this			
Yenisei-Khatanga NGO*	10.8	40.3	51.1
condensate	10.2	7.3	17.5
oil	0.6	33.0	33.6
Pur-Taz NGO**	90.0	132.5	222.5
condensate	1.5	2.1	3.6
oil	88.5	130.4	218.9

NGO= Oil and gas area
* in Ust-Yenisei raion
** in Bolshekhet raion

Source: Krasnoyarsk Geological Committee.

1.3 Oil reserves: economic structure

The accepted way of classifying reserves in Russia uses strictly geological methods and reflects the degree to which the reserves have been surveyed; it does not allow for the probable efficiency or commercial viability of recovery. This makes accurate comparison with Western classifications impossible. By way of example, the category of surveyed (proven) reserves used as the basis for forecasting oil recovery covers 'inactive' as well as 'active' reserves. Inactive reserves are impossible to recover given current levels of technology.

Western estimates of oil in the ground are therefore quite different from Russian estimates. As a rule-of-thumb Western assessments of recoverable reserves are often half of the Russian assessments.

The only major evaluation of oil reserves combining geology and economics made in the last ten years in Western Siberia covering all known fields, prospective structures and areas with a concentration of prospective resources, totalling some 1200 objects, was conducted by a group of research organisations in Tyumen in 1986 - 1987 (*Geologo-ekonomicheskaya*).

One of the economic tools used to assess recoverable reserves was Net Present Value, applied over the period when the fields would be completely exploited, using available technology. The oil was valued in terms of *zamykayuschie zatraty* 'marginal costs' reflecting the 'market value' of the oil in a planned economy. Oil production in various areas was tested against three different price levels: 60, 80 and 100 rubles per tonne (At the time the official price paid to the producer was 23 rubles per tonne. 100 rubles was the world market price, using the official exchange rate). Using this method, a structure for the reserves could be worked out and interpreted as follows:

a) reserves which would be profitable to exploit at a price of 60 roubles/tonne or less;

b) sub-profitable reserves offering a profit if the price of oil came within the 61 - 100 rouble/tonne range,

c) non-profitable reserves with a negative net profit given a price of 100 rubles per tonne.

At the time the calculations were made all the reserves in the categories a) and b) could be profitably exploited only if the output could be exported. The share of reserves in these categories was estimated at around 53% of total resources in Tyumen oblast. It is striking that the economic evaluation referred to here gives approximately the same result with regard to how large a share of the reserves can be profitably exploited (53%), as the correctional factor (0.5) commonly used by western experts for Russian reserve estimates, which are based purely on geological parameters.

The economic evaluation found marked differences in the proportion of 'reserve categories' for different types of areas - fields, prospective structures, probable zones - and the size and productivity of the reserves in them (large or small pools, high output or low yield). Not unexpectedly the proportion of categories a) and b) was lowest in the Far North and Arctic regions (where Gazprom is the dominant operator today).

Table 3: Structure of oil reserves in the areas of operation of some organizations in northern Tyumen. Share of 'profitable and sub-profitable' resources in each reserve category.

Area	Of proven reserves	Of probable reserves	Of all resources*
Gazprom's	31.2	19.8	8.9
Purneftegaz'	45.8	53.0	21.0
Noyabrskneftegaz'	63.4	56.8	49.4
Krasnoleninskneftegaz' (Kondpetroleum)	75.0	84.0	60.4
Tyumen oblast total	69.9	63.6	52.5

*including prognosticated resources

Source: *Geologo-ekonomicheskaya..*, 1987.

Despite the inadequacy of the studies, it is possible to use the reserve estimates made in the mid-eighties and early nineties together with the economic analysis from 1987 to draw some useful conclusions about the economic potential of the resources today. Errors are likely to understate the potential, since in general one would expect that technological developments have made it possible to recover a larger share of the resources commercially today.

1.4 Parcelling out the fields

Current legislation on ownership rights has a major impact on the potential for hydrocarbon production in the Northern Ob-Yenisei region. It is also of great significance for possible foreign participation.

At present around 90% of the oil reserves in the northern areas of Tyumen (not including Yamal) are already under licence (Table 4). The majority of the licence holders are former state production associations which have now become joint stock oil companies and also geological survey enterprises producing oil. In most cases these companies were awarded their licences on a non-competitive basis, i.e. their areas of operation under the old system

were converted into licences in the new system. Oil companies set up with the participation of local authorities are also among the licence holders.

Together, these entities control the largest and potentially the most profitable of the new fields; Krasnoleninskoye with reserves of 1296 million tonnes and Talinskoye with 390 million tonnes are licensed to Kondpetroleum/SIDANKO, Priobskoye with 850 million tonnes to Yuganskneftegaz/YUKOS and Yugraneft, Kamennoye with 438 million tonnes to Kondpetroleum and Krasnoleninskneftegazgeologiya, Palyanovskoye with 426 million tonnes to Yugraneft and Krasnoleninskneftegazgeologiya, and Russkoye, which has 410 million tonnes is held by Tyumenneftegaz.

