WHITE ROSE OILFIELD
DEVELOPMENT APPLICATION

PROJECT SUMMARY

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This Development Application is submitted by Husky Oil Operations Limited (as Operator) on behalf of itself and its co-venturer Petro-Canada, who are the project proponents. The application is comprised of a Project Summary and five volumes.

- Project Summary
- Volume 1 – Canada-Newfoundland Benefits Plan
- Volume 2 – Development Plan
- Volume 3 – Environmental Impact Statement (Comprehensive Study Part One (issued October 2000))
- Volume 4 – Socio-Economic Impact Statement (Comprehensive Study Part Two (issued October 2000))
- Volume 5 – Safety Plan and Concept Safety Analysis

This is the Project Summary. A number of Part II documents have also been prepared in support of the Development Application. These are outlined in Appendix A.

PETRO-CANADA

Husky Oil

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1 INTRODUCTION

The White Rose field is located approximately 350 km east of the island of Newfoundland on the eastern edge of the Jeanne d'Arc Basin, and is approximately 50 km from both the Terra Nova and Hibernia fields (Figure 1.1-1). The Jeanne d'Arc sedimentary basin is recognized as the principal oil-producing basin off the eastern coast of North America. The basin is a significant business area for Husky Oil Operations Limited (Husky Oil) and a key to the company's continued growth.

Husky Oil's land holdings (Significant Discovery Areas and Licenses) in the Jeanne d'Arc Basin are indicated in Figure 1.1-2. Husky Oil is one of the leading operators and interest holders in the Canadian east coast offshore oil industry, holding an approximate 32 percent net working interest in the Significant Discovery License areas in the Jeanne d'Arc Basin. The current land holdings are a result of substantial investment and an extensive exploration program initiated in 1982, as well as a series of inter-company and land sale acquisitions over the past 18 years. White Rose is one of five Significant Discovery Areas operated by Husky Oil in the Newfoundland offshore.

Husky Oil, in a co-venture with Petro-Canada, proposes to develop an economically significant oil discovery in the White Rose Significant Discovery Area. Petro-Canada, is the operator of the Terra Nova oilfield and, like Husky Oil, holds substantial interests in the Newfoundland offshore.

The average interest of the co-venture parties in the White Rose oilfield development are:

- Husky Oil 72.5 percent
- Petro-Canada 27.5 percent

Over the entire White Rose Significant Discovery Area, Husky Oil has a 77.1 percent interest and Petro-Canada has a 22.9 percent interest.

1.1 Project Scope, Rationale and Regulatory Requirements

1.1.1 Project Scope

The White Rose oilfield development will involve recovering an estimated 36 million cubic metres (m^3) (230 million barrels) of recoverable oil from an area of approximately 40 km^2 in the Jeanne d'Arc Basin. A ship-shaped floating production, storage and offloading (FPSO) facility, similar to that selected for Terra Nova, is proposed to be used to develop the oilfield. This facility will be able to store between 111,000 and 135,000 m^3 (700,000 and 850,000 barrels) of oil (approximately eight to ten days of oil production) and will contain topside processing units, accommodations and a turret.

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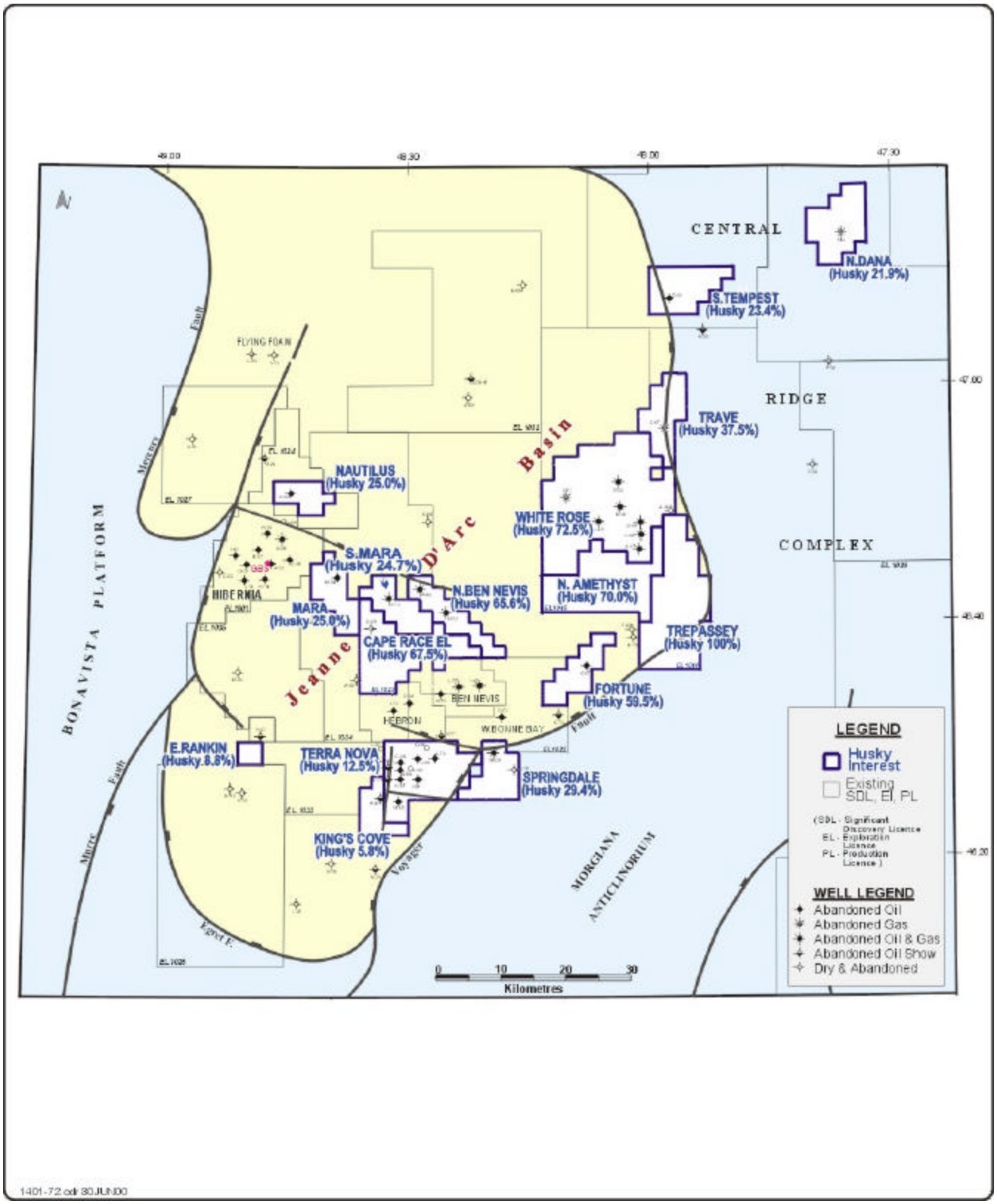
Figure 1.1-1 White Rose Location

Figure 1.1-2 Current Husky Oil Land Holdings and Working Interests in the Jeanne d'Arc Basin



There will be three to four drill centres on the seafloor, with production and water and gas injection wells located at each centre. These drill centres will be located in three to four excavated glory holes that lie below the seabed to protect the wells from iceberg scour. The drill centres will be connected to the FPSO facility with flexible flowlines and risers. The FPSO's turret will be designed to allow the facility to disconnect from the subsea drill centres and move in the event of an emergency

Developing the White Rose oilfield will require drilling up to 10 to 14 production wells in the South Avalon reservoir. The production from the combined wells is estimated between 12,000 to 18,000 m^3 (75,000 and 110,000 barrels) of oil daily. Up to an additional 8 to 11 water and gas injection wells will be drilled for resource conservation and to maintain reservoir pressure. The wells will be drilled in phases over a four to six-year period. Up to four to six production wells, one to three water injection wells and one gas injection well will be required for First Oil production.

Both seawater and produced gas will be used for maintaining reservoir pressure. Seawater will be treated and then injected into the reservoir. Produced gas will be reinjected for conservation and, if necessary, reservoir pressure maintenance. There is no intention to flare produced gas, except for specific and limited operational, maintenance and safety requirements. The South Avalon pool has an estimated production life of approximately 14 years.

1.1.2 Project Rationale

Both Husky Oil and Petro-Canada believe that this project will meet international market demands for oil and generate considerable economic benefits for the local and provincial economies of Newfoundland and Labrador, and the economy of Canada. The development will increase employment and training opportunities for people of the province and contribute to the growth in petroleum industry infrastructure and business opportunities through the increased demand for goods and services. This will ultimately attract new investment to the province, contributing to the sustained growth of the provincial and Canadian economies.

The White Rose oilfield has much smaller reserves compared to the predecessors, Hibernia and Terra Nova. However, offshore developments involve high levels of capital expenditures with significant cost risks. Therefore, Husky Oil must undertake detailed engineering and economic analyses of the White Rose oilfield development to determine economic viability prior to proceeding with development commitments. Securing regulatory approval for the development will further mitigate risks and ascertain development costs and thus facilitate a development commitment decision. From Husky Oil's perspective, the proposed development will satisfy its goal to acquire, find and develop substantial oil reserves. This will have a major impact on the company's overall growth and be in keeping with its mission statement: "to maximize returns to its shareholders in a socially responsible way."

1.1.3 Regulatory Requirements

In Newfoundland and Labrador, plans for developing offshore oil projects must be approved by the Canada-Newfoundland Offshore Petroleum Board (C-NOPB). Under the *Canada-Newfoundland Atlantic Accord Implementation Act* and *Canada–Newfoundland Atlantic Accord Implementation Newfoundland Act* (*Atlantic Accord Acts*), companies proposing such projects must prepare and submit a Development Application (DA) to the C-NOPB. In March 2000, Husky Oil and its co-venturer Petro-Canada initiated the DA process by submitting a project description to the C-NOPB for the White Rose oilfield development.

In addition to preparing a comprehensive DA for the C-NOPB, Husky Oil is also required to carry out an environmental assessment that fulfills the requirements of the federal environmental assessment process under the *Canadian Environmental Assessment Act* (CEAA). The C-NOPB, Department of Fisheries and Oceans (DFO), Environment Canada and Industry Canada have all declared that they are Responsible Authorities (RAs) under CEAA, and issued a scoping document (dated July 21, 2000) to guide Husky Oil in preparing its environmental impact statement (EIS) and supporting documents. Husky Oil submitted a Comprehensive Study to the lead RA, the C-NOPB, on October 10, 2000. The Comprehensive Study consisted of the EIS and SEIS, prepared according to both the Issue Scoping document and C-NOPB Guidelines. The Comprehensive Study, currently under review by the RAs, is intended to fulfil the requirements of the C-NOPB Guidelines document with respect to environmental matters.

Therefore, because the Comprehensive Study has already been submitted, the Development Application documentation for the White Rose oilfield development contains the following components:

- Canada-Newfoundland Benefits Plan (Volume 1);
- Development Plan (Volume 2); and
- Safety Plan and Concept Safety Analysis (Volume 5).

This summary of the DA highlights the key aspects of the White Rose project and provides an overview of the DA.

1.2 White Rose Field

The White Rose Significant Discovery Area consists of several oil and gas pools, including the South Avalon pool and the North Avalon pool. The South Avalon pool covers approximately 18 km², with an estimated 36 million m^3 (230 million barrels) of recoverable oil. The Avalon Formation sandstones were deposited during the early Cretaceous as shoreface sands along a north-south trending shoreline roughly paralleling the eastern margin of the Jeanne d'Arc Basin.

1.2.1 Exploration History

The first three wells drilled on the White Rose Significant Discovery Area, White Rose N-22, J-49 and L-61, were drilled between 1984 and 1986 (Figure 1.2-1). Results of these wells were encouraging, as oil and gas were encountered in all wells. Based on these results, the White Rose E-09 well was drilled in 1987-1988. This well was drilled into a separate structural culmination on the southern flank of the complex. It was the first well drilled in the South Avalon oil pool and encountered over 90 m of net oil pay, indicating the potential for commercial development.

In 1999 and 2000, three additional delineation wells were drilled into the South Avalon oil pool, White Rose L-08, A-17 and H-20 (Figure 1.2-1). These wells confirmed the extent and quality of the reservoir encountered by the E-09 well.

A fourth well, White Rose N-30, was also drilled in 1999. It was drilled into the North Avalon pool, downdip from the N-22 well. Results from this well provided additional information on the gas and oil contained in the North Avalon pool and also provided data on the northern limit of the South Avalon pool.

The four wells drilled into the South Avalon pool, together with detailed interpretation of three-dimensional seismic data, have established reserves of approximately 36 million m^3 (230 million barrels) of recoverable oil for the field.

1.2.2 White Rose Reserves and Development

The extensive coring, testing and analysis of related data from the delineation program has given Husky Oil confidence in a depletion plan for reserves in the South White Rose oil pool. The depletion schedule and reserves shown in Figure 1.2-2 and Table 1.2-1 (Reserves Summary) indicate the potential for the South Avalon oil pool.

Figure 1.2-1 Delineation Well Locations

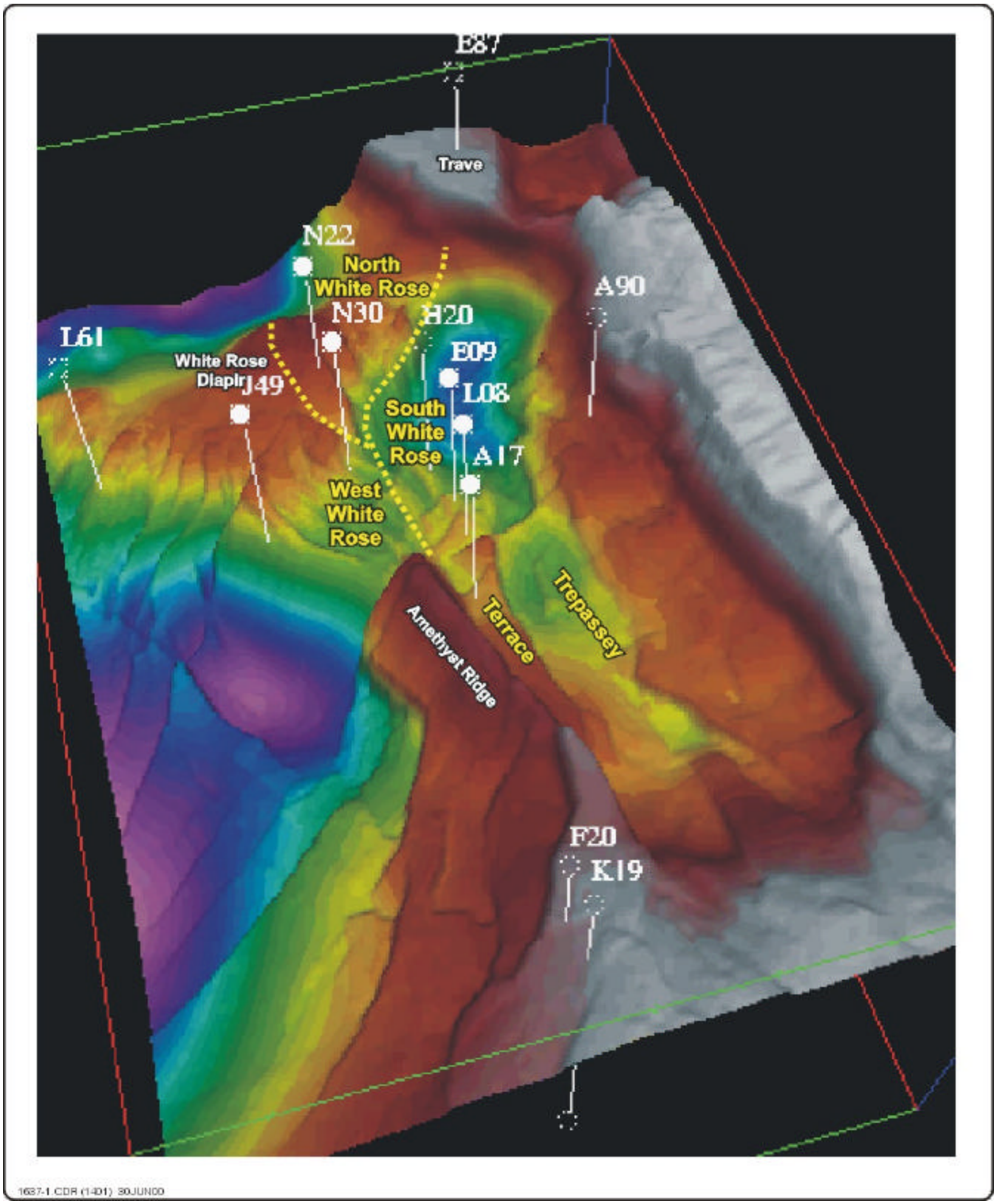


Figure 1.2-2 Depletion Schedule for the White Rose Field

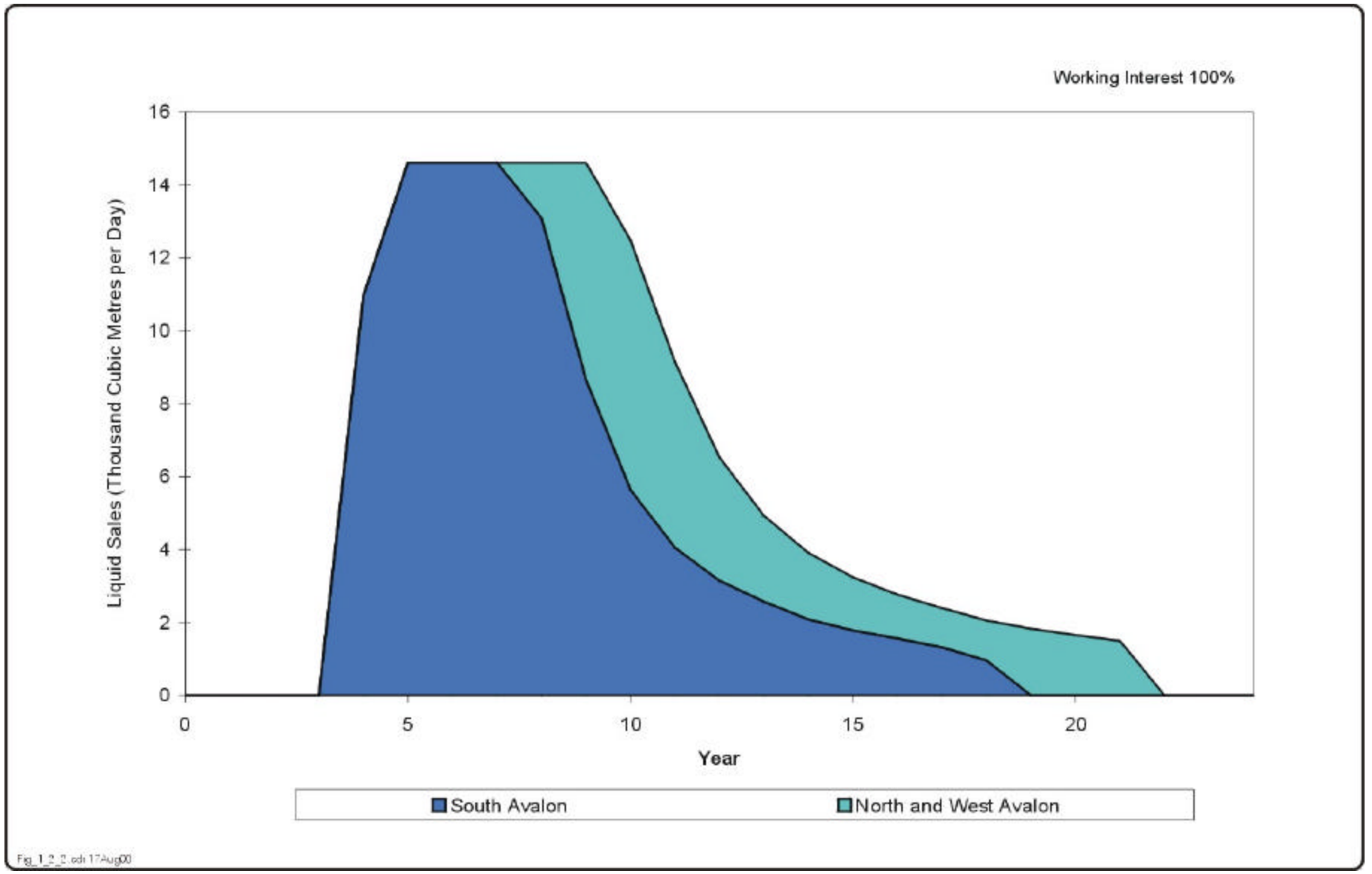


Table 1.2-1 Avalon Oil – Original Oil in Place (OOIP) and Reserve Ranges

Pool	P90 (million m^3)	P50 (million m^3)	P10 (million m^3)
South Avalon			
OOIP	114.4	120.0	138.2
Reserves	34.2	36.2	46.4
North Avalon			
OOIP	24.8	28.6	32.4
Reserves	5.4	6.7	8.3
West Avalon			
OOIP	32.1	37.0	42.1
Reserves	7.0	8.9	11.1

Note: P90 = 90 percent probability
P50 = 50 percent probability
P10 = 10 percent probability

In the north and west areas of the White Rose Significant Discovery Area there is potential for a number of ancillary oil pools, the North and West Avalon pools which contain smaller volumes of oil. Current estimates of potential recoverable oil reserves from these smaller pools is in the range of 12 to 20 million m^3 (75 to 119 million barrels) from the combined West Avalon and North Avalon pools. If further evaluation of these resources determines that economically recoverable reserves exist, it is the proponent's intention to ultimately tie these pools into the White Rose oilfield development infrastructure. A South Avalon depletion scenario for an additional 16 million m^3 (100 million barrels) of oil from these subordinated ancillary oil pools is illustrated in Figure 1.2-2. This scenario shows a typical oilfield development sequence where outlying pools are evaluated for their potential to extend the main pool production plateau at an optimal cost. Developing these ancillary pools depends on further evaluation after development drilling and the start of production for the South Avalon oil pool.

