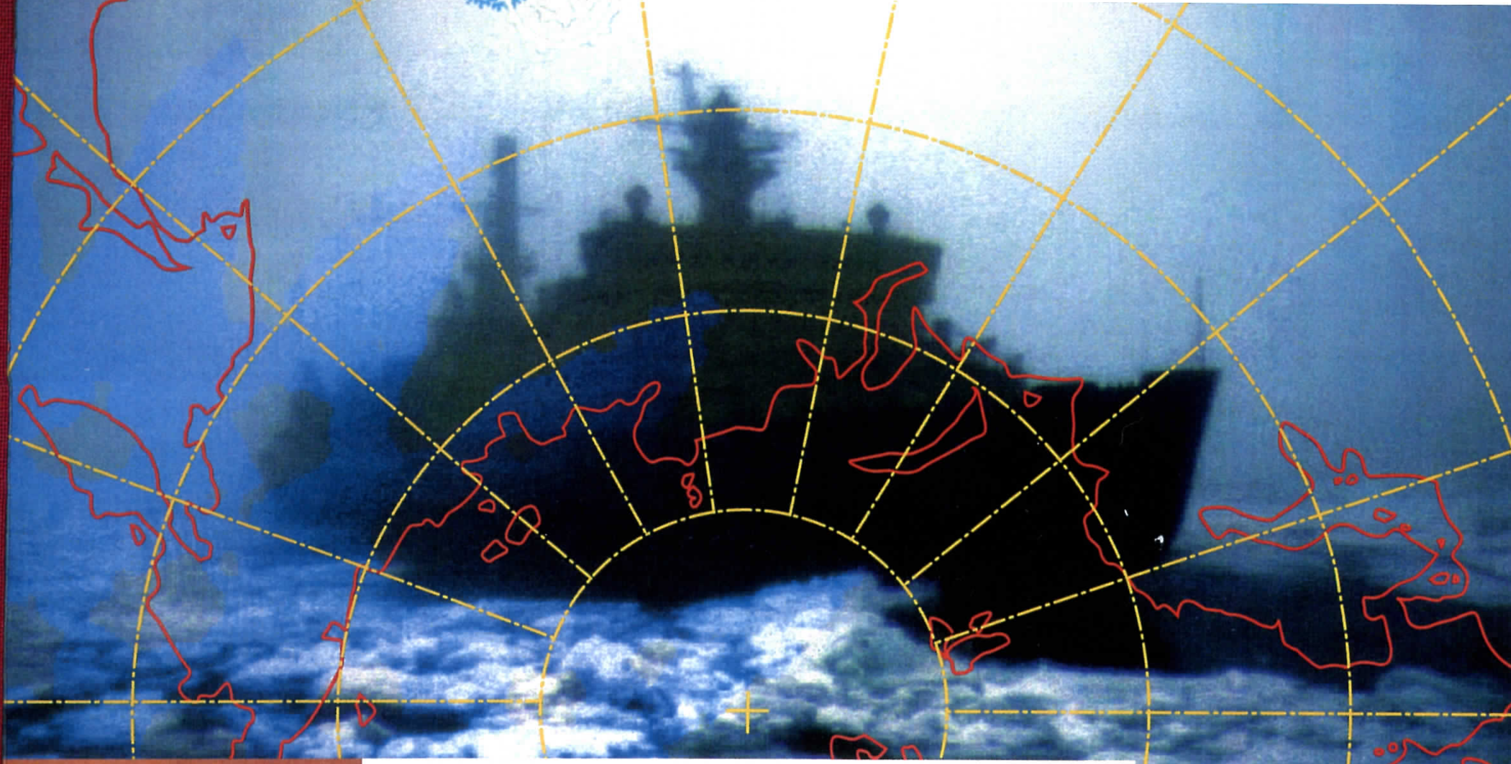

INSROP WORKING PAPER
NO. 50-1996, III.07.5

Seagoing Logistics Solutions to Oilfield Material Supplies

Tony Wood and Robert Martin

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)

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Sub-programme III: Trade and Commercial Shipping Aspects.

Project 07.5: Seagoing Logistics Solutions to Oilfield Material Supplies.

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

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 efficincy of shipping. Russia, beeing 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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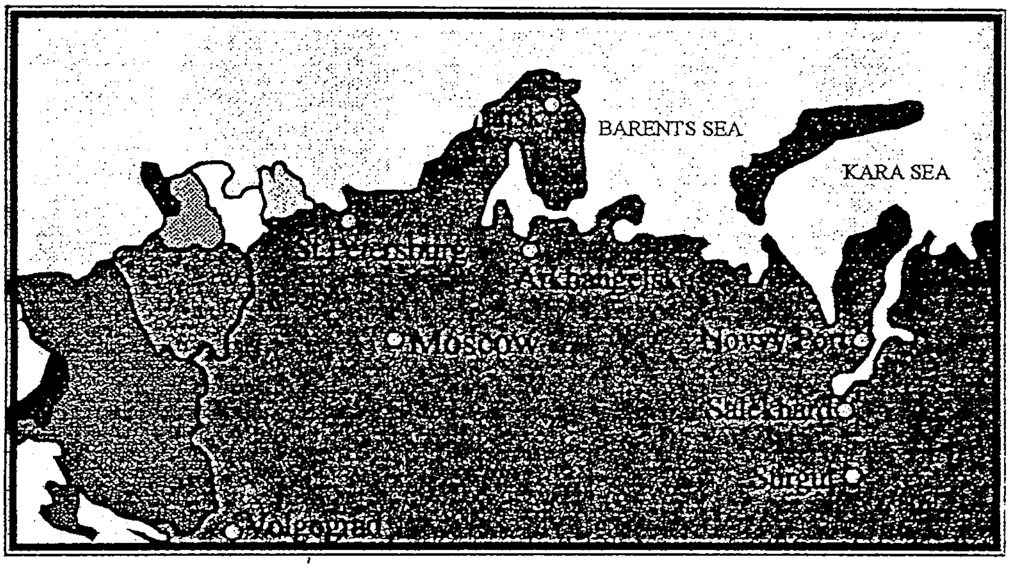
Seagoing Logistics Solutions to Oilfield Material Supplies



Prepared for

Stiftelsen for Samfunns og Næringslivsforskning (SNF)

by

MAI Consultants Ltd

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Contents

Definitions

BCM	Billion Cubic Metres
TCF	Trillion Cubic Feet
bnbbl	Billion Barrels
mmbbl	Million Barrels
bopd	Barrels Oil Per Day
mmbopd	Million Barrels Oil Per Day
USGS	United States Geological Survey
FSU	Former Soviet Union
JV	Joint Venture
LNG	Liquid Natural Gas
LPG	Liquid Petroleum Gas

1 Introduction

1.1 Aims of the Project

To evaluate the market for seabourne logistic solutions to material supplies to the oilfield developments in the Western Siberia and Timan Pechora regions of Russia.

1.2 Methodology

The key to an evaluation of the market for seaborne logistics for West Siberia and Timan Pechora is to estimate the imported materials and equipment requirements of the projects likely to go ahead in the regions. In order to achieve this, we adopted the following methodology:

1. Definition of the reserves and prospectivity of the regions (section 3).

2. Identification of the procurement pattern likely to be used in developments in the regions. This is an important component of the logic used to estimate materials and equipment imports, since some goods are likely to be procured from within the Former Soviet Union (FSU), but others will almost certainly be imported. The balance of imports and domestic procurement is likely to vary depending on the involvement or absence of international investors. (Section 4.)

3. In addition to defining the reserves and prospectivity, we identified the projects planned for the regions. (Section 5.)

4. Based on MAI's experience of the regions and the broader conditions in Russia, we assessed the likely timescale and sequence for these projects. (Section 5.)

5. The projects and prospects for the regions were classified according to their reserves base. (Section 5.)

6. Based on the classification of projects by reserves size, cost estimates were developed. These cost estimates were derived from a calculation of the equipment and materials required, and consist of a breakdown of capital expenditure by equipment and material items. (Section 5.)

7. In conjunction with our assessment of the likely procurement patterns, these cost estimates were used to derive the volume of imports of equipment and materials into the regions.

8. By combining the cost estimates for each class of project with the number of each class of project and likely sequence of these developments, we developed phased regional expenditure estimates; i.e. aggregate regional capital expenditure estimates broken down by year. (Section 5.)

9. Applying our understanding of procurement patterns allowed us to provide an annual breakdown of the likely volume of imported goods. (Section 5.)

10. Our estimates of expenditure and imports of goods to the regions produced not only a cost for each item but a weight. It was therefore possible to provide an assessment of the loads to be freighted into the regions from outside the FSU. (Section 6.)

11. Transportation from within the FSU to the regions is described, but this information applies mainly in considering domestic procurement. (Section 6.)

We have also provided an assessment of the main economic issues affecting the progress of oil and gas projects in the regions. The disposal price of crude and gas, their transportation cost and the fiscal regime applied to projects were examined. (Section 7.)

The fields that have, or are likely to have, western involvement have been identified.

1.3 Assumptions

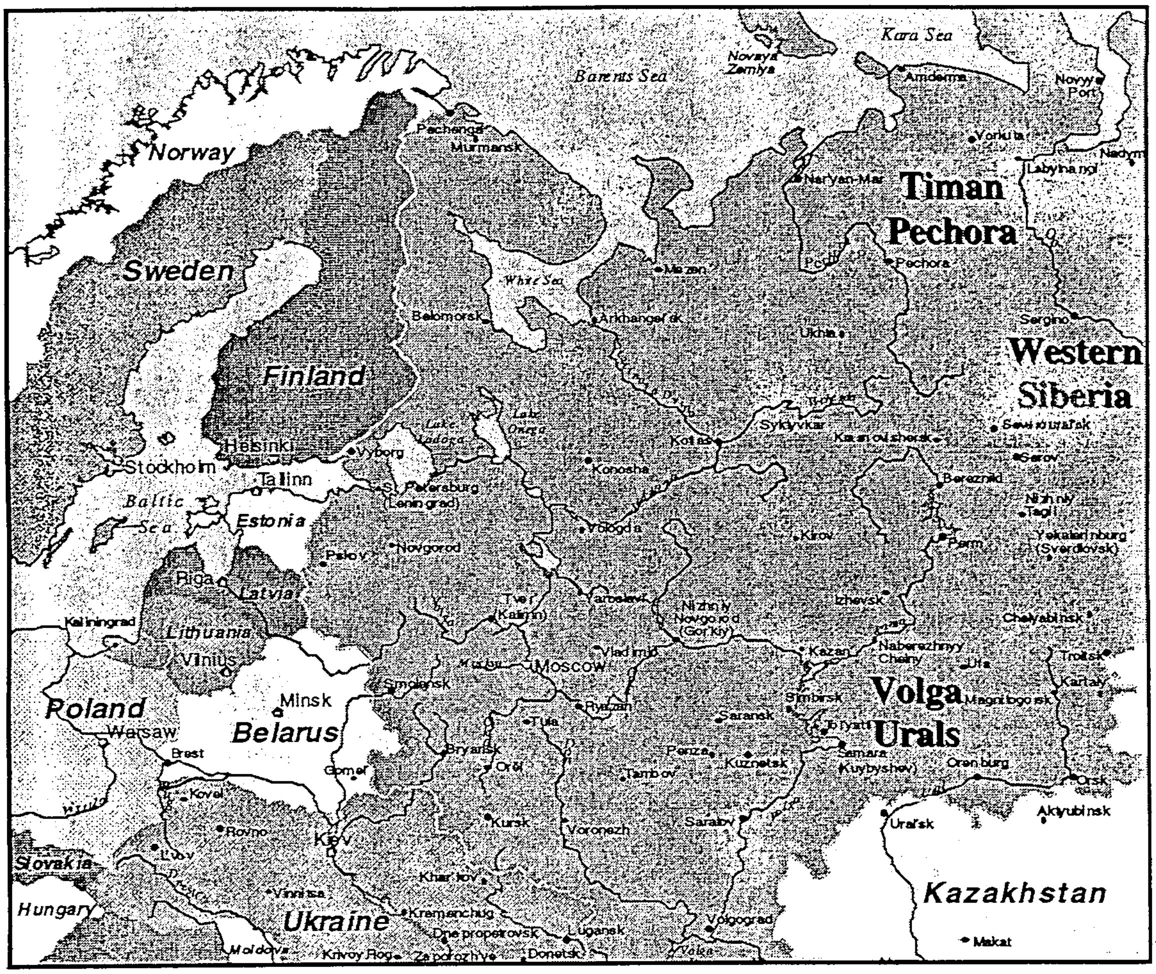
All fields, whether new developments or refurbishments, have been classified as either super giant, giant, large or small depending on the recoverable reserves. Giant fields are those with recoverable reserves of 500 MMbbl, large fields are those with recoverable reserves of 250 MMbbl and small fields are those with recoverable reserves of only 50 MMbbl. Super giant fields have been assumed to be equivalent to 3 giant fields.

1.4 Sources of Data

MAI's database of Russian oilfields was accessed to identify the number of fields in the Western Siberia and Timan Pechora regions that are awaiting development or will require rehabilitation during the period 1995 to 2010. The database has been compiled from information contained in journals such as the Russian Petroleum Investor, Nefte Compass and the Financial Times East European Energy Report plus data from in-house projects for the FSU.

Information on the availability, quality and cost of oilfield services and major equipment and materials from the FSU has principally been taken from the Russian Oil and Gas Equipment Survey (ROGES). This was carried out jointly by MAI Consultants Limited and VNIIOENG of Moscow. The initial report presenting the results of this survey was issued in September 1993. Since then the database has been refined and updated based on information gathered by MAI Consultants when performing studies on other more recent FSU projects.

2 Location map of West Siberia and Timan Pechora



3 Regional Overview - Western Siberia and Timan Pechora

3.1 Introduction

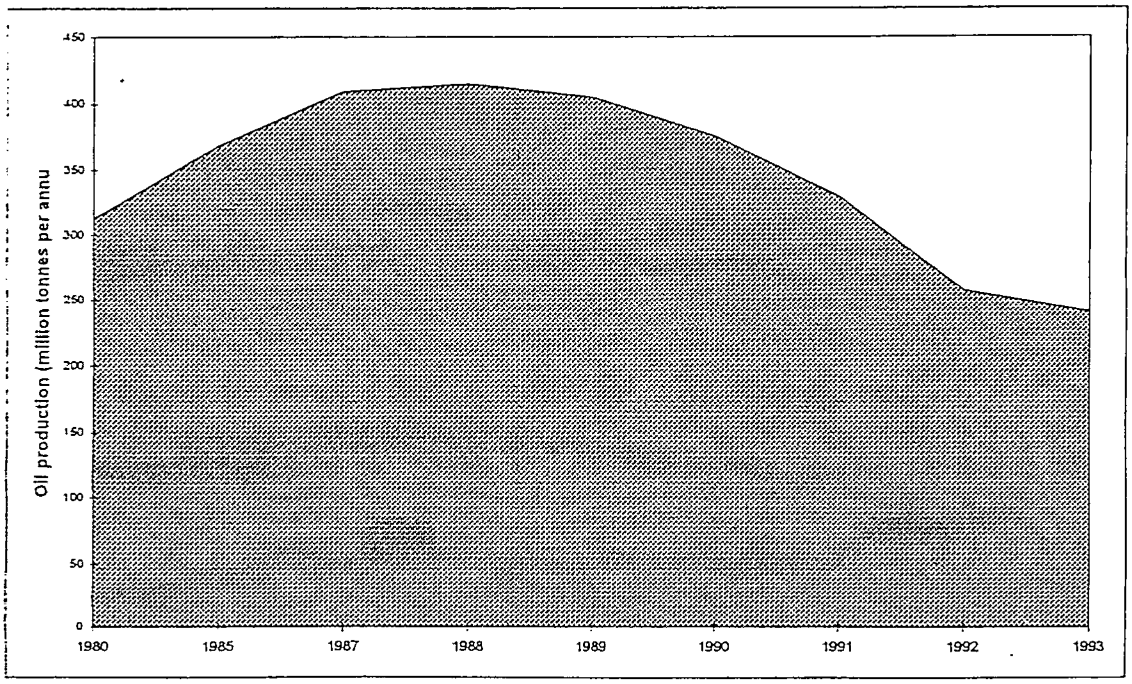
This section describes the current production, prospectivity and main fields for West Siberia and Timan Pechora. It demonstrates that the preponderant role of West Siberia as Russia's main producing region is set to continue, and that Timan Pechora will become increasingly important.

3.2 Western Siberia and Timan Pechora Oil and Gas Field Developments

3.2.1 Western Siberia

West Siberia accounts for 75% of Russian oil production. In 1987 the United States Geological Survey (USGS) - estimated original recoverable reserves in the basin to be 70 billion barrels and more than 1000 TCF gas of which 42 billion barrels of oil had been produced to the end of 1993. Production at peak in 1988 was 415.1 million tonnes per annum (3 billion barrels), more than 8,000,000 bopd, Figure 3.1.1. Given West Siberia's dominance of the Russian oil industry, it's major fields account for many of the problems of Russia's deteriorating oil sector.

Figure 3.2.1 West Siberia oil production, 1980-1993



In the first half of the 1960's the first results came in West Siberia with discovery of the Megion and Ust-Balyk fields. In 1965, Samotler, the largest field in Siberia, was discovered.

West Siberian output soared after Samotlor, classified a "giant" field, went on stream in 1969. Development proceeded rapidly with reliance on water flooding and artificial lift and three rounds of infill drilling. In 1975 the field produced 86.5 million tonnes (1.9 mmbopd) and as much as 130 to 140 million tonnes in 1977. In 1980 Samotlor peaked at 154.6 million tonnes (3,070,000 bopd), more than the entire annual output of the UKCS. Thereafter production declined: in 1988 the field produced 87 million tonnes (1.2 mmbopd), in 1990 about 53 million tonnes and in 1992 about 30 million tonnes (0.7 mmbopd).

Samotlor is typical of the giant fields to the Middle Ob region, with oil contained in many clastic reservoirs of Cretaceous and Upper Jurassic age at depths of 1,600 to 2,150 metres. Porosities range from 20% to 30% and permeabilities from 1.1 to 2 Darcies. Initial well flow rates for some reservoirs were 750 to 1,450 bopd.

Federovo, the second largest field in West Siberia, was discovered in 1963. The field contains 16 reservoirs of Early Cretaceous to Early Jurassic age, most of which are present over the entire field with others restricted by stratigraphic pinchout or truncation against minor faults on the flanks of the structure. Porosities range from 16 to 27% with permeabilities of 75 to 290 milli Darcies. The principal reservoirs were developed using an in line water flood. Wells responsible for 96% of production are now on artificial lift. Production peaked at 35.1 million tonnes (69,700 bopd) in 1983 and has since declined.

The lack of technical and financial resources has drastically restricted the number of new oilfields being developed in West Siberia. 14 new fields were brought on stream in 1989, one in 1991 and none in 1992. Six small fields were brought on stream in 1993.