The rights to all the major gas condensate fields in Tyumen, including those on Yamal, have been assigned to Gazprom. The monopoly endowed by these rights includes rights to undeveloped fields. The position of Gazprom was reinforced when the Agreement between Gazprom and the Yamal-Nenets Autonomous Okrug was signed in February, 1995 (*Biznes MN*, 6, 1995)[5].

[5] For a discussion of Gazprom's role in the region see: Kryukov and Moe, 1996.

Table 4: Proven reserves included in licences as of mid 1994

Licence holder	Number of objects	Reserves, mill. tonne
"Far North":		
Purneftegaz	32	826
Purneftegazgeologiya	8	55.3
Tyumenneftegaz	1	410.0 *
Noyabrskneftegaz	45	914.8
Total for the far Northern *raiony*	86	2206.1
"The Near North":		
Kondepetroleum + Krasnoleninskgeologiya + Yugraneft + Khanty-Mansiiskgeologiya	5	1360.0
Yuganskneftegaz/Yukos + Yugraneft	2	849.2 *
Yuganskneftegaz/Yukos	1	299.8 *
Khanty-Mansiiskneftekhant	7	266.8 *
ANK Aki-Otyr	3	69.2 *
Total for the "Near Northern" *raiony*	18	2845.0
TOTAL	104	5051.1

* Includes probable reserves

Sources: Tankaev, 1995; *'Svedeniya..*, 1995., 1, 1995.

The oil fields in the Bolshekhet raion[6] in Krasnoyarsk have not yet been licensed and are so far under the control of the local Geology Committee, or Geolkom, which supervises

[6] Note that this is a *geological*, not administrative *raion.*

the tenders. In terms of rights, or claims to them, the largest presence in the oil, gas and condensate fields in the Ust-Yenisei raion in Krasnoyarsk krai is Norilskgazprom[7].

Generally speaking, it is impossible for independent investors to acquire any stake in these fields other than by way of agreements with the licence holders. In Khanty-Mansiisk a special tender was organised for joint projects with Russian licence holders. Amoco won the right to cooperate with YUKOS/Yuganskneftegaz on the development of the giant Priobskoye field.

Another player which could emerge on the domestic side is Rosneft which in 1995 was being recreated into a joint stock company. It was granted authority, under presidential decree no. 327 of 1st April 1995, to manage the state's share of hydrocarbon output under production-sharing agreements. This means that a Russian licence holder will have to cooperate with the foreign investor to obtain exclusive rights to sell the state's share of the output. The alternative would be for the licensee and the investor to enter into an alliance with Rosneft, with a tripartite agreement on how to allocate output.

2. Production of oil and condensate

2.1 The dynamics of production, from initial development onwards

Production in the Northern Ob-Yenisei region was begun at the end of the 1970s. By 1995 more than 565 million tonnes of oil and condensate had been extracted (5.5% of initial recoverable reserves). 423 million tonnes of this came from the Far North *raiony* (7.2% of initial recoverable reserves) and 82 million tonnes (1.9%) from the Near North. Almost all production has been in *raiony* belonging to Tyumen oblast.

Up to 1992 the only producers operating in the area were the specialised production enterprises of the oil and gas industry. Then geological companies became actively involved in production, as did the independent companies, especially those which had backing of foreign capital (Table 5). But the former state economic structures now converted to joint stock companies with mixed ownership still maintain their dominant position. In 1994 they accounted for 92% of the total volume of oil and condensate produced in the northern part of Tyumen. The total oil and condensate production in the area amounted to 46 mt in 1994, roughly equivalent to the production level in a country

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[7] This organization produces and supplies gas in the Norilsk area and was not included in Gazprom when the company was set up, since it is not connected to the integrated trunkline network.

like Oman. The lion's share of this output was taken care of by two producers, Noyabrskneftegaz and Purneftegaz

Table 5: Total production over time of oil and condensate from oil producers in Northern Tyumen

	1978-89	1990	1991	1992	1993	1994
FAR NORTH - TOTAL	241350	59361	54751	47861	42503	37650
including: OIL	213841	52430	47717	40978	36410	32456
Purneftegaz	22964	11736	10805	9780	9332	8249
Noyabrskneftegaz	191147	40235	35931	29890	25620	22678
Purneftegazgeologiya	-	-	...	327	504	582
Yamalneftegazgeologiya	-	-	-	12	13	7
Urengoyneftegazgeologyia	-	-	-	-	7	-
Purnefteorgprogress	-	-	-	-	-	76
JV Geolbent	-	-	-	-	-	125
Udmurt Republic enterprise	-	-	-	-	104	149
CONDENSATE	27509	6931	7034	6883	6093	5194
Urengoygazprom	27109	6892	6568	6183	5345	4368
Yamburggazdobycha	-	-	425	661	611	560
Yamalneftegazgeologiya	-	-	-	-	19	162
Purneftegazgeologiya	-	-	-	-	34	33
Zapolyarneftegazgeologiya	-	-	-	-	13	10
Urengoyneftegazgeologiya	-	-	-	-	24	16
Norilskgazprom	400	39	41	39	34	30
Udmurt Republic Enterprise	-	-	-	-	13	15
NEAR NORTH TOTAL (OIL)	34600	12578	9800	8217	8048	8345
Kondpetroleum	34600	12578	9800	8017	7010	6562
Khanty-Mansiiskneftegazgeologiya	-	-	-	98	254	544
Krasnoleninskneftegazgeologiya	-	-	-	-	211	400
Krasnoleninsk oil enterprise	-	-	-	-	275	192
Yugraneft	-	-	-	...	239	412
Nord (Krasnolensinsk)	-	-	-	103	...	...
Negusneft	-	-	-	-	59	230
Evikhon	-	-	-	-	-	5
TOTAL - NORTHERN TYUMEN	275950	71939	64551	56078	50552	45995

