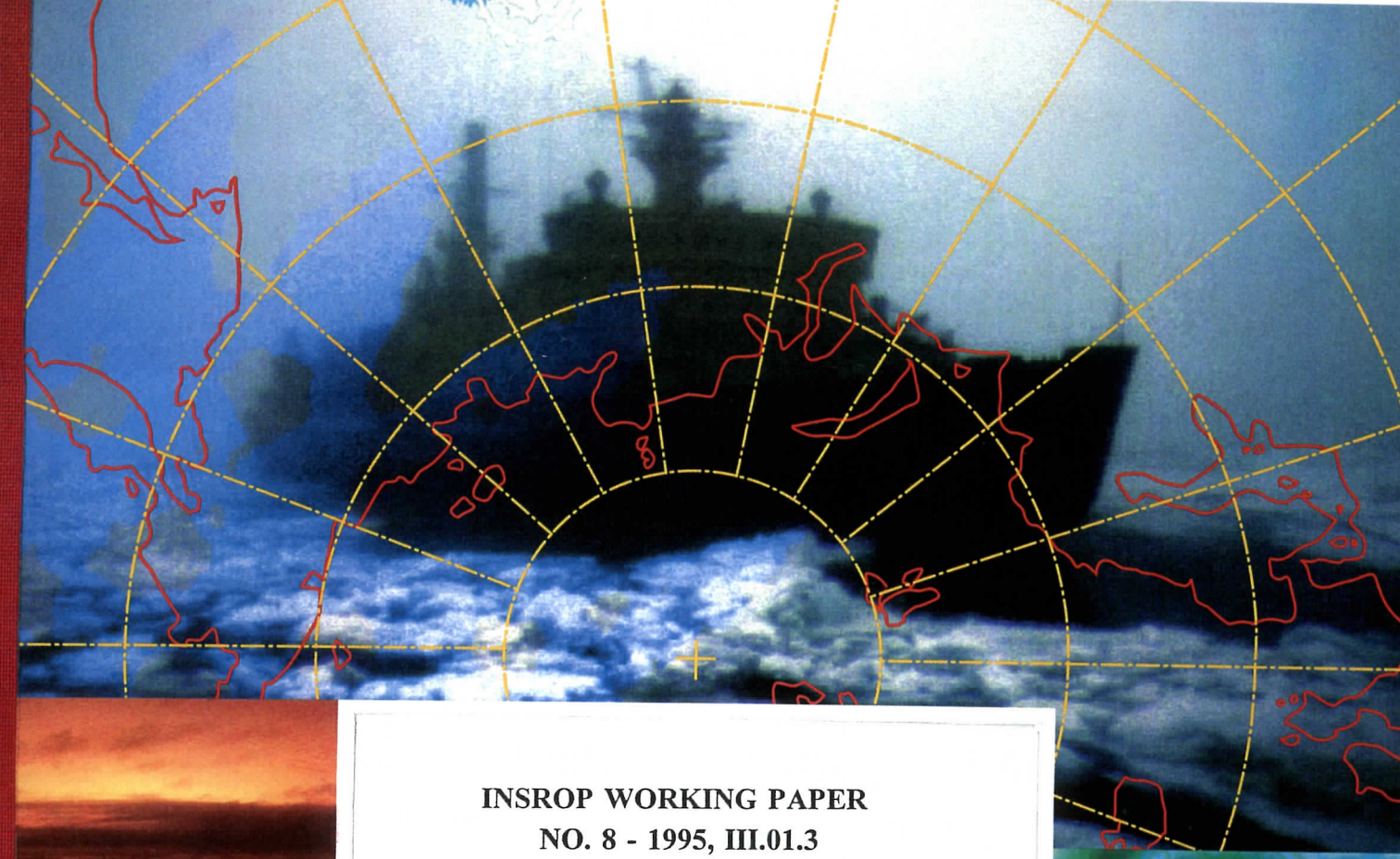
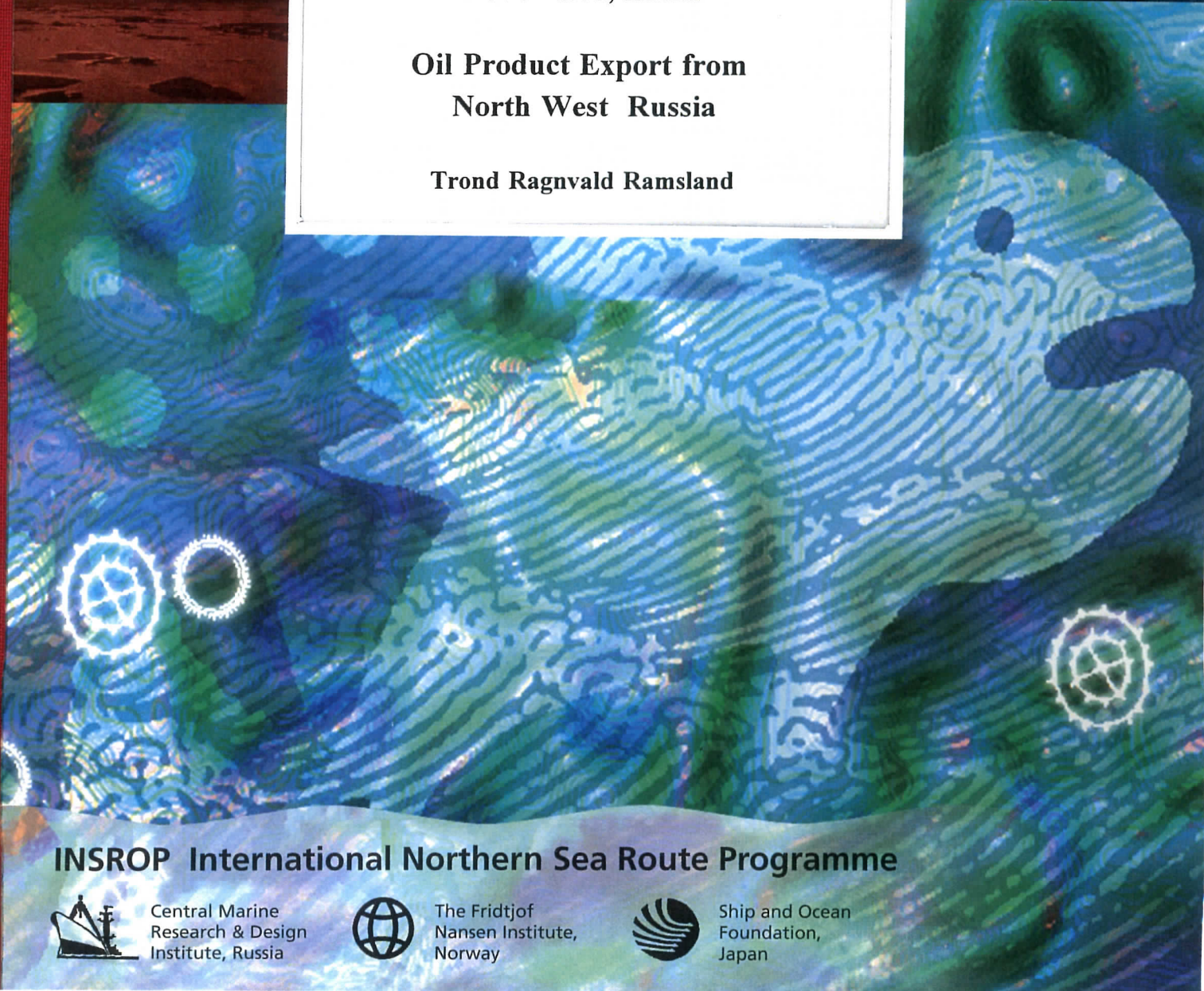


INSROP WORKING PAPER
NO. 8 - 1995, III.01.3

# Oil Product Export from North West Russia

Trond Ragnvald Ramsland



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

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## Title: Oil Product Export from North West Russia

Sub-programme III: Trade and Commercial Shipping Aspects.

Project III.01.3: Development of Oil and Gas Exports in Northern Russia.

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## *What is an INSROP Working Paper and how to handle it:*

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## FOREWORD - INSROP WORKING PAPER

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

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

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

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

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# OIL PRODUCT EXPORT FROM NORTH WEST RUSSIA

Trond Ragnvald Ramsland, *MSc*

FIGURES



TABLES

## APPENDICES

## INTRODUCTION.

As the refinery process adds significant value to crude oil, oil product export is a prime foreign exchange earnings vehicle for the Russian government. Although crude oil production in the former Soviet Union and Russia is in decline (Figure 1), crude oil and oil products still accounted for 47 % of Russia's export earnings in 1992, or $6 billion. That was down from $22 billions in 1986. In terms of quantity, 60 million metric tonnes of crude oil, and 30 million metric tonnes of oil products were exported in 1992. Unleaded gasoline and low sulphur diesel fuels represented about 50 % of the oil product export.

The observed upswing in Russian crude oil export in 1992 and in the first half of 1993, is related to a dramatic decline in domestic consumption and during the fall, some refineries refused to take delivery of feedstock due to storage tanks brimming with unsold products. Based on its current proven reserves, Russia's long-term prospects as a gas, crude oil and oil product supplier are excellent given enough capital to exploit the natural resources. To facilitate increased investments in the export oriented industries, 50 % of Russia's foreign debt was rescheduled at the Paris Club meeting in May 1993.

Western government creditors agreed upon a grace period of 5 years on interest payments, and on a 10 year extension of maturities. The London Club of western commercial creditors (owed $35 billion) has yet to decide, but is likely to agree on equally generous treatment. The underlying logic is clear, if the debt is not rescheduled, Russia still cannot pay.

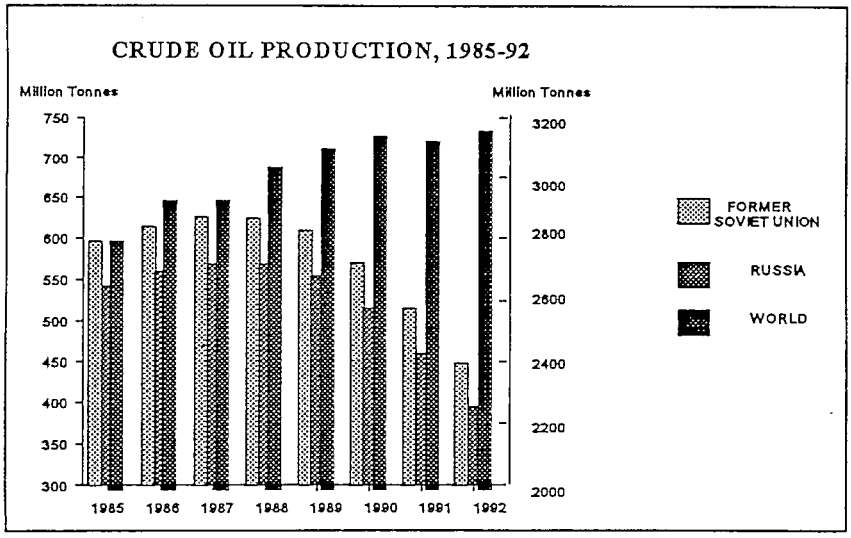



**Figure 1**

Current regional imbalances in refining capacity and low yield of high grade products per tonnes in the refining process, indicate that Russia in the short to medium term is likely to become net importer of high octane fuels, while simultaneously exporting low grade products and crude oil. This paper thus focuses on the low grade product of residual fuel oil. It will bring overall transport cost down as the number of ballast legs for vessels on timecharter are reduced. The recession in

Western Europe has reduced local demand for white oil products, and refineries thus have an incentive to seek new markets.