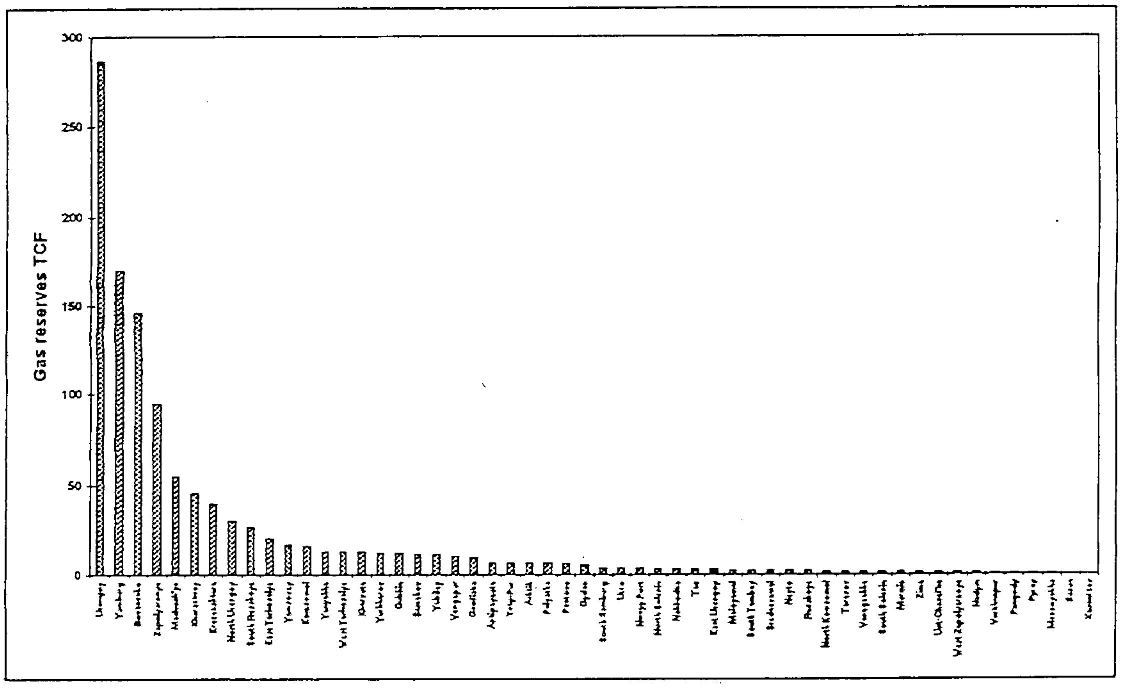
There are nearly 200 named gas fields in West Siberia. Reserves data have been published for 66 fields using the following classification (which is unique to the FSU):

- Category A: reserves defined in existing deposits, through actual exploitation;
- Category B: reserves in known deposits with economic recovery established in at least 2 wells to different depths plus favourable drilling and geophysical indications;
- (Categories A and B together constitute 'explored reserves', similar to the American 'proved + probable reserves')
- Category C_1: reserves proven by recovery from single wells with outline of the traps, or by being adjacent to wells in category A or B;

- ❒ Category C_2: reserves inferred from indications in unexplored blocks (in the tectonic sense) or horizons (in the stratigraphic sense) of investigated deposits; also reserves in newly discovered but so far untested structures within the limits of districts known to contain hydrocarbons.

1986 $A+B+C_1$ original reserves were 22 tcm (777 TCF) gas; $A+B+C_1+C_2$ original reserves were more than 32.5 tcm, (1148 TCF), Figure 3.2.2. 73% of gas reserves are dry gas at depths less than 1,200 metres in Late Cretaceous, Cenomanian strata. This gas is a mixture of thermogenic gas from the Bazhenovsk Formation and biogenic gas from the Cenomanian. Early Cretaceous and Jurassic clastics at depths of 3,500 to 1,500 metres contain 27% of gas reserves with associated, gas condensate and oil. This gas is a thermogenic gas from the Bazhenovsk Formation.

Figure 3.2.2 West Siberia $A+B+C_1+C_2$ gas reserves



Developed Fields

There are more than 450 named oil fields in the West Siberian basin, of which 91 are known to be undeveloped. Of the 123 known developed fields, 9 are in the 'super giant' category with reserves of more than 10 billion barrels of oil, 73 are in the large category with reserves of more than 350 million barrels, 24 in the medium category with reserves of 50 to 350 million barrels and 17 in the small category with reserves less than 50 million barrels.

Published data for the gas fields in the northern part of the basin suggest that any remaining giant fields will be confined to remote areas untested due to technical or transportation considerations (Grace, J.D. and Hart, G.F, 1986).

Other gas possibilities in the basin include gas hydrates, gas condensate discoveries in deep and untested Middle and Late Jurassic reservoirs, the largely unexplored Palaeozoic section and the unexplored offshore Arctic Ocean shelf. With more than 70 years of gas reserves at current rates of depletion, further exploration in the north of the basin, except perhaps for condensate reserves, has not been a government priority.

USGS estimates from 1987 of undiscovered conventionally recoverable petroleum resources are 30 billion barrels of oil and 350 TCF gas.

3.2.2 Timan Pechora

The Timan Pechora basin is situated on the north eastern part of the Russia platform, between latitudes 60° and 70°. The basin is bounded to the east by the Urals and to the west by the Timan ridge. To the north it opens up into the Barents Sea which is a separate target for exploration. The prospective area of the basin exceeds 300,000 km^2.

Most of the Timan Pechora basin lies within the Komi Republic. It also extends across an internal border into the Nenets Autonomous Okrug of the Arkhangel'sk Oblast. Most of the current production from the basin comes from fields within the Komi Republic but the majority of the large fields slated for development lie in the Nenets Okrug.

To date more than 150 fields have been discovered: 96 oil fields, 33 gas condensate fields and 21 oil and gas fields. The basin has estimated proven reserves of 1.3 billion tonnes (9.4 billion barrels) and 800 bcm gas (28 TCF). Published estimates suggest that only 7.9% of original oil reserves and 14.5% of original gas reserves have been produced, Table 3.1.3. In recent years the basin has accounted for approximately 3 to 3.5% of oil production from the FSU and 1% of gas production. Most of the productive portions of the basin are within the Arctic Circle. The bulk of the basin consists of swampy lowland or taiga, with tundra along the margins of the Pechora Sea. Much of the area is underlain by permafrost.

Table 3.2.3 Timan Pechora Basin reserves data

Author	Original Gas Reserves (TCF)	Remaining Gas Reserves (TCF)	Original Oil Reserves (MMSTB)	Remaining Oil Reserves (MMSTB)
$A+B+C_1$ Saggers, 1994 and Makarevich, 1994	33.0	28.25	10.23	9.42
$A+B+C_1+C_2$ Saggers, 1994			14.58	13.77

Partly because of the difficult conditions and the heavy and paraffinic oils the area received a lower priority than the Volga Urals and later Western Siberia. Of the 150 discovered fields only 23 are producing. Thus the area is one of the most attractive in the FSU as the region contains giant undeveloped fields and has the added advantage that direct export to world oil markets could be achieved from ice-free ports on the north coast. Obviously export from the north coast can only become a reality if such a network is in place; in past months western companies active in the Timan Pechora region, such as the Timan Pechora Company which consists of Amoco, North Hydro, Exxon and Texaco, have been pushing for the Northern Gates project to become a reality. Northern Gates would involve the construction of an export terminal on the Barents Sea coast that would be linked by pipeline from the Komi Republic and the Nenetsk Autonomous District. The Russians, on the other hand, have been insisting that export be via their planned Baltic way route, which would involve an export pipeline leading south to the Finnish port of Porvoo. Both routes will in fact be needed if future annual exports from the Timan Pechora basin reach 35 to 40 million tonnes, which is projected around 2005.

Developed Fields

150 fields discovered in the basin, 23 are under production, a further 21 have been appraised and await development and 106 are in various states of appraisal.

Petroleum production from the basin peaked in 1983 at over 20 million tonnes, (400,000 bopd), falling to 11.1 million barrels by 1993, (220,000 bopd), Figure 3.2.3. Gas production peaked about the same time at nearly 20 bcm (1,935 MMSCFD), falling to 4.7 bcm in 1993 (454 MMSCFD), Figure 3.2.4.

A key factor in maintaining crude oil output in the 1980's was the development of thermal recovery methods for the heavy paraffinic oils that characterise the region using in situ combustion and steam injection. No wells were drilled in the region in 1992 due to lack of funds and further falls in regional production can be expected until ventures involving western companies achieve full field development.

Figure 3.2.3 Timan Pechora oil production, 1975-1993

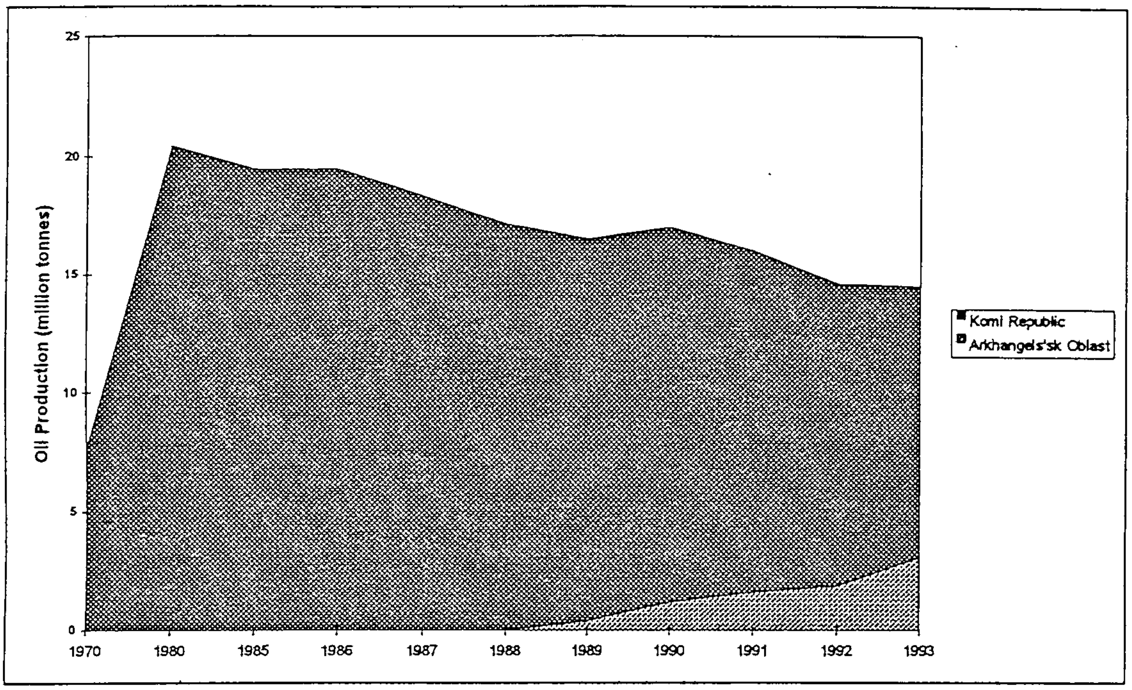
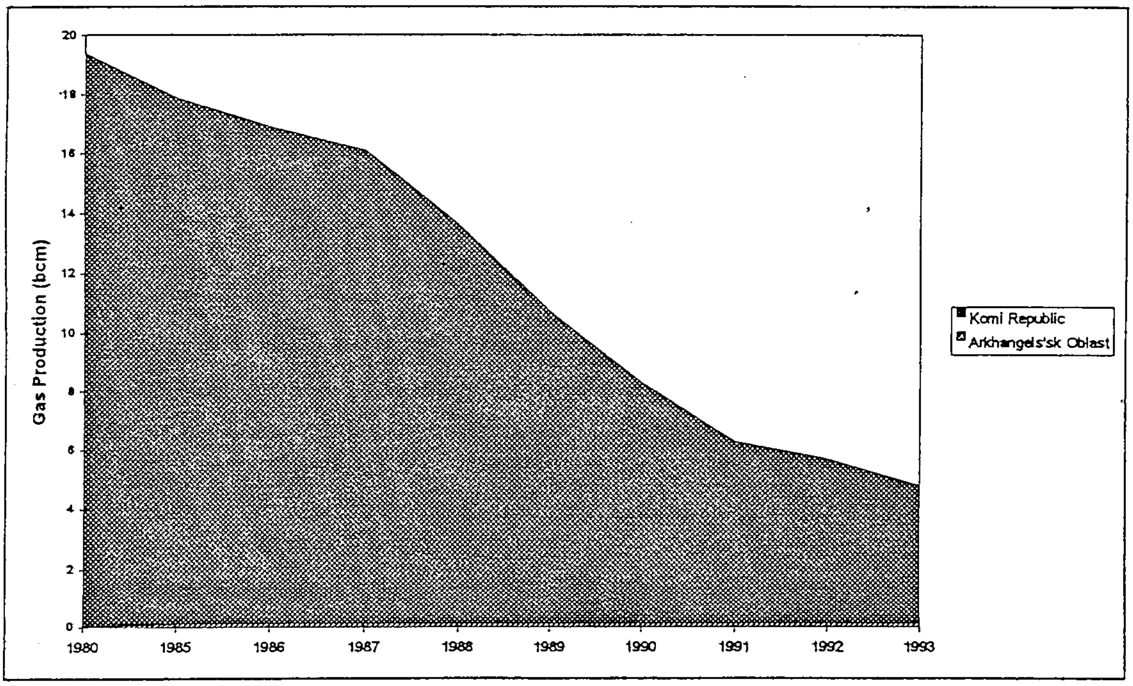


Figure 3.2.4 Timan Pechora gas production, 1980-1993



In the early stage of development of the basin from the 1930's to 1950's, several small fields in the area south of the Pechora and Usa rivers were brought on production. These included the Chib'yu field as well as the heavy oil field at Yarega, which was essentially a mining operation. The principal producer from the region in the 1960's was the West Tebek field which was developed in 1962. Two other fields Dzh'yer and Pashnya were developed in 1967 and 1970 respectively.

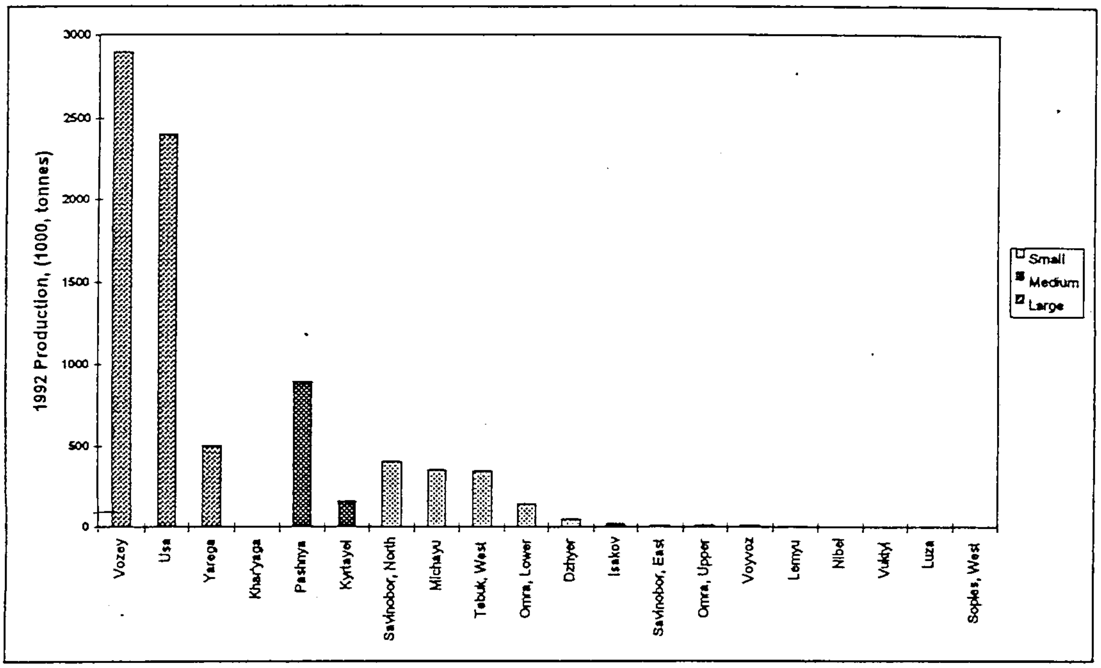
In the 1960's exploration moved to the north of the basin round Ukhta and two major fields with reserves of 70 to 700 million tonnes (0.5 to 5 billion barrels) were discovered. The Usa or Usinsk field, discovered in 1963, came on stream in 1973 and the Vozey field, discovered in 1972, came on stream in 1975. These developments were followed by the discovery of the Upper Grubeshor field. Usa and Vozey accounted for 75% of regional production in 1991.

By 1974 production exceeded the capacity of the local refinery at Ukhta and a 720mm, 1800 km, pipeline was constructed from Usa via Ukhta to Moscow. More recently the development focus has moved to the Khar'yaga field although it is in the Nenets Oblast is still operated by Komineft. Similar to other fields in the region, Khar'yaga produces a heavy oil which requires special extraction methods, including steam and gas injection and surfactant flooding. Khar'yaga was connected to the existing trunk line via an 80 km link to Vozey in 1987 which became operational in 1989.

Oil development continued in the south of the Komi Republic with development of the Karatel field and Kyrtayel field in 1988. First commercial oil from the Peschano-Ozero field on Kolguyev Island in the Barents Sea was produced in 1987 with total output of less than 40,000 tonnes (800 bopd) in both 1992 and 1993.

Figure 3.2.5 shows 1992 production and field size for 20 of the 23 fields known to be producing in the region.

Figure 3.2.5 Fields Operational in 1992



Exploration

Russian estimates suggest that there is an additional 5 billion barrels of oil and 10 TCF of gas to find in the Timan Pechora basin. The key exploration opportunities are considered to be;

- The relatively unexplored northern part of the basin
- Deep reservoirs between 5 and 7 km in the southern part of the basin

The petroleum potential of the poorly explored Barents Sea is chiefly connected with a system of deep rifts, the Finnmark Trough, South Barents and North Novaya Zemlya depressions. Triassic and Jurassic clastics are the main target for exploration although upper Palaeozoic carbonates may also be productive. The petroleum potential of the depressions and expected ratio between gas and oil depends upon the distribution and facies of Lower to Middle Triassic source rocks. Upper Jurassic, Kimmeridge Clay equivalent bituminous shales may only be mature locally. Most probable amounts of recoverable petroleum in the Barents Sea have been estimated by the USGS at 14.2 billion barrels of oil equivalent and 312 TCF gas.

4 FSU Oilfield Equipment, Manufacturing & Services

4.1 Introduction

This section describes the nature and status of the Russian oil-related engineering sector. Its purpose is to provide some of the background supporting the projections made in section 5 on import requirements. In order to put this supporting material into context, the first part of this section describes the recent history of oilfield developments in Russia. The subsequent sections identify the key characteristics of the sector and range of equipment and services historically and currently available.

4.2 Recent history of oilfield development

Russian oilfield development in recent years has been heavily focussed on Western Siberia and Timan Pechora. Some 75% of Russia's oil and gas production comes from Western Siberia; 1993 output from the region was 1.7bnbbl crude and 574bcm gas. In spite of its position as the pre-eminent producing region, Western Siberia contains 91 known but undeveloped fields, and has proven reserves of 28bnbbl crude and 46,000bcm gas. Timan Pechora produces only 3.5% of Russian crude and 1% of Russian gas; output in 1993 was 105mmbbl crude and 4.8bcm gas. However, the region is extremely prospective: of 150 known fields, only 23 have been developed and proven reserves are calculated at 9.4bnbbl crude and 799bcm gas.

The pattern of oil field development in these regions has promoted the use of modularized equipment, transported into place by waterway and over land routes. Modularization in the Former Soviet Union has been based on the application of standard designs for oilfield developments, and standardized equipment items. This has led to the production of large modules for use in extreme Siberian conditions, and the development of transportation methods for moving modules of 500 tonnes and greater large distances for hook-up and commissioning during short weather windows. Due to the relative lack of development in Timan Pechora, the focus for modularized developments has been Western Siberia. The town of Tyumen is, consequently, the location for the largest fabrication yard in these regions. Timan Pechora's requirements will, to a limited extent, be met by fabrication yards based on shipyards located at Murmansk and Arkhangelsk.

In both regions, future new developments will be in ever-remoter areas, posing increasing technical and transportation difficulties. Where these new developments involve international investors, the existing equipment range and the fabrication facilities are likely to be displaced by imported equipment and modules.

4.3 Status of FSU oilfield equipment, manufacturing and services

The Russian oil and gas industry is in a state of decline: capital investment has fallen dramatically by comparison with five years ago. The actual level of investment is difficult to determine because of poor reporting, but as an indication, it is worth noting that the level of manufacturing output has fallen by around 45% since 1991.

There are around 30,000 wells in Russia which have been shut in for lack of demand or lack of equipment to maintain them. This creates potentially huge demand for equipment and services, but the domestic oil companies' lack of funds and slackening demand have combined to cut the level of demand for engineering goods to a minimum. The spills from pipelines in the Usinsk region in mid-1994, when some 2mmbbl crude leaked from a trunk pipeline from Timan-Pechora to central Russia, provide an indication of the overall status of oilfield equipment and the urgent need for maintenance and repairs.

The service sector has suffered a fall in the level of activity commensurate with that experienced by the manufacturing sector. The major fabrication yard in Tyumen is reported to be operating at well below its capacity.