Source: *Neftyanaya..*, 1993; *Rossiyskiy Neftyanoy Byulleten*, 43, 1994; Tyumen Oblast Statistics Committee

2.2 Output forecasts

The fall in output of oil and gas condensate in these areas over the last four years was not due to the drying up of reserves but was an outcome of the economic and institutional crisis in Russia. Up-to-date assessments of proven and prospective reserves show that output of liquid hydrocarbons has not yet peaked. Combining trends in extraction and forecasts of specific new field development plans combine to indicate a potential for huge increases in output. Theoretically, with all fields fully developed and operational, the annual output of oil and condensate from northern Tyumen could reach 200 million tonnes[8]. This is broken down by *raion* as follows:

Total for Far North *raiony*		110
Krasnoselkup	6	
Nadym	8	
Pur	60	
Taz	23	
Yamal	13	
Total for Near North raions		90
Khanti-Mansi	33	
Oktyabr	53	
Beloyar	4	

For the raions of Krasnoyarsk krai, a figure of 9-10 million tonnes can be projected;

Bolshekhetskiy raion	8 - 9
Ust-Yeniseiskiy raion	up to 1 million tonnes.

3. The problem of transporting oil and condensate

3.1 How the Northern Sea Route can solve the problem

There are obvious links between the Northern Sea Route and the development of the oil and gas industry in the Northern Ob-Yenisei region. Equipment and materials needed for oilfield infrastructure can be brought in, and hydrocarbons can be brought out. But whereas supplies and equipment for many projects in the North have been shipped by sea, it has not been the practice to use the sea route for transporting hydrocarbons.

Traditionally, transport needs were met in another way. During the 1970s and 80s an extensive pipeline network was laid, transporting oil and condensates from all areas now under production and capable of delivering around 400 million tonnes of liquid

[8] Production volumes have been calculated by the authors on the basis of information on reserves and assumptions of a reasonable exploitation rate.

hydrocarbons annually beyond regional boundaries, with six trunk oil pipelines stretching over 10,000 km across Western Siberia. However this system may not be sufficient in the future for four main reasons:

One is the lack of a dedicated transport infrastructure in areas with major resources development. The second is the monopolized pipeline infrastructure which makes production companies very dependent on the state company Transneft for transporting oil and Gazprom for gas condensate, and on the Fuel and Energy Ministry to get access to the oil export infrastructure. Thirdly, the handling capacity of the Russian oil export terminals at the sea ports on the Baltic and Black Seas is limited, while pipeline transit problems through the Ukraine have not been solved. Lastly, there is in fact no reliable 'way out' for Siberian oil to the Russian Far East and the countries on the Pacific seaboard.

As regards the first point, future sites in the Yamal, Lower Ob, Pur-Taz and Yenisei-Khatanga regions have no access to the trunk lines in the northern part of Western Siberia. Furthermore the oil and condensate fields are spread over a large area and the proven reserves in each of them are often very small. This makes the traditional, inflexible pipeline transport systems sub-optimal with regard to costs.

But the implementation of alternative and more flexible transport solutions is also affected by an increasingly market-oriented oil industry. Investors will demand as stable operating conditions as possible if capital intensive development projects in Northern Siberia are to be realized. In addition to a workable legal framework, e.g. production sharing legislation, reliable infrastructure, which cannot easily be disturbed by administrative competence conflicts, is a key issue. This means that for investors, dedicated transport infrastructure which is more or less under their own control will carry a premium.