The ports of Kola and the White Sea area have been chosen as locations for oil products export for a number of reasons. After the break-up of the Soviet Union, Russia retained 90 % of the oil production. However as indicated in the figure below, Russia retained only 43 %[1] of the port through-put capacity for liquid cargoes, in the ports Novorossiysk, Tuapse and Nadhodka. (based on the assumption that the through-put figures are representative for total capacity).

The port charges and handling fees at Tallinn, Ventspils, Liepaja and Klaipeda have increased pressure on the St. Petersburg port. Being in a monopoly position in the Russian Baltic, St. Petersburg port authorities have in turn increased their rates. The exporters of oil products thus face a shortage of port infrastructure for export purposes and increased cost through higher port charges and laytime penalties due to port congestion. The loss of the Baltic ports and Odessa is particularly important as Russia is now deprived of its best ice-free ports further reducing the relative competitive position of Russian oil products.

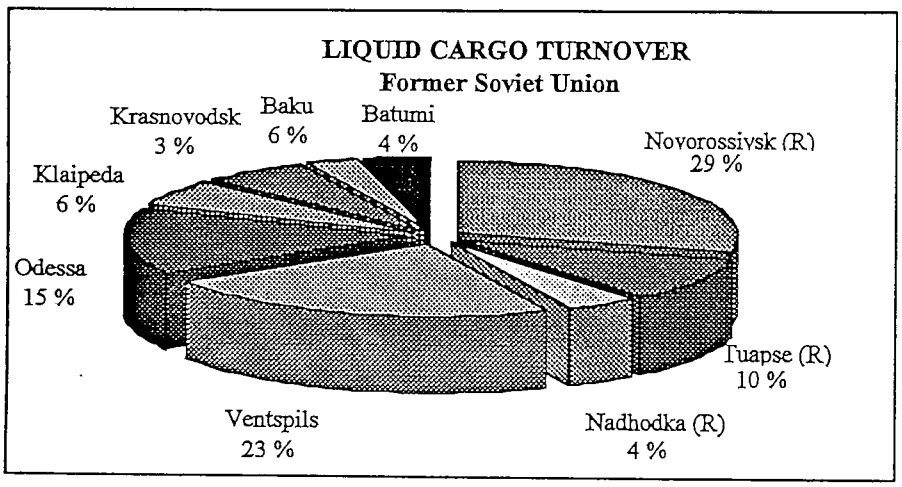



**Figure 2**

Kotka in Finland has been used to relieve pressure, but both the policy decision by the Russian Parliament which states that seaborne export of oil and oil products shall be from Russian ports and the increase of Finnish tariffs suggest that export should be shifted to the north. It also conforms with the shift in exploration and production to Timan Pechora and Yamal.

[1] Marine Policy & Management, dec 1993

## REFINERY CAPACITY BY REGION:

As can be seen from the figure below and Appendix 1, the major concentration of refinery capacity, and thereby residual fuel oil production, is in the Volga-Ural heartland. Combined with the West Siberian refineries it makes up 51 % of total fuel oil supply. The refineries can be classified as both "resource refineries" and "market refineries". "Resource refineries" as the distance to the crude oil production area is relatively short and "market refineries" as they meet the demand of major concentration of consumers in the Volga-Ural region.

The seaside refineries under the North West, Far East and Southern regions however, are best located to serve the function as "Intermediary Refineries", placed between the crude oil producer and the export markets, particularly in Europe and the Far East but also in North America. These refineries also function as "market refineries", as considerable consumer demand exists within the region. This paper focuses on the export potential through the northern ports and correspondingly refineries under the North-Western heading are the prime target.

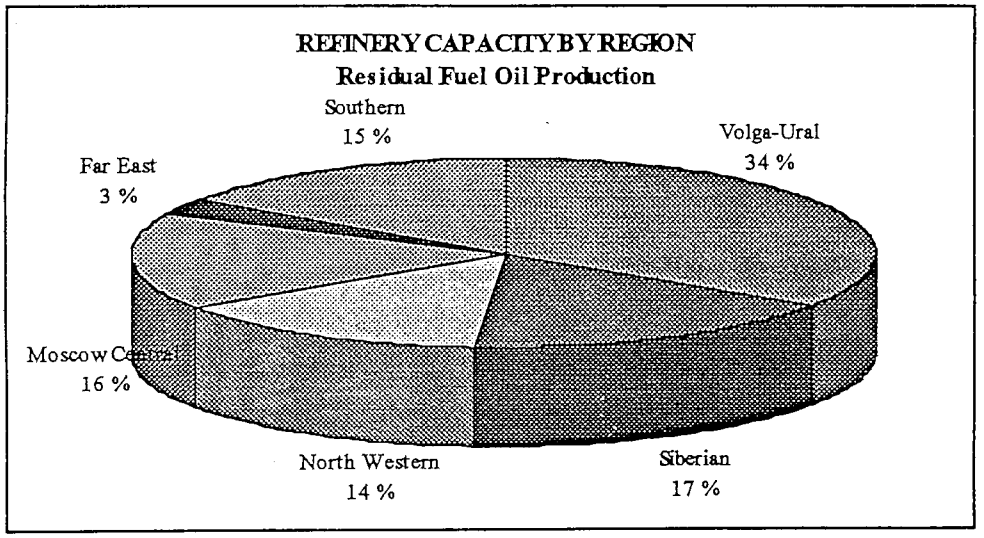



**Figure 3**

## DOMESTIC DEMAND FOR RESIDUAL FUEL OIL IN THE NORTH-WESTERN REGION.

St. Petersburg port and corresponding demand for bunkers is an important demand factor for the residual fuel oil originating at Kirishi refinery, but the major demand for lower grade products as residual fuel oil originates from the heavy industry and power stations. Yaroslav is in an analogous situation, serving the identical users in the Vologda, Yaroslav and Archangel area. It is located on the Northern railway which connects it to the port of Archangel, but has a disadvantage in terms of distance (17 versus 3 hours transit). Although it is beyond the current available data to fully build up the industrial demand function, I will conclude on the probable direction.

*The Heavy Industry :*

The transformation to a market economy has already led to massive reduction in output from heavy industry. Indications are that this process will rather tend to accelerate than bottom out, and demand will consequently drop. It is important to remember that demand for residual oil in an industrial setting is derived demand for the industrial product itself. Low demand due to a depressed world economy and current world overcapacity of energy-intensive production of aluminium, copper, ferrosilisium and nickel of which Russia is a major producer will, other things equal, lead to a drop in demand for residual oil.

*Power Stations :*

Residual Fuel Oil used for electricity competes with other forms of primary energy like gas, coal, hydroelectricity and nuclear power. Continuous problems in Russian nuclear power plants with frequent shut downs and strong environmental pressure against capacity increases through newbuildings make increased supply from nuclear power unlikely. Gas is abundant in Russia and its long term propensity of use will increase.

Coal is also abundant in Russia, but large wage increases, frequent strikes, inefficient extraction and conversion to market economy which partly reflects these factors in price increases indicate that the competitive position of coal vs. residual fuel oil will decrease. Coal is also very sensitive to increases in transport cost which is indicated to be 40 % of total cost[2]. Introduction of proper cost accounting principles to regional railways which reflects cost accurately, will likely double railway tariffs for coal. Coal is thus other things equal at a disadvantage versus residual fuel oil.

I thus conclude that demand for residual fuel oil to heavy industry will fall, and that short term demand for residual fuel oil for power generation will increase.

**DOMESTIC SUPPLY OF RESIDUAL FUEL OIL.**

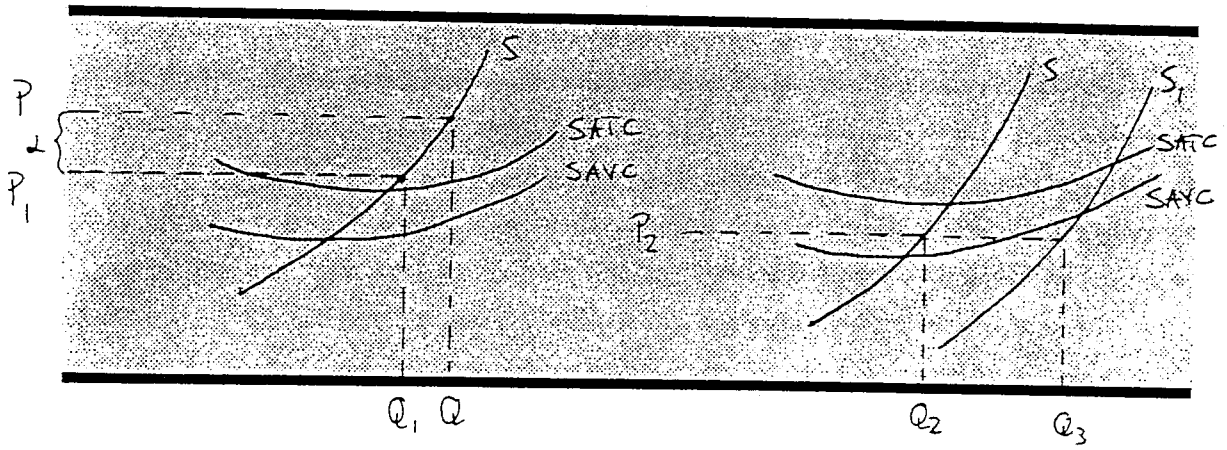
*The Current Observed Picture :*

In a perfect competitive industry all refineries are making essentially the same product, for which they are all charging the same price. However, even if all products are homogeneous or identical each refinery might exercise some discretion over the price it charges if buyers have imperfect information about the quality or characteristics of the various oil products. With the exception of the Moscow Commodity Exchange which only partly covers the refinery sector, lack of coherent and timely information on quality and price characterize the market.

The unstable railway tariffs, congestion at seafront and low through-put at oil terminals further distort an efficient pricesetting mechanism. The market for lower grade products products is shown

[2] Alexey I.Dunin, Chief Foreign Relations, Vorkuta Ugol

in figure 3. In general terms the export market for the individually traded consignment (usually as a shipload) is expressed price mean basis ARA-fob barge Rotterdam as quoted in the daily "Platt's marketscan". For a Russian refinery a normal situation would be a price P at quantity Q, which leaves a margin of alfa to cover transport, brokerage cost and profit.




The current shortage of sea-front capacity and railway/port charge increases originating due to monopoly power in ports and railway administrations, further increase the transport cost portion to a point where price fob refinery will be depressed to p1, at which q1 should be supplied. Production continues below short run average cost (SATC) at Q2, but above short run average variable cost where the refinery faces a shut down decision.

The latest 150 % rate increase at railways and continued congestion at seafront leave a fob refinery price which under normal circumstances should not recover short run average variable cost (SAVC). Still, indications are that supplies of Russian dirty products, in particular M40/M100 fuels used for both further refining and ship fuel, are increasing, and refiners are willing suppliers (Q3) at prices below normal cost recovery. There are a number of factors giving this scenario plausibility.

*The Domestic Market for Crude Oil.*

The cost of crude oil constitutes more than 85 percent of total refining cost. As crude oil exporters have experienced identical increases in pipeline export tariffs (Transneft/ Rosneftetrans), terminal handling fees (Novorossiysk in particular) and transit fees in Ukraine and the Baltic, the propensity to supply domestic refineries increase vs. export. Consequently a fall in domestic crude oil prices occurs and total refining costs decrease.