Currently, only small oil and gas projects are moving ahead in West Siberia and Timan Pechora. Fields with output levels of 5-10,000bopd are being developed by international joint ventures, e.g. the Yuzhnoe field near Nizhnevartovsk, operated by the Eurosov JV. This project and others similar to it are making almost exclusive use of equipment, materials and services procured within the Russia and Ukraine. Even if they were to import a considerable proportion of their requirements, this would constitute a negligible volume of freight traffic. Other active projects are in the area of enhanced oil recovery (EOR) from developed, mature fields. These projects also require relatively low levels of investment, and have involved limited imports, whose volume is set to fall as the necessary equipment begins to be produced within the FSU.

4.3.1 Industry organisation

Most items of engineering goods and services are supplied by one or two large enterprises, generally based in Russia or Ukraine. This applies mainly to the onshore industry - the only offshore industry is based on companies located along the western coast of the Caspian sea.

These monopolistic suppliers were part of the overall structure of the Soviet oil and gas industry and organised by a nominally integrated plan for the whole industry. Since the breakup of the Soviet Union, the engineering sector has lived a hand-to-mouth existence, surviving however possible as central funding dried up and orders dwindled. The most successful plants have been those which have formed joint ventures, obtained API certification or traditionally maintained high standards. Their success has been entirely predicated upon action undertaken independently.

Most engineering plants have become joint stock companies, in which the state sometimes has retained a stake. This shift has run in parallel with moves to require substantial pre-payment for goods and services, which contrasts sharply with the previous system of deliveries under the plan, with settlement through central and regional budgets. This move has further curtailed output, since most of the engineering plants' customers are themselves faced with non-payment or fixed low prices for substantial portions of deliveries of crude and gas.

4.3.2 Plant and site locations

The oil and gas-related engineering industry is concentrated in a very few areas: the Volga-Urals industrial cities, central Russia, north-western Russia, western Ukraine and to a lesser extent in Tuymen. None of the big plants are located in or near the oil and gas producing regions of west Siberia and Timan Pechora. Some of the fabrication yards are located in these regions, like Sibkomplektmontazh (Tuymen) or the shipyards in Murmansk and Arkhangelsk.

4.3.3 Equipment, materials and services - range and availability

The majority of oilfield equipment required is available within the FSU, but the range is often limited. Virtually all enterprises operate to Russian GOST standards, although many plants realise that they will need to conform with international standards if they wish to sell to international clients. Many claim to be able to work to international standards, with consequent cost implications, and some have demonstrated this in practice. Catalogue engineering is a major aspect of the industry - design is tailored to whatever is available.

At present, availability of engineering goods and services, especially those plants which have best survived the collapse of the FSU, is not a problem. Rather, engineering companies are suffering from low demand.

4.3.4 Spares and maintenance

In the past, spares were not generally made with the equipment item. Spares were manufactured only when production targets were met, as production generally had to be halted while spares were made. Consequently, spares were only manufactured at certain times of the year or possibly only during one period each year. As a result, it was often easier to replace an entire equipment item than obtain the necessary spare parts required to keep the equipment operational. This situation led to field operators developing their own repair facilities. It also ensured that much equipment became idle due to lack of servicing.

This philosophy is now changing and the availability of spare parts is improving somewhat. This is due to the fact that field operators do not have the funding necessary to replace equipment when it fails. Field operators are more aware of the need to maintain equipment through a regular program of inspection and maintenance. Previously equipment was repaired (or replaced) only when it broke down - now field operators are attempting to get the maximum life out of their equipment, and hence spares are in greater demand than ever before. Spares are still generally manufactured to order - manufacturers do not as a rule keep an inventory of spare parts. Lack of adequate maintenance remains a serious problem resulting in many idle wells and high pollution levels. As a result field operators are setting up specialist maintenance programs using their own technical staff to inspect, repair and maintain their oilfield equipment. Field operators are typically very large organisations and they have their own repair workshops and depots which enable them to carry out most of their own repairs.

4.3.5 Equipment design standards, specifications and reliability

There are numerous GOST standards - the set of standards developed in the Soviet period - and other regulations which apply to the engineering sector, but no detailed comparisons have been undertaken to determine how they compare with international standards such as ISO, API or ASME. Most of the GOST standards examined are comprehensive, specifying materials and sizes, QA procedures and safety requirements. It is known that in some areas GOST standards are more stringent than western standards.

There used to be a state inspection authority within the FSU which was well regarded while it operated - it has now been disbanded and quality and inspection responsibilities lie with the individual plants. Each plant usually has a Division of Technical Control (OTK) which supervises and inspects the manufacturing process.

Most of the manufacturing procedures observed and processes do not conform to international standards of quality, material traceability, etc. However, by comparison with typical western designs for onshore Texas or the Middle East, much of the equipment is perfectly adequate and "fit for purpose". It might be necessary in some cases to adapt the equipment to international specifications and most manufacturers would not appear to have a problem with this. Critical items would still need to be sourced internationally. Use of Russian equipment would necessitate employing a Russian designer which would be familiar with relevant standards and regulations - in particular the safety and environmental aspects.

Much of the existing equipment range is based on dated designs. Coupled with poor quality standards in the Soviet period, this led to reports of frequent equipment failures. To some extent, this perception is exaggerated. Even goods produced by manufacturers with higher than average standards for production have been reported to fail with an unacceptable frequency, but further examination indicates that they were often being used in conditions far outside those for which they were designed. For example, although NPO Frunze (Ukraine) manufactures a range of pumps for use in aggressive conditions, ordinary pumps are regularly used in saltwater conditions. Ordinary carbon steel flowlines are often used in high H_2S conditions, and there is an additional problem with flowlines in that only 1 in 200 is plant-tested where such flowlines are destined for the Russian oil industry.

Historically, imports of some items, such as high-grade, large diameter tubulars, or high-grade production and casing tubulars, cables, connectors and some compressors have been high despite the extra cost involved.

4.4 Outlook for manufacturing, fabrication and construction

4.4.1 General

A growing number of manufacturing and service JVs is being established in Russia. Some of the longer established are involved in equipment items such as xmas tree and rig production. The aim of these JVs is to introduce international standards into the Russian engineering sector, and thereby to persuade investors in the major projects set to go ahead in the next few years to procure within Russia rather than internationally. A relatively small number of Russian and Ukrainian engineering companies have traditionally worked to high standards, and sold internationally. Other companies, particularly suppliers of steel and tubulars, have successfully gained API certification based on their existing infrastructure and a modified version of their traditional product range.

The half dozen best known of these manufacturers and the engineering JVs will certainly play some part in supplying the expected major developments, but given their scope and the intentions of international investors, their role will be limited.

4.4.2 Conversion of military industrial facilities

There is a decree awaiting ratification by the Russian parliament which will authorise the conversion of former military manufacturing plants to oilfield equipment. Some of these establishments have already commenced production of items which are short supply in Russia or were formerly supplied from the former Soviet republics, and have accumulated large stockpiles of equipment which they have been unable to market.

Yards and plants that were once used for military purposes are slowly changing their orientation and are moving towards the expanding oil and gas industry. In early March 1995, the Zvezdochka yard in Severodvinsk (near Arkhangelsk) in North West Russia won its first major contract in the oil and gas sector. The contract, which involves building the first two ice-resistant jack-ups in the world for client Gazprom, marks the beginning of an extensive restructuring programme intended to make it one of Russia's leading suppliers of oil and gas installations. The platforms will weigh around 14,000 tonnes and will be delivered as an EPC contract in 1997 and 1998 respectively. The yard is being revamped in co-operation with Kværner Oil and Gas and others in the industry. The yard is situated near the Sevmash submarine yard, about one and a half hour's drive from Arkhangelsk.

President Boris Yeltsin visited the Zvezdochka plant as early as 1992, when he pointed out the necessity of restructuring the military industry and developing Russia's huge oil and gas reserves in the Timan Pechora and Arctic regions. In 1993, following a visit by Prime Minister Chernomyrdin (a former chairman of Gazprom), it was proposed that the two yards in Severodvinsk (Zvezdochka and Sevmash) should be converted into modern engineering workshops to serve the oil and gas industry. Severodvinsk, a town of 200,000 inhabitants which has been cut off from the rest of the world until recently because of its military significance, has been a centre for marine technology with responsibility for development, construction and repair of advanced Russian military submarines and nuclear vessels.

Zvezdochka employs more than 10,000 engineers and skilled workers, and because of its importance to the military industry, it has always been given high priority by the Russian government. Consequently, it has attracted Russia's best engineers and skilled workers, and it has had access to advanced information technology.

4.5 Summary & Conclusions

The range of FSU-produced equipment and services meeting international standards is relatively limited, although much of it is 'fit for purpose". Consequently, procurement within Russia and Ukraine is likely to be an option for small projects involving Russian and international investors, or for larger projects without foreign participation. Even for this latter category, it is increasingly likely that some international procurement will take place in order to achieve the highest possible reliability of the production and processing plant.

5 Import Requirements - Western Siberia & Timan Pechora

5.1 Introduction

This section identifies the main projects with international involvement for West Siberia and Timan Pechora. This project information constitutes the background for the calculations on import requirements for the regions.

5.2 Individual Field Developments - Current Activity

5.2.1 Western Siberia

Western oil company involvement in West Siberia has focused on new field development projects although significant investment has been committed to increasing production from already developed fields. Investors fall into two categories;

- Western oil companies who are keen to develop relationships and understand the problems of doing business in the region, while limiting financial exposure and
- Oil field service companies using World Bank and EBRD finance in small joint ventures with the geological and production associations of the region.

Table 5.2.1 summarises some of the more important developed field projects involving Western companies.

Table 5.2.1 West Siberia- Developed field projects involving Western companies

Field	Companies	Production BOPD	Project Description
Kharampur North, Kharampur South and Festival fields	Conoco		Limited development work in the Kharampur North, Kharampur South fields and undeveloped Festival field involving drilling of 1800 development wells.
Pridorozh East	AGIP		Swap with LUKoil for production from the Pridorozh East field which is expected to produce 700 million barrels over the next 20 years for a share in two AGIP concessions offshore Tunisia.
Priob	Amoco Eurasia Petroleum	450,000 bopd at peak	The field has 5 billion barrels of reserves and 200 development wells. $10 bn investment is expected over the fields 50 year life.
Samotlor	Fracmaster/Pan Canadian Petroleum	Target production of 35,000 bopd from project	Workover project costing $35 million of the super giant Samotlor field.
Sutormin	Texaco	1995- 140,000 bopd including incremental production of 30,000 bopd	Two year project to restore 150 wells on the giant Sutormin field with estimated remaining reserves of 1 billion barrels. Work commenced in 1993.
Vasyugan	Fracmaster	Target production of 20,000 bopd from the project	Well simulation project.
Vatyegan West and Tagrin fields	Phibro Energy Production/ Anglo Suisse	1997 peak at 150,000 bopd net 14,000 bopd available for export.	White Knights joint venture to redevelop the Vatyegan West and Tagrin fields.

5.2.2 Timan Pechora

Table 5.2.2 summarises the major Western led projects in the region involving developed fields. Only four joint ventures have been negotiated or are under negotiation for developed fields. These projects will have relatively little impact compared with projects on undeveloped fields in the region, Table 5.3.3.

Table 5.2.2 Timan Pechora- Developed field projects involving Western companies

Field	Companies	Production BOPD	Project Description
Kharyaga	Total	First oil expected in 1996 to 1997	Development of the Khariaga oil field with estimated reserves of 250 million barrels. This contract has yet to be approved by the Russian government.
Komi Republic	Amkomi	1,700 bopd in 1994	A small joint venture was formed by Aminex plc to drill development wells on producing fields in the Komi Republic. Total investment to date is $6.7 million.
Mid Kharayga and Kharyaga oil fields Layavozh, Vasilkov, Komzha and Korovin gas fields.	Saga/Shell		Joint venture to develop discovered reserves on the Mid Kharyga field and drill workover wells over the Kharyaga oil field and Layavosh, Vasilkov, Komzha and Korovin gas fields.
Vanyegan and Ayogan oil fields	Occidental		EOR project for the Vanyogan and Ayogan fields currently producing 45,000 bopd from 100 wells.
Vozey West and Famen South fields	Quest Petroleum-Mannai/Callina NL/ Star Valley Resources	2,000 bopd net production to the group with expected production of 10-30,000 bopd by Sept 1993	Joint venture for the workover of the Vozey West and Famen South fields.

5.3 Individual Field Developments - Planned and Future Activity

5.3.1 Western Siberia

Exploration maturity and undeveloped fields

Available data on the exploration maturity of the oil plays in the southern part of the basin suggests all the major fields have been discovered and that remaining discoveries will be in the medium to small classes, (less than 350 million barrels). This conclusion is based on three important observations:

- The basin's geology is simple and well understood
- Well densities are high
- Reflection seismic, which is of excellent quality, was used from the 1960's to locate and develop the fields of the region

With more than 90 undeveloped fields, some in the billion barrel class, there is no great need for further exploration at least in the short term. The technical challenges posed by these 90 accumulations are considerable, as the easy fields were developed first leaving fields with complex reservoirs or very thin oil and gas columns for later.

Western oil companies have focused their efforts in the region on exploitation of undeveloped fields. Table 5.3.1 summarises the key undeveloped field and exploration projects in the region.

Table 5.3.1 West Siberia- Undeveloped field projects involving Western companies

Field	Companies	Production BOPD	Project Description
Chernogor	Anderman Smit/ St Mary Land and Exploration/ Itochu	6000 bopd 1994, 10,000 bopd 1995, 25,000 bopd in 1998	Development of the 85 million Chernogor field. A total of 200 development wells will be required, with 3 wells completed by May 1995 at a total costs of $300 million.
Gubkin North	Benton Oil and Gas Co	1994, 2,000 bopd 1995, 5,000 bopd Phase 1- 10,000 bopd	Development of the Gubkin North field with reserves of 312 MMSTB oil, 45 million barrels of condensate and 12 TCF gas. Geoilbent JV plans to spend $300-400 million drilling 232 development wells. A 75,000 bopd pipeline has been built and a further 37 gas pipeline is required.
Khanty-Manysiske area	Petro-Hunt/Dresser Industries	Eventual production of more than 100,000 bopd	Explore and develop reserves in 8 areas in the Khanty-Manysiske autonomous region with estimated reserves of 3.1 billion barrels. Total investment of $1.4 billion over 13 years.
Komsomol (North?)	Quintana		Development of the Komsomol North field with estimated reserves of 1.15 billion barrels involving drilling of 170 wells, and expenditure of $330 million.
Mogutlor	Pennzoil		Appraisal drilling of the Mogutlor field with estimated recoverable reserves of 40-45 million barrels.

Table 5.3.1 West Siberia- Undeveloped field projects involving Western companies (continued)

Field	Companies	Production BOPD	Project Description
North Urengoy	Bechtel Energy Group	First gas expected 1996	Joint development to develop the 30 TCF North Urengoy gas field. the first phase is expected to cost $250 million with a total cost of $1.3 billion over 30 years.
Pudinsko-Parabelsky area	Imeg Management		Development of 20 minor accumulations north west of Tomsk with total reserves of 145 million barrels.
[illegible]tov, [illegible]voportov and Bovanenkov gas fields	Amoco		Development feasibility study for 3 Yamal Peninsula gas fields.
Salym West, Vadelyp North, Vadelyp South and Salym, West Upper fields	Shell	240,000 bopd peak	Development proposal for the 460 million barrel Salym West, Vadelyp North, Vadelyp South and Salym, West Upper fields. Development of the Salym West, Vadelyp North fields is economic. Plans for Vadelyp South and Salym West Upper would only be economic at oil prices of $21 to $25 and are the subject of a dispute with the Russian Government, Roskomnedra and Khanty-Mansisk officials.
Urnin	Ramco,		$1 billion development of the Urnin field with estimated reserves of 220 million barrels.
Yegan South	Dana Exploration		Investment in a joint stock company preparing to develop the 30 million barrel Yegan South field.
Yen-Yakh and Samburg fields	Swift Energy		In 1992 the joint stock company, Senega was formed to develop the Yen-Yakh and Samburg fields.
Yuzhnoye	Eurosov Petroleum/ Siberian Oil Corporation	1995, 5,000 bopd expected to rise to 40,000 bopd	1993 joint venture to develop the Yuzhnoye field with estimated reserves of 140 million barrels. A total of 70 development wells will be required. There are additional plans to develop 1.7 billion barrels in 24 fields southwest of the Ob river.

5.3.2 Timan Pechora

Exploration maturity and undeveloped fields

The prospects for new discoveries in the Timan Pechora basin and offshore Barents shelf are good. Before there is a significant exploration effort in the Timan Pechora basin it is likely that many of the 127 undeveloped fields in the basin will be brought on stream using the existing infrastructure and any new infrastructure developed by joint ventures involving western companies developing the giant fields of the Nenets Okrug.

Undeveloped fields

150 fields have been discovered in the basin. 23 are under production, a further 21 are appraised and awaiting development and 106 are in various states of appraisal. There are therefore 127 potential new field development opportunities in the basin.

41% of remaining reserves are in the Komi Republic, from which most of the current production originates. 59% of remaining reserves are in the Nenets Okrug which contains the majority of the large undeveloped fields such as the giant Khar'yaga, Toravey, South Khylchuyu and Naul fields.

Table 5.3.2 shows the fields which are:

- Under development, (bold type)
- Have been approved for development but were not operational in 1992, (bold type) and
- Fields under appraisal

Table 5.3.2 Fields under development or appraisal and undeveloped fields

Large	Medium	Small
Ardalin	Cherpayu	**Bagan**
imeni Anatoloa Titova	Gulyayev, North	**Bagan, South**
imeni Romana Trebsa	**Khosedayu, North**	**Grubeshor, upper**
Inzyrey	Khosedayu, West	Kharyaga, East
Khasyrey	Khosolta	**Kharyaga, North**
Khylchuyu	Kolva	Kolva, Upper
Naul	**Labogan**	Kozhva, North
Pescahno-Ozer	Lyzha, South	Krytayel, South
Toravey	**Makharikha, Central**	**Layavozh**
Varandey	Myadsey	Lekkeyaga
Vozey, Upper	Nyadayu	Lekkeyaga, West
	Prirazlom	Medyn
	Salyuka	Osovey
	Sandivey	Padimey
	Saremboy, North	**Pashshor**
	Sedyaga	Podveryu
	Shapkina, South	Pyzhyel
	Toboy	Sosnov
	Toravey , South	Subor
	Veyakshor	Tark
	Visov	Usino-Kushshor
	Yareyu	**Vaneyvis**
		Yareyaga, West

Fields which are under development or have been approved for development but were not operational in 1992 are shown in bold type

Table 5.3.3 shows the new field development projects in the basin involving western partners.

Table 5.3.3 Timan Pechora- Undeveloped field projects involving Western companies

Field	Companies	Production BOPD	Project Description
Ardalin	Conoco	25,000 by mid 1996 Export to Kharyaga in 40,000 bopd pipeline	Polar Lights- joint venture to develop the Ardalin field with reserves of 100 million tonnes, (725 million barrels). First oil output started in late August 1994. Onstream production is about 22,000 bopd with peak production of 25-26,000 bopd in mid 1996.
Lyzayu South and Kozhva North	Occidental		Appraisal drilling of two fields with expected reserves of 300 million barrels.
Nanet Oblast	Conoco		Polar Lights- Second development of 1 billion barrels of oil. Oil export will either be via the Komi Republic of via an offshore oil terminal.
Prirazlom	BHP/Hamilton		Joint venture to evaluate the 500 MMSTB Pirazlom field, 31 miles offshore in the Pechora Sea.
Romana Trebsa	Texaco/Exxon/ Amoco/Norsk Hydro	120,000 bopd by 2000 and 2003	Explore and develop a 2,847 square mile area of the Timan Pechora basin.
Upper Vozey	Gulf Canada Resources/British Gas	Initial production was 5000 bopd in 1992 increased to 16,000 bopd in 1994	Project in 276,000 square kilometres which is based on a joint development of the Upper Vozey oil field near Usinsk.
Shapkina, South	Neste		Neste formed a joint stock company to develop the Yuzhno-Shapkina field with estimated reserves of 130 million barrels.

5.4 Regional Import Requirement

5.4.1 Introduction

MAI have developed an estimate of the size of the equipment and materials import market over the next 15 years for the oilfield developments of the Timan Pechora and Yamal regions of Russia. The study methodology and findings are outlined in this section.