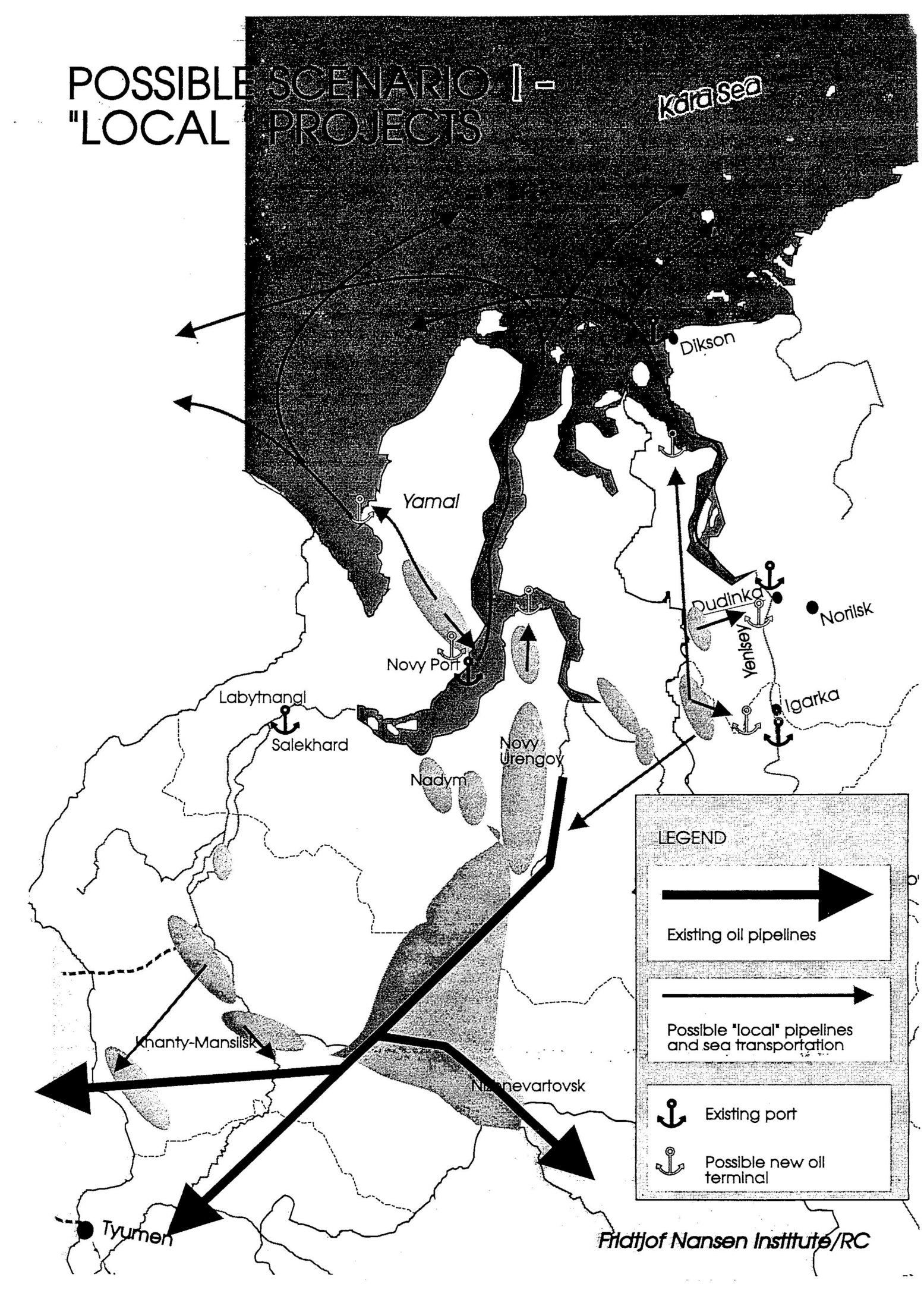
For the Northern Ob-Yenisei region which fringes the Arctic Sea, the natural alternative is to employ a range of transport systems which make use of the Northern Sea Route. The route also offers contacts with new markets in the East as well as in the West.

3.2 Alternative Approaches to the NSR

Two very different approaches for using of the Northern Sea Route in conjunction with development of oil fields in the Northern Ob-Yenisei region can be outlined here.

'Local' projects
Such projects combine the NSR with local transport networks as part of separate, small-scale projects (development of individual fields or groups of fields).

The main assumptions for development along such lines would be that production in the northern part of Siberia is developed on a 'strictly competitive' basis, with independent field development projects, and transport solutions being set up by separate companies as risk ventures. The cost issue will of course be crucial for each individual project. Only projects where there is a lack of real alternatives for bringing bulk hydrocarbons out will employ the NSR. Infrastructure costs will necessarily limit the number of fields that can be developed independently.


POSSIBLE SCENARIO I -
"LOCAL" PROJECTS
Kara Sea
Dikson
Yamal
Dudinka
Norilsk
Yenisey
Novy Port
Labytnangi
Salekhard
Igarka
Novy Urengoy
Nadym
Khanty-Mansiisk
Nizhnevartovsk
Tyumen
LEGEND
Existing oil pipelines
Possible "local" pipelines and sea transportation
Existing port
Possible new oil terminal
Fridtjof Nansen Institute/RC

Possible projects

The opening of the Yamal peninsula can be considered within this framework since there are several good reasons why a sea link for the oil and condensate output of the Yamal fields would be a sensible option. The transport scheme for output from the Bovanenko field (the first Yamal project) as proposed by Nadymgazprom and Amoco includes a pipeline and a terminal for tankers on the Baidaratskaya Gulf. The pipeline could then be extended overland deeper into the Yamal, towards the south-east, taking in the Arkticheskoye, Sredne-Yamalskoye and other fields.

Such a scheme would offer a throughput of 2.5 million tonnes of oil and condensate a year, using a pipeline up to 400 km long and 377/426 mm in diameter and costing around 300 - 350 million USD (not including branch lines)[9]. The terminal would cost an estimated 200 - 250 million USD[10].