*The Domestic Market for Light Products.*

For a western refinery, a barrel of crude oil will on average yield 49 to 55 percent gasoline, 20 to 24 percent gas oil, 6 percent jet fuel, 6 to 11 percent residual fuel and 3 to 6 percent naphtha. The remainder is asphalt and butane. Thus, a factor 5 to 1 for gasoline vs. residual fuel oil exists. As

mentioned in the introduction, there is strong domestic demand for light products like gasoline and aviation fuel and shortages occur.

A corresponding price increase for gasoline has been observed, and thus increases the ability for gasoline to cross-subsidize export of dirty products at prices below cost recovery. At Russian refineries however, a factor of only 2-3 to 1 (Table 1) exists due to low technoloy. Consequently total gasoline revenue versus low grade products will not be of the same magnitude as if the identical situation existed for a western refinery.

*Storage Capacity for Dirty Products.*

Low domestic demand, logistic problems at railways, lack of maintenance of existing storage capacity and pumping equipment have caused a build-up of dirty products in storage. The situation for most refineries is now critical as lack of storage facilities and inefficient logistics planning lead to suboptimally through-put. This is an incentive in itself to sell off surplus dirty products at low prices.

*Generation of Foreign Exchange.*

The current weak Russian economy, and the high foreign debt described in the introduction make the generation of foreign exchange an incentive in itself. That also applies to each individual refinery. Refineries are matched against a pre-set budget and are obliged to generate a given amount of foreign exchange. Refineries which do make an active effort to control logistics and sell products on *fob port*[3] terms, can increase profitability as domestic transport cost will be incurred in roubles. Foreign exchange charges do not reflect rouble cost as national companies can negotiate lower rates on railway transport in the rubel economy than foreign companies which must pay premium rates.

**Table 1.**

| RUSSIAN AGGREGATE REFINERY THROUGH-PUT 1975-92<br>Percent output of product type per refined barrel of crude oil | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1975 | 1980 | 1985 | 1990 | 1991 | 1992 | 1995 |
| Motor Gasoline | 15,27% | 16,51% | 14,55% | 14,10% | 13,37% | 12,10% | 13,31% |
| Gasoil | 21,79% | 23,96% | 24,13% | 26,27% | 24,61% | 22,48% | 22,75% |
| Residual Fuel Oil | 40,23% | 47,43% | 42,33% | 34,57% | 32,09% | 30,33% | 29,33% |

*Central Government vs. Regional Authorities.*

The latest railway tariff increase is an example of domestic barriers to trade, imposed by the central government in Moscow on regions rich in energy and minerals. A clear correlation between natural resource abundance and demands for greater regional independence can be found. By levying extra

[3] Free on Board, accoding to INCO terminology

tariffs on oil products for export the central government forces refineries in Bashkiria, Tataria, Chuvasia and Komi to focus on regional domestic markets.

Upstream crude oil producers will choose to bypass refineries in the autonomous regions to achieve higher prices, and either export through governmentally controlled pipelines, or deliver to refineries close to the coast. The logic behind the action of the central government is to limit the economic base from which independence claims can be sustained and power projected, a policy which may o backfire and increase tension.

For a long term economic perspective however, it makes sense to constrain capacity in the central region to meet regional demand, and use pipeline transportation to the littoral as pipelines are a more cost-efficient mode of transport for large volumes. Refineries at or close to the coast face less logistic problems in an export scenario both in terms of quantity and quality, which focus on maintaining the specific properties of the individual consignment under transport, and time and regularity of shipments. A refinery which is located on the coast can respond quicker to demand and deliver directly to a waiting ship and is likely to have its own storage facilities.

A refinery which is located in the heartland will have a higher variance of transit time to the export ports, and face either higher rental cost for railway wagons, higher port charges for a vessel waiting in port or degrading of quality as the individual consignment must use intermediate storage tanks where the product is mixed with other lots. Additionally, local non-tariff barriers to trade, like delays and paperwork etc. should be less likely to arise, as elements in the logistic chain are under the control of the same regional authority.

All the above-mentioned factors will increase the propensity to export versus domestic consumption of residual fuel oil.

*Capacity to meet an export increase :*

As can be seen from figure 2 and appendix 1, the major supply of residual fuel oil is from the Volga-Ural region. However, the quantity of 12 million metric tonnes produced in the North-Western region will be sufficient to meet the major part of an increased export demand.

The export department at Kirishi states that an additional 2 Million metric tonnes can be shipped northbound on the October railway subject to adequate rolling stock. The same conclusion holds for Yaroslav-Ukhta supply to Archangel over the Northern railway.

Due to competitive factors and the previously mentioned downstream integration by Volga-Ural located refineries, some of the potential export increase indicated below may originate from the Volga-Ural refineries, though they have a geographical disadvantage.

**RAILWAYS[4] :**

There are two major railway administrations in the logistic chain. The October railway controls the region around St.Petersburg and stretches northwards through Karelia to Murmansk. The Northern Railway administration is located in Yaroslav and controls the link to Archangel.

Hopefully, the two railways will adapt to the demands that the individual markets generate. The Northern and October railways which handle both passenger and bulkshipments on an extensive scale, must focus on a management structure which centres on engineering and operating functions in order to increase the current volumes of oil product shipments.

The scenario will potentially increase foreign exchange generation which is important for the railways, as they carry burdens from the Soviet past which must be financed. The railway industry, like other industries, provides a number of social services for its employees which extend beyond what is considered normal in the west. Examples thereof are health care, child care, educational services, housing, vacation facilities, food provisions and other services. However, the costs are separately identified in both management and accounting terms by the railways, and should not pose any serious impediments to achieving proper commercial performance.

Positively, the fundamental principle of accountability has been introduced at division-level, which is the principal operating unit of each railway. They are responsible for train operations in their division together with train control, rolling stock and infrastructure maintenance responsibilities and social services. They have full cost and revenue accounting functions, local balance sheets and profit & loss accounts. The increased and predictable generation of foreign exchange transactions could be a significant motive for competition among the October and Northern railways as the two distinct markets develop, and also among the individual divisions the railways mutually.

To further increase incentives one should identify self-interest, and produce strong incentives for critical local work units within divisions to meet their target. Local incentives are likely to be much more powerful than the wider commercial interest of the railway as a whole.

The potential export volumes are set out in Appendix 2. At the October railway an additional volume of 2,05 million metric tonnes can be accommodated for which an adequate seafront infrastructure exists for the total volume. The Northern railway can accommodate an additional volume of 3.75 mmt for which a reasonable, adequate infrastructure potential exists for 2.09 mmt at the seafront in Archangel.

A connecting line from the eastern leg of the Northern Railway at Usinsk to Arkhangel, was started but not finished. As this line would enter on the eastern side of the Dvina river the bridge over the Dvina would not limit the export volumes over Arkhangel.

[4] Vice Precident, Northern Railway Administration, Archangel

Quality of railway throughput is more difficult to estimate. In the logistic chain, regularity of shipments and low variance of waiting time and handling time at refinery, transit time to port and handling time at seafront terminal are all critical factors. Storage capacity and depth at the seafront terminal are correlated to regularity and predictability on the individual railway shipment. Limited storage capacity at seafront and resticted depth at the terminal (which compels the use of shuttle-tankers) increases the importance of regularity and predictability of the railway transport. Disruptions which lead to prolonged waiting for the export tanker, will cut trading profit on oil products by the daily timecharter equivalent. For a 30,000 dwt product tanker, each 24 hr delay will reduce trading profit by approximately $ 9-12,000.

The critical phase however, is likely to be the low handling rate when transferring oil products from railwagon to storage. In October, at the time of survey, 300 railwagons were side-tracked at the Kola railway station due to lack of capacity and logistic planning. One should also observe the possibility of market rigging between the two administrations which could easily ruin an otherwise profitable export of oil products.

**THE PORT INFRASTRUCTURE :**

For most oil exporting countries in the world, the strategy has been to locate refineries at the coast to facilitate export of oil products, and not only crude oil, to generate as much domestic value added to the raw material as possible. In European Russia the pattern differs as the sourcing of crude oil from the distant Tyumen, Western Siberia and Caspian regions and is moved to the central region for refining and consumption. Export constraints thus exist due to the above-mentioned shortage of ports and loss of the Lithuanian "balancing refinery[5]" at Mazheikiai. Residual fuel oil must consequently be shipped out from the heartland by rail and available seafront terminals with adequate rail connection are limited. Export terminals are located in Klaipeda, Ventspils and Tallinn. The Russian state oil major, Lukoil, has integrated downstream and invested in the terminals to have control over its export, the percent stakes not certain.

In the northern region five potential sites have been identified. The major concentration is on the Kola peninsula in the Murmansk area, a converted supply port for the fishing fleet and the naval installations at Severomorsk. Further, a new facility at Kandalaksha at the White Sea is under construction. In Archangel there are two alternative sites; The existing oil terminal, Roskomnefteproduktbas, northwest of the city, and an area at the coal terminal, Levij Bereg, on the west bank of the Dvina River.

[5] Also called 'intermediate refinery'. Pjlaced between the crude oil producer and the consumers of its oil products. The refinery serves a large area, and can switch between diffrent qualitites. Called 'balancing refinery as it can balance surplus and deficit in various regions.

*Murmansk* [6]*:*

In Murmansk two potential port facilities exist. The old supply port for the fishing fleet which is under the control of a Russian-German joint-venture, "Murman Oil", is located in the bottom of the Kola fjord, south of Murmansk. The current through-put is 750,000 tonn/year of which 350,000 tonnes for export. The facility consists of one shallow draft pier of 150 m length. Storage capacity is 5x4000 tonnes for dirty products and 7x4000 for light products and a shuttle tanker of 5,000 dwt has been acquired due to depth limitations. Pump capacities are 400 tonnes/hr at seafront and 470 tonnes/hr for the shuttle tanker.

As can be seen in Table 2 below, the major constraint is the cargo discharge from railwagons to storage tanks. A standard 60 wagon train will at best be emptied in 27 hrs.

Table 2. CAPACITY CONSTRAINTS "MURMAN OIL"

| Railway to Storage | Storage to Seafront | Feeder Vessel |
|---|---|---|
| 1.152.000 Metric Tonnes | 3.456.000 Metric Tonnes | 1.825.000 Metric Tonnes |

Murman Oil is connected to Artic Service, which acquired a Russian built 150,000 dwt tanker, the "Krivbass" of the "Krym" class, for intermediate storage. The vessel was docked in Hamburg (Blohm & Voss) in 1993 where additional heating coils were installed. Artic Service is a commercial vehicle for the Murmansk regional authorities through the Department of Commercial Affairs. The tanker is located opposite of the Murman Oil terminal (the fishing vessel port) anchored at 32 m depth. It was inspected by a norwegian team and found in good working order, no corrosion in the main tanks and new heating coils.

The government of the autonomous republic Tatarstan represented by "Petra"[7], a Moscow based transport and oil trading company, has integrated downstream to exercise greater control over its oil products logistic chain by investing in the tanker. The autonomous republics of Tataria, Bashkiria, Chuvasia and Perm all face tariff and non-tariff barriers set up by monopoly operators or by the sheer lack of coordination and control. The bureaucracy, delays, laytime penalties and port congestions lead to sub-optimal trade solutions and increased downstream integration should be expected by the refineries located in the Volga-Ural region.

In terms of accessibility and presence of professional western operators, the "Murman Oil" facilities currently offer the best, if not the only potential, for a western investor. However, the transfer operation has not materialized as of January 1995 due to Artic Service being under investigation charged for economic crimes. The tanker is currently under control of the 'Sevzapcombank' of Murmansk, the status of the investment of 'Petra' being uncertain.