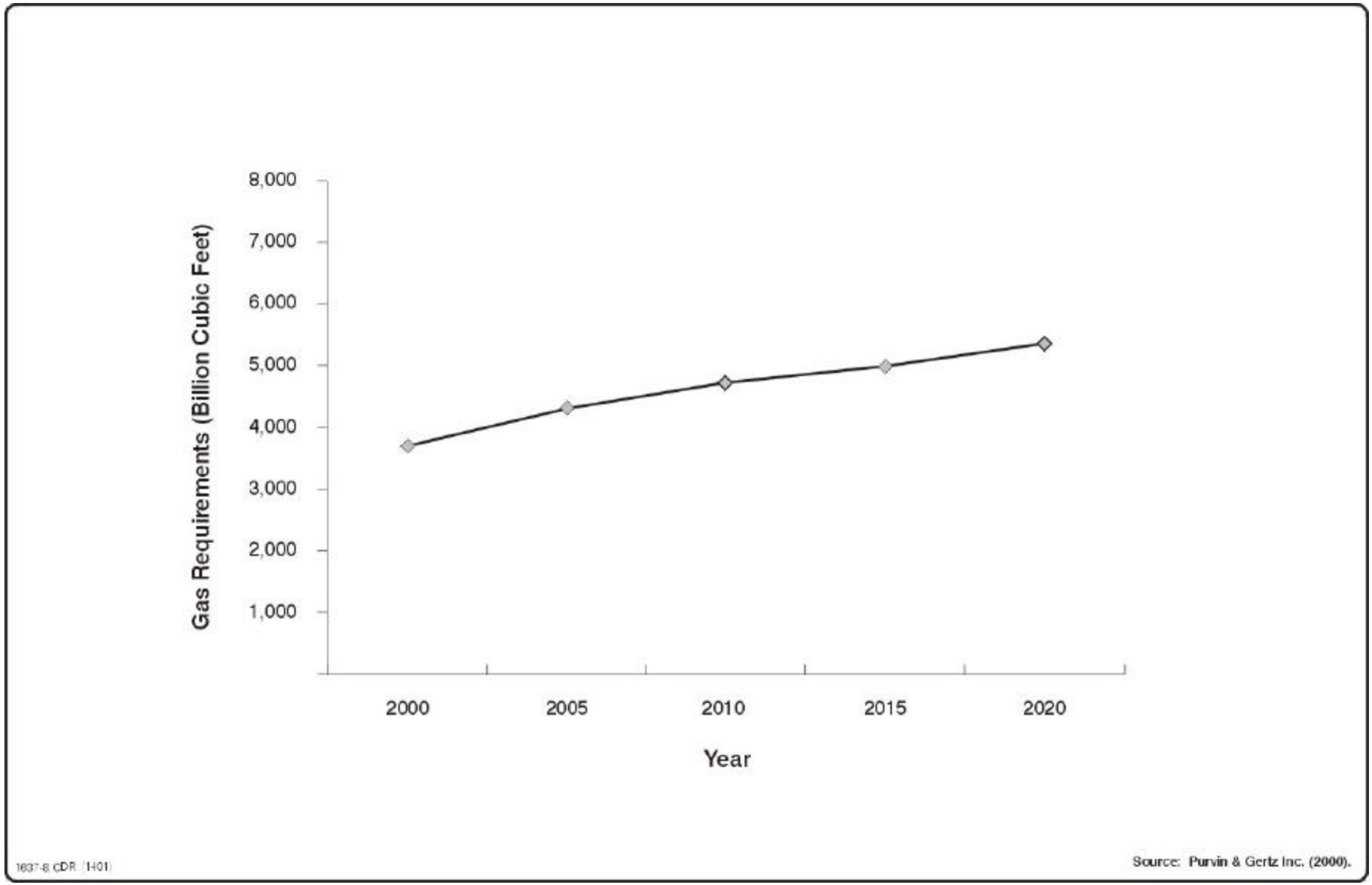
The North and West Avalon and South Mara pools, combined with associated gas from the South Avalon pool, have potential recoverable gas resources of 71 billion m^3 (2.5 trillion cubic feet (tcf)) of which less than half is currently proven. A gas development on the Grand Banks depends on the gas market, pricing, transportation infrastructure and threshold reserve conditions, which have yet to be achieved. These factors are discussed below.

1.2.3 Conditions Necessary for White Rose Gas Development

The future conditions necessary for White Rose gas development are assessed as follows:

- **Gas Market Supply and Demand** – There must be a high degree of confidence in firm contracts for gas export to the United States market. While recent studies indicate that the prospects for substantial demand for gas imports to the United States are excellent (Figure 1.2-3), firm contracts will require proven reserves, committed transportation and firm prices.

Figure 1.2-3 United States Import Requirements for Natural Gas



- **Gas Price Forecast** – There must be relatively high and stable gas prices as Grand Banks gas will be a relatively high cost resource to develop due to its remote location and lack of established infrastructure. Current price forecasts (Figure 1.2-4) are for Henry Hub prices in the US$2.50 to US$3.00 range in the medium to long term.

- **Regional Supply Outlook** – The discovered gas resources offshore Newfoundland, based on a report published by the C-NOPB in May 2000 and Husky Oil's assessment of P50 gas potential at White Rose are listed in Table 1.2-2.

Table 1.2-2 Discovered Natural Gas Resources – Offshore Newfoundland

Field	Billion m^3	Billion ft^3
Hibernia	38.7	1,375
White Rose	70.6	2,500
Terra Nova	7.6	269
Ben Nevis	8.9	315
North Ben Nevis	3.3	116
Springdale	6.7	238
South Mara	4.1	144
North Dana	13.3	472
Trave	0.8	30
Total	**154.0**	**5,459**

While this indicates that there is a significant gas resource offshore Newfoundland, it should be noted that an estimated 76 percent of this resource occurs as solution gas in an oil pool, or as a "gas cap" over an oil pool (NOIA 2000). As such, the development and availability of these resources will depend on oil development and in most cases, will occur after oil resources have been depleted. For instance, the gas produced at Hibernia and Terra Nova will be required for reinjection into the oil reservoir to maintain reservoir pressure.

In addition to currently discovered resources in the Jeannne d'Arc Basin, there is potential to discover more gas resources, both in the Jeanne d'Arc Basin and in basins to the south, such as the Laurentian Basin (Figure 1.2-5). While this is encouraging, the regional supply is currently based for the most part on undiscovered resources, or resources that cannot be accessed until some time in the future. To proceed with future gas development, industry must have a series of clearly delineated gas fields and associated gas that will support the ultimate sales contracts in the market place.

- **Transportation Costs** – Firm plans must be put in place for gas infrastructure such as a major pipeline connecting the Grand Bank gas fields to the North American pipeline grid. (Figure 1.2-6). Equally important is proving up the gas reserves necessary to underwrite the infrastructure investment.

Figure 1.2-4 Selected Natural Gas Prices

(Forecast in constant 2000 US dollars using 2% inflation)

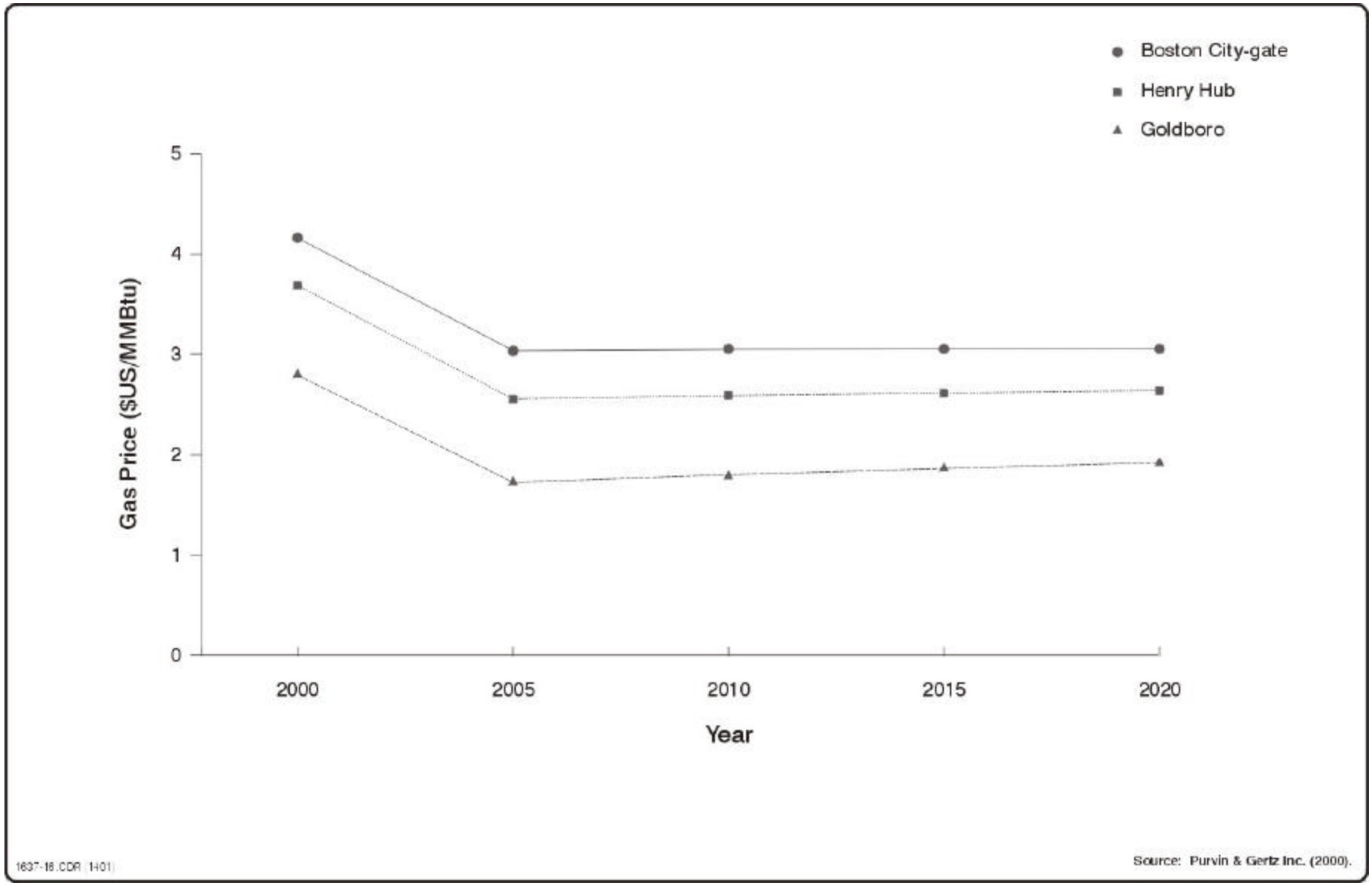


Figure 1.2-5 Reserves Potential of Canada's East Coast Sedimentary Basins

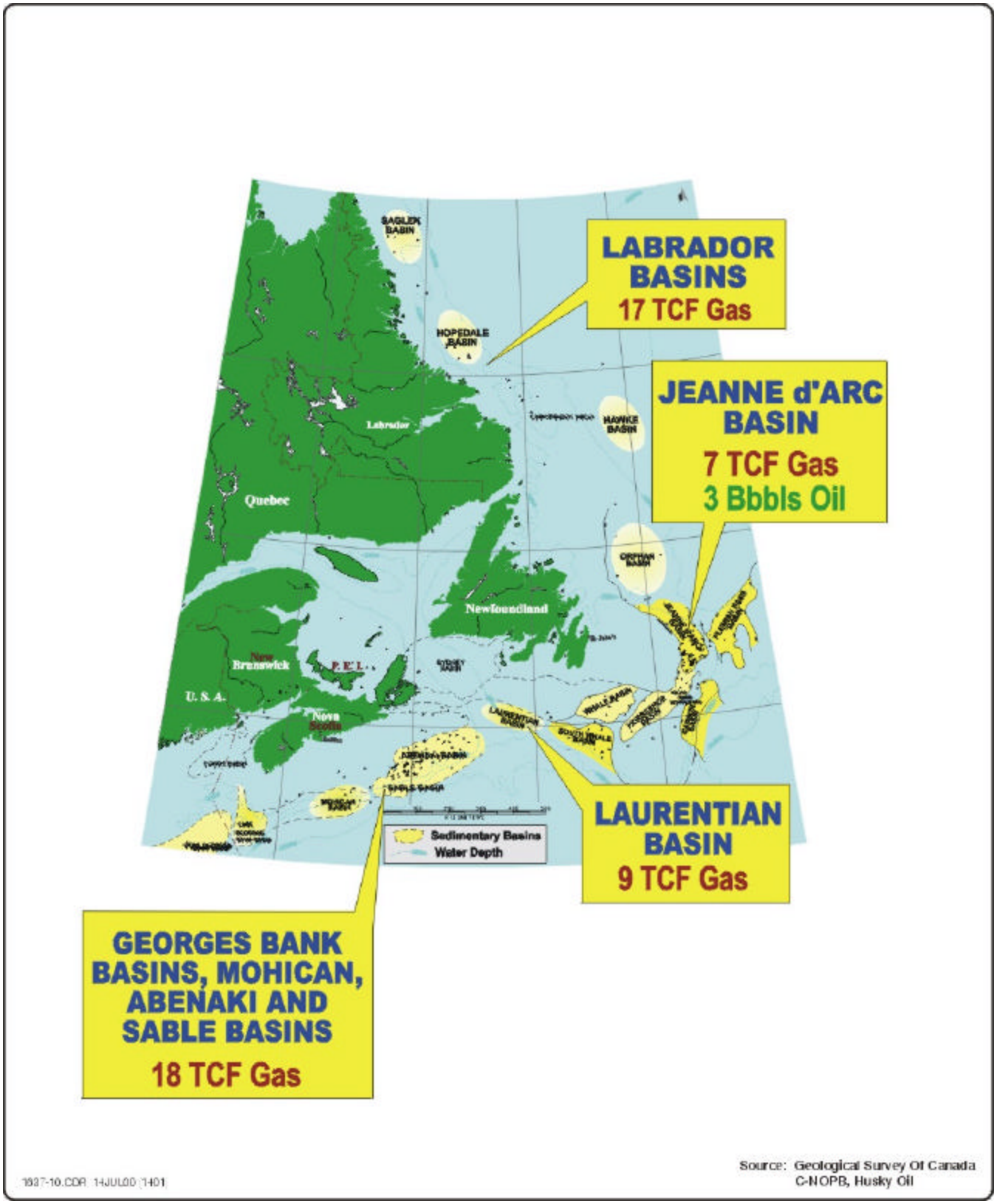


Figure 1.2-6 Gas Infrastructure Investment Required

P/L = Pipeline

Initial cost estimates for a pipeline route offshore and onshore Newfoundland to the Goldboro gas plant in Nova Scotia suggest that a representative cost of service for the pipeline would be approximately US$1.50 per MMBtu, assuming 900 million ft^3 per day throughput. Given that the price forecast prepared by Purvin & Gertz (2000) suggests a netback at the Goldboro plant of approximately US$1.72 per MMBtu (Figure 1.2-4), a US$0.22 MMBtu platform netback to producers for recovery of field development costs is indicated. As the required netback is likely much higher, additional reserves and greater pipeline throughput volumes are likely required in order to reduce unit throughput costs for Grand Banks gas to be viable. In any event, sufficient reserves have not yet been proven to support the 900 million ft^3 per day pipeline.

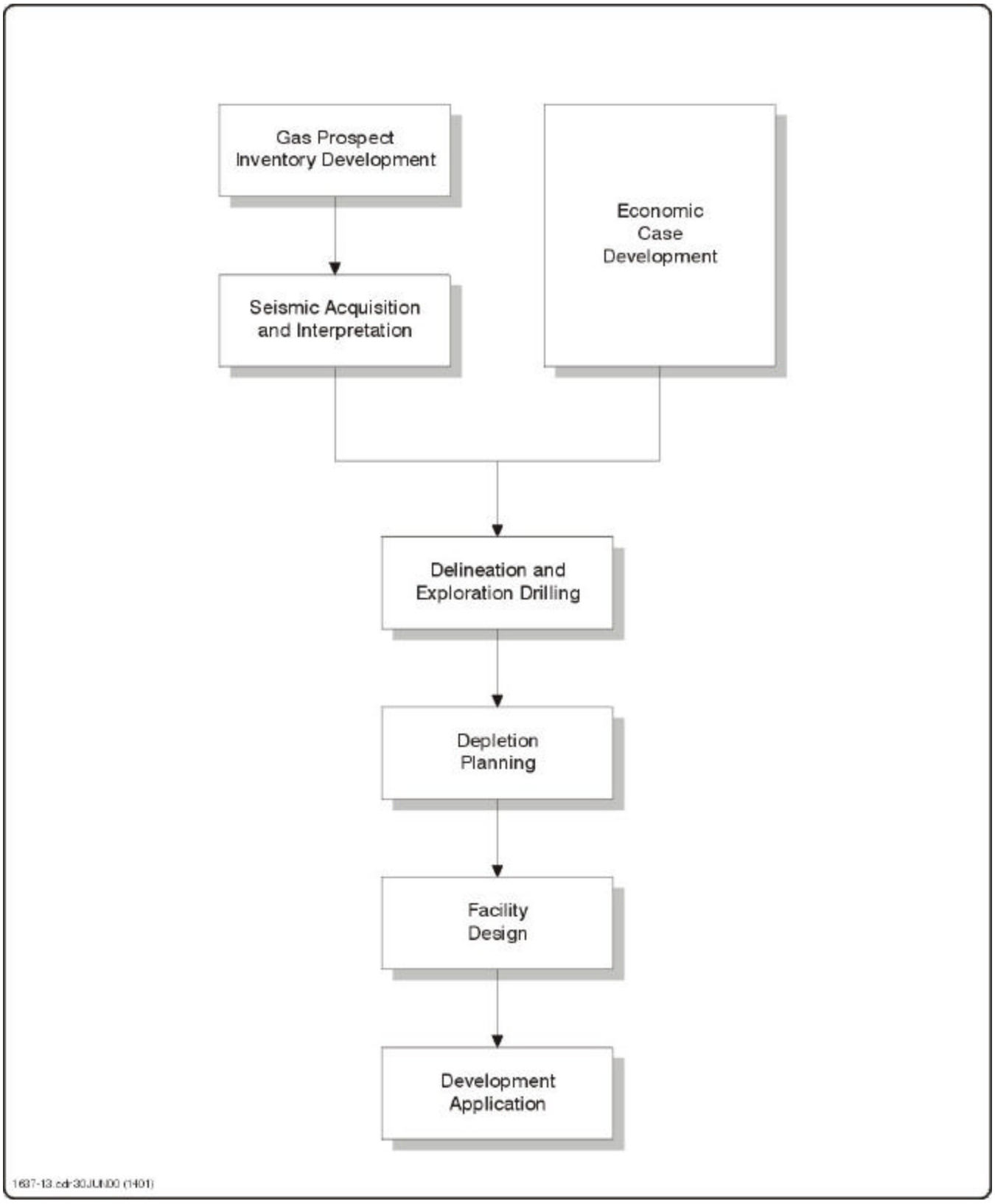
Due to the existence of grounding icebergs on the Grand Banks, additional engineering for pipeline design and maintenance must be developed and proven to secure investment in the gas transportation system. This also requires the cooperation of all the operators with gas resources.

For this to occur, companies must develop a convincing economic and technical model to support the high risk and expense of seismic and drilling programs. The work sequence required to develop such a model and progressively move towards gas development is shown in Figure 1.2-7. This illustration is a typical resource development model followed globally by the petroleum industry and is representative of the sequence that has led to the existing oilfield developments in the Newfoundland offshore.

Husky Oil is not seeking development approval for natural gas, but as required in the C-NOPB guidelines (C-NOPB 1988), the DA discusses the approach taken by Husky Oil to this resource. This discussion addresses potential reserves, factors leading to future development, and timing and steps planned to obtain additional information about the gas pool. If commercial viability of White Rose gas is determined in the future, Husky Oil will seek approval to develop this resource at the appropriate time. Technical evaluation indicates that developing and transporting the South Avalon and future ancillary oil pools will not negatively affect nor be dependent on future development of gas. Husky Oil believes that developing this resource will facilitate exploration for and development of the gas resources.

Husky Oil envisions the White Rose project building on the foundation of past oil projects with respect to Canada and Newfoundland benefits and associated economic growth in the region. The company has broken new ground by locating project engineering work in the province. This move will enhance the sourcing of work in Newfoundland and Labrador, as well as further establish a strong engineering technical base for future developments in which Husky Oil and other operators are involved. In particular, Husky Oil sees the province hosting the development of advanced subsea expertise and technology, clearly a key to participation in the high-end sector of the petroleum industry's future worldwide.

Figure 1.2-7 Model for Gas Development



1.3 Production Facility Selection

In November 1999, Husky Oil initiated a concept selection study to identify the potential alternative means of developing the White Rose oilfield. The concept selection study was undertaken by Kvaerner SNC Lavalin Offshore (KSLO) in St. John's. Eight options were initially assessed, with five carried through for further screening.

The eight alternatives evaluated were:

- steel FPSO facility;
- concrete FPSO facility;
- steel floating, production, drilling, storage, offloading (FPDSO) facility;
- concrete gravity-base structure (GBS);
- steel semi-submersible facility with and without integral storage;
- concrete semi-submersible facility;
- disconnectable concrete tension leg platform (TLP); and
- concrete barrier wall with floating production unit (FPU).

The evaluation criteria included:

- technical requirements;
- capital costs;
- construction time;
- concept maturity;
- concept deliverability; and
- risk considerations.

A two-stage process was used to evaluate the concepts. The first stage involved qualitative screening whereby options that were either insufficiently developed or clearly failed to satisfy primary technical criteria were identified. As a result of this first stage, the disconnectable concrete TLP, concrete barrier wall with FPU, and steel FPDSO facility were not carried forward as they either did not meet Husky Oil's technical requirements or were prototype development concepts with no operating history in harsh-environment offshore locations.

The second stage of the screening process used a number of economic indicators, such as net present value, rate of return and present value profitability index, to assess the five remaining options carried forward for detailed evaluation.

These remaining five options (steel FPSO facility, concrete FPSO facility, steel semi-submersible facility with and without integral storage, concrete semi-submersible facility and concrete GBS) were further analyzed with respect to construction time, capital costs, concept maturity, concept deliverability, and risk considerations. The ranking of the five options on the basis of construction costs and time is shown in Figure 1.3-1, while the ranking of the five options based on the technical risk associated with each option is shown in Figure 1.3-2. The steel FPSO option is shown to be the most cost-effective option and to have the least technical risk. The only two development concepts that were shown to be technically and economically feasible were the steel semi-submersible with or without integral storage and steel FPSO options. These two options were further evaluated as part of each component of the DA.

A summary of the five volumes is provided in Chapters 3 to 7 of this document.

1.3.1 Preferred System

The concept selection study concluded that the preferred option for developing the White Rose oilfield was a steel FPSO facility using subsea wells located in glory holes, similar to that selected for the Terra Nova Development. This system was evaluated as top preference on project cost and time to First Oil (Figure 1.3-1). As an example, a typical North Sea Steel FPSO facility is shown in Figure 1.3-3.