Another project on the Yamal would be the Novo-Portovskoye Field. The projected output is here up to 19 million tonnes a year, and the terminal and its pipeline would cost around 550-600 million dollars.

It would also be feasible to transport oil and condensate from fields which lie inland on the Taz peninsula or along the right shore of the Gulf of Taz (Yamburg, Nakhodkinskoye and others).

Another possibility is the development of fields from the Bolshekhetskoye group in Krasnoyarsk krai. There are several alternative corridors for a pipeline from these fields:

- a northerly course, to the mouth of the Yenisei, linking up with a pipeline from the Ust-Yenisei fields,

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[9] The figures given are based on data on costs of recent construction of similar transport infrastructure, in particular the pipeline Usa-Ukhta-Yaroslavl-Kirishi-Primorsk-Porvo, with average costs of 0.65 mill USD per kilometer for 720-820 mm pipe and 0.87-0.9 mill. USD per kilometer for 1020 mm pipe. (*Biznes-Segodnya*, No. 57, 9 November, 1994.). A coefficient of 1.2 was used to take account of the fact that only 2/3 of the Usa-Porvo line is found in geographical regions similar to the northern part of West Siberia. The calculation also incorporates the extra expenses associated with construction in the far north based on historical experience, a coefficient of 1.5 to 2. Correction for the relative costs of the construction of pipelines with different diameters is based on Dubinskiy and Dubinskaya, 1984.

[10] Cost basis is construction of a floating terminal in Odessa, costs for various alternatives have been reported in *Biznes MN*, No 8 and 17, 1995, and a terminal with onshore equipment in Tamani on the Black Sea, see *Rossiyskiy Neftyanoy Byulleten*, No. 40, 1 September, 1994, plus various construction costs data for field developments in Western and Eastern Siberia.

- east to Dudinka or Igarka on the Yenisei, or

- west to the Gulf of Ob.

With up to eight million tonnes of oil and condensate pumped along it, the pipeline would need to be 520 mm in diameter. It would cost, depending on the alternative chosen, from 250 to 550 million dollars, and the facilities for transfer to tankers would cost 300 - 450 million dollars.

However it is also conceivable that these fields can be linked with the existing infrastructure by building a line to Pur-Pe, which would be about 400 km long and cost 350 - 400 million dollars. From there oil can be pumped along existing pipelines in the West Siberian network.

The main disincentive to developing these projects has been the high unit cost of transportation. The projects mentioned here could compete with the existing transport infrastructure, if the cost of transporting one tonne output does not come out at more than 25 - 30 dollars, in the Near North, or 30 - 35 dollars, in the Far North[11]. In Tyumen oblast a wellhead price of about USD 65 per tonne is considered normal.

An 'integrated' project
There could also be an integrated approach where the Northern Sea Route is used as a new 'corridor' for transporting hydrocarbons from the Northern Ob-Yenisei fields, as a key strategic element in developing oil fields in this area. In contrast to the first scenario which envisaged independent projects making use of sea transportation, this scenario presupposes a coordinated policy to establish a new transport channel to serve oil projects in the area.

Such a scheme would require substantial investments. It is clear that the state alone would neither have the resources, nor probably see it as its task to establish such a channel. A more likely possibility would be the setting up of a consortium of Russian and foreign industrial concerns and financial institutions, using the Trans-Alaska pipeline as a model. Obviously state agencies would have to be included, but not as the primary source of capital.