[6] Andrei Kopyov, Director General, Murman Oil
[7] Andrei Filatov, Vice Precident, Petra Trading

In the Severomorsk area two naval oil bases exist with railway connection. One in Severomorsk connected through the rail-station Vaienga, where the railwagons are parked, and a one-kilometre shuttle track to the storage facilities. No technical specifications are currently available, but can be in future through the Administration of the Northern Naval Fleet. Arctic Shipping Services[8] operates out of Murmansk area, probably through Sevoromorsk, for transshipments to the Northeastern Siberian settlements. ASS operates two modified "Lunni" class ice-strenghtened 16,000 dwt product tankers, the 'Lunni' and 'Oikku'.
The operation must be seen in light of gaining experience in oil transport in Arctic areas as significant volumes of crude oil will be produced in the Nenets/Timan Pechora region from 1996 and onwards. The potential volume of crude oil export could in an optimistic scenario reach 24 million metric tonnes per year from 2001[9].

The second naval facility is located 15 km north of Komsomolskaja station which lies between the cities of Murmansk and Severomorsk. The total storage capacity is 200,000 cubic meters, and the port facility can accommodate up to 16,000 dwt tankers. However, the base was closed a few years ago for environmental reasons. The basic structure is promising in terms of storage and berthing, but the size and the scope of the investment to make the base operative are uncertain.

The October railway connects the Kola peninsula with St. Petersburg further south, and the refinery in Kirishi is located on this railway. The refinery at Kirishi currently ships 7,000 tonnes/day northbound on the railway which equals about 2,550,000 tonnes a year. The October railway administration indicates that a yearly volume of 5,000,000 tonnes can be accommodated. The complete structure is set out in Table 1. The obvious bottleneck is the low throughput capacity from railwagon to storage tanks, especially in winter at low temperatures. This further aggregates the problem of available rolling stock where occasional shortages have already appeared.
A second constraint is the railway through Murmansk city which limits the oil products volume which can be delivered by rail to Komsomolskaja and Sevoromorsk to 1,000,000 tonnes. Consequently, no investment appraisal which originates from locations north of Murmansk (Komsomolskaja, Severomorsk) should be made for volumes larger than 1,000,000 tonnes. The current 750,000 tonnes yearly consumption by the Northern Fleet should not be expected to decline further.

[8] Kværner Masa Yards, Neste Oil, Murmansk Shipping Company, NSR Administration
[9] Joint Venture, Timan Pechora Company (Norsk Hydro, Amoco, Texaco, Arkhangelgeologia). The export of crude oil from the Timan Pechora region is subject to a separate INSROP Project in 1995.

*Kandalaksha*[10]

Two different infrastructures exist in Kandalaksha. A new facility is under construction where storage capacities are indicated to be 40,000 tonnes oil products. A connected sea front can accommodate 15-20,000 dwt product tankers. Depth at the to main quays is 7,5 m, whereas one pier has increased depth at 9,3 meters by using pontoons. The tidal range is 2 m, so vessels above 8.000 dwt must load the last portion at high tide.

A separate naval installation exists 25 km along the coast from Kandalaksha. Storage capacity was indicated at 20,000 tonnes, of which 10,000 tonnes would be available for commercial purposes. 20,000 dwt vessels were said to be accommodated. However, in order to be allowed use of the base, a 25 km additional railway track must be constructed for user's account, which makes the concept unrealistic as the existing port facilities are being upgraded. However, further use of naval facilities can be discussed with the Administration of the Northern Naval Fleet.

*Archangel*[11] *:*

The oil terminal (Arkhangel Roskomnefteproduktbas) outside Archangel is located to the northeast of the city, and the vessels has to transit up the Dvina river from the White Sea. The channel has been dredged to 11,5 m, and plans exists to dredge it further to 13 m. The base has storage facilities of 220,000 tonnes, of which 40,000 tonnes are earmarked for residual fuel oil, 40,000 tonnes for gasoline and 120,000 tonnes for diesel.

An intermediate storage facility situated between the rail depot, and the main storage tanks is of 40,000 tonnes capacity, but must be upgraded as ground water seeps into the tanks and contaminates/degrades the oil products. Heavy fuel oil cannot be handled in winter due to lack of heating equipment. Heating must be installed to defrost the heavy fuel oil in rail wagons, in the intermediate storage facility, and along the 2 km pipeline to the pier.

The seafront consists of two quays of 120 m length and are separated by a 80 m indentation. can handle 16,000 dwt (9 m draft) vessels which load 10,000 tonnes, transit through the canal to the White Sea and are subsequently filled up by one or two shuttle tanker loads. The terminal currently handles 750,000 tonnes for regional consumption and transit to North East Siberia, and 500,000 tonnes for export. A major constraint is the railway bridge over the Dvina river, which can accommodate an additional 1,000,000 tonnes. Therefore the export potential is limited to 1,500,000 tonnes a year.

The management of the base had an agreement with the joint venture they themselves were part of, Arctic Shipping Services. However, the joint venture now shippes through Murmansk,

[10] Vasilij Ryntsin, Vice Precident, Kandalaksja Port Authorities
[11] Jurij Grigorjev, Director General, Arkhangel Commercial Port

roskomnefteproduktbas status in the joint venture uncertain. The vessels 'Ledastern' and 'Elbestern' of Rigel Schiffahrts G.M.B.H in Bremen also participate on the trade. As the season for oil product transport to East Siberia is four months only, it is clear that the Roskomnefteprodukt complex can be developed into a major oil product export operation, although at a geographical and climatic ( The White Sea is ice-covered for 5 months) disadvantage versus Murmansk. Lower railway tariffs from Yaroslav compensates partly for this disadvantage.
The ownership structure at the base is unsure, but Wectab[12], which is owned by the Russian-Swede Max Grunfeldt has established a joint venture, BIMS, with the management for purchasing of oil products. They also cooperate with the international oil trading company Vitol.

A second option evaluated is the use of 220 m seafront at the coal terminal, Levij Bereg, on the west bank of the Dvina River. The lack of width, 80m, and current use of the coal facilities leave space for only 19-20 wagons. With defrost/transit time of 8 hrs per 20 wagons, the theoretical capacity (winter defrost) will be 1.090.000 tonnes/year. The river must either be dredged as the current depth is 3-6 m, or the seafront prolonged 30 m into the river where the depth is 8-10m. Significant investments must be made in the facility.

As mentioned above, the railway bridge over the Dvina river is a constraint for the Neftebas. The railway itself however, will be able to increase the yearly volume to 5 million tonnes subject to enough railcars. Consequently a surplus capacity of 1.660.000 tonnes exists on the railway which can be utilized only; if a new railway bridge over Dvina is constructed, or if the available area at the coal terminal is enlarged, or more suitable port areas are found further out on the west bank towards Severodvinsk. Transit time from Yaroslav is 17 hrs, and from Uktha 2,5 days. The railway cost is 500 USD/wagon from Yaroslav and 90 USD/wagon for the empty return leg.
The potential for the Neftebas could have been significantly increased if the new railway-link from the Usinsk-Uktha area were completed, as the track would have arrived at the east side of Dvina and consequently would avoid both crossing the river and the city of Archangel. This work however, has been discontinued.

*Kolgujev:*
On the island Kolgujev in the Barents Sea, Artikmorneftegasrazvedka of Murmansk extract and export crude oil. The company has license to produce and export 50.000 metric tonnes per year, but the export in 1991 was 44.000 tonnes and in 1992, 38.000 tonnes. Arkhangelgeologia also extract and export from Kolgujev, the license is 100.000 tonnes a year, the actual export was 40.000 tonnes in 1993.

[12] West East Consulting and Trading, based in Gothenburg, Sweden

## THE NORWEGIAN MARKET FOR RESIDUAL FUEL OIL (M 100).

I have chosen to match the potential export from the northern ports of Russia to the Norwegian market for residual fuel oil for three reasons;

Firstly the shorter distance will lower the transport cost portion of the traded fuel oil which increases the profit potential.

Secondly the Norwegian market is currently dependent on fuel oil originating from the Antwerp-Rotterdam-Amsterdam (ARA) region and brought in by small lots to Norway, with some originating from Mongstad and Sola refineries. The method of small shipments is expensive, and consequently vessels which calls at ports in the ARA range or elsewhere bunker there. If a separate market for significant volumes exists in Norway, the size of the market can justify infrastructure investments due to lower transport costs. Storage facilities north of Mongstad are being planned, and can handle Russian residual fuel oil.

Thirdly, The ARA range market is much more volatile due to the large quantities and numerous players in the market. By focusing on control of the complete logistic chain, and long-term supply contracts, higher and more stable prices can be achieved. The regularity of shipments out of the Mongstad/Sture range is important in this respect. The time-sensitive[13] specialized buoy-loading tankers used in the North Sea have limited options to seek alternative fuel supply, and therefore open the potential for long-term supply contracts.

Long-term arrangements are important as other things equal, the northern ports will be at an internal disadvantage versus the Baltic ports in terms of railway distance and distance to the main market in the ARA range. The port infrastructure in the Baltic is of higher standard (Tallinn, Ventspils, Klaipeida), and not affected by ice to the same degree as Archangel. It is thus important to look at alternative markets to compensate for the disadvantages.

Shown below in table 3 is the aggregate market for residual fuel oil for bunkers use in Norway. The complete calculations are found in Appendix 3. However, some comments must be made to the method used. The distances indicated in Appendix 3 are single voyage. All consumption figures are based on a round-trip voyage, consequently all distances are multiplied by two to arrive at total consumption. It is reasonable to assume that vessels spot chartered for a single voyage would bunker maximum subject to competitive quality and price. As the bunker capacities of the vessels far exceeds the single journey consumption, the figures would then be inflated. For Mo i Rana destinations and ports of origin where not available, and distances are arbitrarily determined to 1000 nm.

[13] To avoid slowdown of output on the oil fields, the vessels are limited in their trading range, as they must keep their round-trip schedules.

Not included are the traditional cabotage and liner services on the Norwegian coast and the considerable seismic and fishing fleet activity in the North, Norwegian and Barents Seas as most of these vessels run on marine diesel oil (MDO) and not fuel oil. A separate market could arise for diesel, but as previously concluded, the current supply situation does not justify any large infrastructure investments concerning MDO or lighter fuels.

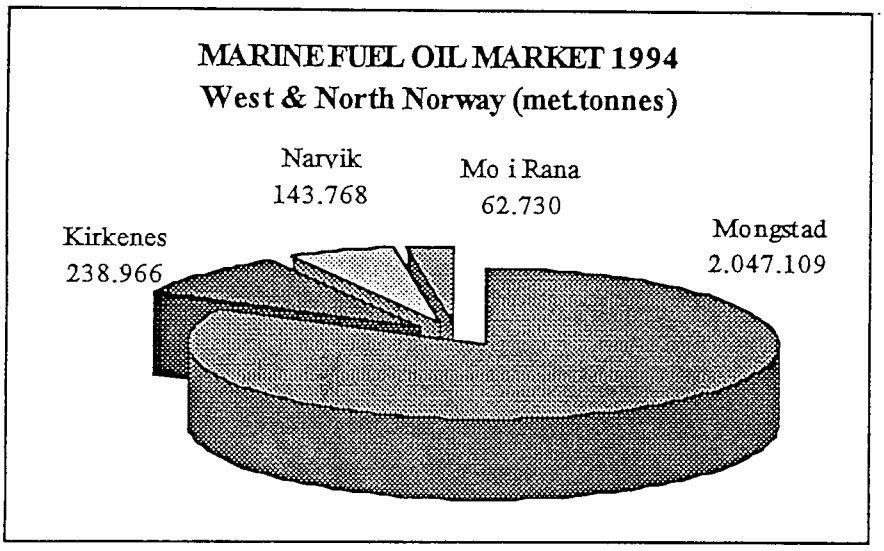



**Figure 4**

The market for residual fuel oil is estimated to be a total of 2,49 million metric tonnes for bunker purposes. The major demand originates at the Mongstad-Sture area from the export of crude oil and oil products. A major market also exists in Kirkenes and Narvik originating from mineral and iron ore shipments. The proximity to Murmansk and Archangel is important as transport cost will be reduced significantly versus alternative supply from the ARA range.