Key factors contributing to the selection of the steel FPSO facility as the preferred option are:

- It is the most economically feasible way to develop the White Rose field, taking into account feasibility, flexibility, deliverability, costs, risk and safety, and Canada-Newfoundland benefits.
- It has the most commercial and technical flexibility. Therefore, it is well suited to a complex field with technical challenges, such as White Rose, which is considerably smaller than Terra Nova and Hibernia.
- It has the flexibility to deal with different production and storage levels effectively.
- It has a proven track record in harsh environments, with some 60 FPSO facilities currently in operation or under construction around the world.
- It can produce both oil and gas in sequential development.
- It has the flexibility necessary to tie-in future fields.
- It can be producing at capacity earlier than other production facilities.
- It poses less of a challenge at decommissioning than other production facilities.

Figure 1.3-1 Construction Costs and Time for the Five Production Options

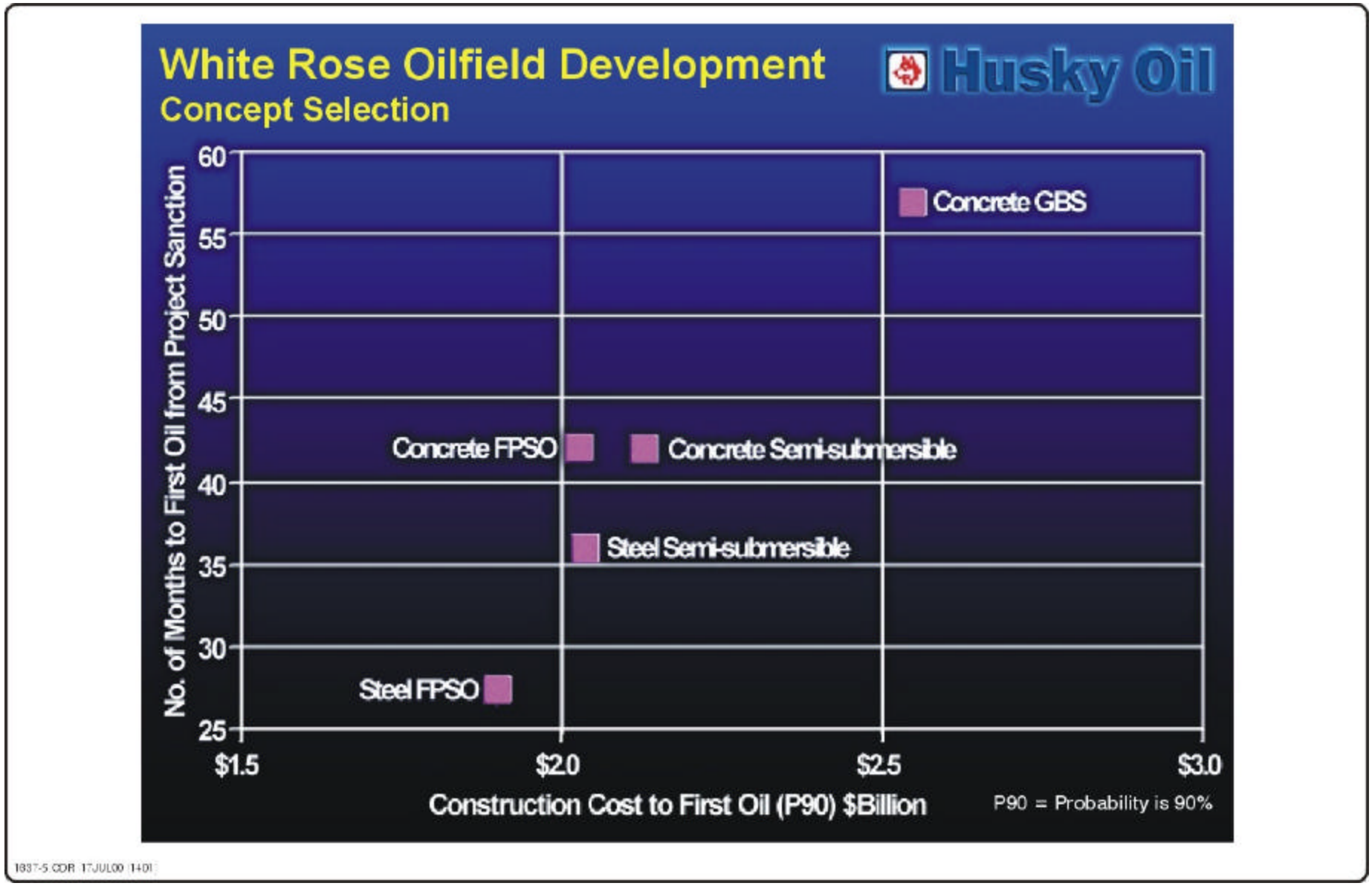


Figure 1.3-2 Relative Technical Risk for the Five Production Options

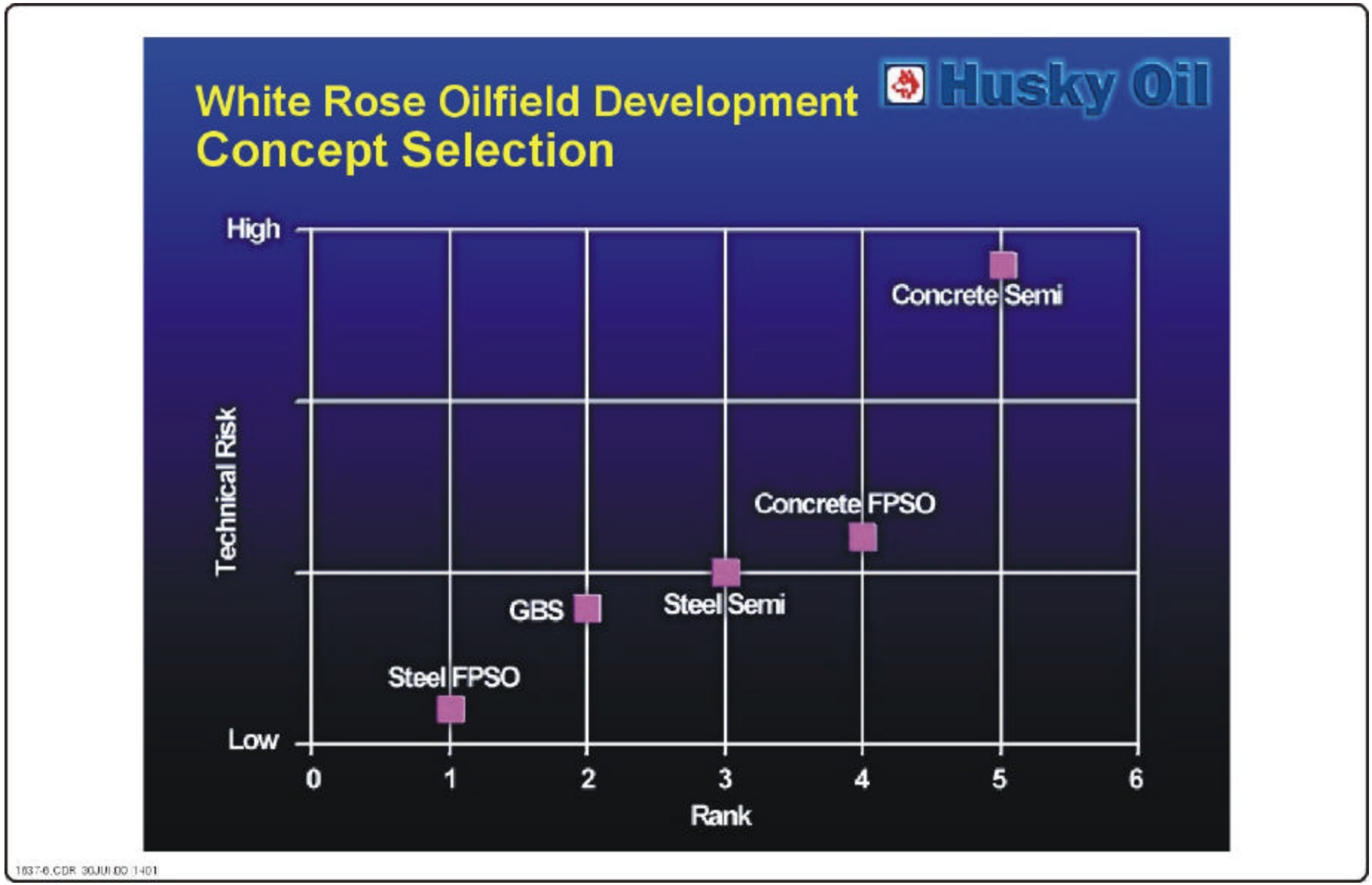


Figure 1.3-3 Typical North Sea Steel FPSO Facility

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In addition, the steel FPSO will:

- provide opportunity for continuous employment and a growing industrial base for the province;
- provide an opportunity, on a competitive basis, for Atlantic Canada and specifically Newfoundland facilities and workers to continue working in the province;
- increase opportunities for facilities in the province providing expertise in engineering, subsea and topside fabrication, drilling and supply services on a competitive global basis;
- establish and consolidate a proven and leading exportable technology in the province for future developments off Canada's east coast and abroad; and
- enable expertise and industry within the province to keep pace with the current needs and trends in offshore oil and gas development around the world.

1.3.2 Alternative Systems

The physical characteristics of the four alternative systems evaluated are briefly described in the following subsections. Only the steel semi-submersible with a detached floating storage unit is considered technically and economically feasible.

1.3.2.1 Concrete Floating, Production, Storage and Offloading Facility

This concept consists of a concrete barge outfitted for production, storage and offloading in a similar fashion to a steel FPSO. Due to displacement considerations, its plan area is necessarily larger than the equivalent steel FPSO. It has the ability to disconnect, if required, due to extreme conditions or icebergs.

The concrete FPSO option was considered inferior to the steel FPSO option on the basis of feasibility. There are no existing units in the world and the construction scale is so large it would create expensive demands on construction facilities.

A concrete FPSO is marginally more flexible than a steel FPSO because the vessel size has to be large to support its own self-weight, and this size provides additional deck space.

With respect to deliverability, the concrete FPSO was considered inferior to the steel FPSO option because of the likelihood of limited construction facility competition for the concrete hull and the lack of industry experience on the required scale.

This system was evaluated as second preference on project cost and third for time to First Oil (Figure 1.3-1).

1.3.2.2 Steel Semi-Submersible Facility With and Without Integral Storage

The semi-submersible concept consists of a floating hull form with four columns connected by sub-surface pontoons. Production facilities are mounted on the facility deck. The subsea facilities are similar to those for a FPSO facility. The semi-submersible is anchored to the seabed by fixed catenary chain and wire moorings and does not 'weather vane'. The flexible risers are fixed to a porch(s) on the semi-submersible facility's hull. In the event of iceberg threat, the porch(s) could be disconnected, the risers lowered and the unit moved aside using thrusters mounted on the pontoons.

Many of the key technical issues for a steel semi-submersible mirror those for a concrete semi-submersible. This option was assessed as being similar to the concrete semi-submersible in respect of flexibility, but having a higher ranking in respect of feasibility and deliverability. This higher ranking was largely due to considerable operational experience, with almost 40 production units in operation worldwide.

This system was evaluated as third preference on project cost and second on time to First Oil (Figure 1.3-1). A principal reason for selecting the steel FPSO facility over the steel semi-submersible was the forecast life-cycle cost. The steel semi-submersible cost was estimated to be $190 million more than the steel FPSO facility at the production level anticipated. Another disadvantage is the lack of existing engineering for an emergency disconnect system.

1.3.2.3 Concrete Semi-Submersible Facility With and Without Integral Storage

This concept is similar to the steel semi-submersible concept, except the construction material is concrete.

The only concrete semi-submersible in existence is the Troll B structure, installed in 1995 in the Norwegian North Sea. The semi-submersible is a production facility without drilling or storage capabilities. It has a design capacity to produce 27,000 m^3 (170,000 barrels) of oil per day. This structure is very large compared with equivalent steel production units, having a plan area approximately 40 percent greater, a wave area more than 200 percent greater and a displacement more than 300 percent greater. A concrete semi-submersible unit for White Rose would be smaller than the Troll B, but would still be significantly larger than a steel semi-submersible, leading to significantly higher mooring costs.

One disadvantage of the concrete semi-submersible concept is the lack of an emergency disconnect system. Although feasible, this would take a reasonable amount of design development. Another significant deficiency is the need for an independent means of propulsion in the event an emergency disconnect is required.

This system was evaluated as fourth preference on project cost and third on time to First Oil (Figure 1.3-1).

1.3.2.4 Concrete Gravity Base Structure

The GBS concept evaluated is conceptually similar to that used on the Hibernia field. However, it has an innovative design with the potential for much lower costs. The structure rests on the seabed and is designed to resist the forces imposed by iceberg and other environmental loads. The topside facilities include drilling equipment, as well as the process plant, with all wells drilled and maintained from the platform. Oil is stored within the base structure and offloaded via a subsea pipeline to a loading buoy located a short distance from the GBS.

It is ranked second with the steel FPSO option based on feasibility. However, the proposed design requires significant issues to be resolved before there is sufficient confidence in material quantities. These relate to risk assumptions with respect to the foundation design, where the soil strength is unknown, and local ice pressure loads.

A significant challenge for the concrete GBS is considered to be deliverability, where the concept is ranked lowest of the top five options.

This system was evaluated as last preference on project cost and last on time to First Oil (Figure 1.3-1). It also showed a negative return on investment.

The concrete GBS was ultimately eliminated as an option on the following grounds:

- It is not economically viable for a field the size of White Rose as there are insufficient petroleum reserves established or likely to be established in the field to recover the cost of the GBS.
- Its forecast construction cost is $507 million more than the steel FPSO option.
- It has a forecast negative return on investment.
- Of all options considered, it ranks the most unfavourably with the steel FPSO option based on cost and deliverability.
- Its construction is complex.
- It requires a long lead time.
- It presents substantial problems for decommissioning and abandonment, which would likely become much greater liabilities over time. It is not practical for relocation for further service at another site.

While the final decision on a production facility for gas will require a full review when the gas development conditions have been met, Husky Oil believes that the steel FPSO design developed for the White Rose oilfield will be capable of producing gas resources at White Rose should they be proven to be economically viable.

A strategic assessment for the White Rose Significant Discovery Area has provided the following conclusions:

- Of the eight options assessed, the steel FPSO option represents the most technically and commercially viable option for developing the White Rose oilfield.
- Using a steel FPSO facility to develop the White Rose field allows for the optimal subsequent development of possible additional oil and gas resources.

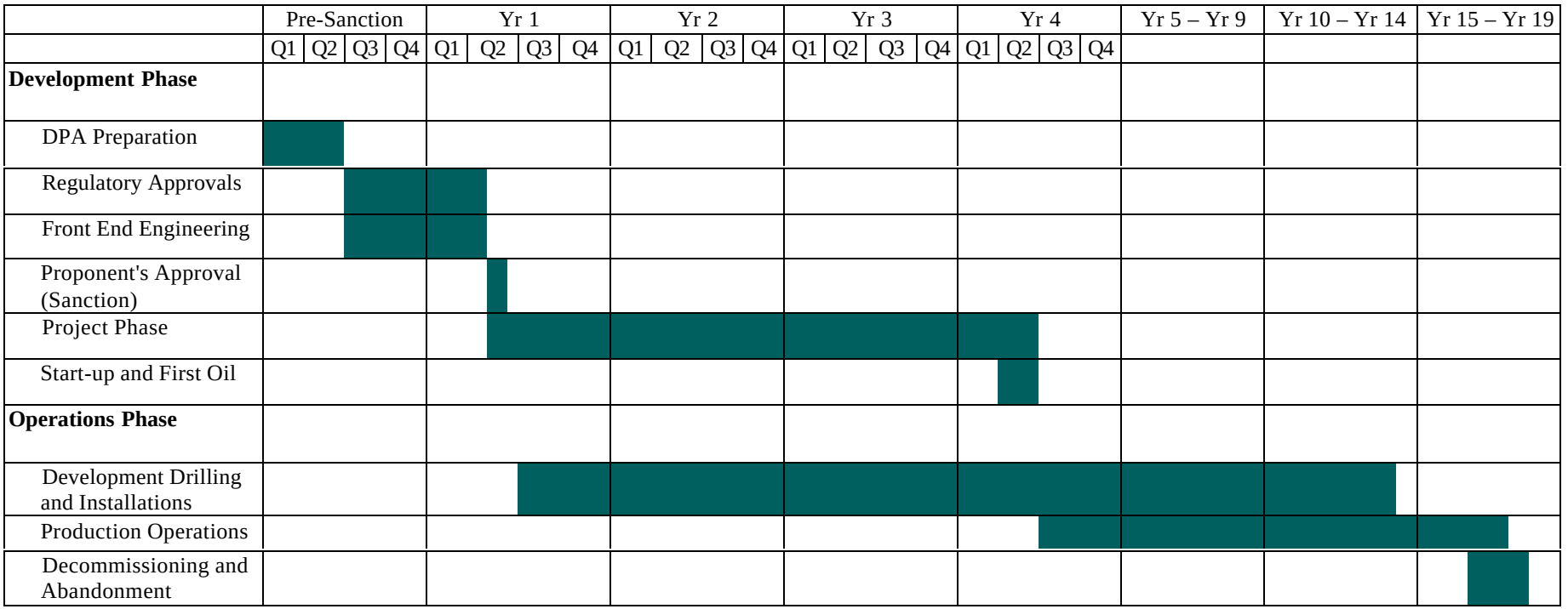
Assuming full field development of resources, the steel FPSO shows improved and superior returns compared to all other cases. This case maximizes the resource recovery in the earliest timeframe and also maximizes investor returns and government income.

In summary, Husky Oil has concluded that pre-investment in gravity-based production facilities for White Rose is not only uneconomic given the risks of meeting gas development conditions, it is also sub-optimal in terms of maximizing the benefits of all potential resources at White Rose in the event these conditions are met.

1.4 Schedule

A project development schedule is provided in Figure 1.4-1.

Figure 1.4-1 Project Development Schedule



2 ISSUE SCOPING AND STAKEHOLDER CONSULTATION

Husky Oil conducted an extensive issues scoping and stakeholder information/consultation program in preparing the DA and Comprehensive Study for the White Rose oilfield development. This program met the requirements of CEAA, the C-NOPB guidelines (1988) and the *Atlantic Accord Acts.* It allowed Husky Oil to identify the Valued Environmental Components (VECs) that form the focus of the assessments conducted for the White Rose oilfield development.

The scoping/consultation program involved:

- reviewing relevant legislation and guidelines;
- reviewing the scoping document issued by the C-NOPB, DFO, Environment Canada and Industry Canada;
- reviewing documents prepared for the Terra Nova and Hibernia oilfield developments;
- reviewing issues raised during the Terra Nova Development environmental assessment review process;
- consulting community, business, women's and non-governmental organizations, and the general public (key informant workshops, open houses and meetings/presentations);
- holding meetings with government departments and agencies;
- conducting media briefings and preparing press releases;
- tracking articles/stories from media sources;
- distributing project information (two mail distributions);
- establishing a project information telephone number (724-7244 and 1-877-724-7244);
- setting up a project-specific web site (www.huskywhiterose.com);
- documenting issues and concerns, and following up when necessary; and
- using professional judgement based on the particular characteristics of the White Rose oilfield development.

A detailed report of the issues scoping and stakeholder consultation program is provided in the White Rose Oilfield Development Public Consultation Report (JWEL 2000). This report contains a detailed description of the scoping/consultation program and a comprehensive list of all observations, questions, comments, issues and concerns identified throughout the scoping/consultation program. Following is an overview of the program components and a synopsis of comments and issues received.

2.1 Regulatory Requirements

The starting point for the issues scoping process was a review of the C-NOPB guidelines (1988), and the CEAA and its associated Responsible Authority's Guide (1994). The C-NOPB guidelines provide the direction necessary for addressing the regulatory requirements of the *Atlantic Accord Acts.* The C-NOPB guidelines and CEAA set out the regulatory requirements for a DA and a federal environmental assessment, respectively. They established the initial scope for the DA and related assessment.

2.2 C-NOPB Scoping Document

The scoping document issued by the regulatory agencies on July 21, 2000 is a principal regulatory tool pursuant to CEAA providing specific direction for the content of the environmental and socio-economic assessment. It stated that Husky Oil must consider the factors outlined in Section 16 of the CEAA and matters listed in the appropriate sections of C-NOPB guidelines (1988), as well as issues and concerns identified during its regulatory, stakeholder and public consultation. The scoping document guided the preparation of the Comprehensive Study pursuant to CEAA, submitted in October 2000. The scoping document also provided additional information for the regulatory consultation. Considerations noted in the scoping document included:

- cumulative environmental effects, including fishing activities, marine bird hunting, marine transportation, Hibernia and Terra Nova projects, and approved or reasonably foreseeable petroleum exploration activity;
- environmental assessment methodology and testable hypotheses;
- air emissions, including greenhouse gas emissions, and any implications for worker health and safety;
- description of the seabed area predicted to be affected by dredging, trenching and dredge spoil disposal, drill cuttings and other discharges;
- marine and/or migratory birds using the Grand Banks and their habitat;
- marine fish, shellfish, reptiles and marine mammals and their respective benthic and water-column fish habitat;
- presence of structures and/or operations associated with the project, including project-related vessel traffic;
- traditional, existing and potential commercial, recreational and aboriginal/subsistence fisheries, including foreign fisheries;
- discharges and emissions, including electromagnetic emissions from radio equipment and planned project discharges to the marine environment, and waste management;
- accidental events, including blowouts, oil and chemical spills, chronic oil pollution and spill response;
- physical environment, including meteorological, oceanographic and seabed characteristics, sea ice and icebergs, monitoring, observation and forecasting programs, and ice management;

- environmental management, including policies for pollution prevention, environmental effects and compliance monitoring, management system auditing, training, chemical selection and management, fisheries liaison, compensation strategies for damage to fisheries and other affected parties, fish habitat compensation and emergency response;
- environmental effects monitoring (EEM), including program characteristics, parameters and hypotheses, baseline information, integration with other programs, independent/peer review of results, linking results to the environmental management system (EMS), and habitat compensation and post-dredging monitoring; and
- abandonment/decommissioning plans and monitoring.

2.3 Literature and Information from Previous Offshore Oil Developments

Various materials from other oil developments in the Newfoundland offshore, in particular the Terra Nova Development, were reviewed for direction in completing the DA and for any information of relevance to the White Rose oilfield development.