5.4.2 Methodology

The estimate for the equipment and materials import market was developed as follows:

- **Field Review :** MAI's database of Russian oilfields was interrogated to assess the numbers of fields that are awaiting development or will need refurbishment over the period 1995 to 2010 in the Timan Pechora and Yamal regions. These fields were classified as either large (500 MMbbl of recoverable reserves), medium (250 MMbbl of recoverable reserves) or small (50 MMbbl of recoverable reserves). Fields with, or are likely to include, western oil company involvement have been identified.

- **Development Schedule Review :** Based on MAI's experience and recent studies a view has been taken as to when the identified fields will be developed. This view has taken into account the major factors that influence when and whether a field will be developed. These factors include:
  - Funding
  - Available infrastructure
  - Political stability

- **Que$tor Cost Estimates :** MAI has developed a project development cost estimating suite of programs called Que$tor that has become a widely accepted tool within the oil industry. Costs are updated every 6 months. Three generic project cost estimates have been generated to reflect the field classification determined in the field review. The estimates break capital expenditure down into a number of components that include, production facilities, wellsites, drilling operations, pipelines, terminals and infrastructure. Each component is further broken down into equipment, materials, pre-fabrication, construction, design & management and contingency.

- **Regional Spend Estimate :** Using data from the field review, the cost estimates and the development schedule, a total expenditure estimate for the region has been produced. This estimate constitutes an assessment of the total equipment, materials and services market for Timan Pechora and West Siberia.

- **Procurement Pattern :** Using MAI's Russian Oil and Gas Equipment Survey database, an assessment has been made of the percentages of equipment and material items that oil companies will source from anything outside Russia (see section 4). It is assumed that developments with western oil company participation will, especially in the next few years, source more from the West than developments that are wholly Russian-funded.

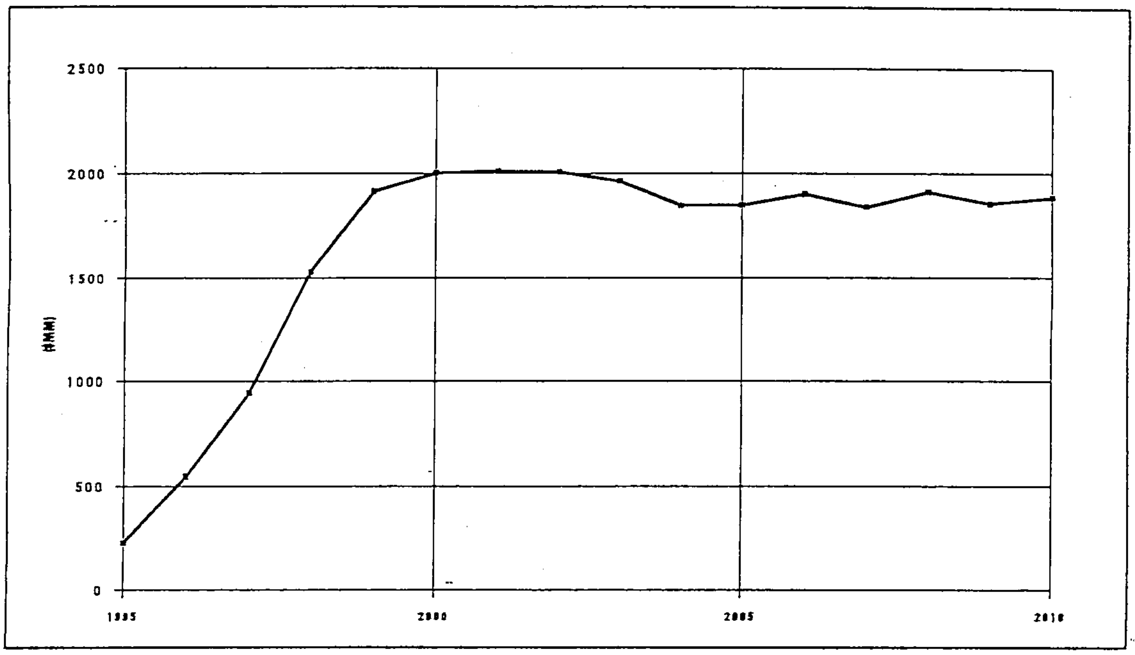
- **Imported Supplies Estimate :** Based on the anticipated procurement pattern and the regional expenditure estimate, we have estimated the volume of imported equipment and materials To reflect some level of uncertainty, high, medium and low estimates have been generated.

5.4.3 Results

5.4.3.1 Regional Expenditure Estimate

The total size of the market is displayed in Figure 5.4.3.1-1. These costs include not only equipment and materials, but also fabrication, construction, design & management and contingency.

Figure 5.4.3.1-1 : Expenditure Estimate - Timan Pechora & West Siberia



Over the period 1995-2000 it is expected that investment in the region will grow considerably. It is expected that western oil companies will begin to gain more access, bringing new funds. Refurbishment of producing fields, long neglected, will begin. It is estimated that investment will be sustained just below $2 bn per year beyond 2000.

Table 5.4.3.1-1 splits the regional expenditure estimate into equipment and materials, fabrication and construction, design and management and freight components.

Table 5.4.3.1-1 : Expenditure Estimate Breakdown

$ millions

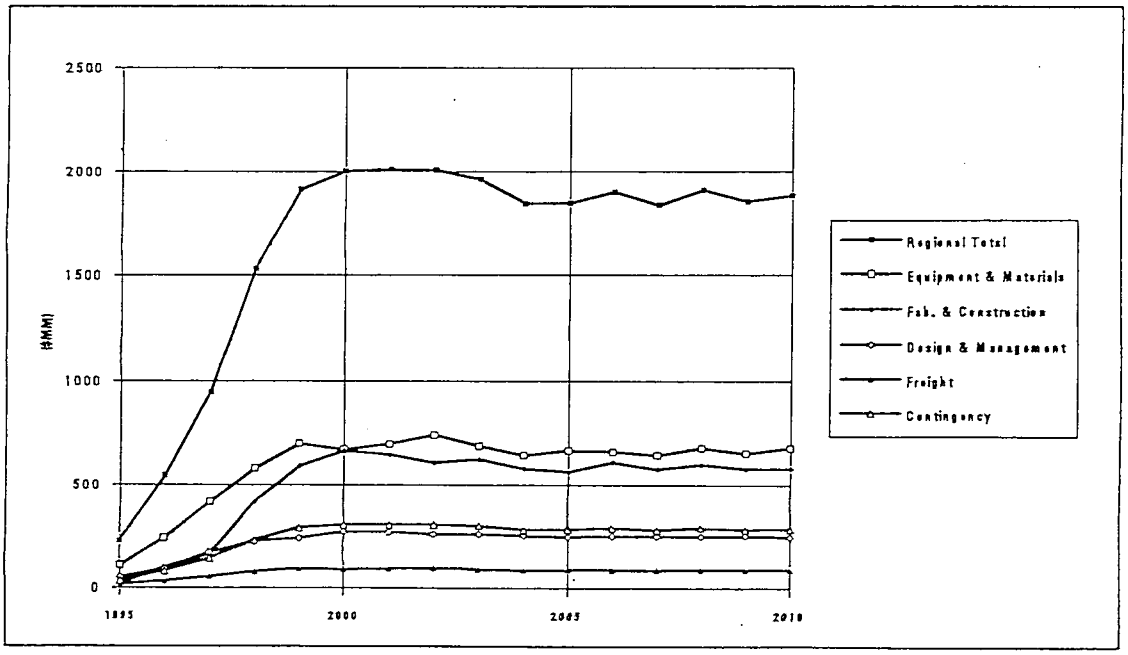
Year	1995	1996	1997	1998	1999	2000	2001	2002
Equipment & Materials	107.5	239.2	416.4	579.4	697.5	670.7	695.8	738.0
Fab. & Construction	20.0	101.5	162.0	416.8	592.2	662.4	645.8	607.2
Design & Management	50.8	91.2	170.5	224.4	240.2	271.2	269.5	258.0
Freight	14.3	32.6	56.2	78.2	93.3	88.5	93.5	98.2
Contingency	34.0	80.8	140.2	229.8	290.4	306.9	306.2	305.6
Total	226.6	545.3	945.3	1528.6	1913.6	1999.7	2010.8	2006.9

Year	2003	2004	2005	2006	2007	2008	2009	2010
Equipment & Materials	687.2	644.1	666.5	659.5	644.1	678.1	652.8	678.1
Fab. & Construction	623.2	579.9	563.2	610.5	576.8	599.1	577.9	579.8
Design & Management	259.7	252.6	246.2	251.3	250.2	250.2	252.8	246.2
Freight	90.9	86.0	88.7	87.5	86.0	90.1	87.1	90.1
Contingency	300.8	281.5	281.8	291.1	280.4	292.2	283.0	287.7
Total	1961.8	1844.1	1846.5	1899.9	1837.6	1909.6	1853.6	1881.9

On average, for the field developments under consideration, just over 40% of the expenditure relates to equipment and materials, with over $600 million per year being spent by 1999. This represents the total market for oilfield materials supply to the region.

Figure 5.4.3.1-2 illustrates the cost breakdown on a year by year basis.

Figure 5.4.3.1-2 : Expenditure Estimate Breakdown



5.4.3.2 Supply Sources

MAI's survey of Russian Oil and Gas Equipment (ROGES) has been used to identify what oilfield equipment is available in the FSU and assess its quality, cost and criticality to a project. Using a small, onshore development as a basis, the following conclusions were drawn (Table 5.4.3.2-1):

Table 5.4.3.2-1 : Russian Equipment Survey

Item / Service	Criticality to project	Quality (% Western)	Cost (% Western)	Extra Costs	Russian Content
Christmas Tree	High	90	85	Inspection	High
Well Casing	Medium	75	50	Inspection Repairs	High
Pressure Vessel	Medium	85	70	Standards Inspection	Low
Water Inj. Pump	Medium	80	60	Inspection	Low
Oil Export Pump	Medium	80	60	Inspection	Low
Gas Compressor	High	85	85	Inspection	Medium
Linepipe	Medium	80	55	Inspection Repairs	High
Control/ESD	High	50	60	Design Inspection Testing	Low
Instrumentation	High	70	60	Testing	Medium
Pipe Valves	Medium	80	60	Inspection Testing	Medium
Steelwork	Low	85	55	Testing	Low
Drilling Rig	Medium	90	80	Upgrade/Test	High
Design Institute	Medium	75	25	Supervision	Medium
Fab/Construction	Medium	70	50	Inspection	High
Drill Contractor	Medium	70	50	Supervision	High

Table 5.4.3.2-1 compares each item/service against typical onshore Gulf of Mexico standards. Extra costs incurred with choosing Russian items/services are highlighted.

Resulting from the ROGES study the following conclusions were drawn.

It is considered that the equipment items and services available in the FSU that may be used by western oil companies in Russian oil and gas developments are:

- ❑ Design Institute - with supervision/audit by western consultants
- ❑ Christmas Trees - by joint venture company
- ❑ Linepipe/Casing - with suitable testing and inspection
- ❑ Drilling Rigs - with modifications
- ❑ Pressure Vessels - with western standards and inspection
- ❑ Water Injection Pumps - with western standards and inspection
- ❑ Oil Export Pumps - with western standards and inspection
- ❑ Piping - for compatibility
- ❑ Fabrication/Construction Institute - western procedures, inspection and QA
- ❑ Drilling Contractors

While these conclusions hold true for small developments led by Russian companies and investors, which may use up to 90% FSU-produced equipment and materials, they are not relevant when large developments led by international investors are being considered. International investors with interests in major projects are more likely to use Western designs, equipment, material and fabrication. This is especially true as most developments involving international investors or some of the larger Russian companies are located in harsh northern environments.

As an example, the Romana Trebsa, Titov, Varandeiskoe and Toraveiskoe fields (located in Timan Pechora) are to be developed by a consortium led by Texaco, Exxon, Amoco and Norsk Hydro, based on large modules (up to 500 tonnes) imported from Gulf of Mexico fabrication yards. Transportation will be effected using Mighty Servant class semi-submersible vessels. Given the size of the field, and the degree of harshness of the environment, the consortium is planning to import most materials and equipment.

The conclusion that many items of Russian equipment can be used in small developments must be balanced by two other considerations.

The first consideration is the actual availability of these items in the FSU. The ROGES survey found that some items were just not available all the time, necessitating the import of western equipment. In 1993, for example, large proportions of some items were imported: 20% of pump rods, 50% of linepipe for pipelines, 40% of downhole tubulars. These items were imported simply as a result of the collapse in the Russian engineering sector. Since then the supply situation has changed radically, and many plants have large stocks of standard Russian-design equipment and materials, but no buyers, due to the lack of development and maintenance activity by or insolvency of their major customers.

The second consideration is quality related. Those Russian oil and gas companies with significant resources to deploy are now keen to acquire high-quality corrosion-resistant equipment and materials where appropriate, and as a result rely on imported equipment to a much greater extent than was the case in years gone by. This situation is likely to change with time, as more FSU manufacturers produce goods to international standards. Wholly Russian funded developments will be less likely to use as much western equipment and services.

Cost, quality, equipment criticality, availability and oil company confidence were all taken into account when taking a view of the percentages of individual equipment and material items that oil companies (both western and Russian) will source from outside Russia. Table 5.4.3.2-2 details the main equipment and materials percentage assumptions for the high, middle and low predictions. "West" refers to developments with western oil company participation and "Russian" are wholly Russian funded developments.

Table 5.4.3.2-2 : Percentage of Demand to be Imported

Main Oilfield Equipment Groups		Percentage of Demand to be Imported					
		High		Medium		Low	
		West	Russian	West	Russian	West	Russian
Production Facilities							
Process Equipment	Flowline Manifolds	54	6	45	5	37	4
	Oil Processing	90	30	75	25	62	21
	Gas Processing	90	30	75	25	62	21
	Storage	48	6	40	5	33	4
	Export Pumping	72	6	60	5	50	4
	Gas Compression	100	84	85	70	71	58
	Metering	90	30	75	25	62	21
	Water Injection + Treatment	100	42	85	35	71	29
	Safety	100	36	85	30	71	25
	Utilities	30	6	25	5	21	4
	Coms & Control	100	48	85	40	71	33
	Power Generation	66	24	55	20	46	17
	Power Distribution	66	24	55	20	46	17
Materials	Steelwork	30	6	25	5	21	4
	Piping	30	6	25	5	21	4
	Electrical	100	90	90	75	75	62
	Instruments	96	48	80	40	66	33
	Other	60	0	50	0	42	0
	Civils	24	0	20	0	17	0
Wellsites							
Process Equipment	Manifolding	54	6	45	5	37	4
	Test Facilities	96	24	80	20	66	17
	Power Generation	66	24	55	20	46	17
	Power Distribution	66	24	55	20	46	17
	Utilities	30	6	25	5	21	4
	Coms & Control	100	48	85	40	71	33
	Safety	100	36	85	30	71	25
Materials	Steelwork	30	6	25	5	21	4
	Piping	30	6	25	5	21	4
	Electrical	100	90	90	75	75	62
	Instruments	96	48	80	40	66	33
	Other	60	0	50	0	42	0
	Flowline	100	24	90	20	75	17
	Civils	24	0	20	0	17	0
Drilling Operations							
Equipment	Wells	100	48	90	40	75	33
Materials	Casing / Tubing	90	48	75	40	62	33
Pipelines							
Pipeline Materials	Pipeline Materials	90	60	75	50	62	42

The high and low predictions from Table 5.4.3.2-2 are based on a +/- 20% swing in demand for each item.

Percentages were assigned to all cost items, not just equipment and materials. These enabled the generation of the imported supply estimates detailed in Section 5.4.3.3.

5.4.3.3 Imported Supplies Estimate

The total market for goods and services is defined in Section 5.4.3.1 and is established to be worth just below $2bn per year. Of this the proportion that is likely to be imported is displayed in Figure 5.4.3.3-1 (middle prediction). Table 5.4.3.3-1 displays the values on a year by year basis. (Freight values are not final.)

Figure 5.4.3.3-1 : Imported Goods and Services - Timan Pechora & West Siberia

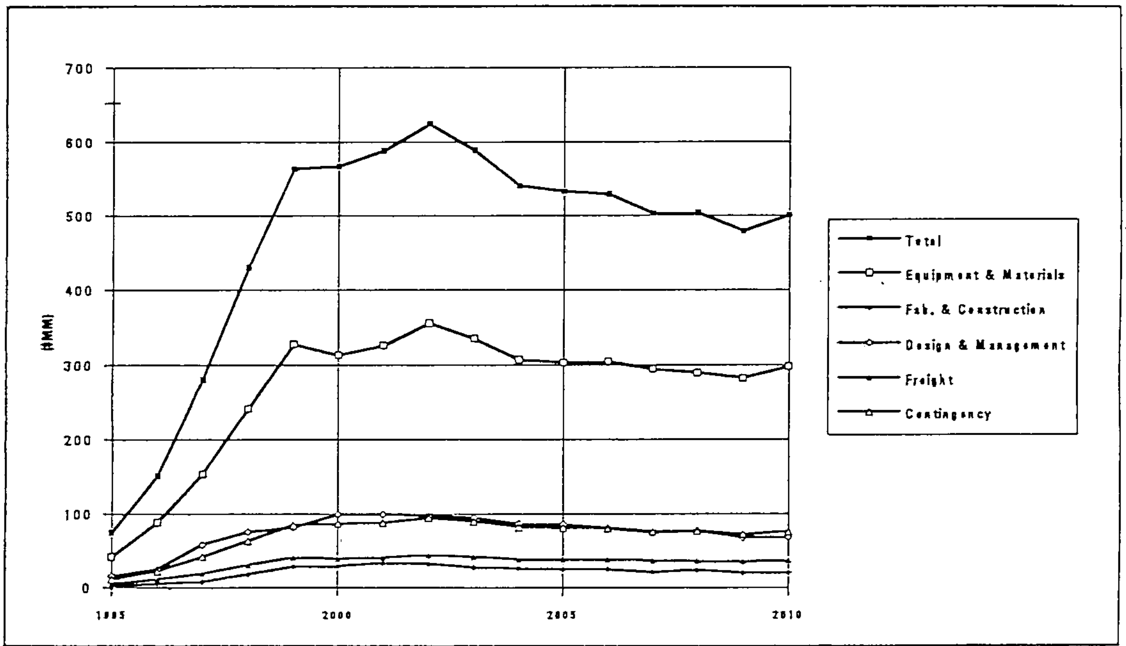


Table 5.4.3.3-1 : Imported Goods and Services - Timan Pechora & West Siberia

$ millions

Year	1995	1996	1997	1998	1999	2000	2001	2002
Equipment & Materials	41.9	88.0	153.3	242.3	327.7	313.4	326.1	355.5
Fab. & Construction	1.2	5.5	7.8	17.9	28.2	28.6	32.7	32.1
Design & Management	15.3	24.3	58.5	75.6	81.6	99.5	99.7	97.2
Freight	5.2	11.0	19.1	30.4	40.8	38.8	40.7	44.2
Contingency	11.5	22.3	42.1	63.4	84.7	86.5	88.4	94.6
Total	75.0	151.1	280.8	429.6	563.0	566.8	587.8	623.7

Year	2003	2004	2005	2006	2007	2008	2009	2010
Equipment & Materials	335.3	307.2	303.5	304.6	294.6	289.9	283.0	298.0
Fab. & Construction	27.5	25.7	24.4	24.9	20.7	23.5	19.7	20.1
Design & Management	94.7	87.0	85.8	80.9	74.4	77.1	67.9	68.6
Freight	41.6	38.2	37.7	37.8	36.6	35.9	35.3	36.9
Contingency	89.8	82.0	81.0	80.3	76.2	76.9	72.4	76.4
Total	588.9	540.1	532.4	528.5	502.5	503.3	478.3	500.0

From the analysis the following observations have been made:

In 1995 very little will be imported into the region. No new fields are being developed. It is predicted that the expenditure on goods and services will increase rapidly to the end of the century. It is then predicted that the value of imports will stabilise beyond 2000. A slight decline in imports could follow as confidence in local supplies amongst western oil companies increases and availability of local supply improves.

Imported equipment and materials are estimated to account for 40% of the regional spend in 1995, increasing to 47% by 2000 (middle prediction). This translates into a 650% increase in the value of imports between 1995-2000, although from a very low base.