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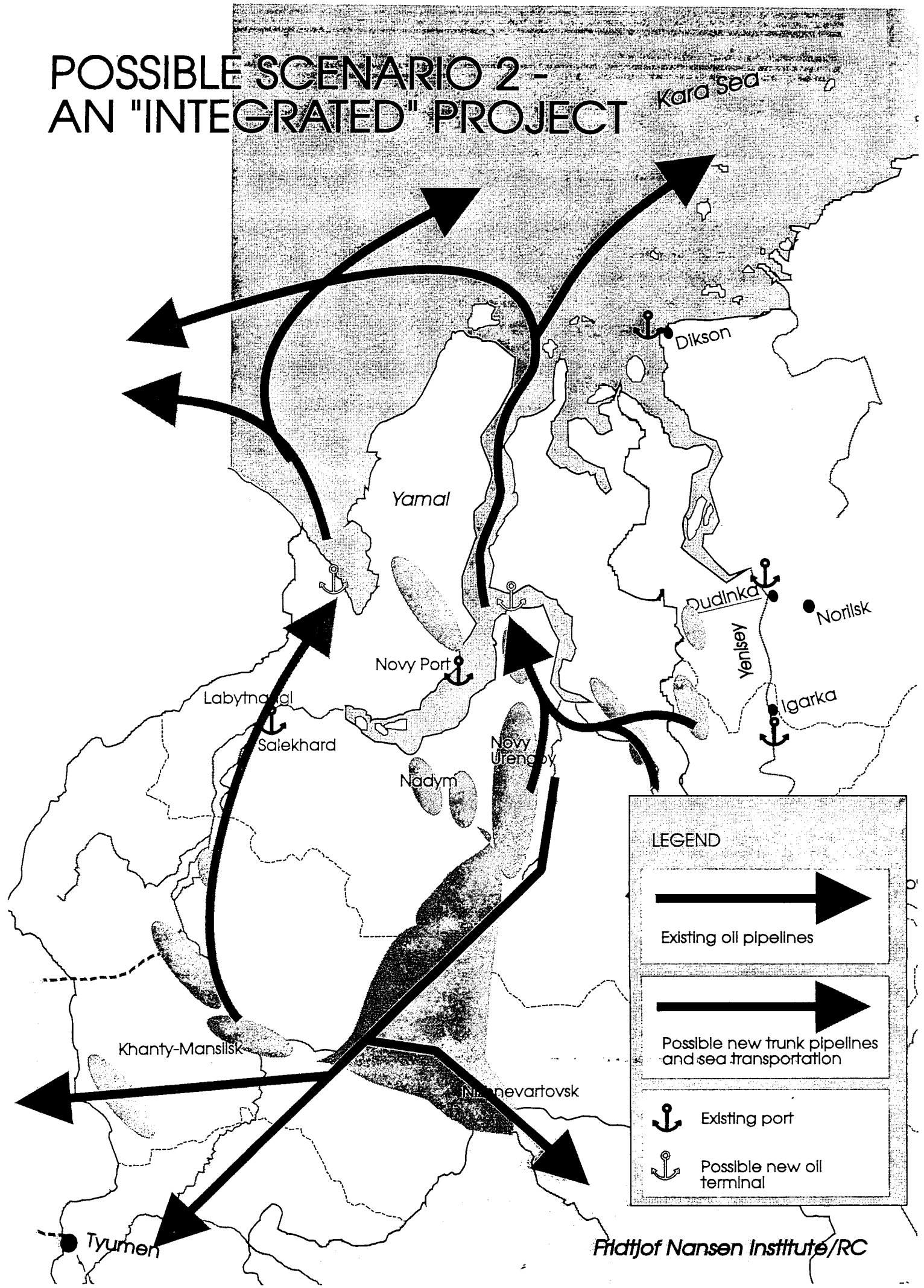
[11] The basis for comparison is here average costs for transportation in existing pipeline systems:

Transport tariff within the Russian Federation:	10-15	USD per tonne
Transit through Latvia or the Ukraine:	3-4	"
Handling in Ventspils or Odessa:	5-6	"
or		
handling in Russian ports:	2-3	"
Further tanker transport:	10	"
Sum:	22-35	"

Source: *Rossiyskiy neftyanoy byulleten*, 46, 16 October, 1994; *Biznes* MN, No 8, 1995.

POSSIBLE SCENARIO 2 - AN "INTEGRATED" PROJECT



To maximize the economic value of the new transport route, its development would have to be coordinated with the licensing processes in the adjacent areas. Specific transport requirements could be included in the licences, and the timing of the various projects could optimize the use of infrastructure investments. But obviously such a coherent policy can only be carried out if the competition between regions over investments and competition between federal and regional authorities over the control of hydrocarbon resources is checked.

One argument in favour of the new transport corridor is the rapidity with which the existing pipelines are now wearing out. The first was constructed over 25 years ago and needs major overhaul if not replacement. Investment in refurbishment should take into account the sea route and its added flexibility.

Another point, mentioned earlier, is the lack of handling capacity at the ports. The situation is likely to be exacerbated despite the opening of new terminals on the Baltic and the Black Sea. The limitations put on tanker traffic and the additional volumes of Kazakh oil, around 15 - 20 million tonnes per year to be pumped overland across Russia, as well as some of the offshore oil from Azerbaidzhan, will reduce available capacity for Siberian oil.

Investment in infrastructure to make use of the NSR can in the authors' opinion be considered as a precondition for the opening of major fields, indeed provinces, with large reservoir capacity. Two projects stand out as the most interesting.

The first of these revolves around the construction of a main pipeline which would run south-north and would connect to the NSR, via Salekhard to the Ob Gulf or to the Baidaratskaya Gulf. It would take oil from companies operating in the Oktyabrsk and Khanti-Mansi *raions* in the Krasnoleninskaya, Palyanovskaya, Kamennaya, Priobskaya and Prirazlomnaya oil sectors. The 1220 mm line would be 750 - 1350 km long, pumping up to 50 - 70 million tonnes of oil a year, and would cost 1000 - 1800 million dollars. Loading facilities at the sea ports would cost another 700 - 900 million dollars.

The second option would be the construction of a major east-west oil and condensate network to the Ob Gulf, starting at the fields in the Bolshekhetskaya group in Krasnoyarsk krai and linking up with the Tyumen fields, in particular Russkoye, Zapolyarnoye, Vostochno-Messoyakhskoye, Urengoy and Yamburg. With diameters ranging through 530, 820 and 1020 mm, the 800 km pipeline would transport up to 30 - 40 million tonnes per annum and cost 600 - 800 million dollars. Building the terminal facilities would cost 450 - 600 million dollars.