Husky Oil, as part of its scoping activities, reviewed the submission and presentation made by the Natural History Society of Newfoundland and Labrador to the Terra Nova Development Environmental Assessment Panel. The submission was a reporting of concerns emerging from a review of the EIS for the Terra Nova Development. Key areas of concern included drilling fluids, produced water, oil spills, benthic communities, marine birds, sea ice and ice management, emergency response and cumulative effects.

2.4 Public Consultation

Public consultation is a key component of the White Rose oilfield development. Ongoing consultation with the public, regulatory agencies, media and other stakeholders will continue over the life of the project. To date, the public information and consultation program involved the following events and activities:

- six key informant workshops (one each in Clarenville and Marystown, and four in St. John's);
- eight open houses (two each in Clarenville, Marystown, Arnold's Cove and St. John's); and
- meetings with community, women's, non-governmental organizations and business groups (Clarenville, Marystown, Arnold's Cove, St. John's, Placentia, Gander and Corner Brook).

The following tools were used to provide information and to obtain input:

- project description as submitted to the C-NOPB (on March 21, 2000) to initiate the DA and environmental assessment processes;

- project summary booklet, which provided an overview of the proposed project, including information on the exploration history, development plan, production system, subsea installations, project schedule, environmental management, Canada-Newfoundland benefits, and environmental assessment and DA process;
- project update booklet that highlighted what was heard throughout the scoping/consultation program as of May 2000 and what Husky Oil was doing to address the various items raised;
- display boards for the open houses (based on information from the project description, and summary and update booklets);
- comment forms (distributed at the open houses and with the project description mail out);
- project information telephone number (724-7244 and 1-877-724-7244) at Husky Oil's office in St. John's;
- project-specific web site (www.huskywhitrose.com); and
- media briefings and press releases.

2.4.1 Key Informant Workshops

The purpose of the key informant workshops held in March 2000 was to discuss the proposed project, environmental review process and potential effects, and to ensure community issues and concerns were identified and addressed in the DA. The workshops in Clarenville and Marystown were designed for a general discussion, while the four workshops in St. John's had specific themes, namely fisheries, environment, community and benefits. Attendance at these workshops was by invitation to key stakeholders to ensure a range of local interests were represented and that the group size was conducive to an open discussion. A total of 76 people participated in the six workshops representing a range of community sectors and interests, including local business, transportation, housing, health, education, social services, recreation, public safety, fishing industry, environment industry, development associations, and municipal and provincial government.

The workshops involved Husky Oil representatives providing an overview of the project followed by an informal, facilitated discussion of issues and concerns. Discussions at the community and benefits workshops focused primarily on benefits related subjects, including employment and business opportunities, opportunities for women, skill requirements and training. Also, discussed were accommodations and facilities for workers and their families, employee support systems, and oil spill potential and response capabilities. At the fisheries workshop, items discussed were fisheries (historical, current and future), cumulative effects, vessel traffic, exclusion zones, amount and type of activity at the site before and during development and production, waste management, oil spills and chronic pollution issues. During the environment workshop, discussion focused on seabirds, marine mammals, fish, environmental assessment and DA process, responsibility for vessels, waste management, accidental events, chronic pollution, oil spills, cumulative effects, baseline studies and monitoring programs.

Four themes emerging from all workshops were: the need for providing timely, accurate and appropriate project information; the need for ongoing communication over the course of the project; learning from the Hibernia and Terra Nova oilfield developments; and not generating false expectations with respect to the benefits that will result from the White Rose oilfield development.

Two follow-up workshops were held in November 2000 with environment and fisheries-related organizations. The purpose of these workshops was to provide an overview of the Comprehensive Study that was submitted to the C-NOPB in October 2000, and allow opportunity for further comment about the proposed development. The workshop with environmental organizations focused on the EIS (Comprehensive Study Part One (Volume 3)), while the fisheries workshop focused on the commercial fisheries component of the Socio-Economic Impact Statement (Comprehensive Study Part Two (Volume 4)). As with the previous workshops, to facilitate discussion attendance was by invitation to individuals who had expressed interest and provided feedback on environment and fisheries issues related to the project. All invited participants were informed, prior to the workshop, that the Comprehensive Study Report was available on the White Rose web site and that the full study was available on request.

Fifteen people participated in the two workshops, including a representative of the C-NOPB who attended both workshops. At the environment workshop, discussion addressed shipping the oil, sea birds (studies, concentrations, mortality and observers), fisheries data sources, oil spills, by-catch of fish and sea birds, cumulative effects assessment, effects of the physical environment on the FPSO facility, waste disposal, contingency planning and monitoring. At the fisheries workshop, discussion addressed the fisheries data sources used, traditional catches (pre-moratorium), effects of seismic activity on fish, compensation, no fishing zone and effects of oil spills.

2.4.2 Open Houses

There were two series of open houses, with an open house being held in Clarenville, Marystown, Arnold's Cove and St. John’s during each series. The open houses provided an opportunity for visitors to speak directly with Husky Oil representatives and to voice their interests or concerns. Attendance was open to all members of the public with 341 people attending the first series of open houses in March 2000, and 88 attending the second series in May/June 2000. The open houses were held from 3 pm to 9 pm, allowing people to attend at their convenience. Husky Oil representatives were responsible for presenting all information about the proposed development and answering any questions.

Advertisements for the open houses were placed in regional newspapers (weekly publications) and in *The Telegram* (daily publication), as well as broadcast on local radio stations. Posters were mailed to the town clerks in nearby communities for posting at the respective town halls and other prominent locations within the communities. These advertisements and posters described the purpose of the open houses and listed the location, date and time of the events.

The first series of open houses featured a set of displays about the proposed White Rose oilfield development, including information on oilfield location, general field information, Husky Oil land holdings and working interests on the Grand Banks, White Rose exploration history, development plan, selected production system, subsea installations, environmental management, Canada-Newfoundland benefits, DA and environmental assessment. Displays at the second series of open houses focused on providing an update of the work undertaken for the DA. This second set of displays highlighted what was heard throughout the scoping/consultation program and Husky Oil's plans for addressing these items.

Comment forms were distributed at both series of open houses, with 97 forms being completed during the first series of open houses and 38 completed at the second series. During the first series of open houses, 77 percent of respondents indicated that they were satisfied or very satisfied with the proposed White Rose oilfield development. At the time of the second series, 91 percent of respondents indicated a level of satisfaction with the project.

The primary items discussed during the open houses and noted on the comment forms were benefits related, including employment and business opportunities, skill requirements, training, economic benefits for local communities and the province, production facility selection and developing the natural gas resources at White Rose. Other items noted were environmental effects, oil spills, ice management, and safety equipment and procedures. The four themes heard during the workshops, about learning from previous offshore oil developments, communication, project information and expectations, were also heard during the open houses.

2.4.3 Other Community Meetings

Husky Oil representatives met with various municipal and business groups while preparing the DA. Husky Oil made presentations to town council and chamber of commerce representatives in the Arnold's Cove area, Clarenville, Corner Brook, Gander, Marystown, Placentia and St. John's. At each of these events, Husky Oil representatives made a brief presentation about the project and addressed questions raised by participants. Discussions focused primarily on benefits and development related items. In all, about 120 people participated in these presentations.

Husky Oil representatives made a presentation at a St. John's Board of Trade luncheon in April 2000 and at the annual petroleum industry conference hosted by the Newfoundland Ocean Industries Association (NOIA) in June 2000. In both cases, a brief presentation was followed by an opportunity for questions. Over 700 people participated in these sessions. Presentations were also made to the St. John's Rotary Club, Association of Professional Engineers and Geoscientists of Newfoundland, Consulting Engineers of Newfoundland and Labrador, Canadian Association of Power Engineers and Newfoundland and Labrador Federation of Municipalities.

Husky Oil representatives have also met with members of the Natural History Society of Newfoundland and Labrador to review and discuss project information and status.

2.5 Meetings with Government Departments and Agencies

Husky Oil has made significant effort to keep elected members and government officials informed about its activities. Over the last two years Husky has given updates and held meetings with federal, provincial and municipal politicians to build awareness of White Rose and gain understanding of the factors that can influence the project. Federal and provincial officials such as Deputy Ministers and Assistant Deputy Ministers in key government portfolios have been briefed periodically on activities for the White Rose development. To date, Husky Oil has had approximately 100 meetings with representatives of various departments and agencies, including:

- Atlantic Canada Opportunities Agency;
- C-NOPB;
- Canadian Environmental Assessment Agency;
- DFO;
- Department of Industry, Trade and Technology;
- Department of Mines and Energy;
- Environment Canada;
- Natural Resources Canada; and
- Women's Policy Office, Government of Newfoundland and Labrador.

These meetings focused on briefing the various government departments and agencies about Husky Oil's plans for developing the White Rose oilfield, answering questions, seeking direction with respect to regulatory requirements, and identifying possible issues and concerns.

Various individuals knowledgeable about fisheries were contacted for the socio-economic effects analysis of commercial fisheries. Individuals contacted were from federal and provincial government departments, fish processing companies and fish harvesters association. Contacts were asked to provide information on developing fisheries, the distribution of existing fisheries, plans for expanding the fleets and fishing industry infrastructure. While the primary focus of these contacts was the socio-economic effects analysis, it also served as an avenue for distributing project information to a wider audience and provided an additional opportunity for people in the fishing industry to voice any concerns. No new issues or concerns were raised.

2.6 Media Briefings

Husky Oil representatives have been responsive to media inquires and have endeavoured to build an open relationship with the local Newfoundland media. Information has been provided to both provincial and national media outlets through news releases, media briefings and one-on-one interviews. A media briefing was held in November 1999 by Husky Oil officials to announce the results of the 1999 drilling program and approach for the concept engineering study. In April 2000, Husky Oil provided an update to the media on the production facility selection, why gas development is not currently feasible, an overview of the 2000 drilling program, the economics of the White Rose project and an overview of Husky Oil's other interests on Canada's east coast.

2.7 Tracking Media Sources

Husky Oil regularly monitored media agencies province-wide, including newspapers, radio (news reports and call-in shows) and television news programs. Any issues noted were recorded, assessed and incorporated into the issues database. Husky Oil officials followed up with reporters on issues, when warranted.

2.8 Project Information Distribution

Husky Oil has completed two mailings of project information. The first mailing in early May 2000 was to the key informant workshop participants and included the project description, project summary booklet and comment form from the first series of open houses. In June 2000, the project update summary was distributed to workshop participants, the Boards of Directors of the St. John's Board of Trade and NOIA, and select business and government contacts.

A third mailing was done when the Comprehensive Study was submitted to the C-NOPB. A letter outlining the status of the approval process for the White Rose oilfield development was sent to workshop participants, municipal governments in the communities visited during the consultation program, and select business and government contacts. This letter also informed people that the Comprehensive Study Report was available on the White Rose web site and that a full copy of the report was available on request. As of December 2000, 141 copies (hard copies and compact disks) of the Comprehensive Study had been distributed.

2.9 Internet and Telecommunication Sources

To improve accessibility and communication, Husky Oil established a project information telephone line and web site for the White Rose oilfield development. Both the telephone line and web site were widely advertised. The web site is updated as new information becomes available. Husky Oil has monitored these sources regularly and recorded all contacts. However, response has been limited with inquires mainly

regarding employment and business opportunities, except for one note to the web site indicating support for selecting the FPSO production facility and one requesting information on safety with respect to icebergs.

2.10 Issues and Concerns

The main message heard throughout the scoping/consultation program was that the majority of participants were supportive of the development and interested in seeing it proceed. There was also a strong interest in ensuring that the project proceed in an environmentally, socially and economically responsible manner.

A number of general items that apply to all aspects of the project were noted throughout the consultation program. They are:

- learn from the Hibernia and Terra Nova experience;
- ensure ongoing, two-way communication with stakeholders;
- ensure project information is accurate, timely and appropriate; and
- not to raise false expectations in relation to benefits from the project.

Items raised throughout the scoping/consultation program have been incorporated in project planning and are reflected in the DA.

3 CANADA-NEWFOUNDLAND BENEFITS PLAN

The *Atlantic Accord Acts* are federally and provincially enacted legislation. These parallel *Acts* require a benefits plan to be submitted to and approved by the C-NOPB before a development plan can be approved.

The Canada-Newfoundland Benefits Plan (Volume 1) for the White Rose oilfield development documents Husky Oil's commitments to and plans for:

- employing Canadian, in particular Newfoundland and Labrador, residents for the White Rose Project; and
- using Canadian, in particular Newfoundland and Labrador, businesses for providing goods and services for the Project.

The plan discusses potential benefits related to two technically and economically feasible production alternatives for the White Rose oilfield development, the steel FPSO vessel and steel semi-submersible floating production facility.

The benefits plan outlines the following:

- benefits philosophy, beliefs and guiding principles;
- benefits process and commitments;
- policies and procedures for project management, supplier development, procurement and contracting, employment and training, research and development, and monitoring and reporting;
- construction and operations processes that may affect Canadian and Newfoundland benefits;
- goods and service requirements for the White Rose development and ability of Newfoundland and Labrador and other Canadian companies to deliver these goods and services; and
- labour requirements for the White Rose development and availability of Newfoundland and Labrador and Canadian workers to fill these requirements.

3.1 Principles, Policies and Procedures

3.1.1 Benefits Philosophy and Principles

Husky Oil is committed to maximizing benefits associated with the White Rose development for Newfoundland and Labrador, where practically and commercially achievable. The company is supportive of policies and practices that support industry and labour in the region of the development, including long term economic benefits to the community and the project.

Husky Oil's Canada-Newfoundland benefits philosophy for its Grand Banks programs is based on certain beliefs and guiding principles. With respect to Canada-Newfoundland opportunities, Husky Oil believes:

- that over the life of the project, the capabilities and resources exist to perform the majority of the work required for offshore development in Newfoundland and Canada;
- there is a substantial skill and industrial base in Newfoundland and Labrador, and other parts of Canada;
- training local personnel and the technology transfer to local Canadian companies reduces long-term operating costs and provides cost-effective support for current programs and future projects;
- that it has a good understanding of the objectives, conditions and commitments necessary to achieve cost-effective Canadian and Newfoundland and Labrador content; and
- Husky Oil recognizes the right of Newfoundland and Labrador to be one of the principal beneficiaries of the oil and gas resources off its shores.

Husky Oil's benefits principles are:

- full and fair opportunity will be provided for Canadian and, in particular, Newfoundland and Labrador companies and workers to participate in the supply of goods and services;
- first consideration will be given to personnel, support and other services that can be provided by Newfoundland and Labrador, and to goods manufactured in Newfoundland and Labrador, where such goods and services are competitive in terms of fair market price, quality and delivery;
- an innovative, cooperative, supportive and open pursuit of opportunities for Canadian and, in particular, Newfoundland and Labrador companies and residents to achieve "best value" for the project; and
- "best value" for the project will be emphasized in evaluating opportunities.

The process being used by Husky Oil to ensure its beliefs and guiding principles for Canada-Newfoundland benefits evolve into corporate culture and are adopted as policy by all contractors, sub-contractors, manufacturers, suppliers and vendors in the procurement chain includes:

- conducting the development according to the *Atlantic Accord Acts*;
- making Husky Oil's Canada-Newfoundland benefits guidelines a contractual obligation for companies involved in the White Rose project and an integral part of the company's requests for proposals (RFP);
- requiring prospective contractors to indicate how they will maximize Canadian-Newfoundland and Labrador content within a competitive framework, and how they propose to comply with benefits guidelines in respect to Canada-Newfoundland benefits; and
- continuing work with all prospective contractors to ensure the company's Canada-Newfoundland benefits guidelines are incorporated into final contract agreement.

3.1.2 Canada-Newfoundland Benefit Commitments

Using the principles of the *Atlantic Accord* as its foundation, Husky Oil's Canada-Newfoundland benefits commitments can be summarized as follows:

- Full and fair opportunity will be provided to Canadian and Newfoundland and Labrador businesses to participate on a competitive basis in supplying goods and services for the project.
- Individuals resident in the province will be given first consideration for training and employment opportunities with the development.
- First consideration will be given to services provided from within the province and goods manufactured in the province, where competitive based on "best value". "Best value" is defined as a blend of total cost, quality, technical suitability, delivery and continuity of supply and services, with total cost comprising initial purchase price plus operating and maintenance costs.
- The White Rose oilfield development will be managed from St. John's, Newfoundland.
- Husky Oil will provide early identification of opportunities for the supply of goods and services required for the project, work with governments and industry organizations to jointly identify potential Newfoundland and Labrador suppliers of such required goods and services, and provide feedback to unsuccessful suppliers, as appropriate.
- Where bids are essentially equal on a "best value" basis, first choice will be given to goods and services provided from Newfoundland and Labrador. In all bidding processes, the level and quality of Newfoundland benefits, as well as technical and commercial considerations, shall be selection factors in awarding development contracts.
- Qualified offshore fabrication and construction yards in Atlantic Canada, specifically Newfoundland and Labrador, will be provided a full and fair opportunity to bid on work on a competitive basis, such that:
  - Husky Oil will undertake to cause, when competitive under international bidding on a "best-value" basis, the fabrication, assembly and outfitting services associated with the topsides facilities of the floating production facility, subsea facilities, mooring system and production risers to be performed in Canada; and
  - where Newfoundland fabrication/assembly/outfitting facilities exist and are qualified to be capable of undertaking the development activity, Husky Oil will require contractors to bid the work using a Newfoundland location in addition to bidding other locations.
- Husky Oil will require the project management and system engineering work, to take place substantially in Newfoundland where competitive.
- Husky Oil will require contractors and subcontractors to comply with the benefits principles, objectives and commitments.
- Husky Oil supports and encourages technology transfer and research and development initiatives and, in association with its major contractors, will be developing comprehensive strategies for these areas.

3.1.3 Benefits Policies and Procedures

Husky Oil's benefits commitments are reflected in its policies and procedures for planning and executing the White Rose oilfield development. Since it started work on the White Rose project, the company has had in effect policies and procedures for project management, supplier development, employment and training, research and development, procurement and contracting, and monitoring and reporting.

3.1.3.1 Project Management

Husky Oil opened its East Coast Regional office in 1997, and has been committed to managing the White Rose project from St. John's. The Husky Oil project management team in St. John's is responsible for the overall conduct of all project operations and ensuring that they are carried out safely and in an environmentally responsible manner, in accordance with all corporate and regulatory policies. Having decision-making and key management functions in the St. John's office assists in focusing on local and regional benefits issues, increases understanding of local capabilities and increases sensitivity to local concerns.

An integrated management team involving Husky Oil and Petro-Canada personnel is responsible for planning and supervising all project activities. A general manager with proven offshore development experience will lead the integrated management team through the front-end engineering and design (FEED), contractor/partner selection, project sanction and construction phases. A core team of experienced specialists will develop the contractor selection process and then be combined with contractor staff for the execution phase.

Initially, the staffing resources will be organized in three teams: the FPSO facility team; subsea team; and a project services support team. A task-based development team will be established following the award of major contracts for the FPSO, subsea package and glory hole excavation to carry the project through to First Oil. This team will include technical specialists, project control staff and contractor representatives.

Experienced contractors with proven track records of successfully managing and operating similar FPSO projects, from design to production operations, have tendered proposals to provide additional construction and operations expertise and technical support. If these proposals meet evaluation criteria, an FPSO facility contract will be developed through negotiations that will address technical, commercial and Canada-Newfoundland benefits considerations.

The subsea contract package will consist of all equipment from the subsea tree to the riser connection on the FPSO facility. The strategy for this component of the project will be to contract for the complete subsea system in a single contract, which will encompass everything from detailed design to installation, commissioning, interfacing and the option of providing ongoing operational support. The glory hole excavation will be dealt with as a stand-alone contract and bid competitively. In line with the objectives for the project, the preferred solution is to conclude agreements with experienced lead contractors who will manage the supply of all services required, preferably under a single, lump sum "turnkey" contract.

Husky Oil is determined to elevate Canada-Newfoundland benefits to a distinct position in White Rose corporate culture. This will see the management team challenging individuals at every level to consider how they might improve local benefits and opportunities. To this end, internal Canada-Newfoundland benefits workshops will be initiated to encourage Husky Oil employees and contractors in engineering and procurement to pursue methodologies that will promote domestic potential.

3.1.3.2 Supplier Development

Husky Oil has made a concerted effort to inform the local supply community of its plans as soon as they are confirmed or aspects of the development are known. Information sessions and workshops have been held with vendor and supplier associations and representatives.

Contractors responding to RFPs issued by Husky Oil are required to identify potential Canadian and Newfoundland suppliers of the required goods and services. Project management and system engineering work undertaken by contractors must be done in Newfoundland and Labrador, where commercially practical. Husky Oil has undertaken a number of supplier development initiatives, including working with local companies to develop new or expand existing expertise, providing feedback and information, and support of technology transfer initiatives.

3.1.3.3 Employment and Training

Husky Oil believes that the greatest opportunity to increase Canada-Newfoundland benefits is associated with the entire life cycle of the White Rose project, and indeed, with the life cycle of the East Coast oil and gas industry. To this end, a sustainable industry must recognize that the ongoing development of local skills is essential.

Training requirements for offshore developments cover a broad spectrum from regulated, industry health and safety requirements to skilled trades upgrading, such as welding and pipefitting. Husky Oil and its contractors will identify the minimum training standards for staffing all phases of the project. Also, as part of human resources planning, Husky Oil and its contractors will collaborate with government and training institutions to identify existing or anticipated skill shortages in the labour pool.

Succession planning will be undertaken to replace, over time, non-Canadian workers with qualified Newfoundland and Labrador and other Canadian workers, taking into account competency, safety and employee development. In 1999, Husky Oil and its major contractors employed 529 people on its delineation drilling program, of whom 94 percent were Canadian and 86 percent were Newfoundland residents. The company is committed to working with major contractors to develop the steps necessary for recruiting and advancing Newfoundland residents, and other Canadians, for the full range of positions and capabilities associated with the project. Husky Oil requires its contractors and sub-contractors to provide relevant training and learning opportunities for their personnel.

The company also maintains a Workforce Diversity Policy that will be implemented throughout the White Rose project and required for all contractors operating or hiring in Canada. This policy reflects Husky Oil's commitment to building a work environment that is free of discrimination and harassment. Husky Oil's Bridging Program seeks to remove traditional barriers to employment diversity. The White Rose project is considered by Husky Oil to be an ideal opportunity to expand the principles of the Bridging Program. Husky Oil is also committed to liaising with community-based organizations, such as the Women in Resource Development Committee, and supports efforts to increase women's participation in the oil and gas industry and related construction and fabrication opportunities.