Therefore we can conclude that a separate market exists in Norway for the potential export supply increase through the northern ports of 2,5 million tonnes. Subject to price and quality, the export increase will generate 137,500,000 USD in total foreign exchange earnings at a fob Murmansk price of 55 USD/tonnes. The shipping operation will be estimated below.

## THE SHIPPING OPERATION, PORT SELECTION.

Based on the remarks made under "port infrastructure", two port alternatives, Neftebas in Archangel and the Rybport/"Murman Oil" constellation in Murmansk will be evaluated. The costing for three options has been set out in Appendix 3. A fourth option, the use of a floating terminal moored near Vaienga will be evaluated separately.

Option 1 is the use of Murman Oil facilities, and shipment by a 31150 dwt Finnish built product tanker. Rates have been set at 9000 USD/day which reflect the current market. Other particulars are set out in the appendix. It makes no use of intermediate storage vessel for reasons stated below.

Option 2 is export from Neftebas in Archangel using a "Lunni-class" vessel. Based on inquiries at Murmansk Shipping Company, which is responsible for the operation of Arctic Shipping Service vessels, rates are set at 13000 USD/day indicated to be the absolute minimum to reflect its special purpose ice-going properties. Rates are however 5,000 USD/day above a conventional product tanker of similar size. Arctic Shipping Service is, as previously concluded, likely to use the vessels year round for export purposes.

Option 3 is the use of the "Lunni-class" in shuttle traffic between Archangel and Murmansk, and intermediate storage at the "Krivbass". Rates for storage/handling are indicated to be 5 USD/tonnes, and 1,90 USD/month for storage. Total rate will then be Option 1, as the cargo must be moved on from Murmansk to port of destination, + Option 3, the shuttle operation + USD 6,90 for the storage and handling.

Port of destination will be Mongstad/Sture range for all options in Appendix 4. Costs of shipment to the Mongstad/Sture range and to Rotterdam with identical particulars are shown in Appendix 5a and 5b. The exact USD/tonnes for the two direct routes and the transport cost differentials are set out in matrix form for timecharter rates between USD 8000 and 15000 (USD 500 intervals) for both options.

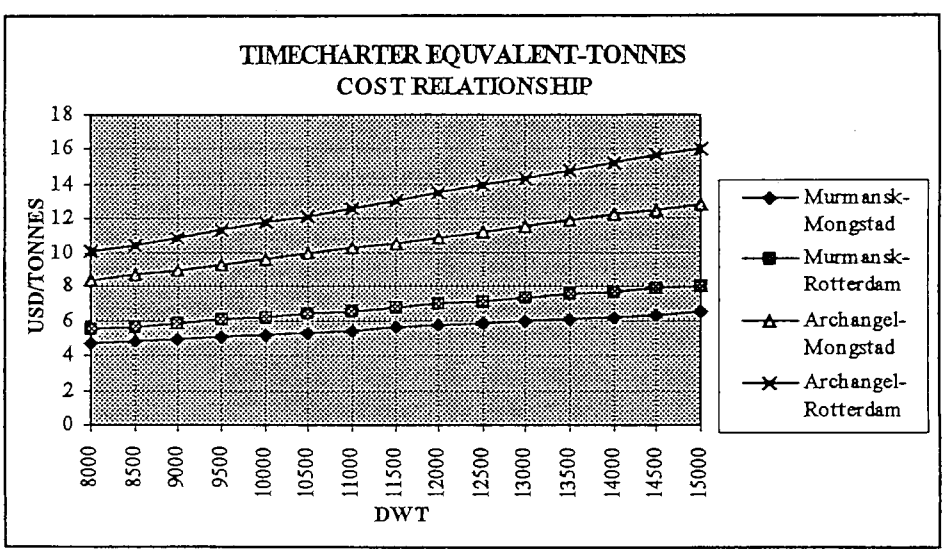



**Figure 5**

At the given timecharter rates, fuel consumption and port charges, transport cost will be USD per tonnes 4,91 from Murmansk, USD per tonnes 11,57 direct from Archangel and USD per tonnes 16,05 with intermediate storage to the Mongstad/Sture range. Obviously, Murmansk should be preferred on a pure shipment cost basis. Seen in the figure above, economies of scale make Murmansk the better alternative at any which timecharter rate (other things equal) between USD per day 8.000 and 15.000 for the two vessels.

The reader should note that port fees at Murmansk have been set at USD 40,000 and 5,000 at Archangel as adjusted long-term rates. Exact figures for Murmansk, USD 76,000 for a 30,000 dwt vessel are incorporated in the figures in Appendix 4c as the short-term alternative.

Roskomnefteproduktbas in Archangel is affected by the fact, that without purpose-built ice-tonnage the base is useless for almost half the year and consequently local authorities will be under pressure to set low rates. The fact that the terminal is located outside both the city limit and the sphere of Northern Shipping Company also low port charges.

As indicated below the use of intermediate storage raises total shipment cost from Archangel by USD 4,48 per tonnes, but through-put volume at the Roskomnefteproduktbas triples from 564,796 metric tonnes to 1,743,932 metric tonnes, if one single purpose-built "Lunni-class" is used as shuttle-tanker between Archangel and Murmansk. A sensible pricing of transfer fees at the terminal or at the VLCC or both could significantly increase the viability and scale of oil products export.

| | |
|---|---|
| *Lunni-class feeder transport Archangel-Murmansk* | *$ 4,24* |
| *Storage & Handling in Murmansk* | *$ 6,90* |
| *Murmansk-Mongstad* | *$ 4,91* |
| *Sum* | *$ 16,05* |
| *Direct transport Archangel-Mongstad* | *$ 11,57* |
| *Cost increase of intermediate storage* | *$ 4,48* |

## THE VLCC INVESTMENT.

The VLCC investment is evaluated in appendix 6a and 6b. The VLCC is assumed located just west of Vaienga in order to facilitate a direct transfer of oil products from wagons to ship. The key limitation is as previously mentioned the railway through Murmansk which limits the volume to 1,000,000 million tonnes. All costs are set to increase by 5 per cent annually, whereas operating income is stable at 6,9 USD per tonnes.

Appendix 6a evaluates the 1,000,000 tonnes/year through-put which would leave an investor with a return on investment of 8,28% (see investment criteria in appendix 6a).

Appendix 6b evaluates a combined use, direct transfer wagon to ship in Murmansk as above, and the use of shuttle transfer from Archangel. The terminal then accommodates an additional volume of 500,000 tonnes in 1995, and 1,500,000 tonnes from 1996 and onwards, which is close to optimal use of one "Lunni-cl" in shuttle service from Archangel to Murmansk.
To attract this extra volume, the transfer fee for the extra volume is set at 2,42 USD per tonnes tonnes, which when added up, equates the direct shipping cost from Archangel to Mongstad/Sture range (see below and appendix 4). However, the export volume for Roskomnefteproduktbas in Archangel is tripled. In this scenario, the return on investment will increase to 27,68%.

| | |
|---|---|
| *Direct transport Archangel-Mongstad* | *$ 11,57* |
| *less Lunni-class feeder transport Archangel-Murmansk* | *$ 4,24* |
| *less Murmansk-Mongstad* | *$ 4,91* |
| *transfer fee to attract extra through-put cargo* | *$ 2,42* |

## CONCLUSION.

As concluded in the introduction, there will be a northbound shift of the strategic centre of the Russian petroleum industry in the decade ahead. The shift will lead to increased infrastructure investments in the exploration & production of crude oil and gas. The focus on, and relative importance of, the energy sector for the region will increase. However, to generate foreign exchange earnings in the short term, oil products, and residual fuel oil offer the best potential.

Domestic demand is falling and will most likely continue its decline. Likewise, current surplus capacity due to overall declining transport volumes on the Northern and October railways allows an additional export of oil products, subject to enough rolling stock. A quantity of 2.090.000 tonnes oil products can be accommodated on the Northern railway, for which infrastructure exists or can be facilitated within a short time span for 1.660.000 tonnes in the Archangel area. On the October railway an additional export increase of 2.050.000 tonnes is possible for which facilities exist or can be modified within a reasonable timeframe.

Lack of control over railway costs, is a major risk factor. As the residual fuel oil supply originates at points necessitating long railway haulage, and is a low value product, the effect of an unforeseen rate hike could make the whole trade unprofitable. Falling world prices affects this further. However, the current lack of storage for residual fuel, the shortfall of traffic

volumes at the railways and the potential foreign exchange revenues it generates for railway administrations should work to the contrary.

Murmansk, due to its ice free fjord and deep water port, offers the best potential for a western operator who wishes to enter into joint ventures or direct investments to solve the problem of heating in wintertime. The use of naval installations could further improve the relative position of Murmansk.
Local authorities and powerful groups have invested USD 9,000,000 in the "Krivbass" tanker, without any through-put deals having yet been struck and management being investigated. The tanker could potentially be obtained at low cost, as it do not earn money for either the bank or the company. Located at the railway pier near Vaienga which facilitates direct transfer of oil products and correctly managed, it could develop into a profitable business.

By pricing transfer services to exporters who use the Yaroslav-Northern railway - Neftebas/Archangel link in an sensible way, volumes can be significantly increased and the profitability of the VLCC investment improved.

In Archangel, the Roskomnefteproduktbas and Arctic Shipping Services were well integrated, with the Kvaerner group through its Finnish subsidiary Kvaerner-Masa and Neste Oil being the key players. However, of reasons unknown, but probably costs, ASS now ship large quatities out of Murmansk. and North-west Russia is still considered as a major growth market.

Due to ice conditions and prohibitive costs of icebreaker support to western tonnage or use of purpose-built ice-strengthened tonnage in the winter-season, entry barrier costs versus risk assessment for direct investments to upgrade heating and transfer facilities in Archangel, will probably be to high for a number of western operators.

The modification cost of 80 million Finnish "Marka" per "Lunni-class" can hardly justify a Timecharter-rate of 13.000 USD/Day for a 17.000 cu.m. vessel, on top of the storage/transfer fees. As mentioned above, a more modest pricing would increase the probability of significant oil products export through the northern ports.

In terms of geographical and political realities Russia has few, if any, short-term possibilities to increase her export of oil products through Russian ports, other than from the northern ports. However, Lukoil's move to integrate vertically downstream in tank facilities in the Baltic ports of Tallinn, Ventspils and Klaipeida points to other solutions being found.