Figure 5.4.3.3-2 displays all three estimates - high, middle and low - for equipment and materials imports along with the regional total expenditure on equipment and materials. The high and low predictions are based around a 20% swing in demand for each main type of equipment.

Figure 5.4.3.3-2 : Imported Equipment and Materials Estimates

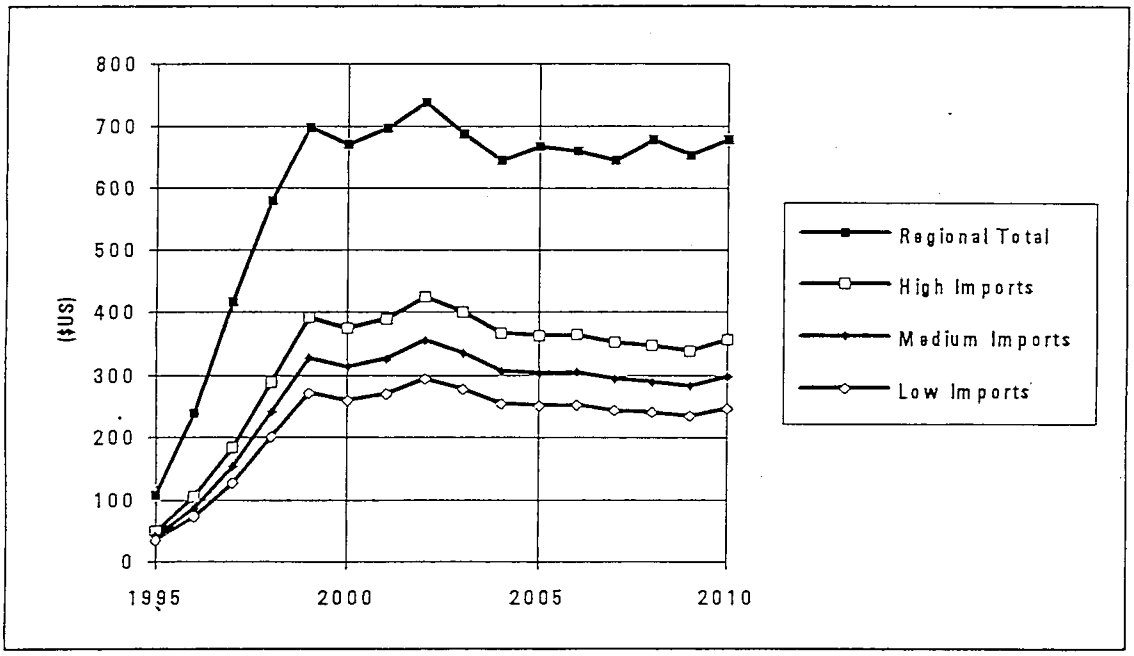


Table 5.4.3.3-2 : Imported Equipment & Materials Estimates

$ millions

Year	1995	1996	1997	1998	1999	2000	2001	2002
Total Regional Spend	107.5	239.2	416.4	579.4	697.5	670.7	695.8	738.0
High Import Prediction	50.3	105.5	183.7	289.6	391.1	374.3	389.2	424.2
Medium Import Prediction	41.9	88.0	153.3	242.3	327.7	313.4	326.1	355.5
Low Import Prediction	34.8	73.1	127.2	201.1	272.0	260.1	270.7	295.0

Year	2003	2004	2005	2006	2007	2008	2009	2010
Total Regional Spend	687.2	644.1	666.5	659.5	644.1	678.1	652.8	678.1
High Import Prediction	400.2	366.7	362.5	363.7	351.8	346.5	338.2	356.2
Medium Import Prediction	335.3	307.2	303.5	304.6	294.6	289.9	283.0	298.0
Low Import Prediction	278.3	255.0	251.9	252.8	244.5	240.6	234.9	247.4

5.5 Conclusions

Assuming a medium level of imports, the aggregate value of the equipment and materials imported into West Siberia and Timan Pechora between 1995 and 2010 will be $4.3bn. As shown in table 5.4.3.3-2 (above), current estimates are that the annual volume of imported equipment and materials will reach $300mm by 1998/99.

Our estimates show freight costs rising from $5.2mm in 1995 to $40.8mm in 1999, and then remaining at around $35-40mm until 2010. The total estimated expenditure on freight services over the period 1995-2010 is $530mm.

This clearly represents a significant market opportunity. A breakdown of the volumes of freight involved is given in the following section.

6 Transportation and Logistics

6.1 Introduction

Whereas section 5.4 presented estimated expenditure on freight for the period to 2010, this section the current and projected demand for freight services based on the volume of equipment and materials to be imported into West Siberia and Timan Pechora over the period to 2010.

Following this breakdown of the volumes to be freighted in, there is a breakdown of the transportation infrastructure in West Siberia and Timan Pechora.

6.2 Current and Planned Demand for Logistics Services

This section deals exclusively with the demand for logistics for *importing* equipment and materials into West Siberia and Timan Pechora.

6.2.1 Introduction & Methodology

The cost estimates presented in section 5 break the expenditure down into the following categories:

- Equipment & Materials;
- Fabrication & Construction;
- Design & Management;
- Freight and Contingency.

Here, we provide an estimate for the weight of the equipment and materials that will be used in the region over the period 1995 to 2010. As with the expenditure forecasts, the total weight of materials and equipment was calculated and the imported portion separately identified.

The weight estimates were produced in parallel with the expenditure estimates, and the methodology used was identical. Having identified the classes of developments, cost and weight estimates were developed representing each of them; i.e. a large, medium and small field development in the regions under consideration. By applying to these estimates the numbers of each class of development and their likely sequence, we produced regional estimates for the cost and weight of equipment and materials required.

Our cost estimates were built up on the basis of a calculation of the weights for the equipment and materials and then applying unit costs per tonne to these weights. Therefore unit weights for materials and equipment were available for each class of development.

As with the cost estimates, the weight estimates provide a regional total requirement. Using our knowledge and judgement of procurement patterns for projects in the regions, we identified the proportion of equipment and materials likely to be imported.

6.2.3 Results

The results of the equipment and materials weight estimates are broken into two broad categories for reporting purposes:

- Equipment weights
- Pipeline and drilling tube/casing weights

Table 6.2.3-1 shows the estimated total weights of equipment and materials for the Timan Pechora and West Siberia regions and Figure 6.2.3-1 illustrates this.

Table 6.2.3-1 : Total Equipment and Materials Weight (tonnes)

Year	1995	1996	1997	1998	1999	2000	2001	2002
Equipments	4,214	14,788	24,646	36,976	42,239	37,446	42,368	42,383
Pipe and Tube	18,024	57,654	74,328	110,466	122,928	124,116	121,818	121,596
Total	22,238	72,442	98,974	147,442	165,167	161,562	164,186	163,979

Year	2003	2004	2005	2006	2007	2008	2009	2010
Equipments	38,115	37,093	37,773	37,295	37,093	38,096	37,353	38,096
Pipe and Tube	125,166	107,274	109,944	121,896	107,274	123,006	108,324	123,006
Total	163,281	144,367	147,717	159,191	144,367	161,102	145,677	161,102

Figure 6.2.3-1 : Total Equipment and Materials Weight (tonnes)

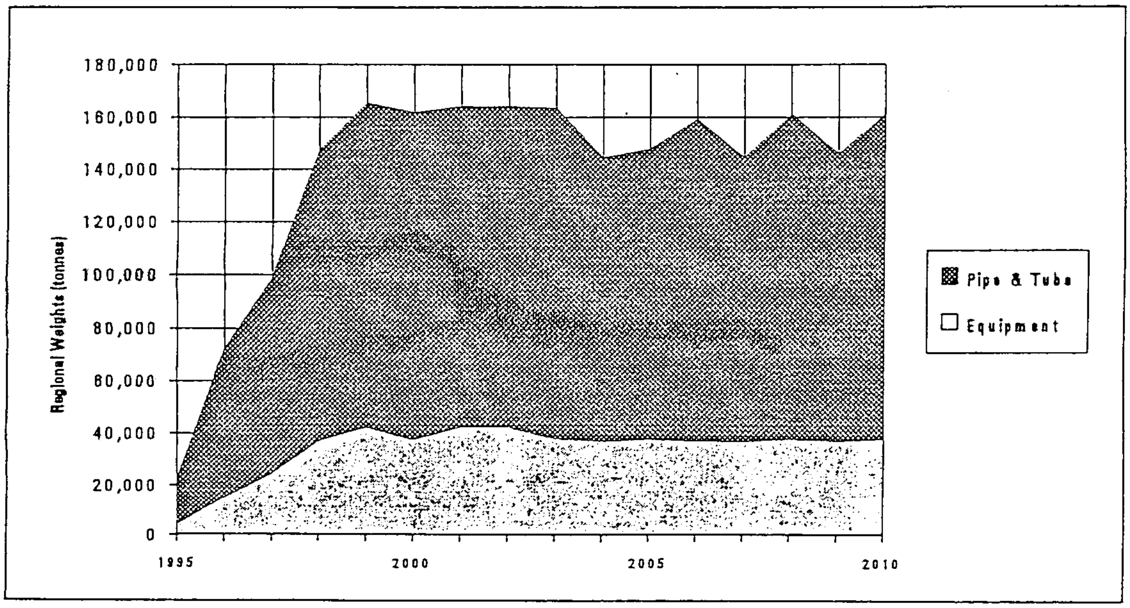


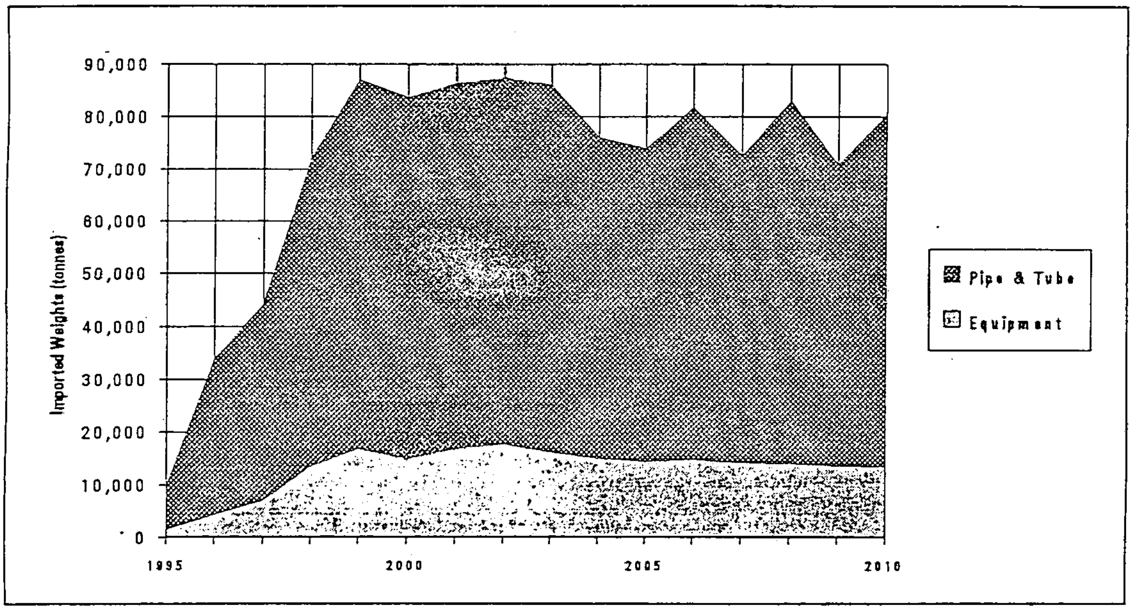
Table 6.2.3-2 shows the estimated weight of imported equipment and materials for the Timan Pechora and West Siberia regions and Figure 6.2.3-2 illustrates this.

Table 6.2.3-2 : Imported Equipment and Materials Weight (tonnes)

Year	1995	1996	1997	1998	1999	2000	2001	2002
Equipments	1,529	4,349	7,126	13,456	16,851	14,975	16,880	17,685
Pipe and Tube	8,196	29,502	37,079	58,727	70,178	68,576	69,345	69,674
Total	9,725	33,851	44,205	72,182	87,029	83,551	86,225	87,359

Year	2003	2004	2005	2006	2007	2008	2009	2010
Equipments	16,206	15,017	14,410	14,752	14,138	14,030	13,622	13,421
Pipe and Tube	69,752	61,011	59,505	66,911	58,437	68,913	57,146	67,095
Total	85,957	76,028	73,915	81,662	72,575	82,943	70,767	80,516

Figure 6.2.3-2 : Imported Equipment and Materials Weight (tonnes)



These results show that current demand for equipment and materials is low, since there is little project activity. A large increase in demand is predicted over the period 1995-1999 with a leveling off thereafter. In weight terms pipeline materials, drill tube and casing represent between 75% and 80% of the total weight of materials and equipment required for the projects in these regions, and a similar proportion of what the likely imports.

Overall, the results of the weights estimates for imported goods show a threefold increase in 1996 by comparison with 1995, and a nearly tenfold increase by 1999. The potential market for seaborne freight services would therefore appear to be an attractive proposition.

6.3 Alternative Routes

The information presented in the remainder of section 6 will generally be of most use in considering procurement from within the FSU.

Oilfield material supplies to West Siberia and Timan Pechora can be imported by:

- Road
- Rail
- River
- Air

The existing transportation infrastructure in these regions is discussed below.

6.4 Road Transportation

There are generally four major classifications of roads throughout the Former Soviet Union.

1st class : 'Highway of state importance'. These are the largest roads, usually having an asphalt surface and more than four lanes (two on each side). The roads have the prefix M.

2nd class : 'Ordinary roads of state importance'. Usually one lane on each side with an asphalt surface. These roads have the prefix A.

3rd class : 'Ordinary roads of republic importance'. These are one or two-lane roads and usually have an asphalt surface.

4th class : 'Others'. Virtually tracks, not covered with asphalt. Not named or numbered.

.4.1 West Siberia

There are only a few first class M roads in Western Siberia. These are the M51, which originates from Chelyabinsk in the west, bypassing Tyumen to the south, passing through Kurgan to Omsk and then on to Novosibirsk. Beyond Novosibirsk the M51 changes to the M52 passing south and then to Barnayl and the Mongolian border. The M53 goes to Tomsk in the north and then to Krasnoyarsk and Irkutsk on Lake Baikal thus crossing the Eastern Siberian basin. This roadway is capable of taking larger transportable loads (up to 50 tonnes), providing suitable vehicles are available. It is open throughout most of the winter season.

The second class roads are concentrated around the Tyumen region running from Tyumen to Yekaterinburg, Tobolsk and Ishym - in total a length of 805 kilometres (500 miles). These roads are usually passable throughout the year and are capable of transporting loads up to 50 tonnes.

The majority of the roads north of the Tyumen region, servicing the oil and gas fields, are 3rd and 4th class roads and are little more than tracks. Most are not passable in the severest winter conditions and four-wheel drive vehicles are essential.

There are winter roads in place from Surgut to the main oil and gas fields. These are reasonably well constructed and have a load-bearing capacity equal to the major roads. This network of "winter roads" covers some 720 kilometres (450 miles) and they are usable from September through to May.

With regard to construction of oil and gas facilities, the operator may need to purchase or hire multi-wheeled, heavy transportation vehicles. Most of those available locally are unreliable as a result of poor maintenance and low parts availability.

6.4.2 Timan Pechora

There are no major roads crossing the area. There is one road of republican significance which has a hard surface, but it is ice covered from November to March. It runs from Syktyvkar in the south to Ukhta in the north. Beyond this point special vehicles are required to cope with unpaved roads.

6.5 Rail Transportation

6.5.1 West Siberia

Rail is used as one of the main modes of transport for the importation of bulk steel and equipment items from other regions of the former Soviet Union. Steel linepipe and plate, as well as drilling equipment, is shipped to the region from areas such as Volgograd, Ukraine and Electrostal near Moscow.

Materials and equipment which are imported from countries outside Russia or the CIS are transported by rail from St. Petersburg. A container system is available for loads of up to 50 tonnes.

The coastal region of West Siberia

The port of Salekhard is connected to western Russia by a main railway link through Pechora, which eventually connects with the railway line between Moscow and Arkhangelsk. The Tobolsk-Surgut-Nizhnevartovsk railway was built in the 1970s, whilst the Surgut-Nadym railway linking the oil centres of Kogalym, Noyabrsk and Purpe was built in the 1980s. In the east of the region there is a remote and single track system from the inland port of Dudinka to Noril'sk and Talna. These railways, however, do not extend into the area of the gas fields and therefore are not used to service gas field developments.

The Tyumen region

The Trans-Siberian Railroad, stretching from East Siberia to Moscow, crosses the southern extremity of this region, running through towns such as Novosibirsk, Tyumen, Omsk and Yekaterinburg. Tyumen is the only centre which has good rail connections to its surrounding towns and cities. The connections are largely single track and as a general rule the rail tracks are usually constructed alongside the main routes and roads. There are a few lines which run northwards into the region, although the network is not extensive. These railway lines connect Tyumen to Tobolsk, Kamyshlov, Tavda and Shadrinsk. There are other rail links which connect Tyumen with Tobolsk, Surgut, Nizhnevartovsk and Strezhevoy on the River Ob, and from this line a branch runs further north to Nadym. Another link from Sverdlovsk runs northwards and then eastwards and terminates on the river Ob to the south of Berezovo.

6.5.2 Timan Pechora

There is a railway line running across the oil and gas region from Syktyvkar in the south travelling north to Mykun, Emya, Ukhta, Pechora, Usinsk and Inta. Oil products are generally shipped by rail in this region.

6.6 River Transportation

6.6.1 West Siberia

Although limited by the short summer-navigation season, the river and waterway systems are used extensively throughout the region as a means of transporting freight and materials for the oil and gas fields. In the northern Siberia region, the lack of an established transport network means that the waterways play an even larger part in the movement of freight, despite being restricted by climatic conditions. The principal rivers are as follows:

The Yenisey River

The main river in this region is the Yenisey. It is 3,487 kilometres (2,167 miles) long, 20 - 50 kilometers (12.5 to 31 miles) wide and 4 - 15 metres (13 to 50 feet) deep, in some parts it is as deep as 20 - 40 metres (65 to 130 feet). It has the largest volume of water in Russia and will take sea-going ships as far as the town of Igarka. It is navigable by smaller vessels as far up river as the town of Kizyl. The river is frozen between the months of October/November and April/May. The principal port, located near the mouth of the river, is Dudinka, and this is generally used to transport all major equipment items and commodities to the region.

The Ob River

The River Ob services the oil and gas centres of Surgut, Tomsk, Novosibirsk and Salekhard. It is used to transport oil and gas products and equipment by river barges which are hired locally. The river has a relatively shallow draught of 1.5 to 5 metres (4.9 to 16.5 feet) in the upper regions, with most of the remainder between 4 and 8 metres (13 to 26 feet). During the flood season, May - June, the depth reaches 10 metres (33 feet). It has a total length of 3,650 kilometres (2,270 miles) and is 3-10 kilometres (1.9 to 6.2 miles) wide, but during October/November to April/May parts of the river are frozen and impassable.

The Irtysh River

The Irtysh is 425 kilometres (264 miles) long and is navigable through to Ust-Kamenogorsk. The depth, in certain parts of its length, is 10-12 metres (33 to 40 feet). Construction materials, machinery, grain and wood are transported on this river servicing the ports of Tobolsk, Omsk, Tara and Ust-Ishym. Parts of the river are frozen between the months of November and April.