Both these options could connect with suggested schemes for transporting liquid hydrocarbons from the Yamal peninsula.

Implementation of both projects could in the longer term mean the opening of an equivalent to a trunk pipeline corridor, capable of throughputting 100 - 130 million tonnes of oil a year. This is of course a very substantial volume, and would amount to more than total present exports from Russia, and correspond to the output from the UK or Norwegian continental shelf.

There are, however, major financial, technological, ecological and navigational hurdles to be overcome. The total investment needed, not allowing for tankers, would be in the region of 3.8 - 5.3 billion dollars. The pipelines would pass through areas of particular ecological vulnerability. And the well known problems of the NSR and navigating large ships through the shallow bays of the Kara Sea will need to be met and resolved.

Summing up:

Transporting bulk hydrocarbons via the NSR is fraught with difficulties, not only financial, but also environmental, technological and navigational. These problems are not the topic of this article and they make a projected timetable for developments impossible. However, if they can be solved there seem to be interesting opportunities with regard to oil from the Northern Ob-Yenisei region.

1. The region encompasses significant parts of Tyumen oblast and Krasnoyarsk krai. It contains very large oil and condensate reservoirs with proven and prospective reserves of over 10.5 billion tonnes. Production so far has exploited around 5.5% of recoverable reserves.

2. With such large reservoirs, an annual output of around 210 million tonnes is theoretically possible under optimal conditions.

3. Any growth in the output of the region (particularly for export) may be retarded because of the limitations of the existing pipelines in the oil transport network.

4. The Northern Sea Route as a way of getting hydrocarbons out from this region to potential markets is an interesting alternative. The potential for access to Eastern markets is unique.

5. There are two possible approaches to the problem: the local perspective - starting with individual schemes involving the transport of up to 30 million tonnes, and the broad-based perspective - with a mainline 'corridor' capable of a throughput of up to 100 - 130 million tonnes a year.

6. Both of the variants discussed require huge investments, the first an estimated 1.6 - 2.2 billion dollars, and the second needing sums of 3.8 - 5.3 billion dollars.

7. Concentration of licences on few hands or a viable cooperation arrangement between licence holders will be a prerequisite to undertake the necessary investments.

8. The financing of such projects will in any case require substantial foreign participation. Foreign investments will only be forthcoming when the interests of investors in Russian companies or through foreign oil companies operating in the region are fully secured.

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APPENDIX

REVIEWS OF THE REPORT

February 22, 1996

Gail Fondahl
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3333 University Way
Prince George BC V2N 429

Dear Dr. Fondahl,

I have reviewed the paper entitled "West Siberian Oil and the Northern Sea Route: Current Situation and Future Potential" for possible publication in **Polar Geography and Geology** as you requested. I have several comments which I hope prove useful. As the paper is now, my overall evaluation is that with major revision this paper could be published. My suggestions for those revisions follow.

The issue of exporting West Siberian oil is very much a "hot" topic today and one of both concern and excitement for foreign and Russian companies. Thus the subject matter of the paper is quite relevant and generally interesting at the moment. The data which is presented on the field reserves and resources draws upon Russian sources not usually found here and hence quit informative. The tables used effectively display the data. However, some maps demonstrating the spatial relationships of these fields, facilities, settlements, ports and Northern Sea Route (NSR) would greatly enhance the readers ability to conceptualize many of the issues presented in the paper.

Some of my main concerns do not deal with the presentation of information on the oil and gas fields, but rather on the theoretical and practical aspects of this paper. There is no obvious organizing framework or argument presented in this article. The article's title suggests that it has to do with the NSR, yet the first substantive discussion of this does not occur until two-thirds of the way through the paper. Once discussion begins, there is very little actually said about the NSR itself. Rather, two alternative pipeline infrastructure projects are discussed. The only considerations are those of costs, which while certainly important, are not the exclusive basis for determining project feasibility. There is not even a clear indication just based on costs which alternative is preferred. While these projects seem necessary in order for the NSR to even be used, there is no discussion about the issues associated with such projects. In fact, the authors state, "Transporting bulk hydrocarbons via the NSR is fraught with difficulties, not only financial, but also environmental, technological and navigational. These problems are not the topic of this article." And yet in the introduction the claim is made that using such a route would open up new commercial links between Europe, North East Asia and the Western Coast of the Americas, as well as facilitate the development of oil and gas in the northern regions of Western Siberia and

Kranoyarsk krai. The analysis presented does not convince the reader how the NSR would do this at all. There does not appear to be a common thread through the article or a strong argument made as to why the NSR should be used or where the funding would come from for any of the projects. Furthermore, there are no references to other works or discussions on these issues.

In summary, I feel that this article raises some interesting questions about transporting hydrocarbon reserves out of Siberia, but does not adequately address how that will be possible and under what circumstances. The data presented about the fields are quite extensive and make a solid case for the need for alternative export routes. However, the only issue which is mentioned is the cost, while environmental, technological and physical problems are ignored. The article needs a clear organizing framework which presents the transportation options, the problems involved, the actors responsible for making decisions, and the basis for choosing such an option. The policy implications of such an analysis would be quite interesting and informing.