## APPENDIX 1

| INDIVIDUAL REFINERY CAPACITIES, 1992. | | | | |
|---|---|---|---|---|
| REGION | CR OIL CURRENT THROUGH-PUT BARRELS/DAY | PERCENT OF TOTAL CAPACITY | CRUDE OIL TONNES/YEAR | RES FUEL OIL TONNES/YEAR |
| NORTH-WESTERN | | | | |
| Kirishi | 386000 | 60% | 19221010 | 5574093 |
| Yaroslav | 357340 | 58% | 17793874 | 5160224 |
| Ukhta | 125700 | 22% | 6259277 | 1815190 |
| Regional Total | | | 43274161 | 12549507 |
| Percent of FederationTotal | | | 13,16% | 14,34% |
| MOSCOW-CENTRAL | | | | |
| Moscow | 243000 | 75% | 12100273 | 3025068 |
| Ryazan | 360760 | 61% | 17964175 | 4491044 |
| Nizhny Novgorod | 453060 | 47% | 22560286 | 6542483 |
| Regional Total | | | 52624734 | 14058595 |
| Percent of Federation Total | | | 16,01% | 16,06% |
| VOLGA-URAL | | | | |
| Novo-Ufa | 377640 | 83% | 18804720 | 4701180 |
| Ufa | 233520 | 67% | 11628213 | 2907053 |
| Ufa | 250220 | 84% | 12459795 | 3114949 |
| Perm | 278400 | 74% | 13863029 | 3465757 |
| Nizhnekamsk | 120000 | | 5975443 | 1732879 |
| Novo-Kuybyshev | 307420 | 58% | 15308090 | 4439346 |
| Syzran | 210360 | 100% | 10474952 | 2618738 |
| Magnitogorsk | 246160 | 118% | 12257626 | 3064407 |
| Orsk | 144200 | 41% | 7180491 | 2082342 |
| Samara | 119580 | 128% | 5954529 | 1488632 |
| Regional Total | | | 113906889 | 29615283 |
| Percent of Federation Total | | | 34,65% | 33,83% |
| SIBERIAN | | | | |
| Omsk | 564000 | 70% | 28084584 | 7021146 |
| Tomsk | 29000 | 46% | 1444065 | 418779 |
| Achinsk | 134040 | 69% | 6674570 | 1668643 |
| Angarsk | 462960 | 65% | 23053261 | 5763315 |
| Regional Total | | | 59256480 | 14871883 |

# OIL PRODUCTS EXPORT FROM NORTH-WESTERN RUSSIA

| | | | | |
|---|---|---|---|---|
| Percent of Federation Total | | | 18,02% | 16,99% |
| FAR EAST | | | | |
| Khabarovsk | 90000 | 26% | 4481583 | 1299659 |
| Komsomolsk | 116140 | 28% | 5783233 | 1677138 |
| Regional Total | | | 10264816 | 2976797 |
| Percent of Federation Total | | | 3,12% | 3,40% |
| SOUTHERN | | | | |
| Krasnodar | 33980 | 72% | 1692046 | 423012 |
| Groznyi | 387720 | 39% | 19306658 | 5598931 |
| Novo-Groznyi | 120000 | 48% | 5975443 | 1732879 |
| Groznyi-Sheripov | 40000 | 67% | 1991814 | 497954 |
| Tuapse | 45000 | 14% | 2240791 | 649829 |
| Volgograd | 189920 | 69% | 9457135 | 2364284 |
| Saratov | 176200 | 89% | 8773943 | 2193486 |
| Regional Total | | | 49437831 | 13460373 |
| Percent of Federation Total | | | 15,04% | 15,38% |
| RUSSIA TOTAL | 6602320 | | 328764911 | 87532438 |

Source : Oil & Gas Journal Dec 21, 1992

## OIL PRODUCTS EXPORT FROM NORTH-WESTERN RUSSIA

**APPENDIX 2.**

| OIL PRODUCT EXPORT POTENTIAL FROM THE NORTHERN PORTS | | Metric | Tonnes | | | | |
|---|---|---|---|---|---|---|---|
| **NORTHERN RAILWAY** | | | | **OCTOBER RAILWAY** | | | |
| Railroad Capacity | | | 5000000 | Railroad Capacity | | | 5000000 |
| Current Shipments : | | | | Current Shipments : | | | |
| City of Archangel | 650000 | | | City of Murmansk | 1450000 | | |
| Sibir/Nenets | 100000 | | | Domestic Fleet | 400000 | | |
| Neftebas Export | 500000 | | | Murman Oil Export | 350000 | | |
| | 1250000 | 1250000 | | Sevoromorsk | 750000 | | |
| | | | | | 2950000 | 2950000 | |
| Potential Increase : | | | | Potential Increase : | | | |
| Neftebas Export | 1000000 | | | Murman Oil Export | 800000 | | |
| West Dvina Export | 1090000 | | | Komsomolskaja | 1000000 | | |
| | 2090000 | 2090000 | | Kandalaksha | 250000 | | |
| Surplus | | 1660000 | | | 2050000 | 2050000 | |
| | | | | Surplus | | 0 | |
| Total | | 5000000 | 5000000 | | | 5000000 | 5000000 |

## APPENDIX 3

| POTENTIAL DEMAND FOR RESIDUAL FUEL OIL IN NORWAY (TONNES) | | | | | |
|---|---|---|---|---|---|
| LOAD PORT | DISCHARGE AREA | DISTANCE (NM) | NO OF VESSELS | CONSUMPTION TONNES/DAY | TOTAL TONNES |
| Kirkenes | ARA | 1650 | 210 | 120 | 238966 |
| Narvik | ARA | 1218 | 204 | 95 | 135660 |
| Narvik | Immingham | 495 | 30 | 95 | 8108 |
| Mo i Rana | Import/Export | 1000 | 15 | 120 | 10345 |
| | Import/Export | 1000 | 4 | 100 | 2299 |
| | Import/Export | 1000 | 9 | 80 | 4138 |
| | Import/Export | 1000 | 26 | 60 | 8966 |
| | Import/Export | 1000 | 22 | 40 | 5057 |
| | Import/Export | 1000 | 15 | 30 | 2586 |
| | Import/Export | 1000 | 26 | 20 | 2989 |
| | Import/Export | 1000 | 44 | 20 | 5057 |
| | Import/Export | 1000 | 38 | 15 | 3276 |
| | Import/Export | 1000 | 100 | 15 | 8621 |
| | Import/Export | 1000 | 59 | 15 | 5086 |
| | Import/Export | 1000 | 75 | 10 | 4310 |
| Sundalsøra | Aughivich | 1350 | 24 | 15 | 2793 |
| | ARA | 790 | 52 | 15 | 3541 |

## OIL PRODUCTS EXPORT FROM NORTH-WESTERN RUSSIA

| | | | | | |
|---|---|---|---|---|---|
| | Jamaica | 5150 | 6 | 60 | 10655 |
| | Central Africa | 3650 | 2 | 60 | 2517 |
| | Eksport | 800 | 30 | 15 | 2069 |
| Årdaltangen | Jamaica | 4990 | 18 | 60 | 30972 |
| | US Gulf | 5375 | 4 | 40 | 4943 |
| Høyanger | Aughivich | 1210 | 4 | 20 | 556 |
| | | 1210 | 8 | 15 | 834 |
| | Export | 660 | 36 | 15 | 2048 |
| Gullfaks | Mongstad | 84 | 175 | 95 | 8026 |
| Statfjord A/B/C | Mongstad | 100 | 215 | 95 | 11739 |
| | ARA | 600 | 270 | 120 | 111724 |
| Heidrun | ARA | 920 | 12 | 120 | 7614 |
| Mongstad | Rotterdam | 582 | 845 | 95 | 268506 |
| | US Gulf | 5275 | 194 | 140 | 823385 |
| Mongstad | US Gulf-Arabian Gulf | 7040 | 6 | 140 | 33986 |
| Sture | US East Coast | 3470 | 65 | 120 | 155552 |
| | ARA | 580 | 504 | 140 | 235200 |
| | US Gulf-Arabian Gulf | 5270 | 10 | 140 | 42402 |
| | US Gulf | 5275 | 40 | 140 | 169770 |
| | Canada | 2600 | 24 | 120 | 43034 |

## OIL PRODUCTS EXPORT FROM NORTH-WESTERN RUSSIA

| | | | | | |
|---|---|---|---|---|---|
| | Trieste | 3482 | 5 | 120 | 12007 |
| | Israel | 3880 | 12 | 120 | 32110 |
| | Bahamas | 4450 | 3 | 95 | 7289 |
| | Finland | 960 | 36 | 120 | 23834 |
| SUM CONSUMPTION | | | | | 2492572 |

# OIL PRODUCTS EXPORT FROM NORTH-WESTERN RUSSIA

## APPENDIX 4 A.

| "KOMMANDANT FETCO" MURMANSK-MONGSTAD | | | | | "LUNNI" CLASS ARCHANGEL-MONGSTAD | | | | | "LUNNI" CLASS ARCHANGEL-MURMANSK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vessel T/C : | | 9000 | | 74000 | Vessel T/C : | | 13000 | | 127111 | Vessel T/C : | | 13000 | | 41167 |
| Speed : | 15 | | | | Speed : | 15 | | | | Speed : | 14 | | | |
| Distance : | 1120 | | | | Distance : | 1400 | | | | Distance : | 280 | | | |
| Roundtrip Days: | 8,22 | | | | Roundtrip Days: | 9,78 | | | | Roundtrip Days: | 3,17 | | | |
| MDO/Day : | 3 | $/Tonnes | 150 | 3700 | MDO/Day : | 3 | $/Tonnes | 150 | 4400 | MDO/Day : | 3 | $/Tonnes | 150 | 1425 |
| MDO/Port : | 22 | $/Tonnes | 150 | | MDO/Port : | 15 | $/Tonnes | 150 | | MDO/Port : | 15 | $/Tonnes | 150 | |
| MFO/Day : | 34 | $/Tonnes | 55 | 15376 | MFO/Day : | 35 | $/Tonnes | 55 | 18822 | MFO/Day : | 35 | $/Tonnes | 55 | 6096 |
| $/Roundtrip Cost : | | | | 83000 | $/Roundtrip Cost : | | | | 140111 | $/Roundtrip Cost : | | | | 54167 |
| Port/Pilot/light Load: | | | | 40000 | Port/Pilot/light Load: | | | | 5000 | Port/Pilot/light Load: | | | | 5000 |
| Port/Pilot/light Dis : | | | | 30000 | Port/Pilot/light Dis : | | | | 30000 | Port/Pilot/light Dis : | | | | 5000 |
| Sum Cost : | | | | 153000 | Sum Cost : | | | | 175111 | Sum Cost : | | | | 64167 |
| Spec.Gravity : | | 0,89 | | | Spec.Gravity : | | 0,89 | | | Spec.Gravity : | | 0,89 | | |
| Cu. Meter : | | 35000 | | | Cu. Meter : | | 17000 | | | Cu. Meter : | | 17000 | | |
| Tonnes/Roundtrip : | | 31150 | | | Tonnes/Roundtrip : | | 15130 | | | Tonnes/Roundtrip : | | 15130 | | |
| $/Tonnes Transported Product : | | | | 4,91 | $/Tonnes Transported Product : | | | | 11,57 | $/Tonnes Transported Product : | | | | 4,24 |
| Tonnes per Year | | | | 1382807 | Tonnes per Year | | | | 564796 | Tonnes per Year | | | | 1743932 |