The table below details the principal ports in West Siberia :

Port	River/Sea	Navigable	Facilities	Rail Line	Roads
Novyy Port	Obskaya Guba Sea	Frozen between November- June	No deepwater berth facilities, Heavy lifting facilities. Not open to foreign vessels.	None	None
Khatanga	Kheta River	Frozen between November-May	No deepwater berth facilities. Heavy lifting facilities.	None	None
Dikson	Yenisey River	Frozen between November-May	No deepwater berth facilities. Heavy lifting facilities limited. Not open to foreign vessels.	None	None
Dudinka	Yenisey River	Frozen between November-May. Open to vessels equipped with ice breakers.	Deepwater draught up to 12 metres (39.4 feet). Heavy lifting facilities. Not open to foreign vessels.	Rail link to Noril'sk	None
Salekhard	Ob River	July until end of October	Some heavy lift facilities. This port is not open to foreign vessels. Draught up to 10 metres (32.8 feet).	Main	Winter roads only.
Staryy Nadym	Nadym River	July until end October	No deep berths. Some heavy lift facilities.	Yes	Winter roads only.
Tomsk	Ob River	All year round	No deepwater berths. Some heavy lifting facilities.	Main	2nd Class
Novosibirsk	Ob River	All year round	No deepwater berths. Some heavy lifting facilities.	Main	1st Class
Tara	Irtysh River	All year round	No deepwater berths. Limited heavy lifting facilities.	None	3rd Class
Omsk	Irtysh River	All year round	Deepwater draught up to 9 metres (29.5 feet). Heavy lifting facilities.	Main	1st Class
Surgut	Ob River	Most of the year	No deepwater berths. Limited heavy lifting facilities.	None	Winter Road
Tyumen	Tura River	All year round	Draught up to 10 metres (32.8 feet). Heavy lifting facilities.	Main	1st Class

6.6.2 Timan Pechora

The Pechora River

The Pechora is 1809 kilometres (1,124 miles) long, 1-2.3 kilometres (0.6 to 1.4 miles) wide and 2-10 metres (6.5 to 33 feet) deep. It also has a delta of 45 kilometres (28 miles). There is regular navigation from the delta to Troitsko-Pechorsk. Navigation is available for sea-going ships up the delta as far as Naryan-Mar. Wood, oil products, charcoal and construction materials are the main goods transported. It services the ports of Pechora and Nar'yan-Mar. The river is frozen between the months of October to May.

Severnaya-Dvina River

The Severnaya-Dvina is 747 kilometres (464 miles) long, and freezes in mid-November until the end of April. It is connected with the Volga River, and is navigable along its whole length. The ports on this river are Kotlas and Arkhangelsk. This river is second only to the Volga in terms of freight turnover, even though it is navigable for only 160 days a year.

The table below details the principal ports in the Timan Pechora :

Port	River/Sea	Navigable	Facilities	Rail Line	Roads
Nar'yan Mar	Pechora River & seaport	Navigation period 120-130 days per year. Normally clear of ice by July	Portal cranes up to 20 tonnes, floating cranes up to 50 tonnes. Draught 5-7 metres (16.4 - 23 feet)	None	Winter roads
Troitsko-Pechorsk	Pechora River	Navigable from March-Nov	Some heavy lifting facilities. Not deepwater	None	2nd Class
Vuktyl	Pechora River	Navigable from March-Nov	Some heavy lifting facilities. Not deepwater	None	4th Class
Kotlas	Severnaya Dvina River	Navigable from March-Nov	Portal and tower crane facilities. Not deepwater	Yes	2nd Class
Arkhangelsk	White Sea at the mouth of the Severnaya Dvina River	Navigable from end April to early Nov, but ice classed vessels year-round navigation possible	Mobile cranes up to 32 tonnes, floating cranes up to 50 tonnes. Draught 5-9 metres (16.4 - 29.5 feet).	Main	1st Class
Pechora	Pechora River	Navigable from March-Nov	Largest northern river port. Heavy lifting facilities. Not deepwater.	Main	3rd Class

6.7 Air Transportation

Air freight companies generally deal with loads of up to 30 tonnes. The maximum load which can be air freighted is 120 tonnes.

6.7.1 West Siberia

The main airports are located in Tyumen, Surgut and Nizhnevartovsk, with smaller airfields located in the vicinity of most major field developments. Helicopters are frequently used to freight supplies to the remoter areas.

6.7.2 Timan Pechora

The main airports are at Naryan Mar, Ukhta, Usinsk and Syktyvkar. As in west Siberia, helicopters play an important part in the supply chain.

6.8 Conclusions

While the logistics of supply within West Siberia and Timan Pechora is fairly clear in outline, the conditions are such that weather windows are of the greatest importance, both for transportation using waterways and over land. Major waterways are unusable for import when frozen, but become available for use within these regions once the cold season begins in earnest. Similarly, overland distribution of goods around these regions is often possible only during periods of freeze, or on rough roads which cause huge damage to the environment, and are increasingly the subject of criticism.

If waterway and overland transport was combined, then transportation would be available throughout most of the year. However, even combining there will be periods (albeit shorter) when both modes of transport will not be suitable, such as at the beginning and end of winter when the temperature fluctuates either side of the freezing point.

The estimates for the total volume of freight to be shifted into these regions over the period 1995 to 2010 is 1.1 bn tonnes, with annual volumes reaching 87,000 tonnes by 1999 and remaining between 70,000 and 80,000 tonnes per year total 2010.

7 Other Issues

7.1 Economic Viability of Oil and Gas Developments

Given that development and operating costs in Russia are relatively competitive by world standards, the viability of oil and gas projects in west Siberia and Timan Pechora is determined by three main factors: the disposal price of the crude, the cost of transportation and the fiscal regime applied. In considering these issues, it is useful to look at disposal and returns in the domestic Russian market, within the FSU and exports outside the FSU.

7.1.1 Crude disposal

Disposal within Russia and the FSU

Russia has not yet raised domestic oil prices to world levels. Producers argue that they need higher prices to sustain production. Russian domestic prices are $6 to $7 per barrel leaving a $10 to $12 gap between domestic and world prices which encourages corruption by making illegal exports a very profitable business.

What really prevents Russia from introducing a deregulated oil market is the physical constraint on export. While there are plans to increase export capacity none of the proposed capacity additions are likely to be completed in the next three or perhaps five years. Consequently Russian domestic prices are unlikely to rise to world levels.

Russia introduced a new system for pricing in near abroad markets on the 1 April 1995. Sales are set at average world prices, fob including tariffs and fees, in roubles or local currency at exchange rates determined by the Russian Central Bank on the 15th of every month preceding delivery. Exports to Kazakhstan and Belarus who have a form of customs union with Russia are treated differently with crude sold at world prices minus the 50,000 rouble export tariff. Exports to the Baltic are at world prices since they are outside the FSU.

In the first quarter of 1995 there was pressure from the Russian authorities for joint ventures to export to near abroad markets while giving domestic producers priority access to ports and the Druzhba pipeline. Article 25 of the Russian law on foreign investment gives joint ventures the right to export 100% of their own production but in the first quarter joint ventures were only able to export 1.14 million tonnes leaving 837,000 tonnes to be sold in near abroad markets or stored.

Data submitted by Occidental Petroleum (US) to the state Duma shows that every barrel shipped to the far abroad yields the company a profit of $2.18 by contrast exports to the near abroad result in a loss of $2.63 per barrel, Table 7.1.1. Not surprisingly joint ventures prefer not to ship crude to near abroad markets but with access to pipelines based/ on past production this is a risky strategy and could restrict future pipeline access.

Table 7.1.1: Oil Sales Profitability, $ per barrel

	Non-FSU Export	FSU Export	Domestic Sales
Selling Price	**15.00**	**10.12**	**7.00**
Duties, taxes and commissions			
VAT	0.00	2.02	1.31
Mineral resource replacement tax	0.83	0.36	0.36
Royalty	0.54	0.24	0.20
Excise Tax	0.96	0.96	0.96
Transportation tariffs	1.90	1.72	2.83
Export commissions	0.09	0.06	0.20
Road Tax	0.30	0.20	0.00
Municipal tax	0.23	0.15	0.15
Export tariffs	3.82	3.82	0.10
Other duties	0.02	0.02	0.00
Earnings after duties, taxes and commissions	*6.31*	*0.57*	*3.72*
Operating costs	2.4	2.4	2.40
Depreciation	0.8	0.80	0.8
Pre-tax profit/loss	**3.11**	**(2.63)**	**0.52**
Profit tax	0.93	0.00	0.16
After tax profit/loss	**2.18**	**(2.63)**	**0.36**

Data source: RPI, April, 1995

Traders have been critical of the numbers quoted by Occidental and claim there are plenty of credit worthy customers in the FSU. The head of Nafta-Moskva's trading department believes that it may actually be more profitable to sell products in the FSU rather than export crude. He believes that the reluctance of Western joint ventures to sell either crude or products to near abroad markets is due to ignorance. Several factors may encourage development of this market;

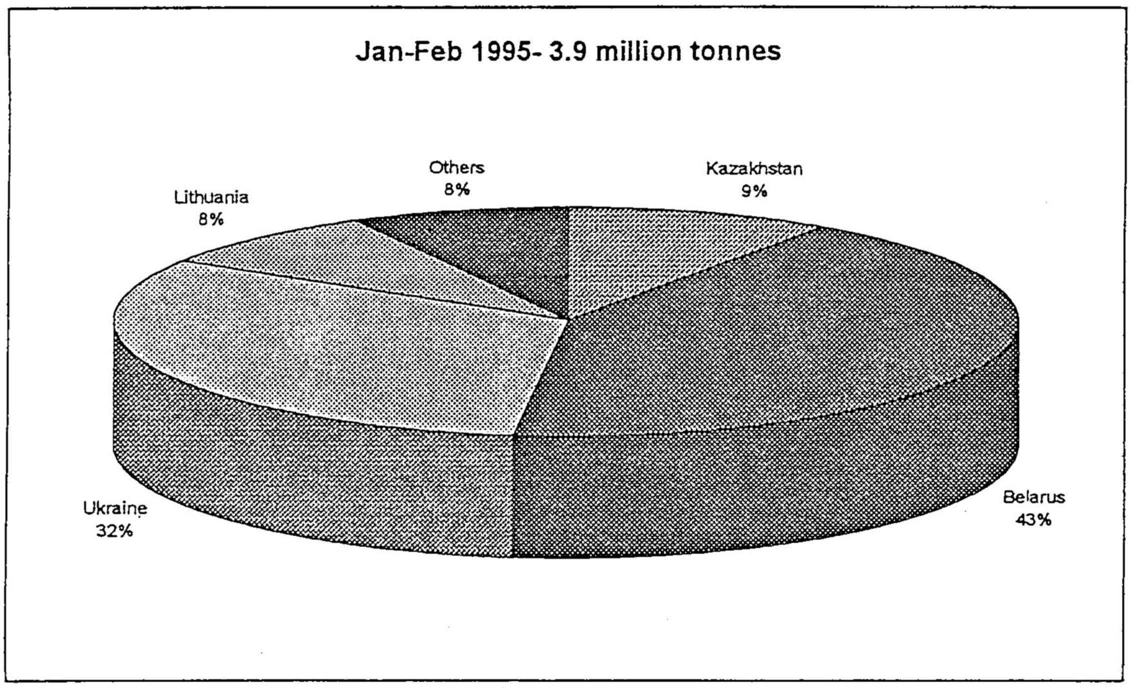
- An intergovernmental treaty between Russia and Belarus lays the foundations for a duty free zone within the FSU which would exempt oil exports from export tariffs. Exports to Kazakhstan are also exempt.

- Joint ventures can ship their FSU quotas to Ukraine and the Baltic and export to the far abroad from Odessa or Ventspils but high transportation and shipping costs make these options relatively unattractive

- As crude and oil product prices rise to world levels in FSU markets with exemption from export duties, VAT and lower transportation costs due to shorter distances, selling to republics like Belarus could be more attractive than export to the far abroad.

Figure 7.1.1 shows the major FSU importers of Russian crude.

Figure 7.1.1: Major FSU importers of Russian crude, January and February, 1995



Disposal within Russia and the FSU

Where exports outside the FSU are concerned, the crucial issue to consider is the net back price of crude. Table 7.1.2 below summarises the position for west Siberian crude, transported by pipeline. No data has been included for crude transported by rail, since the netbacks are consistently negative.

Table 7.1.2: West Siberian crude net back prices via pipelines

Destin-ation	Port	Grade	Via	Price ($/bbl)	Total transport ($/bbl)	Duties, taxes and commiss-ion ($/bbl)	Net back price R 50,000 per tonne excise tax ($/bbl)	Net back price R 20,000 per tonne excise tax ($/bbl)
Augusta	Novorossysk	Urals	Platina	14.85	3.82	7.34	3.69	4.59
Augusta	Novorossysk	Urals	Yurgamysh	14.85	3.87	7.34	3.64	4.54
Augusta	Tuapse	Russian Light	Platina	15.85	4.58	7.34	3.93	4.83
Augusta	Tuapse	Russian Light	Yurgamysh	15.85	4.63	7.34	3.88	4.78
Augusta	Odessa	Urals	Platina	14.85	3.95	7.34	3.56	4.46
Augusta	Odessa	Urals	Yurgamysh	14.85	4.06	7.34	3.45	4.35
Rotterdam	Ventspils	Russian heavy	Platina	11.75	4.23	7.34	0.84	1.74
Rotterdam	Ventspils	Russian heavy	Yurgamysh	11.75	4.27	7.34	0.81	1.04
Poland	Druzhba	Urals	Platina	15.65	1.91	7.34	6.40	7.30
Poland	Druzhba	Urals	Yurgamysh	15.65	1.94	7.34	6.37	7.27
Hungary	Druzhba	Urals	Platina	15.65	2.20	7.34	6.11	7.01
Hungary	Druzhba	Urals	Yurgamysh	15.65	2.23	7.34	6.08	6.98
Slovakia	Druzhba	Urals	Platina	15.65	2.20	7.34	6.11	7.01
Slovakia	Druzhba	Urals	Yurgamysh	15.65	2.23	7.34	6.08	6.98
Russia	Moscow region	Urals	Platina	7.00	1.35	3.83	1.82	2.72
Russia	Moscow region	Russian Light	Platina	7.00	1.35	3.83	1.82	2.72
Ukraine	Odessa	Urals	Platina	14.85	1.98	8.38	4.49	5.39

Assumptions: (i) $16 per barrel Dated Brent FOB Sullom Voe (ii) 4530 roubles per dollar

While prices are better exporting through the Druzhba pipeline there is a limit to how much crude can be shipped to this market without adversely effecting crude prices. Consequently there is spare capacity in the Druzhba pipeline while ports of Novorossysk, Odessa and particularly Ventspils which offer greater are operating at capacity.

The data shown in Table 7.1.2 show that the higher prices achieved from sales of Russian Light via Tuapse compared with Urals via Novorossysk do not accrue to the producers but are used to pay higher port charges at Tuapse which are almost twice those at Novorossysk.

Data available on tariffing in pipelines from other producing regions such as the Precaspian, Volga Urals and North Caucasus suggest that net back prices in Timan Pechora are likely to be slightly higher than those calculated for West Siberia perhaps as much as 70 cents and net back prices in the Volga Urals will be about $1.1 higher.

The potential profitability of sales to near abroad markets are illustrated by the example for the Ukraine which assumes world prices and gives a net back value of $4.5 per barrel. The principal problem with this market and other countries in the FSU is their inability to pay for oil in dollars.

Hidden and future additional costs

The netback prices shown in Table 7.1.2 do not include the hidden costs of export which were estimated by First Deputy Prime Minister Anatoly Chubais at $5 per tonne or $0.69 per barrel.

Should Transneft introduce a quality bank which will reward producers according to the gravity and sulphur content of their crude this will further alter net back prices. Data published in Russian Petroleum Investor, (May 1995), suggests that there will be a premium of $0.03 per barrel for every degree API and a debit of $0.05 per barrel for every 0.1% increase in Sulphur content relative to a standard crude.

7.1.2 Gas disposal

The Russian gas industry is dominated by Gazprom. In 1993 total Russian production was 706.8 bcm of which 105.8 or 15% was exported outside the FSU. Gazprom production is more than 80% of all gas produced, see Table 7.1.3.

Table 7.1.3 Russian Federation & Gazprom Gas Production

	1994 (bcm)
Total Russian Federation Production	706.0[1]
Gazprom Production	570.7[2]
Gazprom Transmission	
Gas line intake	597.3[2]
Gazprom Total gas Delivery	
Russian Federation	317.0[2]
Exports	105.9[2]
Supplies within FSU	90.4[2]
Supplies to Baltic States	3.7[2]
Net Storage	9.9[2]
Pipeline fuel	58.0[3]
Total	584.9[1]

[1] Estimate

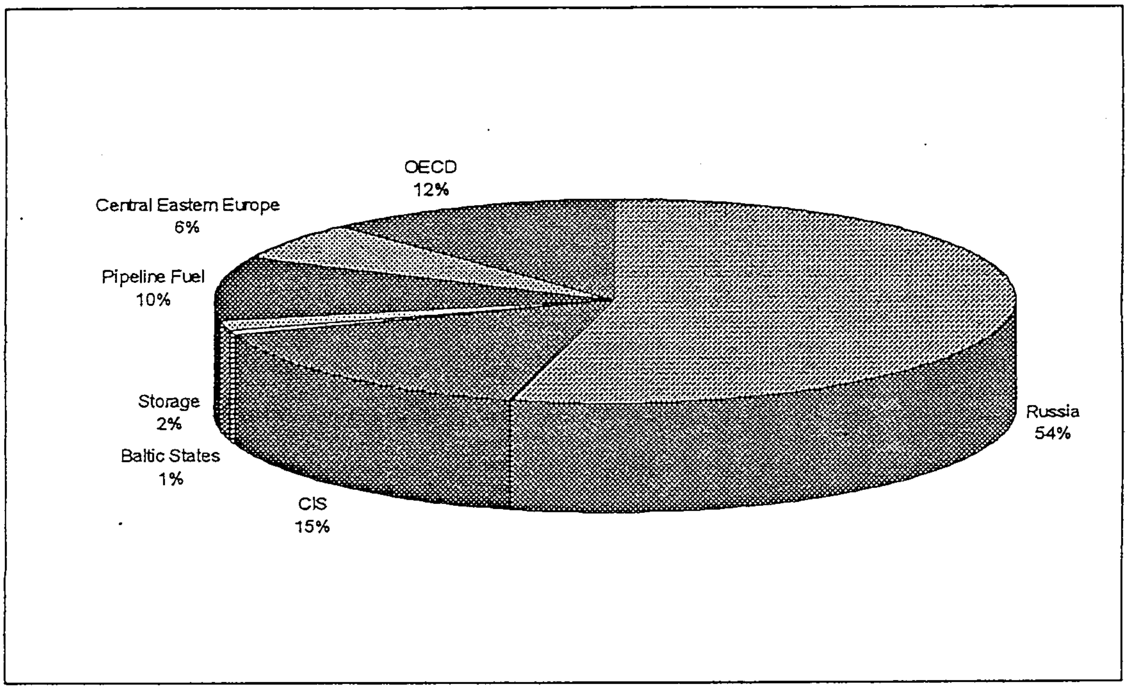
[2] Gazprom, Petroleum Economist, June 1995

[3] RIIA- The Russian Natural Gas 'Bubble'. Consequences for European Markets

The usage of the 108.7 bcm of gas production that does not enter the Gazprom transmission system is unknown but it is probably used in field power generation and for reservoir pressure maintenance by gas reinjection. Official statistics show that associated gas production was 28.2 bcm in the Tyumen Oblast in 1993 of which 4.8 billion bcm was flared. Unofficial estimates put Tyumen Oblast flaring in 1993 at 10 bcm, (about 16% of UK production) and this practise must also account for some of the difference between gas production and gas entering the transmission system.

Figure 7.1.2 (below) shows Gazprom customers in 1994. 54% of gas is sold in Russia, 15% to FSU states, 1% to the Baltic States and 2% was used to increase gas storage. 10% was used in pipeline fuel with the remaining 18% being sold to Central, Eastern and Western Europe.

Figure 7.1.2 Gazprom Customers, 1994



Gazprom's biggest problem is customer indebtedness, Table 7.1.4 (Below). In April 1994 Gazprom was owed $5.12 billion at current exchange rates and this sum is expected to grow.

Table 7.1.4 Gazprom debtors, 1994

Customer	Amount owing at 1 April 1994 at current exchange rates (£ million)
Russian buyers	2300.0
Ukraine	2060.0
Belarus	420.0
Moldova	275.0
Baltic States	1.2

Paradoxically this debt may allow Gazprom to increase the strength of its grip on the gas industry of the FSU as it is persuading debtor states to pay for past and future gas supplies in the form of equity in their gas transmission and gas distribution companies.

Gas prices do not reflect the real price of energy or transport costs. This has had a profound effect on the coal industry where prices reflect real costs including transport costs. Consequently coal is loosing market share to gas which has led to the need for subsidies to the coal industry at the same time as increasing demand for subsidised gas. Currently gas prices are the same for all local distribution companies across Russia although the IEA (International Energy Agency), recently recommended that gas prices be raised to reflect the long run marginal cost of providing and maintaining supply which is estimated at $40 per 100 cubic metres.