If the authors wish to contact me for further elaboration or comments, I would be pleased to oblige. Thank you for the opportunity to engage in this process. It has been both challenging and informative.

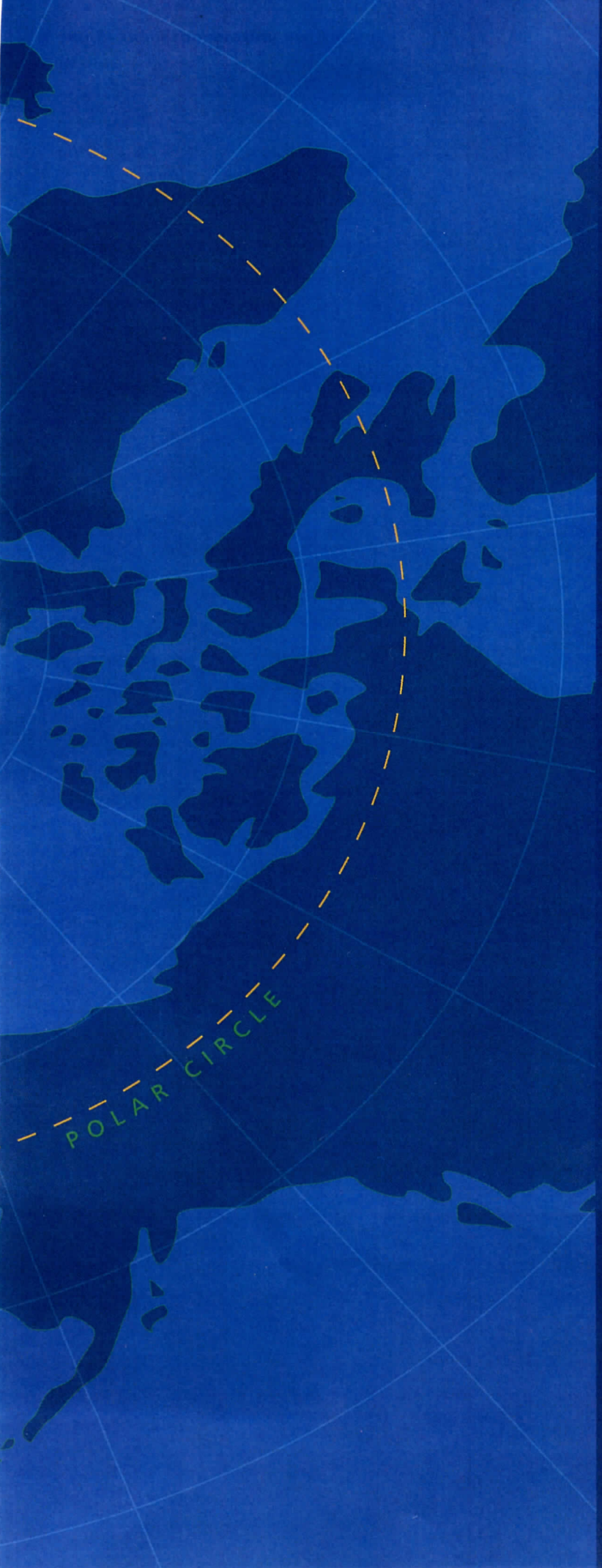
Comments to reviews:

(The reviewers did not receive the maps)

As noted by reviewer 1, it is very difficult to be accurate regarding the timetable for developments. As mentioned in the paper, the authors see commercial interest among license holders as the main motivation for developments. And this motivation will only occur with a certain degree of cooperation and coordination among various license holders, as well as a sufficient legal framework to make the necessary investments justifiable. Solutions making such projects environmentally acceptable is of course another prerequisite. The point of the report is not to say that significant developments in the area are bound to take place within a certain timeframe, but rather to argue that the there is a resource base for such developments and that the resources can be commercially exploited, *if* the framework conditions are right.

The minor revisions and additions suggested have been made. Tyumen oblast is referred to as a geographic area. As indicated on page 1- "The far North" includes the southern *raions* of Yamal-Nenets AO (in contrast to the Arctic North which encompasses Yamal and Gydan peninsulas). "The near North" denotes the northern *raiony* of Khanty-Mansiisk AO.

Reviewer 2 is critical about the article, but the authors feel that the reviewer fails to acknowledge the limited focus of this paper as pointed out above. All the aspects mentioned by the reviewer are certainly relevant and must be taken into account before a final analysis can be made. Many of the issues are being discussed in other INSROP-papers. No development alternative is singled out as preferable. They are presented as possible scenarios given some assumptions on the degree of coordination.



The three main cooperating institutions of INSROP

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

Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia.
CNIIMF was founded in 1929. The institute's research focus is applied and technological with four main goals: the improvment of merchant fleet efficiency; shipping safety; technical development of the merchant fleet; and design support for future fleet development. CNIIMF was a Russian state institution up to 1993, when it was converted into a stock-holding company.

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