## APPENDIX 5 A.

## EXPORT FROM NORTH-WEST RUSSIAN PORTS TO MONGSTAD-STURE RANGE

| TRANSPORT COST DIFFERENTIAL $/TONNES, MURMANSK (HOR) VS. ARCHANGEL (VERT) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T/C RATE | | 8000 | 8500 | 9000 | 9500 | 10000 | 10500 | 11000 | 11500 | 12000 | 12500 | 13000 | 13500 | 14000 | 14500 | 15000 |
| | $/TONNES | 4,65 | 4,78 | 4,91 | 5,04 | 5,18 | 5,31 | 5,44 | 5,57 | 5,7 | 5,84 | 5,97 | 6,1 | 6,23 | 6,36 | 6,5 |
| 8000 | 8,34 | 3,69 | 3,56 | 3,43 | 3,3 | 3,17 | 3,03 | 2,9 | 2,77 | 2,64 | 2,51 | 2,37 | 2,24 | 2,11 | 1,98 | 1,85 |
| 8500 | 8,67 | 4,02 | 3,89 | 3,75 | 3,62 | 3,49 | 3,36 | 3,23 | 3,09 | 2,96 | 2,83 | 2,7 | 2,57 | 2,43 | 2,3 | 2,17 |
| 9000 | 8,99 | 4,34 | 4,21 | 4,08 | 3,95 | 3,81 | 3,68 | 3,55 | 3,42 | 3,29 | 3,15 | 3,02 | 2,89 | 2,76 | 2,63 | 2,49 |
| 9500 | 9,31 | 4,66 | 4,53 | 4,4 | 4,27 | 4,14 | 4 | 3,87 | 3,74 | 3,61 | 3,48 | 3,34 | 3,21 | 3,08 | 2,95 | 2,82 |
| 10000 | 9,64 | 4,99 | 4,86 | 4,72 | 4,59 | 4,46 | 4,33 | 4,2 | 4,06 | 3,93 | 3,8 | 3,67 | 3,54 | 3,4 | 3,27 | 3,14 |
| 10500 | 9,96 | 5,31 | 5,18 | 5,05 | 4,91 | 4,78 | 4,65 | 4,52 | 4,39 | 4,25 | 4,12 | 3,99 | 3,86 | 3,73 | 3,59 | 3,46 |
| 11000 | 10,28 | 5,63 | 5,5 | 5,37 | 5,24 | 5,11 | 4,97 | 4,84 | 4,71 | 4,58 | 4,45 | 4,31 | 4,18 | 4,05 | 3,92 | 3,79 |
| 11500 | 10,6 | 5,96 | 5,82 | 5,69 | 5,56 | 5,43 | 5,3 | 5,16 | 5,03 | 4,9 | 4,77 | 4,64 | 4,5 | 4,37 | 4,24 | 4,11 |
| 12000 | 10,93 | 6,28 | 6,15 | 6,02 | 5,88 | 5,75 | 5,62 | 5,49 | 5,36 | 5,22 | 5,09 | 4,96 | 4,83 | 4,7 | 4,56 | 4,43 |
| 12500 | 11,25 | 6,6 | 6,47 | 6,34 | 6,21 | 6,07 | 5,94 | 5,81 | 5,68 | 5,55 | 5,42 | 5,28 | 5,15 | 5,02 | 4,89 | 4,76 |
| 13000 | 11,57 | 6,93 | 6,79 | 6,66 | 6,53 | 6,4 | 6,27 | 6,13 | 6 | 5,87 | 5,74 | 5,61 | 5,47 | 5,34 | 5,21 | 5,08 |
| 13500 | 11,9 | 7,25 | 7,12 | 6,99 | 6,85 | 6,72 | 6,59 | 6,46 | 6,33 | 6,19 | 6,06 | 5,93 | 5,8 | 5,67 | 5,53 | 5,4 |
| 14000 | 12,22 | 7,57 | 7,44 | 7,31 | 7,18 | 7,04 | 6,91 | 6,78 | 6,65 | 6,52 | 6,38 | 6,25 | 6,12 | 5,99 | 5,86 | 5,72 |
| 14500 | 12,54 | 7,9 | 7,76 | 7,63 | 7,5 | 7,37 | 7,24 | 7,1 | 6,97 | 6,84 | 6,71 | 6,58 | 6,44 | 6,31 | 6,18 | 6,05 |
| 15000 | 12,87 | 8,22 | 8,09 | 7,95 | 7,82 | 7,69 | 7,56 | 7,43 | 7,29 | 7,16 | 7,03 | 6,9 | 6,77 | 6,63 | 6,5 | 6,37 |

## APPENDIX 5 B.

## EXPORT FROM NORTH-WEST RUSSIAN PORTS TO ROTTERDAM

| TRANSPORT COST DIFFERENTIAL $/TONNES: MURMANSK (HOR) VS. ARCHANGEL (VERT) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T/C RATE | | 8000 | 8500 | 9000 | 9500 | 10000 | 10500 | 11000 | 11500 | 12000 | 12500 | 13000 | 13500 | 14000 | 14500 | 15000 |
| | $/TONNES | 5,48 | 5,67 | 5,85 | 6,03 | 6,22 | 6,4 | 6,59 | 6,77 | 6,96 | 7,14 | 7,32 | 7,51 | 7,69 | 7,88 | 8,06 |
| 8000 | 10,06 | 4,58 | 4,39 | 4,21 | 4,03 | 3,84 | 3,66 | 3,47 | 3,29 | 3,11 | 2,92 | 2,74 | 2,55 | 2,37 | 2,18 | 2 |
| 8500 | 10,49 | 5,01 | 4,82 | 4,64 | 4,46 | 4,27 | 4,09 | 3,9 | 3,72 | 3,54 | 3,35 | 3,17 | 2,98 | 2,8 | 2,62 | 2,43 |
| 9000 | 10,92 | 5,44 | 5,26 | 5,07 | 4,89 | 4,7 | 4,52 | 4,33 | 4,15 | 3,97 | 3,78 | 3,6 | 3,41 | 3,23 | 3,05 | 2,86 |
| 9500 | 11,35 | 5,87 | 5,69 | 5,5 | 5,32 | 5,13 | 4,95 | 4,77 | 4,58 | 4,4 | 4,21 | 4,03 | 3,84 | 3,66 | 3,48 | 3,29 |
| 10000 | 11,78 | 6,3 | 6,12 | 5,93 | 5,75 | 5,56 | 5,38 | 5,2 | 5,01 | 4,83 | 4,64 | 4,46 | 4,28 | 4,09 | 3,91 | 3,72 |
| 10500 | 12,21 | 6,73 | 6,55 | 6,36 | 6,18 | 5,99 | 5,81 | 5,63 | 5,44 | 5,26 | 5,07 | 4,89 | 4,71 | 4,52 | 4,34 | 4,15 |
| 11000 | 12,64 | 7,16 | 6,98 | 6,79 | 6,61 | 6,43 | 6,24 | 6,06 | 5,87 | 5,69 | 5,5 | 5,32 | 5,14 | 4,95 | 4,77 | 4,58 |
| 11500 | 13,07 | 7,59 | 7,41 | 7,22 | 7,04 | 6,86 | 6,67 | 6,49 | 6,3 | 6,12 | 5,93 | 5,75 | 5,57 | 5,38 | 5,2 | 5,01 |
| 12000 | 13,51 | 8,02 | 7,84 | 7,65 | 7,47 | 7,29 | 7,1 | 6,92 | 6,73 | 6,55 | 6,37 | 6,18 | 6 | 5,81 | 5,63 | 5,44 |
| 12500 | 13,94 | 8,45 | 8,27 | 8,08 | 7,9 | 7,72 | 7,53 | 7,35 | 7,16 | 6,98 | 6,8 | 6,61 | 6,43 | 6,24 | 6,06 | 5,88 |
| 13000 | 14,37 | 8,88 | 8,7 | 8,52 | 8,33 | 8,15 | 7,96 | 7,78 | 7,59 | 7,41 | 7,23 | 7,04 | 6,86 | 6,67 | 6,49 | 6,31 |
| 13500 | 14,8 | 9,31 | 9,13 | 8,95 | 8,76 | 8,58 | 8,39 | 8,21 | 8,03 | 7,84 | 7,66 | 7,47 | 7,29 | 7,1 | 6,92 | 6,74 |
| 14000 | 15,23 | 9,74 | 9,56 | 9,38 | 9,19 | 9,01 | 8,82 | 8,64 | 8,46 | 8,27 | 8,09 | 7,9 | 7,72 | 7,54 | 7,35 | 7,17 |
| 14500 | 15,66 | 10,18 | 9,99 | 9,81 | 9,62 | 9,44 | 9,25 | 9,07 | 8,89 | 8,7 | 8,52 | 8,33 | 8,15 | 7,97 | 7,78 | 7,6 |
| 15000 | 16,09 | 10,61 | 10,42 | 10,24 | 10,05 | 9,87 | 9,69 | 9,5 | 9,32 | 9,13 | 8,95 | 8,76 | 8,58 | 8,4 | 8,21 | 8,03 |

## APPENDIX 5 C.

## EXPORT FROM MURMANSK TO MONGSTAD/STURE RANGE

| TRANSPORT COST DIFFERENTIAL $/TONNES: MURMANSK (HOR) VS. ARCHANGEL (VERT) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T/C RATE | | 8000 | 8500 | 9000 | 9500 | 10000 | 10500 | 11000 | 11500 | 12000 | 12500 | 13000 | 13500 | 14000 | 14500 | 15000 |
| | $/TONNES | 5,77 | 5,9 | 6,04 | 6,17 | 6,3 | 6,43 | 6,56 | 6,7 | 6,83 | 6,96 | 7,09 | 7,22 | 7,36 | 7,49 | 7,62 |
| 8000 | 8,34 | 2,57 | 2,44 | 2,31 | 2,18 | 2,04 | 1,91 | 1,78 | 1,65 | 1,52 | 1,38 | 1,25 | 1,12 | 0,99 | 0,86 | 0,72 |
| 8500 | 8,67 | 2,89 | 2,76 | 2,63 | 2,5 | 2,37 | 2,23 | 2,1 | 1,97 | 1,84 | 1,71 | 1,57 | 1,44 | 1,31 | 1,18 | 1,05 |
| 9000 | 8,99 | 3,22 | 3,09 | 2,95 | 2,82 | 2,69 | 2,56 | 2,43 | 2,29 | 2,16 | 2,03 | 1,9 | 1,77 | 1,63 | 1,5 | 1,37 |
| 9500 | 9,31 | 3,54 | 3,41 | 3,28 | 3,14 | 3,01 | 2,88 | 2,75 | 2,62 | 2,48 | 2,35 | 2,22 | 2,09 | 1,96 | 1,82 | 1,69 |
| 10000 | 9,64 | 3,86 | 3,73 | 3,6 | 3,47 | 3,34 | 3,2 | 3,07 | 2,94 | 2,81 | 2,68 | 2,54 | 2,41 | 2,28 | 2,15 | 2,02 |
| 10500 | 9,96 | 4,19 | 4,05 | 3,92 | 3,79 | 3,66 | 3,53 | 3,39 | 3,26 | 3,13 | 3 | 2,87 | 2,74 | 2,6 | 2,47 | 2,34 |
| 11000 | 10,28 | 4,51 | 4,38 | 4,25 | 4,11 | 3,98 | 3,85 | 3,72 | 3,59 | 3,45 | 3,32 | 3,19 | 3,06 | 2,93 | 2,79 | 2,66 |
| 11500 | 10,6 | 4,83 | 4,7 | 4,57 | 4,44 | 4,31 | 4,17 | 4,04 | 3,91 | 3,78 | 3,65 | 3,51 | 3,38 | 3,25 | 3,12 | 2,99 |
| 12000 | 10,93 | 5,16 | 5,02 | 4,89 | 4,76 | 4,63 | 4,5 | 4,36 | 4,23 | 4,1 | 3,97 | 3,84 | 3,7 | 3,57 | 3,44 | 3,31 |
| 12500 | 11,25 | 5,48 | 5,35 | 5,22 | 5,08 | 4,95 | 4,82 | 4,69 | 4,56 | 4,42 | 4,29 | 4,16 | 4,03 | 3,9 | 3,76 | 3,63 |
| 13000 | 11,57 | 5,8 | 5,67 | 5,54 | 5,41 | 5,27 | 5,14 | 5,01 | 4,88 | 4,75 | 4,61 | 4,48 | 4,35 | 4,22 | 4,09 | 3,95 |
| 13500 | 11,9 | 6,13 | 5,99 | 5,86 | 5,73 | 5,6 | 5,47 | 5,33 | 5,2 | 5,07 | 4,94 | 4,81 | 4,67 | 4,54 | 4,41 | 4,28 |
| 14000 | 12,22 | 6,45 | 6,32 | 6,18 | 6,05 | 5,92 | 5,79 | 5,66 | 5,52 | 5,39 | 5,26 | 5,13 | 5 | 4,86 | 4,73 | 4,6 |
| 14500 | 12,54 | 6,77 | 6,64 | 6,51 | 6,38 | 6,24 | 6,11 | 5,98 | 5,85 | 5,72 | 5,58 | 5,45 | 5,32 | 5,19 | 5,06 | 4,92 |
| 15000 | 12,87 | 7,09 | 6,96 | 6,83 | 6,7 | 6,57 | 6,44 | 6,3 | 6,17 | 6,04 | 5,91 | 5,78 | 5,64 | 5,51 | 5,38 | 5,25 |