3.1.3.4 Research and Development

Husky Oil supports and encourages research and development initiatives and has a history of promoting technology development programs in Canada's on-shore and frontier regions. Through direct expenditures and participation in industry and government initiatives, Husky Oil contributed approximately $162,000 to research and development initiatives in Newfoundland and Labrador in 1999 and 2000. Husky Oil will undertake an internal consultation process to identify project-related research and development priorities for a multi-year research plan and budget.

3.1.3.5 Procurement and Contracting

White Rose contractors must communicate requirements for equipment, goods and services in a timely fashion to qualified suppliers in Newfoundland and Labrador, and Canada. Debriefing procedures will be part of the procurement process.

3.1.3.6 Monitoring and Reporting

Husky Oil will monitor its own performance, as well as the performance of its contractors and sub-contractors, by audits. Major contractors are required to provide Husky Oil with a detailed monthly report showing the levels of Canadian and Newfoundland benefits achieved and their future goals. An employment benefits audit will be performed at the end of each project phase or major milestone to determine if Newfoundland and Labrador employment goals are being realized, and to develop strategies to ensure continuous improvement in this area, both for future project phases and the progress of the industry as a whole.

3.2 Assessment of Procurement Requirements

As a prerequisite to specific infrastructure demands, fabricating and/or constructing various components of a floating production facility requires certain basic skill sets and procedures. These include an adequately sized workforce skilled in offshore fabrication and construction methodologies, a formal quality control and quality assurance program, established engineering and management groups, and a formal project management and control system.

Awareness of fabrication demands and expectations of the oil industry have become well known to Newfoundland and Canadian companies, and many have taken the necessary steps to take advantage of opportunities. There is currently a growing expectation that companies can meet or be prompted and assisted to meet new fabrication demands.

Specific infrastructure requirements for the White Rose project include:

- hull fabrication for the floating production facility (both FPSO and semi-submersible options);
- topsides fabrication;
- turret fabrication;
- on-shore/at-shore hook up of the topside structures and equipment with the production platform;
- offshore installation;
- production drilling;
- subsea fabrication and installation, including subsea trees, template and manifolds/system integration testing;
- operations/production, including goods and services for vessel operation and subsea maintenance;
- bulk materials, including materials required for fabrication (vessel hull and topsides) and production drilling and operations (maintenance materials, marine fuels, aviation fuels, lubricants and chemicals); and
- equipment requirements for the various systems.

Highlights of the assessment of infrastructure requirements are:

- Fabricating a hull for a semi-submersible production facility in Canada is highly problematic due to the scale of the facility. Physical constraints of existing facilities and resulting additional costs, if modifications or temporary measures were undertaken, make it unlikely that a production semi-submersible could be built in Canada.

- A hull for an FPSO facility cannot be built in Canada because no Canadian shipyard can accommodate a vessel of the size required.

- There are facilities in Newfoundland and elsewhere in eastern Canada with experience in some aspects of topsides fabrication. The potential exists for most, if not all, topsides modules required for the White Rose production facility to be fabricated domestically. However, this is subject to the ability of companies to bid competitively on the international market.

- Turret fabrication experience is limited on the world market. Fabricating the lower portion of the turret is an integral part of the FPSO facility's hull and incorporated at an early stage of hull construction. Fabricating the upper turret is a demanding process subject to rigorous quality control procedures, making it difficult for companies to competitively undertake this work. However, components could be fabricated in Canada and possibly in Newfoundland, depending on the competitiveness of local industry.

- Hooking up the topsides components with the production vessel hull could be undertaken at facilities in Newfoundland or elsewhere in eastern Canada.

- The services necessary for offshore subsea installation and mooring are available in Newfoundland and elsewhere in Canada, usually through joint-ventures with international partners.

- Production drilling will be undertaken using internationally-sourced drilling rigs. Newfoundland and other Atlantic Canada ship yards can provide refit and modification services for these drill rigs. Many companies in Newfoundland and elsewhere in Canada have experience providing the necessary drilling support services and supplies.

- Only a limited number of international companies offer the components necessary for subsea fabrication and installation, and some are available through established joint-ventures in Newfoundland.

- The operations/production phase of the White Rose oilfield development will involve a continuous demand for support services. This demand will have a positive long-term effect on the Newfoundland economy, in particular, the St. John's metropolitan area.

- Bulk material demands for constructing the White Rose production facility will mainly be associated with floating production facility and topsides fabrication.

3.3 Assessment of Employment and Training Requirements

This section of the Canada-Newfoundland Benefits Plan describes the labour requirements for different components of the White Rose project. The availability of Newfoundland residents and Canadians to work on the project is also assessed.

3.3.1 Labour Demand

Husky Oil believes that growth in Newfoundland and Labrador's offshore oil industry should evolve in a way that will eventually result in continuous work for residents of Newfoundland and Labrador, both in engineering and fabrication. Labour requirements for the White Rose oilfield development are summarized in Table 3.3-1. The locations of work will depend on competitive bidding, availability of labour and skills, and stable and equitable labour relations.

Table 3.3-1 Total Labour Requirements

Work Component	Total Person Hours	%	Potential Work Location		
			Newfoundland	Canada	International
Management, etc.	1,052,000	8.60	X	X	X
Hull Fabrication	1,200,000	9.81			X
Turret Fabrication	680,000	5.56	X	X	X
Topsides Fabrication	1,460,000	11.93	X	X	X
Hook-Up & Commissioning	625,000	5.11	X	X	
Offshore Installation	52,000	0.42	X		
Production Drilling	1,050,000	8.58	X		
Subsea	826,000	6.75	X	X	X
Operations/Production	5,293,000	43.25	X		
Totals	12,238,000	100.00			

3.3.2 Labour Supply

The potential for Canadian and Newfoundland and Labrador involvement in the White Rose project may be constrained by labour capability and capacity. If appropriately skilled and experienced workers are not available, the work will necessarily go to non-Newfoundland and non-Canadian workers. There is a high level of awareness, within the federal government, provincial government, industry and training institutions, about the need to plan and prepare for future labour requirements. A number of recent reports and training institution responses indicate that, assuming there is no critical overlap between

White Rose and other major projects, there should be no substantial shortage of Newfoundland and Labrador labour able to work on the project. It is expected that Newfoundland residents and returning Newfoundland residents will fill many positions during the development (construction, fabrication and related requirements), operations (exploration and production) and engineering work for the White Rose development.

Other major construction projects in Newfoundland and Labrador, and elsewhere in Atlantic Canada were reviewed to determine whether they would draw on the same industrial capacity and workers as the White Rose development. In Newfoundland and Labrador, projects considered were the Terra Nova oilfield development, Voisey's Bay mine/mill and processing facility, Churchill River Power Project and the potential Hebron oilfield development. Projects elsewhere in Atlantic Canada considered in the analysis were the Scotian Shelf development, natural gas distribution in Nova Scotia and the Strait Area petrochemical plant.

Given the current White Rose schedule, it was determined that there will only be limited conflicts between industrial and labour requirements for White Rose and those of other major projects. However, this would change if there was a substantial delay in the start of the White Rose work. Delays in the White Rose work could lead to a gap in resource demands between current and White Rose construction, resulting in Newfoundland fabrication workers moving to other projects in Newfoundland or elsewhere in Canada. It could also lead to White Rose construction work occurring at the same time as work on other projects. If such activity exceeded local capacity, this could result in a loss of industrial and employment benefits to Newfoundland and possibly Canada.

3.4 Summary Conclusions

The White Rose project represents the next stage in the evolution of Newfoundland and Labrador's, and Canada's, offshore oil and gas industry. In moving forward with developing the White Rose oilfield using a FPSO production system, Husky Oil is committed to developing a sustainable industry through all stages of the oilfield cycle. In particular:

- Husky Oil believes that benefits to petroleum companies, Newfoundland and Labrador, and Canada as a whole will be substantially increased through the simultaneous pursuit of a variety of projects in an exploration, delineation, development and production context.

- The proposed project builds on past industry development, in particular the Hibernia and Terra Nova projects, and provides continuity in future local procurement and labour requirements.

- Husky Oil's benefits beliefs, principles and process provide a proactive framework for success in maximizing the benefits derived from the Project and industry in all their phases. Husky Oil's policies and procedures will provide a rigorous framework for ensuring there is an effective delivery of benefits within the framework of these beliefs and principles.

- Husky Oil's preferred development option, an FPSO, will allow Newfoundland and Labrador, on a competitive basis, to develop and expand on cutting-edge skills and technologies that present growth opportunities in Canada and internationally.

- The procurement requirements for the White Rose oilfield development are such that a wide range of consumables and contracted services can be acquired in Newfoundland and Labrador and in Canada as a whole.

- The labour requirements identified for the project are substantial, totaling approximately 12.2 million person-hours over the life of the project, the majority of which will be located in Newfoundland and Labrador. The largest components of the total labour requirements are operations/production (43 percent of the total labour requirement) and topsides fabrication (12 percent), hull fabrication (10 percent) and production drilling (9 percent).

- These procurement and labour requirements are such that the Project will make a very substantial contribution to the economy and society of Newfoundland and Labrador.

- However, the total benefits accruing to Newfoundland and Labrador, and to Canada, will be dependent on the ability of companies to be internationally competitive. This is the key to success not only in respect to the White Rose project but also the development of a sustainable domestic offshore oil industry.

4 DEVELOPMENT PLAN

Developing the White Rose oilfield will include:

- design engineering of the selected production system;
- procuring the goods and services required for the production system;
- constructing or modifying various components of the production system;
- installing and commissioning the production system at the White Rose site;
- drilling and completing up to 18 to 25 wells (production, water injection and gas injection);
- production, operation, maintenance and support services over the producing life of the field, designed for a 20-year life span; and
- decommissioning and removing the production system from the White Rose site, and removing and/or abandoning the subsea infrastructure.

4.1 Geology

4.1.1 White Rose Stratigraphy

The stratigraphic section penetrated by the wells drilled in the White Rose region contains Tertiary to Upper Jurassic age rocks. Of the formations penetrated, only the South Mara, Avalon, Eastern Shoals and Hibernia sections have any reservoir-quality sandstones. The oldest rocks penetrated in the White Rose region are from the Voyager Formation in the White Rose N-22 well.

The Egret Member is the main source rock for the hydrocarbons in the White Rose area and was penetrated in the White Rose A-90, Archer K19 and Trave E-87 wells. Oil bearing, overpressured sandstones, probably the Tempest Member were penetrated in the E-09 well.

The Aptian-aged Avalon Formation is the primary reservoir in the White Rose field. In general, the Avalon is a marginal marine, shoreface succession through much of the field. The Avalon is dominated by fine to very fine-grained sandstones, siltstones and shales, and ranges from 0 to 400 m in thickness. The main sandstone accumulations occur in the southeastern portion of the field with the E-09, L-08, A-17 and H-20 wells (South Avalon Pool) exhibiting thicknesses of up to 350 m of sandstone. The Avalon Formation is absent in the White Rose A-90 and Trave E-87 wells.

4.1.2 White Rose Structural Geology

Three episodes of rifting affected the White Rose area. During the first rifting phase, thick Osprey/Argo salt beds were deposited. This salt was tectonically mobilized during the second rifting stage forming elongated salt walls parallel with the emerging Central Ridge. Major north-south and northeast-southwest faults dissect the sediments deposited above the northerly plunging salt wall, including the source rocks. The third rifting stage had a pronounced influence on the area as the salt ridge was divided by salt withdrawal into a major ridge (Amethyst) and a northerly circular dome in which the overlying racks have been ruptured (White Rose).

Three intersecting fault systems oriented northeast-southwest, north-northwest south-southwest and north-south, divide the area. A few major faults (for example, the West Amethyst, Central and Twin faults), together with a low structural trend oriented north-northeast south-southwest, segment the area into three pools (Figure 1.2-1). The pools are:

- the South Avalon Pool (E-09, L-08, A-17, H-20 and environs), which occupies an area of approximately 18 km^2 located east of the Amethyst Ridge and Central Fault; the pool is geologically complex, and limited by the East Amethyst Central and Twin faults;
- the West Avalon Pool (J-49 field and environs) encompasses a 16 km^2 area and is confined between the West Amethyst, Central and North J-49 faults and the crestal erosional edge; and
- the North Avalon Pool (N-30, N-22 and environs) occupies an area of about 10 km^2; it is bounded by the Central Fault, White Rose dome erosional edge, Trave Fault and southeastern end of the Trave Syncline.

4.2 Reservoir Engineering

4.2.1 Reservoir Quality and In Place Resource Assessments

Twenty-five drill stem tests have been carried out in the White Rose field to assist in evaluating reservoir production capabilities and determine fluid properties. Results indicate that each of the three Avalon pools has an oil leg with an associated gas cap and underlying water. The oil-water and gas-oil contacts are different for each pool, confirming that there are sealing faults in the field. The oil is a typical Jeanne d'Arc Basin waxy crude with an average quality of approximately 30° API. The reservoirs have fine to very fine sandstone with a relatively low average permeability in the order of 100 milliDarcies (mD). In addition, there are several calcite-cemented zones that may hinder production.

4.2.1.1 South Avalon Pool

The South Avalon Pool has been delineated by four wells (E-09, L-08, A-17 and H-20). The pool has a 117 m oil leg and contains approximately 65 percent of the original oil in place (OOIP) in the field. The pool is expected to contain between 114 and 138 million m^3 of oil, with proven plus probable (P50) volumes of 126 million m^3.

The gas cap in the pool has an average thickness of 81 m and is expected to contain between 8.2 and 15.5 billion m^3 of the original gas in place (OGIP).

The above volumes do not include the results of the recently drilled H-20 well, which are currently being evaluated. It is expected that the results of this well will only marginally reduce the in place volumes.

This pool has better reservoir quality than the other pools, with an estimated average permeability of approximately 127 mD. Due to the low permeability and the proximity of the gas cap, horizontal development wells will be required to ensure adequate production rates and maximum oil recoveries. With horizontal well lengths in the order of 2,000 m, a typical production well in the pool should initially be capable of producing 3,600 m^3 of oil per day.

4.2.1.2 North Avalon Pool

Two wells, N-22 and N-30, have been drilled in the North Avalon Pool. Both of the wells encountered and tested gas. The average gas column thickness for the pool is expected to be approximately 177 m and contain between 41 and 54 billion m^3 of the OGIP. This represents approximately 50 percent of the gas in the Avalon Formation.

The N-30 well encountered 15 m of oil at the bottom of the Avalon Formation. Extrapolating to the common water gradient in the field, the pool is expected to have a 56-m oil column. The OOIP for the pool is estimated to be between 25 and 32 million m^3. Proven plus probable (P50) volumes are estimated to be 29 million m^3 or approximately 15 percent of the oil in place in the field.

On average, the North Avalon pool is expected to be of poorer reservoir quality than the South Avalon Pool, with an average permeability in the order of 95 mD.

4.2.1.3 West Avalon Pool

Only one well, J-49, has been drilled in the West Avalon Pool. The pool is expected to have an average gas column thickness of 122 m and an oil column of 59 m. The OGIP for the pool is estimated to be between 23 and 37 billion m^3. The OOIP is estimated to be between 32 and 42 million m^3, with proven plus probable (P50) volumes of 37 million m^3. On this basis, the pool is expected to contain approximately 35 percent OGIP and 20 percent of the OOIP in the Avalon Formation.

This pool is also expected to be of poorer reservoir quality than the South Avalon Pool, with an average permeability in the order of 90 mD.

4.2.2 Reservoir Exploitation

4.2.2.1 Reservoir Simulation Model – South Avalon Pool

A three-dimensional reservoir model was developed for the South Avalon Pool to evaluate depletion options for the pool. For reference case reservoir performance determinations, all faults were assumed to be sealing.

A waterflood scheme was used for the reference case development. Several model runs were made to determine the horizontal well locations that would result in optimum recoveries from the model. A total of 10 production wells and seven water injection wells were required to optimize reservoir performance in the model. Horizontal water injection wells were placed well below the oil-water contact to ensure dispersion of the injection water. The location of the horizontal oil producers was based on optimizing recoveries, while maximizing the time to water and/or gas break through.

The recovery for the South Avalon Pool was approximately 39 percent. On a fault block by block basis, recoveries varied from 29 to 50 percent.

A fundamental assumption for the waterflood development case is excess produced gas is conserved by reinjecting it into another pool in the White Rose field. Current plans are to drill the first gas injector in the North Avalon Pool in the N-22 area. After some reservoir response is seen, a decision will be made as to the number, timing and location for additional gas injectors, if they are required. Areas for potential future gas injector locations include the North Avalon Pool, the West Avalon Pool and the south end of the Terrace block in the South Avalon Pool.

4.2.2.2 Alternative Development Options

Three other development options were evaluated for the South Avalon Pool. They were:

- reinjecting all excess produced gas (net of fuel requirements) into the southern portion of the South Avalon Pool;
- reinjecting excess produced gas (net of fuel requirements) into fault blocks across the field; and
- reinjecting only a portion of produced gas cap gas to maintain original gas-oil contacts.

In cases where all produced gas is reinjected into the producing pool, recoveries are reduced significantly. For the partial reinjection cases, recoveries are not affected as significantly, but additional gas injection wells would be required as there would be gas injection both within and outside the pool.

In all cases, reinjection of gas into the pool increases gas handling requirements due to earlier and more significant breakthrough volumes. The increased gas production rates would increase gas compression requirements and reduce project economics.

The water injection reference case maximizes recoveries and minimizes gas handling requirements. Water handling and total fluid requirements are larger in the reference case, but can be managed much more easily than large gas volumes.

4.2.2.3 Reference Case Development Sensitivities

Two types of sensitivities were evaluated with the models. The first type were controllable areas dealing with facility and well constraints. Sensitivities were run to examine the impact of facility oil handling capacities, gas handling capacities, bottomhole producing pressure constraints and horizontal versus vertical or highly deviated wells will have on field production performance and recovery factors. The second type were uncontrollable areas dealing with uncertainties in reservoir quality and performance and included:

- reduced vertical permeabilities;
- permeability barriers;
- reduced permeability in the water leg;
- non-sealing faults;
- sealing sub-seismic faults; and
- faults acting as flow conduits.

The above sensitivities, with the exception of non-sealing faults, had a negative impact on recoveries.

Reducing oil handling capacities had no noticeable effect on field recoveries during the first 15 years of production or on ultimate recoveries. The biggest impact of limiting oil handling capacities to less than 15,900 m^3 per day was to extend the plateau period of the field and to slightly reduce gas handling requirements.

Reducing gas handling capacities did not significantly affect ultimate recoveries, but would reduce recoveries by up to 10 percent during the first 15 years of production period. The biggest effect is to reduce the oil plateau period of the field by a year or more and to extend the field life by approximately six years if gas production was restricted.

An evaluation of whether vertical or deviated wells could be used for oil production rather than horizontal wells showed that significant deviations of wells from horizontal could significantly reduce field recoveries by allowing early gas or water breakthrough. This supports the use of horizontal producers. Further assessment of the use of deviated wells will be carried out as more reservoir information becomes available.

4.2.2.4 South Avalon Oil Reserves and Production Forecasts

The results of the simulation sensitivity work were used to develop probabilistic recovery factor and reserve ranges for the South Avalon Pool. The recovery factor for the pool under waterflood is expected to be between 24 and 39 percent, with a reference case (P50) value of approximately 31 percent. This range of recovery factors was applied to the probabilistic OOIP range for the pool, resulting in recoverable oil reserves ranging from 34 and 46 million m^3. The reference case (P50) reserves is 36 million m^3 assuming no production from the two northern fault blocks in the South Avalon Pool.

The reference case production forecast, shown in Figure 1.2-2, was generated by scaling the field performance forecasts from the reference case simulation model to match the recovery levels determined from the probabilistic reserves assessment.

4.2.2.5 Development Drilling Schedule

Several of the development wells will be pre-drilled prior to production start-up. The proposed strategy is to pre-drill sufficient wells prior to First Oil to have the capability of producing at facility design rates. There will also be pre-drilled water injection wells to provide appropriate initial pressure support and a pre-drilled well for gas injection so that gas conservation can commence as soon as possible. To meet these objectives, up to 10 wells will need to be drilled prior to First Oil and drilling will need to commence approximately two years prior to First Oil, if only one rig is used.

4.2.2.6 Deferred Developments

Three deferred developments will be considered as the results of South Avalon Pool development drilling, production and injection are evaluated. They are:

- North Avalon oil;
- West Avalon oil; and
- White Rose gas resources.

It is expected that the North Avalon reservoir will be of generally poorer quality than the South Avalon pool and, as a result, recovery factors for this area will also be lower. Preliminary assessments indicate that recovery factors could be in the order of 18 to 30 percent, with oil reserves ranging from 5.4 to 8.3 m^3. At least two to three production wells would be required to recover the oil in this area if reasonable production rates and recoveries can be achieved.

The West Avalon pool is also expected to have a poorer quality reservoir than the South Avalon pool, with an expected recovery factor ranging from 18 to 31 percent. The southeastern end of the West Avalon pool has the best potential for economic oil production, as it is closer to the South Avalon core area and most likely to have better reservoir quality, although faulting may be more severe. This area has yet to be drilled to determine reservoir quality and fluid contacts. If current estimates are confirmed, then recoverable oil reserves in this portion of the pool would be between 7.0 and 11.1 million m^3.

In order for oil recoveries to be maximized in the White Rose oilfield, reservoir pressures must be maintained and smearing of the oil leg into the gas cap should be avoided. As a result, depletion of the gas resource should not commence until exploitation of the oil resource is well advanced.

Drilling and depletion of the oil legs, along with gas conservation monitoring, will provide valuable information as to the reservoir quality and compartmentalization. During the oil production phase, all gas, other than that used for fuel gas, will be conserved in the North Avalon pool gas cap.

Development of the above gas for production would likely require approximately 10 additional wells, with associated glory holes and subsea systems. From a facilities perspective, it may be possible to upgrade the FPSO to handle the additional gas volumes, but this would likely require it to be brought into harbour for modification. Earliest timing for beginning gas development for sales is at least five years after First Oil, assuming that a regional gas gathering and export system is put in place. Future conditions for White Rose gas development are outlined in Section 1.2.3 of this summary document.

4.2.2.7 Reservoir Management

Reservoir simulation is being used to evaluate and optimize proposed development scenarios. Development well locations will be drilled based on this information, with updates as required with new data obtained during development drilling. Once sufficient production history exists, the simulation model will be updated periodically to match field history and improve prediction of future performance. Specific reservoir management tasks that will occur include:

- well tests - diagnosing problems or providing information about individual wells or the pool as a whole;
- pressure surveys – evaluating reserves and monitoring voidage replacement performance;
- fluid sampling – collecting surface fluid samples of oil, gas, and water during initial production from each development well; and
- coring and logging – obtaining required information about Avalon Formation.