Gazprom claim to be willing to discuss Western company involvement in field development, gas/chemicals facilities, transmission systems and the manufacture of equipment and tools on a joint venture basis. Upstream the company has shown little inclination to share its vast resources with foreign companies.

One notable exception to this trend is the Bechtel Energy Resources' NorthGas project at the North Urengoi field in western Siberia. NorthGas has a licence to develop Neocomian reservoirs and will bring in gas recycling technology to aid liquids recovery. This is a process that Gazprom has yet to use and is a technique that has broad application to the Neocomian and Jurassic reservoirs of the northern part of West Siberia.

Gazprom the successor to the Ministry of Gas Industries has always been primarily a gas production, transmission and distribution company. When the Vuktyl gas field in the Komi Republic was developed in the late 60's developers were preoccupied with extraction of gas and millions of tonnes of condensate were burned. In the 1970's and 1980's technical experts, supported by the local Tyumen authorities, developed plans to use Cenomanian gas to extract the more valuable condensate from Neocomian and Late Jurassic reservoirs. These plans were rejected by central planners in Moscow who directed that the key priority was development of dry gas reserves in Cenomanian reservoirs.

This viewpoint has now changed but production of natural gas liquids (NGL's) is considerably less than the country's potential.

In addition to the gas market there is a small market for liquid petroleum gas, (LPG). Total production from the FSU in 1994 was 6.42 million tonnes down 40% from 1990. In the FSU LPG is produced from associated and non associated gas, condensate, gas processing plants and refinery streams largely from petroleum produced by Russia. 35 million FSU families, more than 120 million people, use LPG for cooking, half of these families are in Russia. Cooking accounts for 50% of LPG consumption, petrochemicals about 30% and metal cutting and other industrial applications about 20%. Russian LPG prices were 2% of world prices in 1990 rising to 20-30% of world prices in 1994.

Table7.1.5 LPG Consumption, 1994

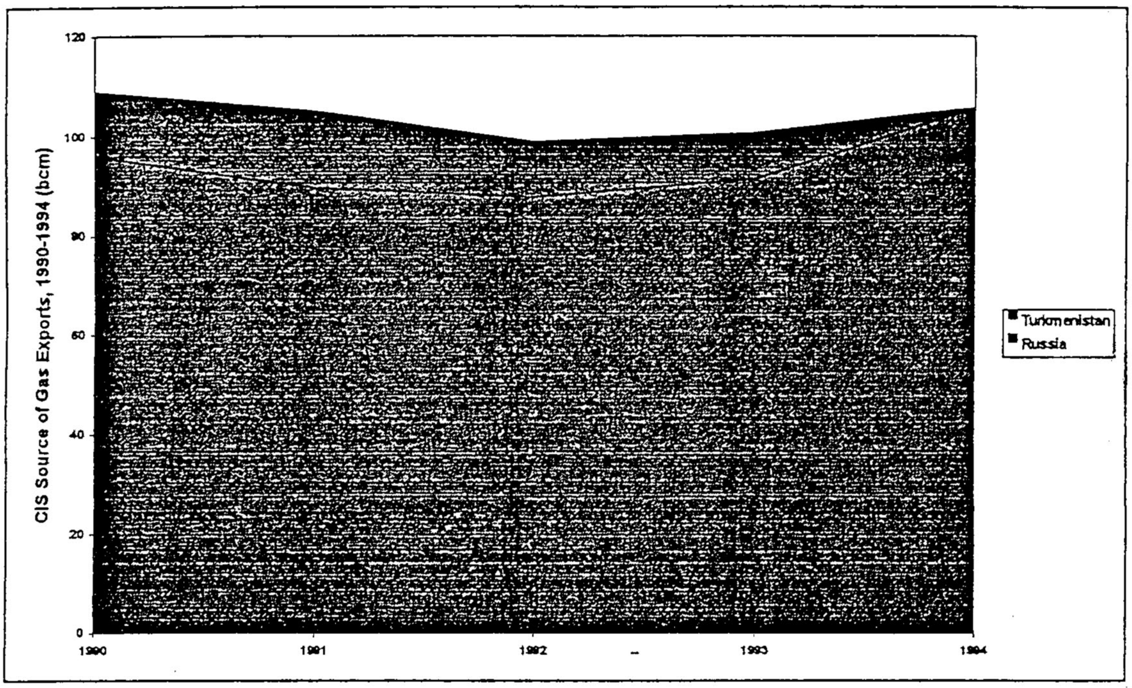
Country	LPG Consumption (tonnes)
Russia	5,200,000
Ukraine	600,000
Belarus	300,000
Lithuania	250,000
Azerbaijan	60,000
Georgia	10,000
Total	6,420,000

Given the total dominance of Gazprom in the Russian gas industry and the absence of plans to deregulate the industry along the lines of the UK and North American gas industries it is unlikely that any Western company could enter the Russian or FSU gas market except in collaboration with Gazprom. Other options to enter the upstream market are associated gas saving projects in the southern part of West Siberia in collaboration with the regions oil production associations. Downstream there are opportunities in the LPG market but these are relatively small compared with upstream oil projects and with sales into FSU markets at 40% of world prices these projects are unlikely to be attractive in the short term to medium term.

To date the focus of Western petroleum industry interest has been on the oil resources of the region. The only significant gas development in the FSU operated by Western companies is the Kazakh, Karachaganak field development by British Gas and Agip. This project ultimately aims to export gas to Western Europe. Given the payment problems that have been experienced within the FSU, Western companies are unlikely to want to be involved in anything other than gas developments aimed at export to Western and Central European markets.

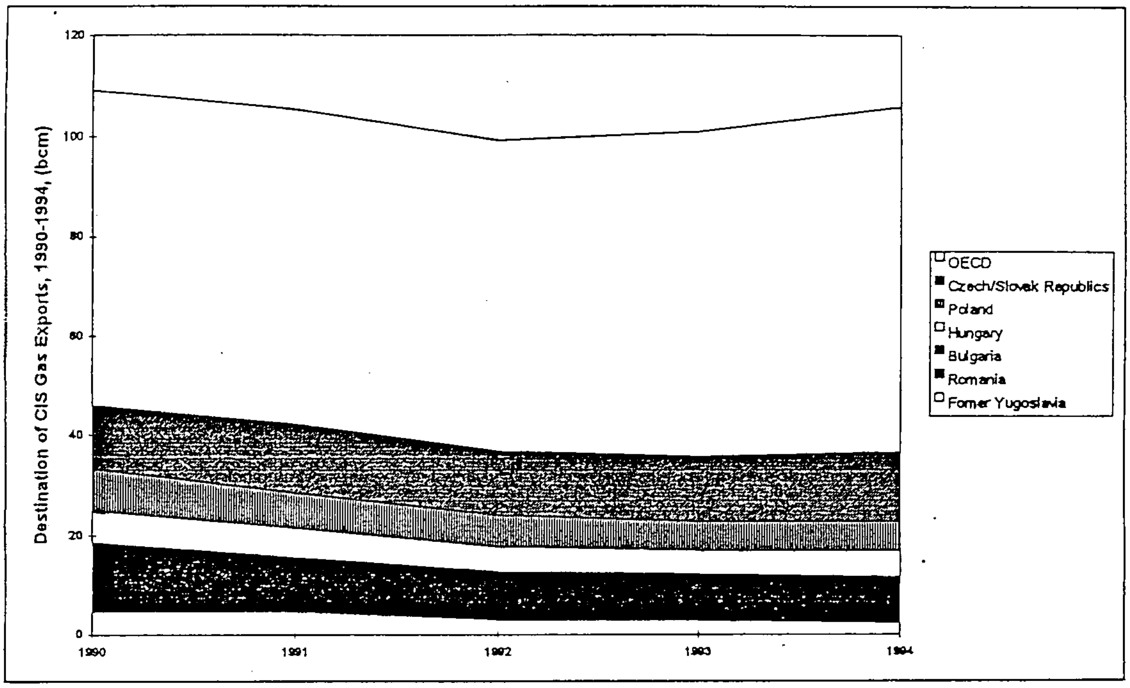
Figure 7.1.3 (below) shows the source of all gas exports from Russia all of which are controlled by Gazprom. In 1994 all the gas exported to Central, Eastern and Western Europe was produced in Russia and Gazprom is unlikely to restore Turkmenistan's export quota while its own production capacity exceeds market demand.

Figure 7.1.3 Source of FSU gas exports to Europe, 1990-1994



Gazprom entered the European market in 1960's when gas sales to Czechoslovakia and Poland begun followed by sales to Austria in 1968. Gazprom now sells to 16 European countries and is shortly to start supplying Greece, Figure 7.1.4 (below). With huge reserves and 25% of world gas output Gazprom is likely play a dominant role in European gas matters well into the next century.

Figure 7.1.4 Russian gas export destinations, 1994



Until 1991 all Russian gas was sold to national gas companies and Gazprom had no access to end users. The company's export strategy anticipates increased involvement in large scale European gas supplies both in their traditional business, delivering to border metering points and in the future in direct exports to consumers in importing countries. To achieve this goal a number of trading houses, public companies and joint ventures have been created in consuming countries including Germany, Austria, France, Italy, Serbia, Slovenia, Poland, Greece, Finland and Hungary.

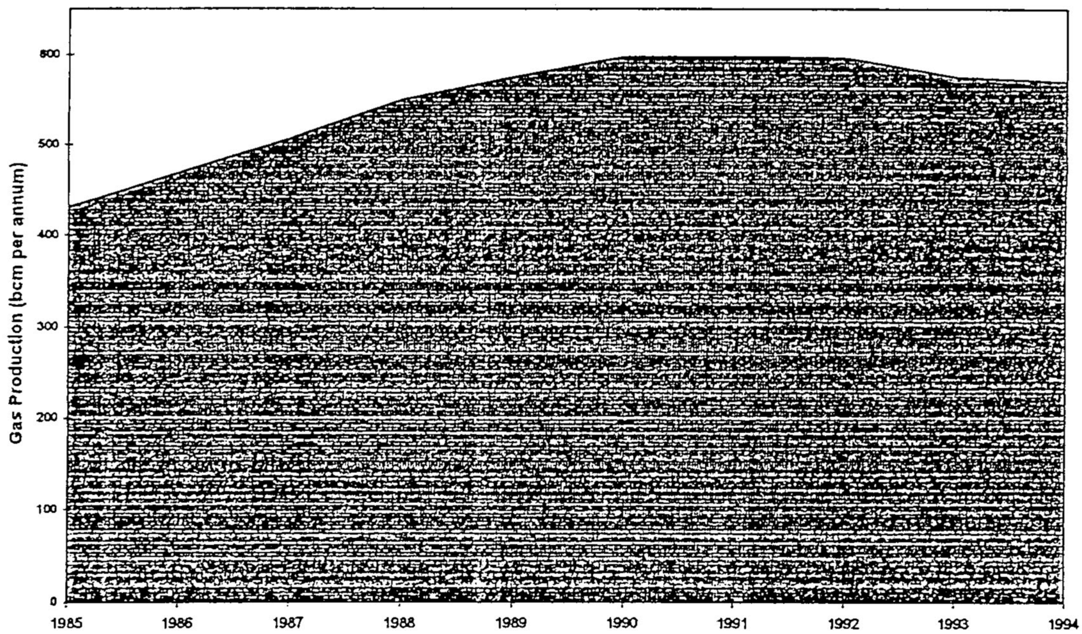
On conservative estimates European gas is set to expand by 100 bcm and perhaps as much as 200 bcm between 1994 and 2010 and it will be impossible to meet this demand from indigenous sources. Gazprom intends to maintain its market share in Europe, currently around 30% which will require increased exports of 30 to 60 bcm.

Gazprom has stated that it is interested in Western company involvement in field development, gas/chemicals facilities, transmission systems and the manufacture of equipment and tools on a joint venture basis. Very few upstream projects aimed at gas production are under discussion. One exception is Rhurgas who are involved in a gas saving project in the Tyumen Oblast with oil producer Purneftegas. Gas will be collected by Purneftegas, processed by Sibneftegazpererabotka and transported by Gazprom. The project could save 6-7 bcm of associated gas per year producing 5 bcm dry gas and 2 million tonnes of LPG.

There has been much debate in the press about whether Gazprom's $40 billion development of the Yammal fields will proceed. Real gas demand by Gazprom's paying customers is estimated at 205 bcm per annum against deliveries of 517 bcm in 1994. Production has fallen since 1990 with the collapse of the Soviet economy, Figure 7.1.5 (below) creating spare capacity of more than 27 bcm. With a 30% share of the European gas market even a 200 bcm increase in the total market or 60 bcm to Gazprom, could be met by (i) switching supplies from customers in default to paying customers in Europe, (ii) associated gas saving projects, (iii) utilising spare capacity created by the fall in production from 1990 peak production and (iv) energy saving projects.

A recent World Bank study suggested that energy efficiency measures could reduce Russian consumption by 80 bcm or 25%. The World Bank is to lend $108 million to nine municipalities channelled through the Russian Energy Savings Fund to install energy efficient equipment at district heating firms and combined heat and power plants. The loan will also provide for upgrade of one municipalities distribution network and installation of meters for commercial and residential users.

Figure 7.1.5 Russian Gas Production, 1985-1994



Probably the most pressing problem facing Gazprom is its dependence on Ukraine's gas infrastructure for exports to Europe. Some 90% of exports use Ukraine's gas transmission system which is fully utilised and in need of expansion. Hence Russia is eager to start construction on the Belarus, Poland link to Germany due to start in 1996 which will deliver 67 bcm at the Polish border and 53 bcm at the German border. This project will greatly increase Russia's reputation as a secure supplier of gas as Ukraine has on occasions extracted gas meant for export on whim.

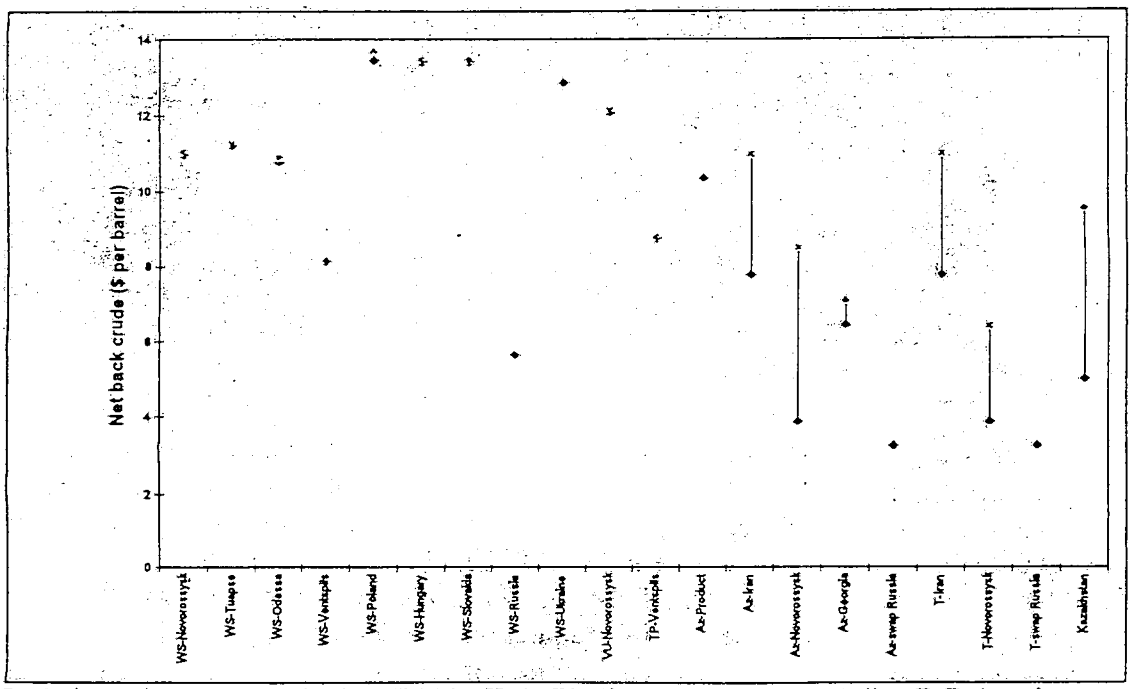
Given the lack of upstream gas projects that are likely to proceed other than associated gas saving projects there is little opportunity for Western company involvement in the Russian gas business other than infrastructure projects, particularly the replacement of Russia's ageing pipeline network. Any local gas marketing or export to Europe would have to be negotiated with Gazprom. Given the shortage of precedents other than gas exports by Turkmenistan which were stopped in 1994 and Kazakh exports to Russia from the Karachaganak field which is discussed below it is difficult to determine the access that western companies will be given to Gazprom transmission systems, the markets that they will be allowed to serve and tariff structure they will face. No data is available on gas pipeline tariffs to world markets, probably because the only users are Gazprom and they have felt no need to release this data. Consequently it is impossible to calculate net back prices to producing areas even though average European border prices for Russian gas a freely available.

7.2 Taxation

The fiscal framework in Russia is evolving steadily, but at the moment is considered inimical to major projects involving international investors. The following charts demonstrate the netback crude prices which can be expected from various projects, divided by location. Comparison of Russian and Caspian projects reveals the relative unattractiveness of the current Russian fiscal regime.

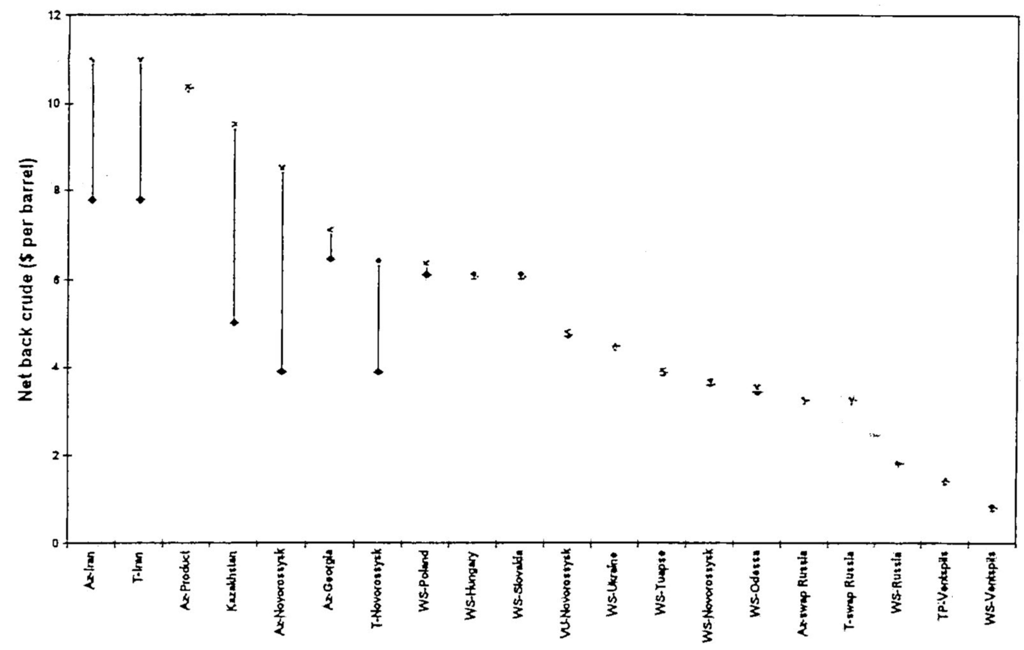
Figure 7.2.1 summarise net back prices for the main producing regions considered in this study before any local taxes, duties and commissions. Figure 7.2.2 shows the same data after local taxes, duties and commissions.

Figure 7.2.1 Net back crude prices before local taxes, duties and commissions



Producing region; WS-West Siberia, VU- Volga Urals, TP- Timan Pechora, Az- Azerbaijan, T- Turkmenistan

Figure 7.2.2 Net back crude prices before local taxes, duties and commissions



Producing region; WS-West Siberia, VU- Volga Urals, TP- Timan Pechora, Az- Azerbaijan, T- Turkmenistan

Before local taxes, duties and commissions West Siberia is a clear winner because costs of moving crude by pipeline are less than the costs of export from Central Asia. After local taxes, duties and commissions Kazakhstan, Azerbaijan and Turkmenistan appear more attractive on a net back basis. The advantage of a high well head net back price is that taxes or the cost recovery, profit sharing and taxation terms of production sharing contracts can be negotiated to suit the capital and operating costs and risks of the specific project. Russian joint ventures suffer from the disadvantage that local taxes, duties and commissions are fixed and take no account of oil price movements, project risks and costs.