## APPENDIX 6A.

| VLCC CASHFLOW PROJECTIONS, (1.000.000 TONNES/YEAR) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| OPERATING INCOME : | 6900000 | 6900000 | 6900000 | 6900000 | 6900000 | 6900000 | 6900000 | 6900000 | 6900000 | 7255556 |
| CAPITAL COST : | | | | | | | | | | |
| Principal : | 5000000 | 4500000 | 4000000 | 3500000 | 3000000 | 2500000 | 2000000 | 1500000 | 1000000 | 500000 |
| Installment : | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 |
| Interest : | 350000 | 315000 | 280000 | 245000 | 210000 | 175000 | 140000 | 105000 | 70000 | 35000 |
| OPERATING COST : | | | | | | | | | | |
| Crewing : | 720000 | 756000 | 793800 | 833490 | 875165 | 918923 | 964869 | 1013112 | 1063768 | 1116956 |
| P&I Cover : | 500000 | 525000 | 551250 | 578813 | 607753 | 638141 | 670048 | 703550 | 738728 | 775664 |
| Maintenance : | 300000 | 315000 | 330750 | 347288 | 364652 | 382884 | 402029 | 422130 | 443237 | 465398 |
| Stores/Lub. : | 200000 | 210000 | 220500 | 231525 | 243101 | 255256 | 268019 | 281420 | 295491 | 310266 |
| Administration : | 800000 | 840000 | 882000 | 926100 | 972405 | 1021025 | 1072077 | 1125680 | 1181964 | 1241063 |
| Classification : | | | 40000 | | 100000 | | | 40000 | | |
| Fuel : | 257607 | 201311 | 201311 | 201311 | 201311 | 201311 | 201311 | 201311 | 201311 | 201311 |
| TOTAL COST : | 3627607 | 3662311 | 3799611 | 3863526 | 4074387 | 4092540 | 4218352 | 4392204 | 4494498 | 4645658 |
| Income Before Tax : | 3272393 | 3237689 | 3100389 | 3036474 | 2825613 | 2807460 | 2681648 | 2507796 | 2405502 | 2609898 |
| Depreciation : | 1800000 | 1440000 | 1152000 | 921600 | 737280 | 589824 | 471859 | 377487 | 301990 | 241592 |
| Interest : | 350000 | 315000 | 280000 | 245000 | 210000 | 175000 | 140000 | 105000 | 70000 | 35000 |
| Loss Carry Forward: | | 0 | | | | | | | | |
| Tax Base : | 1472393 | 1797689 | 1948389 | 2114874 | 2088333 | 2217636 | 2209789 | 2130309 | 2103512 | 2368306 |
| Tax (32 %) : | 471166 | 575261 | 623485 | 676760 | 668267 | 709643 | 707132 | 681699 | 673124 | 757858 |
| Net Income : | 1001227 | 1222429 | 1324905 | 1438114 | 1420067 | 1507992 | 1502657 | 1448610 | 1430388 | 1610448 |
| Cash Flow : | 2801227 | 2662429 | 2476905 | 2359714 | 2157347 | 2097816 | 1974516 | 1826097 | 1732378 | 1852040 |
| Break Even Rate: | 3,63 | 3,66 | 3,8 | 3,86 | 4,07 | 4,09 | 4,22 | 4,39 | 4,49 | 4,65 |
| Handling Charge: | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 |

| | | | |
|---|---|---|---|
| Internal ROR : | 8,28% | NPV : | 537390 |

## INVESTMENT CRITERIAS :

Procurement Price : 8.500.000 USD
Modification Cost : 500.000 USD

Equity : 4.000.000 USD
Loan : 5.000.000 USD

Periods : 10 Years
Interest : 7.0 % (Libor +1,5)

## APPENDIX 6B.

| VLCC OPERATION CASHFLOW PROJECTIONS (2,500,000 T/Y) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| OPERATING INCOME : | 6900000 | 8110000 | 10530000 | 10530000 | 10530000 | 10530000 | 10530000 | 10530000 | 10530000 | 10530000 |
| CAPITAL COST : | | | | | | | | | | |
| Principal : | 5000000 | 4500000 | 4000000 | 3500000 | 3000000 | 2500000 | 2000000 | 1500000 | 1000000 | 500000 |
| Installment : | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 | 500000 |
| Interest : | 350000 | 315000 | 280000 | 245000 | 210000 | 175000 | 140000 | 105000 | 70000 | 35000 |
| OPERATING COST : | | | | | | | | | | |
| Crewing : | 720000 | 756000 | 793800 | 833490 | 875165 | 918923 | 964869 | 1013112 | 1063768 | 1116956 |
| P&I Cover : | 500000 | 525000 | 551250 | 578813 | 607753 | 638141 | 670048 | 703550 | 738728 | 775664 |
| Maintenance : | 300000 | 315000 | 330750 | 347288 | 364652 | 382884 | 402029 | 422130 | 443237 | 465398 |
| Stores/Lub : | 200000 | 210000 | 220500 | 231525 | 243101 | 255256 | 268019 | 281420 | 295491 | 310266 |
| Administration : | 800000 | 840000 | 882000 | 926100 | 972405 | 1021025 | 1072077 | 1125680 | 1181964 | 1241063 |
| Classification : | | | 40000 | | 100000 | | | 40000 | | |
| Fuel : | 257607 | 301966 | 503277 | 503277 | 503277 | 503277 | 503277 | 503277 | 503277 | 503277 |
| TOTAL COST : | 3627607 | 3762966 | 4101577 | 4165492 | 4376353 | 4394506 | 4520318 | 4694170 | 4796465 | 4947624 |
| Income Before Tax : | 3272393 | 4347034 | 6428423 | 6364508 | 6153647 | 6135494 | 6009682 | 5835830 | 5733535 | 5582376 |
| Depreciation : | 1800000 | 1440000 | 1152000 | 921600 | 737280 | 589824 | 471859 | 377487 | 301990 | 241592 |
| Interest : | 350000 | 315000 | 280000 | 245000 | 210000 | 175000 | 140000 | 105000 | 70000 | 35000 |
| Loss Carry Forward: | | 0 | | | | | | | | |
| Tax Base : | 1472393 | 2907034 | 5276423 | 5442908 | 5416367 | 5545670 | 5537823 | 5458343 | 5431546 | 5340784 |
| Tax (32 %) : | 471166 | 930251 | 1688455 | 1741731 | 1733238 | 1774614 | 1772103 | 1746670 | 1738095 | 1709051 |
| Net Income : | 1001227 | 1976783 | 3587968 | 3701178 | 3683130 | 3771055 | 3765720 | 3711673 | 3693451 | 3631733 |
| Cash Flow : | 2801227 | 3416783 | 4739968 | 4622778 | 4420410 | 4360879 | 4237579 | 4089160 | 3995441 | 3873325 |
| Internal ROR : | 27,68% | | NPV : | 12069281 | | | | | | |
| Break Even Rate : | 3,63 | 3,76 | 4,1 | 4,17 | 4,38 | 4,39 | 4,52 | 4,69 | 4,8 | 4,95 |

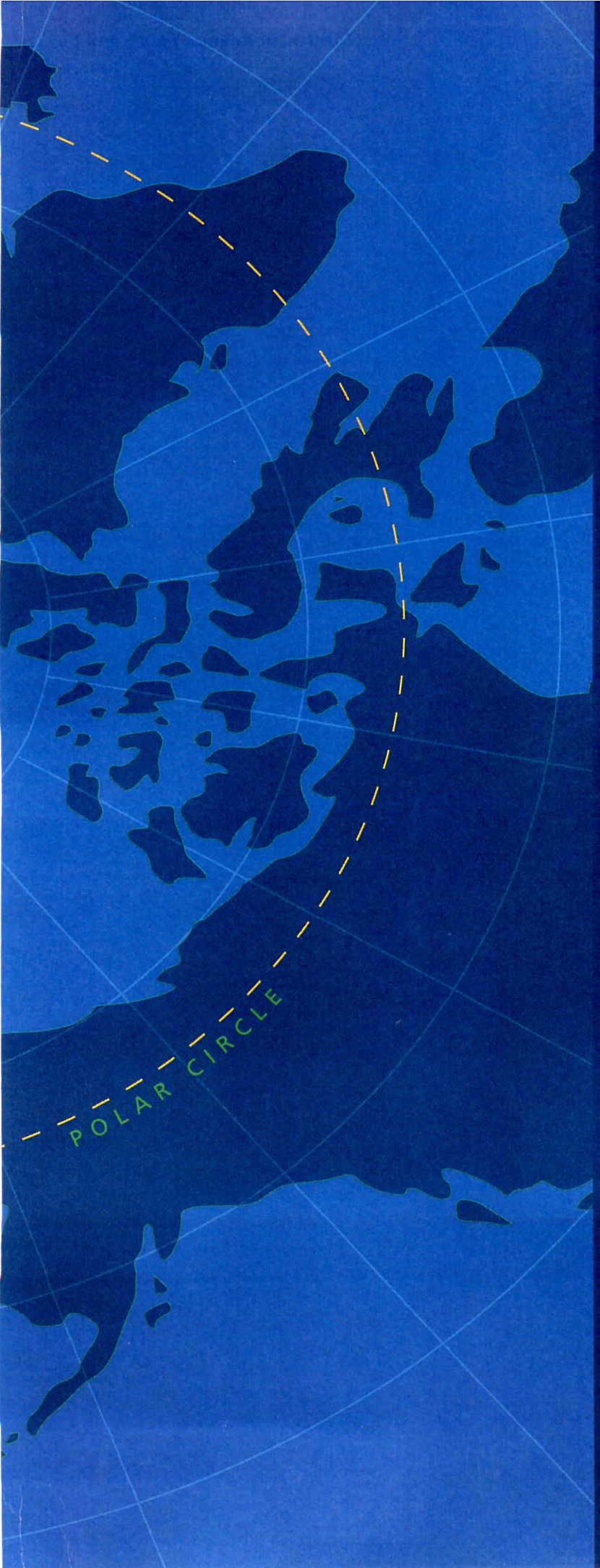
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Handling Charge : | 6,9 | 6,9 | 6,9 | | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 | 6,9 |
| Handling Charge | | 2,4 | 2,4 | | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 |

## INVESTMENT CRITERIAS :

Procurement Price : 8.500.000 USD
Modification Cost : 500.000 USD

Equity : 4.000.000 USD
Loan : 5.000.000 USD

Periods : 10 Years
Interest : 7.0 % (Libor +3)




## 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.