4.3 Design Criteria

The following are the key objectives/philosophies of the project to ensure that the value of the asset is maximized, consistent with the wider business objectives of Husky Oil and co-venturer, Petro-Canada:

- Safety is of prime concern and the project will provide a safe and healthy working environment through the design and operation of the facilities for all personnel. Formal safety assessments and the reporting of safety performance will be undertaken throughout the duration of the project.
- Decision-making will be on a life-cycle basis.
- Integrity of the project (in terms of personnel safety, environmental protection, property integrity and business interruption) is crucial. The project will employ risk management and value engineering principles.
- Sizing of tender parcels and equipment specifications will take into consideration Canadian and Newfoundland suppliers and contractors who can demonstrate appropriate experience and deliver technical competence and commercial competitiveness.
- Availability targets will be developed for each production and operations system.
- A high priority will be placed on environmental protection and compliance with all pertinent laws and regulations, and Husky Oil's environmental management system. The project will be required to demonstrate that objectives are being met during regular performance review, supplemented by periodic auditing.
- As far as practical, the design will ensure that construction, testing, integration and pre-commissioning are performed at the quayside with offshore activities limited to hook-up and final commissioning.
- White Rose production facilities will be designed for a target service life of 20 years.

Engineering and design practices will be common across the project and all designs will conform to relevant codes and standards. Generally accepted international standards, such as the American National Standards Institute/American Society of Mechanical Engineers specifications and American Petroleum Institute recommended practices, will be applied, as appropriate. The most recent editions in effect are as of October 2000.

The FPSO design will be targeted for the following operational capabilities:

- disconnect from its mooring on the approach of an iceberg of mass greater than 100,000 t;
- withstand impact of icebergs up to 100,000 t;
- continuous production in one-year storm conditions;
- station-keeping in 100-year storm conditions;
- operation in moderate sea-ice up to concentrations of 50 percent ice cover; and
- normal planned disconnection during one-year storm conditions.

The operating manuals will be written to define the limits for operation imposed by safety equipment and environmental considerations.

The South White Rose oilfield will be developed using subsea completions tied back to a mono-hull type FPSO unit, permanently moored in approximately 125 m of water, with the crude oil transported to market by shuttle tankers. Accommodation, production separation, water injection, gas lift, gas reinjection, and crude export facilities will be provided on the FPSO.

Subsea wellheads will be located in glory holes to protect them from iceberg scour. Equipment within the glory hole will be designed such that the top is a minimum of 2 to 3 m below the mudline. Manifolds and flowlines will be designed fail-safe to minimize any harmful environmental consequences should they fail or be damaged. Flowline systems will be designed to allow the flushing/purging of production lines in the case of iceberg scour risk. Their location on the seafloor will give ease of access for inspection, testing, repair, replacement or removal. Emergency shutdown valves will be provided. These will ensure the safety of personnel and minimize environmental effects in the event of accidental damage to the production facilities.

The FPSO will require a storage capacity of approximately 111,000 and 135,000 m^3 (700,000 and 850,000 barrels), representing approximately eight to ten days oil production. It must be capable of handling peak oil production of between 12,000 and 18,000 m^3 (75,000 to 110,000 barrels) per day**,** peak gas production of between 6 and 7 million m^3 per day and peak water production of between 15,000 and 30,000 m^3 per day. Due to the presence of icebergs at the field location, the FPSO will have the added capability to disconnect and move off location under its own power.

Side scan sonar images of the White Rose area indicate that the surficial geology is a thin veneer of fine to medium grained sand over a coarser substrate, consisting of sand and gravel. Occasional occurrences of gently-sloped gravel mounds in the area may correspond with old iceberg scour berms.

Past interpretations of biota present in seabed photographs have suggested that the seabed is relatively stable, with relatively little sedimentary transport within the region. This is supported by recent mapping exercises within the region. These clearly display anchor marks from old drilling programs, preserved after 15 to 20 years.

Additional data of the soil types and characteristics are based upon a series of glory holes that were completed in the Grand Banks area for the Terra Nova development. From the current state of geotechnical and geological knowledge of the Grand Banks, it is reasonable to infer that geotechnical conditions at the White Rose site will be similar to those at the Terra Nova site.

4.4 Production and Export/Transportation System

4.4.1 Production System

The production concept is a floating, production, storage and offloading ship-shaped vessel. Production facilities are mounted on raised supports above the vessel deck. Reservoir fluids pass from subsea production wells, via flowlines and risers, up into the turret and then to the production facilities. Produced oil is stored in the vessel cargo tanks and periodically offloaded onto a shuttle tanker via a loading hose.

The FPSO hull will be approximately 200 to 300 m in length, 40 to 45 m in breadth and 22 m in depth, ice-strengthened, and have a lightship weight of approximately 31,000 t supporting a topside process plant with a dry weight of approximately 7,300 t. The FPSO will be moored using a geo-stationary turret, which is anchored to the seabed. The turret mooring will be disconnectable to allow the FPSO to move to avoid iceberg threat. The vessel will rotate ('weather vane') around the turret to take up a position of least resistance to the ambient conditions, with the bow heading into the prevailing wind and waves.

The FPSO will be positioned between the glory holes and will receive production via flowlines that deliver reservoir fluids through the turret located near the bow of the vessel. Stabilized oil will be off-loaded to a shuttle tanker from the stern of the FPSO via a loading hose. To be conserved, produced gas will be compressed and reinjected back into the geological formation through the turret via dedicated flowlines.

While facility designs are very preliminary, it is expected that the processing requirements will be based on a single processing train and will not require any unconventional facilities. The oil will be stabilized in a conventional separation train and de-watered in an electrostatic coalescer. The gas will be compressed for reinjection in a multi-stage compression train. The proposed configuration comprises a three-stage compression system driven by gas turbines.

Accommodations will be located either at the stern or at the bow of the vessel. The pallets containing oil and gas will be located at a safe distance from the accommodations. Typical personnel levels will range from 45 to 50 permanent crew up to 80 to 85 with temporary crew. The accommodation requirement for the FPSO will consider the requirements for normal operation and also offshore hook-up and commissioning and maintenance operations. Utilities, such as the galley and mess, food storage areas, change rooms and laundry, potable water and sewage treatment will be sized accordingly. Other facilities provided will include office, recreational, sick bay and entertainment amenities.

The topside facilities will primarily be located on a horizontal plane raised above the vessel deck. It is envisaged that the topsides will be configured in pre-assembled units, modules or pallets. The number and size of units will be determined as design engineering is undertaken.

Some of the topsides utilities required are: produced and oily water treatment; seawater filter and injection systems; power generation; cooling and heating systems; fuel and inert gas systems; flare and vent system; drain systems; chemical injection; potable, service and fire water; nitrogen; diesel and jet fuel; compressed air; hydraulic power; de-icing; and safety and control systems.

Personnel safety and environmental protection will be paramount in designing the facilities. This will apply to layout and construction and to the provision of safety systems, which will include:

- emergency shutdown valves;
- emergency flare and blowdown;
- hazardous drain;
- fire and gas detection;
- active and passive fire protection;
- personnel escape routes, temporary safe refuge and evacuation;
- energy conservation; and
- gaseous and liquid discharges.

Communications are a critical component in the operation of an offshore oil facility, ensuring both the safety of the facility and its competent operation. The FPSO, on-shore facilities, and all support craft will be linked by state-of-the-art communications systems for voice, data or video.

Generators will be sized to meet the electrical loads of the FPSO vessel, both for normal and emergency operation. They will be able to function on produced gas or diesel. As well, there will be provision for further diesel-driven power generation for emergency.

The subsea facilities for White Rose will include all equipment necessary for the safe and efficient operation and control of the subsea wells and transportation of production and injection fluids between the wells and the FPSO. The subsea facilities include all wellhead completion equipment, trees, manifolds, flowlines, umbilicals, risers, seabed structures, control systems and all interfaces required to control and operate the facilities and associated test, installation, inspection and maintenance equipment. Wellhead equipment, trees and manifolding structures will be located in open glory holes for iceberg protection.

4.4.2 Export System

The offloading facilities will be located at the stern of the FPSO and incorporate a fiscal metering system as an integrated package. The offloading system and offloading rate will be designed with regard to the environmental conditions in the field, such that the availability of the facility is not compromised by weather limitations on a shuttle tanker connecting or remaining connected.

Shuttle tankers will be used for exporting White Rose crude oil to markets in, for example, eastern North America and the United States Gulf Coast, or to a transshipment facility, such as the one currently operating at Whiffen Head, Newfoundland.

4.5 Construction and Installation

Initial design engineering is forecast to start several months prior to project sanction in order to meet the early target date for First Oil and enhance project viability. Any procurement decisions that must be made prior to receiving regulatory approvals would be subject to the successful outcome of the DA review process and project sanction. Project sanction by the proponents, which is conditional upon receiving regulatory approval and confirming commercial viability, would initiate the project and lead into construction, installation and commissioning. The target date for First Oil is approximately 36 months following project sanction.

4.5.1 Facility Construction

Historically, the hull or super structure and topsides of FPSO vessels have been built in separate facilities in different locations. This is also expected to be the case for White Rose. Currently, there is no Canadian shipyard large enough to construct the hull. A modular approach will be followed for fabrication of the topsides. The size of individual modules depends on the lifting capacity available at the shipyard. The turret is normally fabricated in two sections, the first is incorporated into the hull and the second is lifted on later. Structural sections are prefabricated and assembled, either on the hull or separately for later lift into place. The topside facilities are normally manufactured in pre-assembled units, modules or pallets. The hull and upper turret, topside facilities and other equipment are delivered to an at-shore assembly site for hook-up, mechanical completion and testing prior to proceeding to the production site. All onshore construction and fabrication activities are expected to be carried out at existing industrial sites.

4.5.2 Subsea Facilities

Specialized manufacturers will supply flexible line production and injection risers, suitable for use in the harsh environment at White Rose. The risers are typically supplied fully equipped and tested, and ready to install. Subsea manifolds and flowlines will gather the production and convey it to the risers. Manifolds include headers, piping, valves, and control equipment, mounted on a base.

Many proprietary well components will comprise high quality forgings requiring heat treatment, special welding procedures and precision machining. Tree installation will require special running and testing tools. Flowlines will be either flexible or rigid steel pipe. Flexible flowlines will be prepared by the manufacturer, ready for installation. Rigid steel pipe will be manufactured by mills in lengths appropriate to transportation and handling constraints, and the limitations of the lay barge. Consideration will be given to the option of installing the flowlines in cased bundles. In that event, the flowline bundle will be fabricated on-shore at a suitable construction site. Another option, which may be examined for rigid steel pipe, is welding them into long strings on-shore and winding them onto spools on a reel lay vessel for offshore installation.

Depending on their size, manifolds may be installed either directly through the moonpool of a semi-submersible drilling unit or, if small enough, from the deck of a support vessel with sufficient lifting capacity to handle lowering them to the seafloor, where they could be picked up and placed by a drilling unit.

A dynamically positioned vessel, equipped for flexible pipe and cable installation, will be used to install the risers and flowlines. Divers may be used to make the subsea connections.

Wellheads will be installed in the glory holes through the moonpool of the drilling unit. Upon completion of the well-drilling operation, the drilling unit will also be used to install the subsea trees. Final connection of the wells to the manifolds by jumper spools will be carried out by divers.

4.5.3 Marine Support Vessels

Husky Oil proposes to charter existing marine support vessels from existing contractors for resupply services and ice management functions.

4.5.4 Drilling Services

One or more semi-submersible drilling units will be used throughout the life of the field for drilling, re-entering and completing wells. These units will be chartered.

The unit(s) will be moored at each well location supported by onboard chain and anchors. Marine support vessels, with anchor-handling capability, will be used to deploy and retrieve anchors in conjunction with rig anchor handling equipment.

4.6 Development Drilling and Well Completions

Since the discovery in 1984 of the White Rose field, with the drilling of the N-22 well, eight additional delineation wells have been drilled and suspended or abandoned.

Up to approximately 18 to 25 wells will be required to develop the White Rose oil reservoir. Up to 10 to 14 will be producing wells, six to eight will be water injection wells and two to three will be gas injection wells.

Initially, up to 10 wells will be drilled before field production begins. Plans are for wells to be drilled in clusters. Semi-submersible mobile offshore drilling units will be used to drill and complete these wells before the arrival of the FPSO. The remainder will be drilled in parallel with producing operations to meet the depletion plan objectives. The current plan is to start drilling several months after project sanction is received.

There were no significant operational problems encountered during the drilling of the White Rose delineation wells, however, there is always some potential for problems and drilling hazards during drilling operations. The more typical problems that will be addressed within the well design and contingency planning, include:

- shallow gas;
- hole instability;
- formation pressure;
- well control; and
- differential sticking.

The White Rose development well completions design is intended to maximize well productivity, while maintaining appropriate levels of risk and well integrity. Well performance modelling based on the reservoir properties of the discovery and delineation wells has been conducted for both flowing and artificial lift (gas lift) scenarios. The flowing well model suggests that initial oil rates of between 2,800 and 4,200 m^3/d are possible from horizontal development wells completed with 140-mm tubing. A well with average reservoir properties should flow at 3,600 m^3/d of oil prior to water or gas breakthrough.

Water associated with White Rose oil production is expected to increase over the life of the development. The flow modeling discussions above indicate that oil wells will require artificial lift when water cut exceeds 40 percent. Gas lift will be a readily available means of artificial lift with gas compression facilities required for the reinjection of produced gas. Gas lift also has advantages over other means of artificial lift because it has high reliability and efficiency.

Prior to the start of production, all wells in a given glory hole will likely be batch completed after being drilled and temporarily suspended. It is assumed that at the end of batch drilling operations the wells will be left with proper barriers in place and the vertical subsea trees will be fitted with back pressure plugs and external debris covers.

4.7 Production Operations

Husky Oil will be the Operator of the White Rose oilfield on behalf of itself and Petro-Canada, its co-venturer. The operation will be run from the Husky Oil office in St. John's, where the operations management will be located. The management and control of all offshore operations will be the responsibility of the Offshore Installation Manager (OIM) who will be located on the FPSO. The OIM will report to the Operations Manager.

The on-shore organization will be structured to provide total support for all normal offshore operations, during the development and operations phases. The on-shore organization will include personnel with all the requisite skills, knowledge, and experience for ensuring competent support to the offshore operation, even in emergency situations. It will be focused on flexibility, efficiency and cost effectiveness. The permanent core of the on-shore organization team is expected to be 45 to 50 people.

In addition, there will be further personnel on-shore in the following categories:

- helicopter air and ground staff;
- dockworkers and crane operators for supply vessel operations at the shorebase; and
- crews for the supply and standby vessels.

The offshore organization will consist of skilled personnel in all disciplines required for safe, efficient, and environmentally responsible operation of all offshore facilities. The OIM will be responsible for managing the FPSO facility. Semi-submersible drilling units, each of which will be the responsibility of a dedicated onboard OIM, will carry out all drilling. The FPSO OIM will, however, have responsibility for coordinating all offshore activities. These include drilling workover, diving and ice management, in addition to the FPSO-related activities of production, storage, offloading and shipping.

A primary aim in assembling the offshore teams will be to foster teamwork and efficiency. This will be achieved by selecting personnel with appropriate production or marine skills and experience, coupled with cooperative positive attitudes and demonstrated competence. Multi-tasking of personnel will also be an aim, both to increase flexibility and effectiveness and to provide personnel with an enriched work environment. This cross-functional strength will be accomplished through appropriate training.

The crew complement for the FPSO is expected to be approximately 45 to 50 people at any one time. Provision for rotation requires that this number be doubled, giving an FPSO staff strength of approximately 90 to 100 personnel.

Each drilling vessel will require approximately 70 to 100 drilling and support staff during drilling and testing operations. To provide for rotation, this means a requirement of approximately 140 to 200 personnel per drilling unit.

Specific operations and maintenance management systems will be in place for the White Rose oilfield development. The systems will comply with all regulatory requirements, and personnel will be trained to operate in accordance with the manuals and procedures. The systems will cover the following topics:

- systems and equipment;
- reporting relationships;
- maintenance;
- production and marine operations;
- ice management;
- health and safety;
- emergencies;
- alert and contingency plans; and
- environmental control and monitoring.

Operations and maintenance management system documents will be developed in the detailed design phase. They will then be augmented by the various user groups to customize them to their particular needs, while still maintaining compliance with regulatory requirements.

Husky Oil already has an Ice Management Plan in place for its offshore exploration program. This plan will be reviewed, updated and/or modified, as appropriate, for application to the production phase of the White Rose oilfield development. It will be integrated with and draw upon the experience of other operators on the Grand Banks, together with the latest techniques and developing technologies, to produce the optimum plan for ice management for the White Rose development. It will cover both sea ice and icebergs, and will be flexible in recognition of the fact that the sea ice and iceberg conditions at the South White Rose area vary considerably from year to year.

The limiting conditions imposed by environmental factors on the structure and associated systems will be largely predicated upon the final design criteria adopted for the FPSO and equipment specification. The criteria selected for equipment and system redundancy and availability, scheduled maintenance, and unscheduled shutdowns and breakdowns will also directly affect operational efficiency.

Husky Oil intends to investigate all possibilities of cooperation with other operators in the prospective use of shared services and facilities to support offshore operations. Where synergies exist, it is highly probable that efficiencies on this aspect can accrue to all parties.

Contingency plans will be prepared for dealing with major emergencies threatening personnel safety or facility integrity. These plans will comply with the requirements of Section 51 (3) of the *Newfoundland Offshore Area Production and Conservation Regulations*. Contingency plans and standard operating procedures to be implemented for White Rose include:

- emergency response;
- vessel specific emergency response;
- collision avoidance;
- ice management;
- oil spill response;
- ship's oil pollution emergency; and
- emergency communications and family support.

Husky Oil will cooperate with other operators and agencies in all emergency situations through resource sharing and mutual aid. Husky Oil will also participate in joint training exercises with other operators.

Husky Oil promotes safe operations for personnel and environmental protection as key priorities for all operations. A loss management program will be in place specific to the White Rose development. It will become an integral part of Husky Oil's corporate loss control management philosophy. This philosophy is based on eliminating or reducing risks to personnel, assets, production, and environment through a continuous and systematic approach. It covers all aspects related to health and safety, environment, reliability, management of process hazards, risk assessment and loss control.

4.8 Development Costs

Past expenditures on the White Rose field are shown in Table 4.8-1 by year of occurrence. Expenditures totalled $345.7 million between 1984 and 1999. All costs are shown in the dollar values of the year in which they occurred, and are the gross values before Petroleum Incentive Program (PIP) grants.

Table 4.8-1 Past Expenditures (1984 to 1999)

Year	Total Expenditures ($million as spent)
1984	42.1
1985	66.6
1986	39.4
1987	30.8
1988	47.7
1989	0.5
1990	0.3
1991	
1992	
1993	
1994	
1995	0.1
1996	0.3
1997	5.2
1998	3.8
1999	109.2
Total	**345.7**

The capital and operating cost estimates for a new steel FPSO are detailed on an annual basis in Table 4.8-2, and capital and operating costs for a new steel semi-submersible are outlined in Table 4.8-3. They are based on 2000 constant dollar estimates prepared by KSLO, and include all applicable customs duties and sales taxes. These are P50 estimates.

A comparison of P50 and P90 estimates (that is, a 50 percent and 90 percent probability, respectively, of achieving this cost or less) for the FPSO and semi-submersible options is provided in Table 4.8-4. The capital cost estimates include costs for the following items:

- production facility;
- subsea facilities;
- installation; and
- well drilling and completion.

Table 4.8-2 Capital and Operating Costs – New Steel FPSO Facility

	Production		Capital Costs ($Million)							Operating Costs ($Million)
Year	Rate (m^3/d)	Annual (1,000 m^3)	Exploration Drilling	Pre-Production				Post-Production	Total	
				Proj. Admin.	Drilling	Facilities	SubSea			
1				10		111			121	
2				10	115	390	82		597	
3				10	155	390	150		705	
4	14,600	4,000			41	223	82	114	460	59
5	14,600	5,340						155	155	83
6	14,600	5,340						120	120	89
7	14,600	5,340								92
8	13,000	4,780								99
9	8,700	3,160								100
10	5,600	2,060								97
11	4,100	1,480								86
12	3,100	1,150								77
13	2,600	940								71
14	2,100	760								63
15	1,800	650								57
16	1,600	570								51
17	1,300	480								49
18	1,000	350								104
19										
20										
TOTAL		**36,400**		**$30**	**$311**	**$1,114**	**$314**	**$389**	**$2,158**	**$1,177**

Notes:
Operating costs exclude crude transportation costs.
The final year operating costs include $41 million for abandonment of the facility and wells.
The FPSO salvage value is estimated at $40 million (as spent).

Table 4.8-3 Capital and Operating Costs – New Steel Semi-Submersible Facility

Year	Production		Capital Costs ($Million)							Operating Costs ($Million)
	Rate (m^3/d)	Annual (1,000 m^3)	Exploration Drilling	Pre-Production				Post-Production	Total	
				Proj. Admin.	Drilling	Facilities	SubSea			
1				10		120			130	
2				10	115	420	93		638	
3				10	155	420	186		771	
4	14,600	4,000			41	240	93	114	488	62
5	14,600	5,340						155	155	87
6	14,600	5,340						120	120	93
7	14,600	5,340								96
8	13,000	4,780								103
9	8,700	3,160								104
10	5,600	2,060								101
11	4,100	1,480								90
12	3,100	1,150								80
13	2,600	940								74
14	2,100	760								65
15	1,800	650								59
16	1,600	570								53
17	1,300	480								51
18	1,000	350								106
19										
20										
TOTAL		**36,400**		**$30**	**$311**	**$1,200**	**$372**	**$389**	**$2,302**	**$1,224**

Notes:

Operating costs exclude crude transportation costs.

The final year operating costs include $41 million for abandonment of the facility and wells.

The semi-submersible salvage value is estimated at $40 million (as spent).