7.3 Conclusions

Based on the data shown in this section, it is clear that of the key drivers identified in the introduction - disposal price, transportation cost and fiscal regime - the latter is the most problematic. As the charts in section 7.2 demonstrate, the comparative attractiveness of projects in Russia are diminished particularly by the existing fiscal system. Transportation costs are relatively high by world standards, but are not the main cause for concern among international investors. The fiscal system, by contrast, is seen by many as a serious impediment to progress with major projects.

8 Summary and Conclusions

The key to evaluating the market for seaborne logistics solutions for materials supply to West Siberia and Timan Pechora is to quantify the requirement for *imported* goods in these regions.

Total project expenditure, including equipment, materials and freight services, in these regions for the period 1995-2010 is estimated to be $26.2bn, and is shown in detail in the following table from section 5.4:

Table 5.4.3.1-1 : Total Regional Expenditure Estimate Breakdown

$ millions

Year	1995	1996	1997	1998	1999	2000	2001	2002
Equipment & Materials	107.5	239.2	416.4	579.4	697.5	670.7	695.8	738.0
Fab. & Construction	20.0	101.5	162.0	416.8	592.2	662.4	645.8	607.2
Design & Management	50.8	91.2	170.5	224.4	240.2	271.2	269.5	258.0
Freight	14.3	32.6	56.2	78.2	93.3	88.5	93.5	98.2
Contingency	34.0	80.8	140.2	229.8	290.4	306.9	306.2	305.6
Total	226.6	545.3	945.3	1528.6	1913.6	1999.7	2010.8	2006.9

Year	2003	2004	2005	2006	2007	2008	2009	2010
Equipment & Materials	687.2	644.1	666.5	659.5	644.1	678.1	652.8	678.1
Fab. & Construction	623.2	579.9	563.2	610.5	576.8	599.1	577.9	579.8
Design & Management	259.7	252.6	246.2	251.3	250.2	250.2	252.8	246.2
Freight	90.9	86.0	88.7	87.5	86.0	90.1	87.1	90.1
Contingency	300.8	281.5	281.8	291.1	280.4	292.2	283.0	287.7
Total	1961.8	1844.1	1846.5	1899.9	1837.6	1909.6	1853.6	1881.9

A significant proportion of this total regional expenditure will consist of imported goods, and therefore non-Russian freight services. The estimate for imported goods and services is based on the premises laid out in section 4, which deals with procurement from within the FSU, and section 5.4.2, which elaborates the methodology used in developing the cost estimates. In brief, it is our opinion that international investors undertaking large projects will make extensive use of imported goods and services, and that large projects with mainly Russian funding will also use a significant proportion of imported goods and services. By contrast, it seems likely that smaller projects and those wholly funded by domestic Russian companies will make use of mainly domestic equipment, materials and services.

order to reflect a degree of uncertainty as to the extent of imports, estimates were nerated for varying proportions of domestic and imported goods and services. These are shown in the following table, drawn from 5.4:

Table 5.4.3.3-2 : Imported Equipment & Materials Estimates

$ millions

Year	1995	1996	1997	1998	1999	2000	2001	2002
Total Regional Spend	107.5	239.2	416.4	579.4	697.5	670.7	695.8	738.0
High Import Prediction	50.3	105.5	183.7	289.6	391.1	374.3	389.2	424.2
Medium Import Prediction	41.9	88.0	153.3	242.3	327.7	313.4	326.1	355.5
Low Import Prediction	34.8	73.1	127.2	201.1	272.0	260.1	270.7	295.0

Year	2003	2004	2005	2006	2007	2008	2009	2010
Total Regional Spend	687.2	644.1	666.5	659.5	644.1	678.1	652.8	678.1
High Import Prediction	400.2	366.7	362.5	363.7	351.8	346.5	338.2	356.2
Medium Import Prediction	335.3	307.2	303.5	304.6	294.6	289.9	283.0	298.0
Low Import Prediction	278.3	255.0	251.9	252.8	244.5	240.6	234.9	247.4

Over the period 1995-2010, the value of imported goods, assuming a medium level of imports, is estimated to be $4.3bn, and value of associated freight services $530mm. The breakdown of these figures is shown in the following table, drawn from section 5:

Table 5.4.3.3-1 : Imported Goods and Services - Timan Pechora & West Siberia

$ millions

Year	1995	1996	1997	1998	1999	2000	2001	2002
Equipment & Materials	41.9	88.0	153.3	242.3	327.7	313.4	326.1	355.5
Fab. & Construction	1.2	5.5	7.8	17.9	28.2	28.6	32.7	32.1
Design & Management	15.3	24.3	58.5	75.6	81.6	99.5	99.7	97.2
Freight	5.2	11.0	19.1	30.4	40.8	38.8	40.7	44.2
Contingency	11.5	22.3	42.1	63.4	84.7	86.5	88.4	94.6
Total	75.0	151.1	280.8	429.6	563.0	566.8	587.8	623.7

Year	2003	2004	2005	2006	2007	2008	2009	2010
Equipment & Materials	335.3	307.2	303.5	304.6	294.6	289.9	283.0	298.0
Fab. & Construction	27.5	25.7	24.4	24.9	20.7	23.5	19.7	20.1
Design & Management	94.7	87.0	85.8	80.9	74.4	77.1	67.9	68.6
Freight	41.6	38.2	37.7	37.8	36.6	35.9	35.3	36.9
Contingency	89.8	82.0	81.0	80.3	76.2	76.9	72.4	76.4
Total	588.9	540.1	532.4	528.5	502.5	503.3	478.3	500.0

The volume of imported goods, expressed as weights, amounts to 1.1bn tonnes. Between 1999 and 2010, the annual volume of goods to be moved into the regions will be between 70,000 and 80,000 tonnes. This level of requirement for goods and associated freight services clearly represents a significant market opportunity.

However, as section 7 demonstrates, all project activity in West Siberia and Timan Pechora is currently subject to an unattractive fiscal regime. This has delayed progress on many projects for the last 18 months. Discussions taking place within the Russian government and between Russian and international oil companies are gradually improving this situation.

9 Recommendations for Additional Research

The estimates of import requirements shown in section 4 are based on aggregated figures for developments in west Siberia and Timan Pechora involving international investment. In order to better understand the implications of this data, we recommend that a detailed study be carried out of at least one major development.

Based on our knowledge of projects in these regions, we would like to suggest that a detailed study is carried out for the Timan Pechora region. We propose to provide data on the proposed development covering the Romana Trebsa, Titov, Varandeiskoe and Toraveiskoe fields (involving Texaco, Exxon, Amoco and Norsk Hydro). The development plan is for the import of large numbers of modules of production and processing equipment, and the export of crude by tanker. We propose to provide a breakdown of the freight-related data, showing:

- Module numbers
- Module weights
- Module composition
- Phasing of module imports
- Offloading and onward transportation methods
- Details of proposed loading/offloading facilities
- Crude export volumes
- Phasing of crude export volumes

Since the development in question can be viewed as a reasonable model for other major developments in the two regions being studied, the acquisition of detailed project data would significantly enhance the value of the present study to SNF.

It would also be valuable to look in detail at weather windows affecting freight into and transportation within West Siberia and Timan Pechora.

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APPENDIX

REVIEW AND AUTHORS' COMMENTS

Jørgen Ole Bærenholdt Roskilde, 13 February, 1996.

Review of INSROP-project III.07.5 discussion paper "Seagoing Logistics Solutions to Oilfield Material Supplies" by MAI Consultants (via SNF)

General comments

This is first of all a rather professional and comprehensive report introducing light and shade into the complex problems of material supplies for Oilfield (and Gas) in Russia which in itself is a limited field of interest. The paper is a continuation of earlier works by MAI consultants and Russian partners on related questions, and this background has made a cumulative development of a database on oil and gas in Russia possible. The paper also presents very many nice figures. But the paper lacks appendixes presenting ways of calculation (i.e. of political stability?) and examples of calculations, which cannot be checked in the present paper (and this should be possible according to scientific standards). Scientific standards also claim the authors responsible for the paper to be mentioned.

That said, it is surprising (as mentioned in earlier reviews) that discussion papers and projects within the INSROP has not been coordinated to a higher degree. Two other discussion papers (which I have had the chance to review recently) of other subprogramme III projects contain relevant information for this paper, as well as this paper in its more comprehensive approach presents data very relevant to these other discussion papers:
- III.01.3 "The NSR and the rivers Ob-Irtysk & Yenisey" by T. Ramsland et.al
- III.02.3 "Oil and gas in the north-western part of Russia" by Vigdis Nygaard

As I am not a geologist, the paper has not been evaluated in detail on its geological information on deposits and reserves.

More and better maps!

In the production of conditions for development of the NSR, production of illustrative maps could be crucial. This paper only contains one map, which apparently was difficult to copy in a good quality, and which did not include all the names of places and deposits mentioned in the text. For sections 6.4.-6.6 (which are weaker than other parts of the paper) maps of roads, railways and rivers must be produced.

A few detailed comments

p.4 Map includes to small area - as parts of West Siberia and the Barents Sea (Stockman deposits (world's largest) newer mentioned in the text) are left out. Be aware of print quality - do not present to many data in the same map, rather use more maps - but as a rule in same projection and scale for comparison.

p.8 "...direct export to world oil markets could be achieved from ice-free ports on the north coast" - it is not as simple as that, see i.e. technical considerations on the Northern Gate project in INSROP project III.01.3 discussion paper - Part 1:

"Development of Oil exports in Northern Russia" by Y. Ivanov et al.

p.14-15 very good and well balanced considerations of potentials for even export of Russia equipment

p.19 table 5.2.2 and p. 24 table 5.3.3 should be compared with Nygaard (mentioned above) who mentions 6 joint ventures in Komi Republic (pp.5-7) and 3 in Nenets Autonomous Okrug (pp.9-10).

p.22 correct reference to table to 5.3.2

p.25 (see also general comments) lack information on how calculations and estimations were carried out (i.e. in relation to political stability?). Reliability cannot be checked at the moment, and this is crucial as these calculations is the main result of the paper.

p.29 Can we be sure, that Russia actually has less experience and potential in relation to production of equipment for harsh environments? - Or that Russian technology mainly will be used in smaller projects (also p.57 in the conclusion)? - Use of converted military ship yards in Severovinsk (actually mentioned in the paper) is exactly also due to the Russian efforts to fulfil the demands for large-scale equipment for use in harsh environments (sea ice) - in Pechora Sea and Barents Sea (Stockmann gas deposit)

p.38 "...from the port of Dudinka in the east of the region to Norilsk and Talna in the far north..." - it is not clear, that the region considered is West Siberia (?) and whether far north is a part of the Russian definition of regions or is just a more loosely location (remember the distance from Dudinka to Norilsk is only 50 km). How is West Siberia generally defined in this report???

p.39 "...with connections to Tyumen and Omsk..." - actually the Trans-Siberian railway runs through Tyumen (the Northern line) and Omsk (my own observations from 1981). Can also be seen in a good atlas (i.e. Times Atlas of the World).

p.40 Ob river - and Irtysk river - said to be frozen and impassable (Oct)/Nov to April/(May) - but navigable "All year round" in table on p.41!

Pechora river is not in West Siberia (move to p. 42)

p.41-42 tables lacks information on sources (should be compared with field information by T. Ramsland (mentioned above))

p.43 on the seasonality of overland versus river transport: If one combines (alters between) winter/spring? transport overland with summer/fall transport on rivers, how much time a year will then be without possibilities of transport?

p.44ff The FSU (Former Soviet Union) expression is confusing, as the author in several cases apparently means CIS (FSU without Baltic states)

Responses to Comments on MAI's Paper titled 'Seagoing Logistics Solutions to Oilfield Material Supplies'

General comments - It was not thought necessary to include appendices detailing methods of calculation. The paper makes references to the tools used (e.g. Que$tor, ROGES, in-house database of Russian fields, etc.) to obtain the calculations, and this is considered sufficient. As for the discussion of political factors, section 7 of the paper discusses issues such as taxation and the economic viability.

Maps - The reviewer asks for more and better maps, in particular for sections 6.4 to 6.6 (road, rail and river transportation). Maps detailing this information are not readily available for insertion into the paper, and so therefore the text is considered to be sufficient.

Page 4 - Reviewer claims the map is too small, as parts of W.Siberia and Barents Sea are omitted. We consider the map to be suitable as it illustrates the most important and relevant area in the context of the paper. However, the map has been slightly modified to reflect this.

Page 8 - The reviewer claims that our statement "...direct export to world markets could be achieved from ice-free ports on the north coast" is too simplistic. This is accepted, as there is currently no export solution in place for the Timan Pechora area. Indeed, of the two potential export solutions planned, one does not even lead to the north coast; the Baltic Way route (favoured by the Russian government) would start in the Timan Pechora region and terminate at the Finnish port of Porvoo, whilst the second route, Northern Gates (favoured by western companies such as the Timan Pechora Company, consisting of Amoco, Norsk Hydro, Exxon and Texaco) would involve the construction of an export terminal on the Barents Sea coast that would be linked by pipeline from the Komi Republic and the Nenetsk Autonomous District. The text on page 8 has been modified to reflect this.

Page 14-15 - No action required.

Page 19 - We do not have INSROP project III.02.03 by Vigdis Nygaard to compare JVs. However, we are confident that the tables describe the *major* projects.

Page 22 - Reference corrected

Page 25 - The reviewer says that this page lacks information on how the calculations and estimations were carried out. However, we feel the methodology statement adequately addresses this.

Page 29 - The reviewer asks if we can be sure that Russia actually has less experience and potential in relation to the production of equipment for harsh environments. What the paper says is that international investors are more likely to use Western designs, equipment, material and fabrication, and that *most* of the developments involving international investors tend to be located in the harsher environments. We state that the Russian companies may use up to 90% FSU-produced equipment and materials, albeit for smaller developments. Our judgements are based on extensive work, from MAI's Russian Oil & Gas Equipment Survey, and many site visits in the region - we are therefore confident about our remarks. As for the potential of Russian equipment, we note that more and more Russian manufactures will in future years produce goods to international standards, thereby resulting in a decline of the need to import western equipment. On page 15 we state "The half dozen best known of these manufacturers and the engineerings JVs will certainly play some part in supplying the expected major developments....".

The reviewer also asks if we can be sure that Russian technology will be used in smaller projects - in the conclusion (page 57) we do state that we make these statements *in our opinion* and say "international investors undertaking large projects will make *extensive* use of imported goods and services, and that large projects with mainly Russian funding will also use a *significant* proportion of imported goods & services" - the words in italics show that we are saying that this is not exclusive and that some Russian equipment will be used in larger and harsh environment projects, such as the equipment being manufactured at the Severodvinsk military ship yard (reference on page 15).

Page 38 - Correct statement by the reviewer. I have changed the sentence to read "In the east of the region there is a remote and single track system from the inland port of Dudinka to Noril'sk and Talna".

The reviewer also asks how Western Siberia is generally defined in the report - we do not appear to define it anywhere in the text. However, reference to the map on page 3 illustrates the location and hence definition of both Western Siberia and Timan Pechora.

Page 39 - Yes, the Trans-Siberian railway does run through Tyumen and Omsk. The text has been changed to read "The Trans-Siberian Railroad, stretching from East Siberia to Moscow, crosses the southern extremity of this region, running through towns such as Novosibirsk, Tyumen, Omsk and Yekaterinburg".

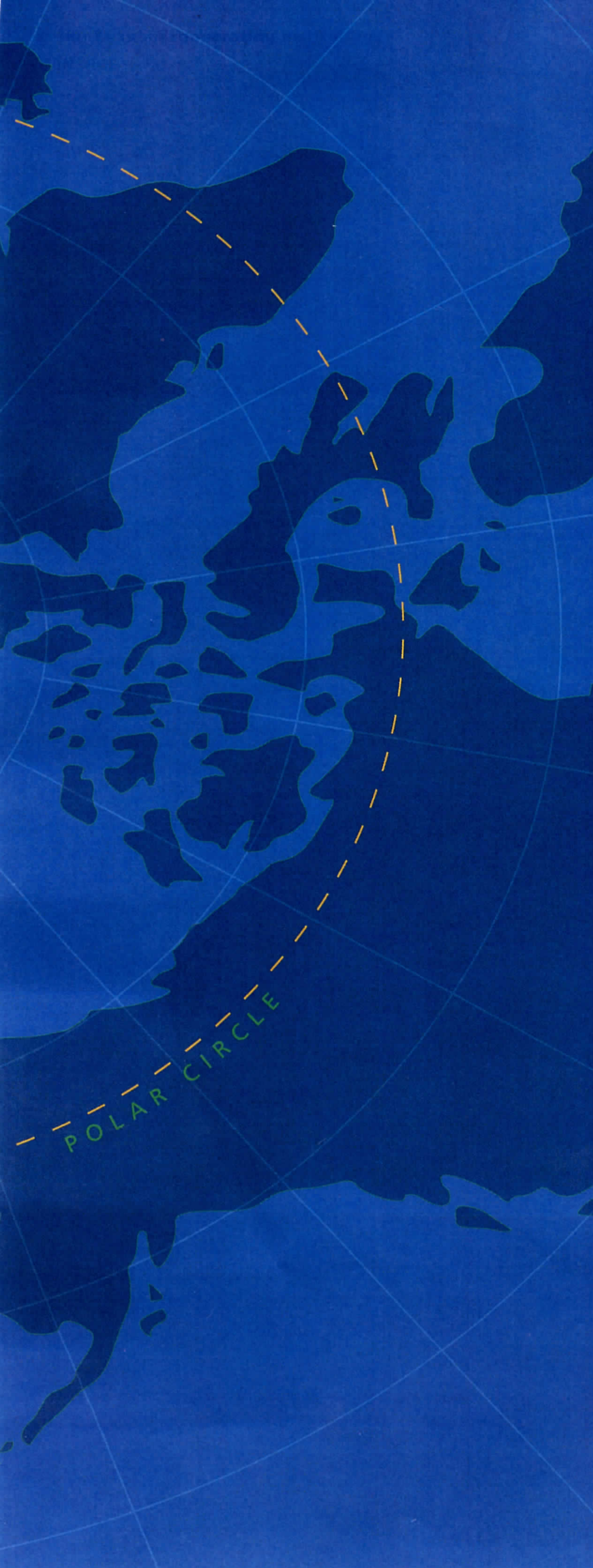
Page 40 - Yes, the report says that the Ob and Irtysh Rivers and frozen during the winter months. However, closer inspection of the table on page 41 does not contradict this, as the navigable comments on the table relate to the ports not the river. In the example of the Ob and Irtysh Rivers, we are saying on page 40 that *parts* of those rivers become frozen, although the areas of the rivers around the ports remain navigable. In order to make this more apparent, the text on page 40 under the Ob and Irtysh Rivers has been changed to read "..parts of the river are frozen and impassable...".

Page 40 - Yes, the Pechora River is not in Western Siberia. The text on page 40 has been moved to page 42.

Pages 41/42 - The reviewer says that the tables lack sources and should be compared with field information from the INSROP paper III.01.03 by T. Ramsland. The source for the table was 'Russia and the CIS Oil & Gas Industry Guide' produced by MAI and published by OPL (Oilfield Publications Limited). Very few of the other tables in the report have a stated source; however, the MAI/OPL reference has been added to the list of references on page 60. As for comparing the information with that of INSROP paper III.01.03, we do not have that paper.

Page 43 - Yes, the two modes of transport (river transport for summer/fall) and overland (i.e. winter roads for winter/spring) may be combined to allow transport to be available throughout the year. However, even by doing this there will be periods (albeit shorter) when both modes of transport will not be suitable, such as at the beginning and end of winter when the temperature fluctuates either side of the freezing point. The text under point 6.8 has been slightly modified to reflect this view.

Page 44ff - The FSU (Former Soviet Union) expression is used because the Baltic states were part of the Soviet Union.



The three main cooperating institutions of INSROP

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

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

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

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

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

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