Table 4.8-4 Comparison of FPSO and Semi-Submersible Option Costs

	Steel FPSO ($ Million)	Steel Semi-submersible ($ Million)
P50 Capital Expenditures		
Capital (2000$Can)		
Capital to Project Sanction	**310**	**310**
Development Capital to First Oil	**1,769**	**1,913**
Drilling	311	311
Total Facility	1,114	1,200
Vessel/Turret	462	521
Topsides/Installation/Other	652	679
SubSea	314	372
SGA	30	30
Development Capital Post First Oil	**390**	**390**
Drilling	389	389
Abandonment	41	41
Salvage Value	(40)	(40)
Total Capital Expenditures	**2,469**	**2,613**
Total Operating Expenditures	**1,087**	**1,132**
P90 Capital Expenditures		
Capital (2000$Can)		
Capital to Project Sanction	**310**	**310**
Development Capital to First Oil	**1,906**	**2,036**
Drilling	342	342
Total Facility	1,198	1,268
Vessel/Turret	497	550
Topsides/Installation/Other	701	718
SubSea	336	396
SGA	30	30
Development Capital Post First Oil	**564**	**564**
Drilling	557	557
Abandonment	47	47
Salvage Value	(40)	(40)
Total Capital Expenditures	**2,780**	**2,910**
Total Operating Expenditures	**1,118**	**1,163**

The operating costs are based on the following assumptions:

- the reservoir parameters will be as described in the Development Plan;
- Husky Oil will operate the development in accordance with a typical joint venture agreement, and will adhere to the management approach and development scenario as set out in the Development Plan; and
- relatively stable economic conditions prevailing worldwide in January 2000 will continue throughout the period of operation.

The operating costs shown do not include crude transportation costs. The final year operating costs include $41 million for decommissioning and abandonment of the facility and wells for floating systems. The salvage value of the two viable options is estimated at $40 million for each (as spent).

5 ENVIRONMENTAL IMPACT STATEMENT

The EIS (Comprehensive Study Part One) assesses the potential effects of the proposed White Rose oilfield development on the biophysical environment. The assessment reflects comments raised by stakeholders, the scoping document issued by regulatory agencies, CEAA and the C-NOPB guidelines (1988).

Valued Environmental Components (VECs) considered in this EIS were determined through the regulatory review and issues scoping process, and include;

- fish and fish habitat;
- seabirds;
- marine mammals; and
- sea turtles.

For each VEC, effects are assessed for the two to three-year development phase, and the expected 12 to 14 year production lifespan of the project. Effects that could continue after decommissioning and accidental events are also considered. The spatial boundaries of the assessment include the Grand Banks and the nearshore areas being considered for on-shore facilities.

The assessment approach involved:

- describing the existing physical and biological environments;
- identifying potential interactions between the biophysical environment and the project;
- identifying, evaluating and classifying anticipated environmental effects, including cumulative environmental effects;
- identifying mitigative measures;
- assessing the residual environmental effects of the project after mitigation;
- determining the significance of residual effects; and
- identifying monitoring and follow-up initiatives.

5.1 Existing Environment

5.1.1 Regional Setting (Physical Environment)

The White Rose oilfield is located on the northeast Grand Banks, in an open ocean site approximately 350 km east of St. John's. The climatic and oceanic conditions, and susceptibility to seasonal intrusions of ice, make this area one of the harsher operating environments in the world.

5.1.1.1 Atmospheric Environment

The marine climate at the White Rose oilfield is similar to that at the Hibernia and Terra Nova fields. Mean monthly air temperatures range from –1.6 °C in February to 13.7 °C in August. Winds in the area are primarily from the west in winter and southwest in summer, and have been recorded at speeds of up to 51 m/s (99) knots.

5.1.1.2 Oceanic Environment

The White Rose site is located in a water depth of approximately 120 m. In the immediate vicinity, the bottom relief is relatively featureless, but steep slopes occur to the north and east on the edges of the Grand Banks.

At the White Rose site in 1999, monthly maximum combined wave heights ranged from 5.6 m (August) to 12.5 m (December). Wave data collected for the area over the past four decades indicate monthly maximum combined wave heights up to 13.7 m.

At the surface, mean monthly temperatures at White Rose range from –0.38^{o}C (February) to 10.7^{o}C (August), and mean monthly values for water salinity range from 31.51 to 32.99 parts per thousand. The warmest water temperatures are in July and August and the coldest are in February, while the salinity is lowest in August and highest in December. At water depths of 50 and 100 m, the temperature and salinity variations are smaller. The temperatures are usually between –1.6EC and 2EC, and salinity between 32.6 and 33.5 parts per thousand.

Oceanic currents at White Rose are comprised of semi-diurnal and diurnal tidal currents, direct wind driven currents, inertial currents, geostrophic currents, and low frequency mesoscale currents. These result from such features as meteorological disturbances, meanders and eddies, and propagation of continental shelf waves. Monthly maximum near-surface current speeds range from 36 cm/sec (January) to 89.9 cm/sec (September), and there is no consistent direction for surface currents in the area.

5.1.1.3 Sea Ice and Icebergs

As a result of its location on the eastern slope of the continental shelf, the White Rose site is susceptible to seasonal intrusions of sea ice and icebergs. Sea ice occurring near White Rose is usually loosely packed and pressure free. Most of the ice coverage ranges from 30 to 100 cm in thickness, and primarily consists of young or first year ice. The White Rose site lies close to the extreme southern limit of the regional ice pack and can be affected by this seasonal flow of ice from Baffin Bay.

The principal origins of the icebergs that reach the White Rose location are the 100 tidewater glaciers of West Greenland. Between 10,000 and 15,000 icebergs are calved each year, primarily from 20 major glaciers between the Jacobshaven and Humboldt glaciers. These glaciers account for 85 percent of the icebergs that reach the Grand Banks. According to the International Ice Patrol, the number of icebergs reaching the Grand Banks each year has varied from a low of 0 in 1966 to a high of 2,202 in 1984, with the average over the last 10 years being approximately 900 icebergs. Of these, only a small proportion pass through the White Rose area. Over the last 10 years, the average yearly number of icebergs sighted in the 1^0 grid containing White Rose has been 47. The maximum number of iceberg sightings was 217 in 1990. The number of icebergs peaks in May, but is at relatively high levels from March to June.

5.1.1.4 Geology

The Grand Banks are largely underlain by crystalline and meta-sedimentary rocks of the Avalon terrain, which contain structural fabrics imposed by Caledonian and Hercynian deformation episodes. Side scan sonar images of the White Rose area indicate the surficial geology is a thin veneer of fine to medium grained sand over a coarser substrate of gravel and gravelly sand. Variable concentrations of benthic organisms (such as, starfish, brittle stars and bivalves) and cobbles are present. The seabed is relatively stable, with relatively little sedimentary transport within the region. The only seabed features are related to seabed disruption by iceberg scouring or dragging of otter trawl doors during fishing activities. The White Rose area is one of relatively low seismic activity.

5.1.1.5 Shoreline Environment

Newfoundland's eastern coastline is generally characterized by rocky headlands and steep cliffs with few, discontinuous pocket beaches and baymouth bars (that is, barachoix). The shoreline varies from being deeply indented to straight with few embayments. To a large extent, the development of this coastline has been strongly influenced by the effects of the last glaciation, as reflected by the predominantly pebble-gravel beaches in the coastal backshore areas and the rarity of sand-dominated beaches along the shoreline. Rivers in the study area are typically small in total volume discharge, with a strong seasonal variation resulting from the annual cycle in precipitation. The tides experienced along the coastlines are moderate in size, with normal tidal heights of approximately 1 m. Pack ice is common along the shoreline from mid-March to late April.

5.1.1.6 Chemical Environment

The concentration of dissolved oxygen in the Grand Banks water column is fairly uniform during the spring with a mean surface value of approximately 8 parts per million (ppm), decreasing to approximately 7 ppm near the bottom. Suspended particulate matter in the water column ranges from 0.01 to 2.77 mg/L and is within ranges reported for other ocean environments. Water samples collected at the Terra Nova oilfield site indicate a mean value of total suspended solids of 2.26 mg/L at the surface and 2.17 mg/L near the bottom.

Detectable trace metal levels are typical of open water areas. Polycyclic aromatic hydrocarbon concentrations at the Terra Nova site were below detection limits; however, other hydrocarbons were detected. The source of the hydrocarbons was suggested to be from atmospheric fallout of aromatic compounds rather than near by point-source emissions.

Sediments on the Grand Banks are generally homogeneous, both physically and chemically. On a regional scale the seabed is relatively homogenous and primarily composed of sand and gravel. Hydrocarbons are ubiquitous in marine sediments and are commonly found in marine phytoplankton. On the Grand Banks, hydrocarbon levels are generally at very low background concentrations.

5.1.2 Regional Setting (Biological Environment)

The Grand Banks ecosystem is a complex and dynamic system, driven by numerous physical, chemical, biological and anthropogenic influences. This section provides an overview of important ecological relationships on the Grand Banks.

5.1.2.1 Commercial Fish and Fish Habitat

Plankton (that is, organisms that drift with water currents) found on the Grand Banks, include microrganisms, algae, juvenile and adult invertebrates, and many species of fish eggs and larvae. Aggregations of plankton are often exploited by feeding fish, seabirds, baleen whales and other predators.

Benthos refers to plants and animals that live in or on the sea bottom. At least 370 benthic species, including polychaete, echinoderm, crustacean (such as scallop, crab and lobster) and mollusc, occur on the Grand Banks. Benthic animals form an important food resource for many species of fish.

Fish are not only an important food source for humans, but are also important ecologically as predators and food for other species. A variety of fish species occur in the White Rose area. However, these species are not unique as they also occur in various other parts of the Grand Banks and elsewhere The White Rose site is located within the North Atlantic Fisheries Organization (NAFO) Unit Area 3Lt. Recent years have seen a significant increase in the value of commercial fish landings in the area, with landings valued at $1.74 million in 1998. During that year, snow crab comprised 98 percent ($1.7 million) of this catch value, followed distantly by porbeagle shark and Atlantic cod. Other species that are or have been important to fishing activity in the project area and adjacent region include Iceland scallop, northern shrimp, Stimpton’s surf clam, yellowtail flounder, short fin mako shark, Greenland halibut, American Plaice, Atlantic halibut, various redfish species, capelin, swordfish, bluefish and bigeye tuna, American lobster, Atlantic salmon, witch flounder, short-finned squid, haddock, grenadier and Atlantic herring. A number of additional species have also been identified as potential commercial fish species in the area. They include various species of wolffish and skate, monkfish (or goosefish),

white hake and winter flounder. There appears to have been a recent shift in the species composition on the Grand Banks, with a decline in stocks for a number of species in addition to Northern cod.

5.1.2.2 Marine Birds

The Grand Banks and the southeastern coast of Newfoundland are very important areas for over 60 species of marine birds, including puffins, guillemots, ducks, razorbills, murres, turns, gulls, jaegers, storm-petrels, shearwaters, sand pipers and gannets. Of these 60 species, approximately 18 are pelagic (that is, living or feeding on the water), nine of which nest in the study area. There are several million of these nesting birds, and there are millions of annual visitors that forage on the Grand Banks. In addition, a wide variety of coastal species, including gulls, terns, cormorants, waterfowl and shorebirds frequent shoreline areas in the study area. Marine birds in the study area eat a variety of prey, including capelin, copepods, amphipods and short-finned squid, and different species forage at different water depths. Several endangered or threatened bird species also occur in or near the area, including harlequin ducks, piping plovers, ivory gulls, manx shearwaters and common black-headed gulls.

5.1.2.3 Marine Mammals and Sea Turtles

Eighteen species of marine mammals are known to occur in the study area, including 14 species of whales and dolphins and four species of seals. A few additional species may also visit the area, but these are not considered important components of the ecosystem because of their infrequent presence. Although most species are seasonal inhabitants, the waters of the Grand Banks and surrounding areas are important feeding grounds for some.

Six species of baleen whales occur in the area: humpback, blue, fin, sei, minke and, possibly, North Atlantic right whales. Although nearly all of these species experienced a decline in numbers due to whaling, it is likely that some are recovering. However, the humpback, blue and fin whales are still listed as vulnerable, and the North Atlantic right whale is listed as endangered. In addition, eight species of toothed whales are found in the region (sperm, northern bottlenose, killer and long-finned pilot whales, common, Atlantic white-sided and white-beaked dolphins, and the harbour porpoise). Most of these marine mammals occur seasonally in the study area and little is known regarding their distribution and population size in these waters. Of the toothed whales found in the study area, the harbour porpoise is listed as threatened and a population of the northern bottlenose whale is considered vulnerable. In addition, grey, harp, hooded and harbour seals occur in the study area at various times of the year. The main diet of seals consists of fish, and invertebrates such as squid and shrimp.

While sea turtles are rare on the Grand Banks, and particularly in the cold water of the White Rose area, three species (leatherback, loggerhead, and Kemp's ridley) are known to occur in the area. The leatherback turtle is listed as endangered by the Committee on the Status of Endangered Wildlife in Canada. The United States National Marine Fisheries Service and Fish and Wildlife Service both list the leatherback turtle and Kemp's ridley as endangered, and the loggerhead turtle as threatened.

5.2 Effects, Mitigative Measures and Monitoring

5.2.1 Effects Assessment

5.2.1.1 Fish and Fish Habitat

During all phases of the White Rose development, project-related structures will be protected by a safety zone and a no-fishing zone. The safety zone for White Rose will be approximately 100 km^2 in total area, encompassing a regulated 500 m buffer around the FPSO facility and each well and a 9.5 km (5 nautical miles) cautionary area. The actual no-fishing zone will be approximately 15.4 km^2, creating a refuge where fish, including commercially important species, could be attracted to the subsea structures and become concentrated. The reef effect and the no-fishing zone acting together at White Rose could also have a positive effect by allowing recovery of the benthos in the area.

Fish may be attracted to illuminated surface waters near the vessels. However, only low numbers and localized areas will be affected and mortality will not increase to any noticeable degree. No underwater blasting is anticipated during construction, however, some excavation and other forms of bottom preparation will be required. Effects of underwater construction on benthos are likely to be negligible because the disturbance will occur over relatively small areas and recolonization is expected to be rapid. Underwater construction may temporarily displace fish and periodic maintenance may disturb some resident fish in the immediate area, but these effects would be negligible.

All development drilling within the White Rose development area will be conducted using water-based or synthetic-based drilling muds. Husky Oil plans to drill primarily with water-based muds. However, synthetic-based muds will be used in difficult or highly deviated areas or to avoid formation damage in the reservoir section.

Drilling muds will be reused and, when they are no longer useable, they will be returned to shore for disposal. Drill cuttings will be removed from the muds and discharged at sea. Drill cutting disposal is expected to be confined within 500 m of the drilling area. Due to the low toxicity of the drilling muds used and small number of wells drilled each year in the development area, the oil concentration in sediments will remain low. Effects on benthos are expected to be low, with small areas experiencing low to high effects. Any fish tainting is expected to be limited to those fish residing in the no-fishing zone or those attracted to the subsea structures.

Produced water, although treated prior to release, could slightly affect water quality downstream of the release point. However, the area affected will be relatively small. Any direct effects to fish and fish habitat as a result of produced water will be negligible and not significant.

The FPSO will have segregated ballast tanks to prevent contamination of ballast water with oil. Cooling water may be discharged at temperatures of approximately 30°C above ambient and is expected to have negligible effects to marine life. Other fluids, such as deck drainage, bilge water, and sanitary and domestic waste will be treated, tested for compliance and discharged. Solid non-hazardous and hazardous wastes will be appropriately contained and transported to shore for disposal. Effects of such discharges will not significantly affect fish and fish habitat.

The effect of atmospheric emissions is expected to be negligible, because emissions of potentially harmful materials will be low and they will be rapidly dispersed in the atmosphere. Flaring will occur only during short term well testing operations, drilling or operational upsets on the production facility. The FPSO facility turbines will burn fuel gas from the process stream as its primary fuel source, and equipment will be carefully selected and maintained to minimize the amount of noxious gases in emissions. All additional produced gas will be reinjected into the reservoir.

As fish are often attracted to offshore drilling platforms, it appears they can adapt well to noises associated with offshore oil exploration. Effects of a passing supply vessel will be transitory and no greater than that of a passing fishing boat. Disturbances to fish from vessel and aircraft traffic, and drilling platforms will have negligible effects. Similarly, transporting the oil to the nearest shipping lane is expected to have a negligible and not significant effect on fish and fish habitat.

The White Rose site will be abandoned at the end of the production life and will be restored to minimize residual effects on the environment. During this phase, there will be some minor disturbance to the sea floor. The most important effect on fish will be terminating the no-fishing and safety zones, if in fact they constituted a refuge. Assuming a diverse commercial fishery operates in the area, conditions should revert to those before development and overall there will be no adverse effect. If some structures remain projecting above the seabed, there will be a positive, very localized effect on fish populations in the area, provided these structures are protected from trawlers.

In the unlikely event of a major oil spill or blowout, juvenile and adult fish can and probably will avoid any oil by swimming from the blowout/spill region. Some eggs and larvae could be affected if they come in contact with a high enough concentration of dissolved oil. Should an accidental event occur, effects of oil spills on fish are predicted to be negligible to low as fish will generally avoid any interactions with the spill. This conclusion is consistent with the findings of both the Hibernia and Terra Nova environmental assessments, which concluded that neither surface spills nor subsea blowouts posed significant risks to either pelagic or demersal fish stocks.

Cumulative effects associated with the White Rose project are expected to be not significant for fish and fish habitat. This includes cumulative effects due to the combined interaction of project's environmental effects, as well as interaction between the White Rose project and other offshore projects and activities. Activities (for example, discharge of drill cuttings, produced water and noise) associated with all three oil development projects (Hibernia, Terra Nova and White Rose) on the Grand Banks will have similar effects on the biophysical environment. The effects of each of these developments both individually and combined are predicted to be not significant for fish and fish habitat. Fish and fish habitat will likely recover within a few years after any disturbance caused by oil developments as currently proposed for the Grand Banks. The no-fishing zones associated with offshore oil developments will positively affect fish, but may negatively affect fisheries as fishing will be excluded in some areas. In the long term, these effects may cancel each other or may have a positive effect.

The commercial fisheries of the Grand Banks are diverse and extensive, and have contributed to effects on fish populations in the area. Assuming that the commercial fishery resource is managed in a sustainable manner by the resource agencies, the cumulative effect of the fishery and offshore development on fish and fish habitat will be not significant. Oil development projects will all have associated vessel traffic, as will exploration activity on the Grand Banks. Offshore oil activity will add an incremental amount of tanker traffic. The cumulative vessel activity of Grand Banks oil developers, including White Rose, Hibernia, Terra Nova and expected exploration activity, will probably comprise less than 25 percent of the total international traffic on the Grand Banks and less than 3 percent when domestic vessels and fishing vessels are considered. Overall, cumulative activity of Grand Banks oil developers on fish and fish habitat will be negligible and not significant.

5.2.1.2 Marine Birds

The presence of vessels (including the semi-submersible drill rig) involved in the development and production phases could potentially disturb and/or attract marine birds. Birds that are active at night, most notably storm-petrels, may be attracted to light sources on offshore facilities and/or may be incinerated by gas flaring. Reasonable effort will be made to allow seabirds found stranded on boats and other offshore structures to recover and be released at night near minimal lighting. The increased availability of food due to the artificial reef and no-fishing zone, the presence of a roosting area at sea and the discharge of human wastes may also attract seabirds. Effects due to the presence of vessels and structures during operations are expected to be negligible, while the effects of lights on seabirds during the development and operations will be low. Vessel and aircraft traffic near seabird colonies could cause disturbance and affect productivity at these sites. However, any such effects would be negligible to low as vessels will be required to maintain a distance of 2 km from any seabird colonies, and aircraft will be required to fly at a minimum altitude of 600 m, when possible, and avoid repeated overflights of bird colonies and concentrations.

The discharge of drill cuttings and other materials during development and production will have negligible to low effects on seabirds. Drill cuttings will be discharged to the seafloor, offering little

opportunity for interaction with birds on the surface. Drilling muds will be reused until they are no longer usable and then they will be transported to shore for disposal. Other fluids, such as deck drainage and bilge water, will be treated (or diluted), recycled or discharged below the water surface. Sanitary and domestic wastes will be treated before discharge, however, seabirds (most notably gulls) may be attracted to this potential food source. Any such effects would be of low magnitude.

The effect of atmospheric emissions is expected to be negligible because emissions of potentially harmful materials will be small and they will be rapidly dispersed in the atmosphere.

The principal sources and potential effects of underwater noise during production will be similar both during the development and operation phases. The noise produced from the FPSO facility will have negligible effects on seabirds; some species will be attracted to the light and some will avoid the noise created by the structure. Direct effects on other species are unlikely because seabirds are highly mobile and can easily avoid the stationary FPSO facility.

The White Rose site will be abandoned and restored to near pre-development conditions at the end of its production life to minimize potential residual effects on the environment. Increased vessel activity during periods when facilities are being removed may cause some disturbance to seabirds, but this will occur over short periods of time and have a negligible effect. A positive effect on marine birds will be realized due to the cessation of activity in the project area.

Accidental events resulting in a substantial release of oil would have serious effects on seabirds. Therefore, it is mandatory to have stringent preventative procedures, practices and technologies in place to prevent such occurrences. While the probability of a large spill or blowout is very small, birds would be at significant risk should one occur. Birds are seriously affected by direct contact with oil, and most birds that come in contact with an oil spill subsequently die. As significant numbers and concentrations of birds occur on the Grand Banks, any oil spill or blowout could cause at least some and, at worst, extensive bird mortality. There is no clear correlation between the size of an oil spill and numbers of seabirds killed. The density of birds in a spill area, wind velocity and direction, wave action, and distance to shore may have a greater bearing on mortality than size of the spill.

The probability of a large spill is very low and of the numerous spill modelling scenarios created, none predicted that oil would be driven close to shore. Therefore, it is extremely unlikely that crude oil accidentally spilled at the White Rose site will reach any seabird colonies in the study area. Due to the makeup of the White Rose crude and its waxy nature, the crude oil will be persistent. It will tend to form water, particles and “wax” balls rather than creating a continuous slick.

Seabirds are known to associate with offshore structures and are at risk of exposure in the unlikely event of an accidental release of oil at the White Rose site. During summer, shearwaters, gulls (including kittiwakes), storm-petrels and fulmars would be the species most likely exposed to oil near the release point. The oil spill trajectory models predict that oil would likely move east and southeast of the White

Rose release point. It is unlikely that oil would move into the central and western portions of the Grand Banks. However, during May and June there is an increased likelihood (still relatively low) that oil would be found along the southwestern depth contours of the Grand Banks. Oil would probably not extend into the southeast shoal, so the large numbers of greater shearwaters and Wilson's storm-petrels and smaller numbers of sooty shearwaters, that moult and forage there during the summer, would probably not be exposed to oil accidentally released at the White Rose site. During winter, large numbers of alcids, most notably thick-billed murres and dovekies, could die from exposure to oil from an accidental spill or blowout at the White Rose site. The exact location of their wintering areas is unknown and likely varies from year to year. It is possible that oil could pass through a substantial portion of those wintering areas, having an effect on large numbers of alcids.

Effects on marine birds due to the White Rose project will be similar to these for Hibernia and Terra Nova, with some types of disturbance (for example, flights and noise) being caused by seismic exploration, marine transportation and fishing vessels. The cumulative effects of the three projects (both individually and a combined) are expected to be not significant. Legal and illegal hunting of marine birds also places pressure on populations on the Grand Banks. However, the Newfoundland saltwater hunt focuses on thick-billed murres (or turrs) and only a portion of the murre population is found offshore. This portion of the murre population will interact with ongoing projects and exploration activity. Overall, the cumulative effects of activity on the Grand Banks (in combination with hunting activity) on marine birds will be not significant.

5.2.1.3 Marine Mammals and Sea Turtles

Potential effects on marine mammals are mainly due to the noise produced by offshore structures and activities. Marine mammals typically are more tolerant of fixed location noise sources, such as a semi-submersible drill rig and FPSO facility, than moving sources. Effects of drilling operations on marine mammals are expected to be negligible to low and will be localized around the drill site. As the production activities will continue for 12 to 14 years, habituation may occur and effects may be reduced to low. Effects will last for the duration of project operations.

Some species of marine mammals will avoid boats and supply vessels, whereas others, such as dolphins and seals, are quite tolerant and may even approach passing vessels. Potential effects on mammals can be reduced if boats maintain a steady course and speed, whenever possible, and avoid areas with large numbers of marine mammals. The effects of vessel traffic on marine mammals during development and production will be low.

The discharge of drill cuttings and other fluids, such as produced water, during development and production will have a negligible effect on marine mammals because these substances will be recycled, treated and/or discharged below the water surface. Drilling muds will be reused until they are no longer usable and then they will be transported to shore for disposal.

The effects of project development, production and decommissioning on sea turtles are expected to be similar to those for marine mammals. Overall, the project will have an adverse, but not significant, effect on sea turtles during all project phases.

The White Rose site will be abandoned and restored at the end of production to minimize effects on the environment. Although decommissioning activities may create some short term disturbance and negligible effects within relatively short time periods, overall, a positive effect on marine mammals may occur as a result of stopping project activity.

Whales are not considered at high risk to the effects of oil exposure, however, whales present in the study area could suffer sublethal effects through oiling of mucous membranes or the eyes if they swim through an oil-contaminated area. These effects are reversible and would not likely cause permanent damage to the animals. There is a possibility that the baleen of whales could be contaminated with oil, thereby reducing filtration efficiency. However, effects would be minimal and reversible. Also, there is little chance that oil will reach the southeast shoal of the Grand Banks where baleen whales, like humpbacks, are known to concentrate to feed on capelin. Whales are present on the offshore portions of the Grand Banks in low numbers at certain times of the year. Therefore, only small proportions of populations are at risk at any time.

Likewise, seals are not considered at high risk to the effects of oil exposure, but some evidence implicates oil spills with seal, particularly young seal, mortality. The majority of seals present in the study area are associated with the edge of the pack ice. In average years, the ice edge extends no closer than several hundred kilometres north of the White Rose area and then only for several months of the year. The oil spill trajectory models indicate that after the oil moves away from a release point at White Rose, it will likely be found to the east and southeast of White Rose. Therefore, it is highly unlikely that oil accidentally released at the White Rose site will reach the ice edge during years with average ice conditions. Few seals are expected to be exposed to oil from an accidental release at the White Rose site and most seals do not exhibit large behavioural or physiological reactions to limited surface oiling, incidental exposure to contaminated food or ingestion of oil.

Sea turtles are rare on the Grand Banks and particularly rare in the cold water of the White Rose area. Although there are no reliable data on sea turtle abundance and distribution on the Grand Banks, at-sea observer data collected by the U.S. National Marine Fisheries Service (NMFS) for the pelagic longline fishery provide some insight. During late summer to early fall, some sea turtles may occur on the Grand Banks. However, most sightings have occurred well west of the White Rose site. There is little chance that sea turtles will be exposed to oil from an accidental release at White Rose. Effects of oil on sea turtles may be reversible, but there is a possibility that foraging abilities may be inhibited by exposure to oil.

Depending on the time of year, location of marine mammals and turtles within the study area, and type of oil spill or blowout, the effects of an offshore oil release could range from negligible to low.

Cumulative effects on marine mammals will be mainly related to noise caused by the offshore oil developments and other offshore activities, and are anticipated to be not significant.

Given the amount of commercial shipping and fishing activity that presently occurs on the Grand Banks, it is assumed that the underwater environment is already noisy. The noise made by the oil and gas industry (FPSOs, supply boats, drilling rigs and seismic exploration) will add to the underwater ambient noise levels on the Grand Banks. However, the incremental noise created as a result of the White Rose project will not likely affect overall noise levels. The cumulative increase in levels of low frequency ambient noise associated with oil and gas development of the Grand Banks will not be appreciable and, in many cases, will be masked by natural events. In the absence of masking, it is possible that animals will be disturbed by the anthropogenic noise sources from industry. Based on studies in other areas, marine mammals would have to be close (within a few kilometres) to the actual sources of noise from oil and gas activities to be affected by them. Thus, the cumulative effects on marine mammals will be from a few isolated sources of noise rather than combined effects over a large area and will be not significant.

5.2.2 Mitigative Measures

Mitigation measures planned for the development, operation and decommissioning phases of the White Rose development to minimize potential effects on fish and fish habitat, marine birds, marine mammals and turtles include:

- using water-based drilling muds, where practical;
- recycling synthetic drilling muds and other drilling-related fluids/solids;
- treating cuttings;
- treating drilling-related fluids, deck drainage, bilge water, sanitary and domestic wastes, cooling water and produced water;
- transporting garbage to shore;
- developing a waste management plan to provide guidance for addressing all offshore wastes;
- designing equipment to reduce atmospheric emissions; and
- preparing a contingency plan to mitigate and remediate effects of offshore oil spills.

Additional mitigation measures proposed for fish and fish habitat include:

- no blasting activity during underwater construction activities;
- selecting materials/methods to reduce effects during underwater maintenance; and
- removing subsea equipment at abandonment to minimize residual effects.

Additional mitigation measures for marine birds include:

- releasing stranded birds that are attracted to surface structures and lights;
- establishing a 2-km avoidance zone around bird colonies for ships and boats; and
- requiring helicopters to avoid colonies and repeated overflights of bird concentrations and/or important bird habitat.

Additional mitigation measures for marine mammals include:

- requiring ships and boats to avoid concentrations of marine mammals;
- requiring ships and boats to maintain a steady course and speed, when possible; and
- requiring helicopters to fly at a minimum altitude of 600 m whenever possible.

5.2.3 Monitoring

EEM programs are designed to verify effects predictions made during the environmental assessment, assess the effectiveness of the implemented mitigation measures, provide an early warning of changes in the environment, facilitate project planning and continuous improvement and, ultimately, to improve the understanding of environmental cause and effect relationships.

Husky Oil will undertake a comprehensive EEM program for the White Rose development. A regional monitoring program is being considered in conjunction with Hibernia and Terra Nova. The development of an appropriate EEM program will include review by relevant government departments through the C-NOPB's approval process. An EEM program is an integral part of the follow-up program required by CEAA.

Proposed components of the EEM program include:

- sediment quality (toxicity, chemistry and benthic community analysis);
- water quality and primary productivity; and
- fish body burden, taint and health.

Husky Oil conducted a supply vessel-based seabird monitoring program in conjunction with the 1999 drilling program and continued this program in 2000. Husky Oil will continue to review this program throughout the development phase of the project and, based on the program results, will make a decision as to whether or not to continue the monitoring program during the operations phase.

Husky Oil conducted a baseline characterization program in the summer of 2000, consisting of a biological cruise in July and a sediment (benthic) cruise in September. The primary purpose of the biological cruise was to collect American plaice and snow crab samples to conduct body burden analyses and multi-function oxygenase/histopathology/haemotology (in American plaice only). Snow crab were selected due to the abundance indicated on the video tapes [see above]. American plaice were selected as the species common to all three sites (White Rose, Terra Nova and Hibernia) to allow for possible future common EEM programs; American plaice were also found to be numerous in the White Rose Area.

The primary purpose of the sediment cruise was to collect sediment samples for chemistry and toxicity analyses and identification of benthic infaunal invertebrates. Any epibenthic species on the surface of each core was identified. Water samples were also taken for chemical analyses at 25 percent of the sediment sample stations and conductivity-temperature at depth casts were taken at 50 percent of the sediment sample stations. The core samples were all sand, supporting the conclusion that the sediment is very similar to Hibernia. The results identified during cruises were consistent with, and provide additional validity for, data used in the EIS (Comprehensive Study Part One).

In the event of a major oil spill, Husky Oil will also implement a dedicated EEM program to determine the effects of any major spills, focusing primarily on marine birds, but also including fish and marine mammals. The structure of the monitoring program will follow the structure of the EEM program established for routine production activities at White Rose. The decision to implement such a program will be made after consultation between Husky Oil and the C-NOPB, and will be based on the circumstances of the spill. In addition, as per DFO's Policy for the Management of Fish Habitat, any habitat compensation measures will be monitored and addressed.

Compliance monitoring will be conducted to verify adherence with applicable legislation and conditions of regulatory approvals. Compliance monitoring will primarily involve monitoring for conformance with the discharge limits identified in the 1996 Offshore Waste Treatment Guidelines. Monitoring programs will be developed to measure and report on waste discharges that are treated according to the guidelines.

5.3 Residual Effects

The overall residual environmental effects of project development and operations on fish and fish habitat, marine birds, marine mammals and sea turtles are assessed as primarily adverse, but not significant. There is also potential for some positive effects on fish and fish habitat. Predicted residual environmental effects associated with decommissioning are predicted to be positive for fish and fish habitat and marine birds, marine mammals and sea turtles. For an accidental release of oil at the White Rose site, the predicted residual environmental effects on fish and fish habitat, marine mammals and sea turtles are adverse, but not significant. For marine birds, the predicted residual environmental effects of an accidental oil spill are adverse and significant. While the probability of a major oil spill is very low, should one occur, it would have a significant adverse environmental effect on marine birds.

In summary, after mitigation measures have been incorporated into project activities, the predicted effects on the biophysical environment are assessed as not significant, with the exception of the potential effect of major offshore oil spills on marine birds.

5.4 Environmental Management System

Environmental management planning brings together information from the Development Plan, environmental and socio-economic assessments, and Husky Oil's Health, Safety and Environment Policy and Loss Control Management System.

Based on the C-NOPB guidelines (1988), a dedicated section on environmental protection planning is required in a DA. However, in the 12 years since the guidelines were published, comprehensive EMS (or health, safety and environment) have been adopted by most industries. In fact, EPPs were the precursors of EMS. However, today an EPP is only one aspect of an overall system guided by a policy driven by a company's top leaders.

Husky Oil has developed and implemented a Health, Safety and Environment Policy that guides the company in all aspects of its business. The policy, plus the programs and procedures that support it, assist Husky Oil in being both responsible and duly diligent in its stewardship of health, safety and environment. This Husky Oil policy is endorsed by the Chief Executive Officer, other officers of the corporation and by the East Coast Operations Manager.

A key document, which supports the Health, Safety and Environment Policy statement, is Husky Oil's East Coast Operations *Health, Safety and Environmental Loss Control Management Performance Standards*.

The key elements of the system include:

- functional/departmental responsibility for health, safety and environment;
- employee rights;
- individual responsibility for health, safety and environment;
- quality assurance;
- organizational rules;
- environmental clauses for contractors;
- environmental audits, including health, safety and environment inspections and preventative maintenance;
- environmental performance targets for atmospheric emissions, discharges, solid wastes and hazardous/dangerous materials handling;
- mitigation measures for routine activities;
- chain of command for environmental decision-making;

- environmental protection procedures;
- EEM procedures and reporting;
- environmental compliance monitoring practices and reporting; and
- optimization measures for the fishing industry.

6 SOCIO-ECONOMIC IMPACT STATEMENT

The SEIS (Comprehensive Study Part Two) presents the results of the socio-economic assessment conducted for the White Rose oilfield development. The assessment reflects the primary comments and issues raised by stakeholders, the scoping document issued by the regulatory agencies, CEAA and C-NOPB guidelines (1988). This section provides an overview of the existing socio-economic conditions in the various study areas, results of the effects analysis (including cumulative effects analysis), and proposed mitigation measures and monitoring programs.

The geographic scope of the assessment is primarily provincial, with more detailed studies of areas most likely to experience direct effects from the White Rose oilfield development. These areas include the St. John's Census Metropolitan Area, Isthmus of Avalon area (an approximate 50-km zone centered on Bull Arm) and Marystown area (50-km commuting zone from Marystown). The analysis of the fisheries also includes North Atlantic Fisheries Organization (NAO) Unit Area 3Lt.

The assessment approach involved:

- issues scoping and consultation;
- identifying VECs (business and employment, community social and physical infrastructure and services, and fisheries);
- describing the major characteristics of the existing environment for each VEC;
- identifying socio-economic environment-project interactions;
- analyzing the nature and extent of the potential environmental effects, including cumulative environmental effects;
- identifying effects management measures to address potential effects;
- evaluating the nature and extent of the residual environmental effects after design and considering effects management strategies; and
- identifying monitoring and follow-up initiatives.

6.1 Existing Social and Economic Setting

The 1990s were something of a "roller coaster" for the provincial economy and this is reflected in a number of performance indicators. Positive developments in the offshore oil industry (Hibernia) were offset by the declaration of moratoria on fishing for northern cod and other groundfish species. A major consequence of the fishery closure has been a declining population since 1991-1992, particularly in rural Newfoundland and Labrador. During the same period, the value of mineral, newsprint and manufacturing shipments increased and, by 1995, there were indications that the economy was starting to rebound. However, through 1996 and 1997, gross domestic product (GDP) declined as a result of the wind-down of the Hibernia construction project, declining value of newsprint shipments and declining

fish landings. Out-migration increased and by 1997-98, it had reached a peak of 9,490 residents, the highest in 20 years.

In 1998 and 1999, Newfoundland posted the strongest economic growth of any province. A growth of 5.3 percent in the province's real GDP was led by gains in exports and capital investment, both of which reached record levels. Economic gains included increases in offshore oil activity, crab and shrimp landings, construction activity, tourism and manufacturing.

6.1.1 Business and Employment

The province's economic growth was reflected in the labour market, with a 1999 unemployment rate of 17 percent, down from 18 percent in 1998. There were job gains in the fisheries, retail trade, construction, tourism and transportation industries.

The St. John's area has shared the economic success enjoyed by the province. Recent years have seen increasing employment in the region, and in 1999 the area's unemployment rate was 10 percent. These declines in the unemployment rate reflect, in part, the important contribution the offshore oil industry is making to the St. John's area economy. St. John's has been the primary location for administrative, engineering, regulatory, training, supply base, air transportation and service activities for the east coast oil industry.

Economic conditions in the Isthmus of Avalon area have fluctuated over the years, reflecting changes in the provincial economy, fishery and major industrial projects within and close by the region. In 1996, the Isthmus area had a population of 17,940, a labour force to 7,875 and an unemployment rate of 24 percent. The Isthmus area has been involved with the offshore oil industry over the last decade (the Bull Arm construction and fabrication facility and the Newfoundland Transshipment Terminal).

The economy of the Marystown area has also fluctuated over the years, depending on fishing, fish processing and the shipyard. In 1996, the region had a population of 12,552, a labour force of 5,465 and an unemployment rate of 34 percent. The Marystown shipyard is the largest shipbuilding and repair facility in the province, and has resulted in Marystown being involved in the Newfoundland oil industry since its early years.

6.1.2 Community Social Infrastructure and Services

Local residents value community infrastructure and services insofar as the quantity and quality of those services in a community contribute to the overall standard and quality of life.

6.1.2.1 Education

In recent years, the province has seen a decline in the number of schools, students, teachers and student-teacher ratio. During the 1999-2000 school year, there 343 schools in Newfoundland and Labrador, with 93,957 full-time students. The student-teacher ratio as of 1998-1999 was 1:15. Post-secondary education in the province is provided through Memorial University of Newfoundland, College of the North Atlantic and 54 registered private training institutions.

Primary and secondary education in the St. John's area is administered by the Avalon East School Board. In 1998-1999, there were 74 schools in the St. John's study area. The number of schools in the area has decreased in recent years, due to changing demographics and consolidation. In 1998-99, there were 31,745 primary and elementary students in the area, with recent years seeing steadily decreasing enrollments in area schools. Statistics on school capacity are not available, although in general, supply continues to exceed demand.

The Isthmus of Avalon and Marystown areas have also seen a decrease in primary and secondary schools and in student enrollment. There were 12 primary and secondary schools in the Isthmus of Avalon area, with 2,719 students in 1998-99. During the same year, there were six primary and secondary schools in the Marystown area, with a total student enrolment of 2,423. The College of the North Atlantic has a campus in Burin.

6.1.2.2 Health and Community Services and Infrastructure

Health and community services in Newfoundland and Labrador are administered by the provincial Department of Health and Community Services. The total health care expenditure in the province in 1999 was forecast to be $1.4 billion, up from $1.3 billion in 1995. There are currently 36 hospitals and 19 nursing homes in the province. The level of service, as defined by the number of nurses and doctors per capita, is comparable to other Canadian provinces. In 1998, the overall physician-to-population ratio was 1.7 physicians per 1,000 persons and the registered nurse-to-population ratio was 9.8 per 1,000 persons.

The St. John's area has a number of acute and long-term health care facilities and one health care centre. The Dr. G.B. Cross Memorial Hospital in Clarenville serves the Isthmus area. The Marystown area has one acute-care facility, the Burin Peninsula Health Care Centre.

6.1.2.3 Social Assistance and Employment Services

The Department of Human Resources and Employment is the provincial agency responsible for income support through social assistance and employment-related services. In the St. John's area, there is a St. John's Region office, three district offices within the City and others on Bell Island and in Conception Bay South. The District Office for the Isthmus of Avalon area is located in Clarenville, while the office for the Marystown area is located in Marystown. The demand for social assistance in the St. John's and Marystown areas has increased over the past decade, while the number of social assistance cases in the Isthmus of Avalon area has declined.

6.1.2.4 Security and Safety: Policing and Fire Protection

Newfoundland and Labrador is policed by the Royal Newfoundland Constabulary (RNC) and the Royal Canadian Mounted Police (RCMP). The RNC has jurisdiction over the St. John's area, while the Isthmus of Avalon and the Marystown areas fall under the jurisdiction of the RCMP. Newfoundland has the lowest level of policing (767 officers) in Canada, which largely reflects the province's relatively low crime rates.

As of March 2000, 303 fire departments served the province, with the present number and qualifications of fire-fighting and prevention personnel considered adequate to meet existing needs. In the St. John's area, fire protection services are provided by the St. John's Regional Fire Department and volunteer fire departments in various communities. The Isthmus is served by fire departments in five local communities, while fire protection in the Marystown area is provided by volunteer departments in five local communities and a composite fire department in Marystown.

6.1.2.5 Recreation Services and Facilities

The St. John's area contains numerous recreation and leisure facilities capable of accommodating a wide range of activities. Some of the existing facilities are used to full capacity, and there is a demand for some new types of facilities. The Isthmus of Avalon area also has a range of recreational facilities, many of which are found in the Clarenville-Shoal Harbour area. Likewise, there are a number of recreational facilities in the Marystown area, with Marystown and Burin having the widest range of facilities and serving a number of the smaller communities. The facilities and programs appear to satisfy the needs of local residents.

6.1.3 Community Physical Infrastructure

Community infrastructure is valued by local residents, business and industry insofar as its quantity and quality contribute to the functioning of the local economy and society and, hence, the overall standard and quality of life.

6.1.3.1 Housing

The number of dwellings in the province has grown considerably over the past 20 years. However, the number of annual housing starts has declined. In 1996, there were 185,500 occupied private dwellings in Newfoundland, with most being owner-occupied, single-detached homes.

In 1996, there were 60,295 occupied private dwellings in the St. John's area, of which 61 percent were located within the City of St. John's itself. Much of the growth in the region continues to occur in Conception Bay South and Mount Pearl. Annual housing starts in the area have fluctuated over the last decade, with the general trend being one of decline. In recent years, the housing market, as reflected in number and value of sales, has generally improved, and vacancy rates have fluctuated widely. Social housing in the St. John's area is provided by the City of St. John's and the Newfoundland and Labrador Housing Corporation.

The total housing stock in the Isthmus Area increased by 26 percent between 1991 and 1996, with most growth occurring in the Clarenville-Shoal Harbour area. In 1996, there were 3,895 occupied private dwellings in the Marystown area, where the housing market is affected by the seasonal and annual fluctuations in employment by the main employers in the area.

6.1.3.2 Ports and Airports

St. John's Harbour is administered by the St. John's Port Corporation, a federal agency. There is approximately 5 km of available dockface. Currently, the port serves as a container and roll-on/roll-off (RoRo) terminal for vessels carrying freight between Halifax and Montreal. The A.H. Harvey wharf is used by Hibernia and Terra Nova for shore-based marine services. Overall, the port has been considerably underused in recent years, with traffic tonnage declining in the early 1990s. Cargo tonnage handled has increased in recent years, with over one million tonnes of cargo being handled in 1999.

The St. John's International Airport is the busiest commercial airport in the province. The main terminal serves scheduled national and international passenger air traffic, most charter flights and air cargo traffic. Helicopter, military and private aircraft also use the airport. Over 800,000 commercial passengers used the airport in 1999. In response to increased passenger demand and anticipated further increases, the St. John's Airport Authority is currently undertaking a $48 million redevelopment program, including runway improvements and terminal building upgrading.

6.1.3.3 Industrial and Commercial Land, Warehousing and Office Space

The dockyard in St. John's covers approximately 7.5 ha (18.5 acres) at the western end of the Port of St. John's. The dockyard is capable of providing a range of marine and offshore services. Its facilities include a graving dock, marine elevator, transfer and repair berths, mobile cranes, fabrication shops, warehousing and laydown areas. There are currently eight industrial parks in the St. John's area, with a total area of 464 ha (1,150 acres). Highway access from these industrial lands to other key infrastructure elements such as the Port of St. John's and the St. John's Airport is generally good. St. John's and Mount Pearl are the only communities in the study area with substantial amounts of commercial warehouse space. Office space for administrative and development and operations-phase activities is found mainly in St. John's.

The Bull Arm site represents the most significant industrial lands in the Isthmus area relevant to the offshore industry. While the construction/administration area is closed, the fabrication and assembly yard are currently in operation for the Terra Nova project. There are other industrial and commercial lands in the area with most concentrated in Clarenville and Arnold's Cove.

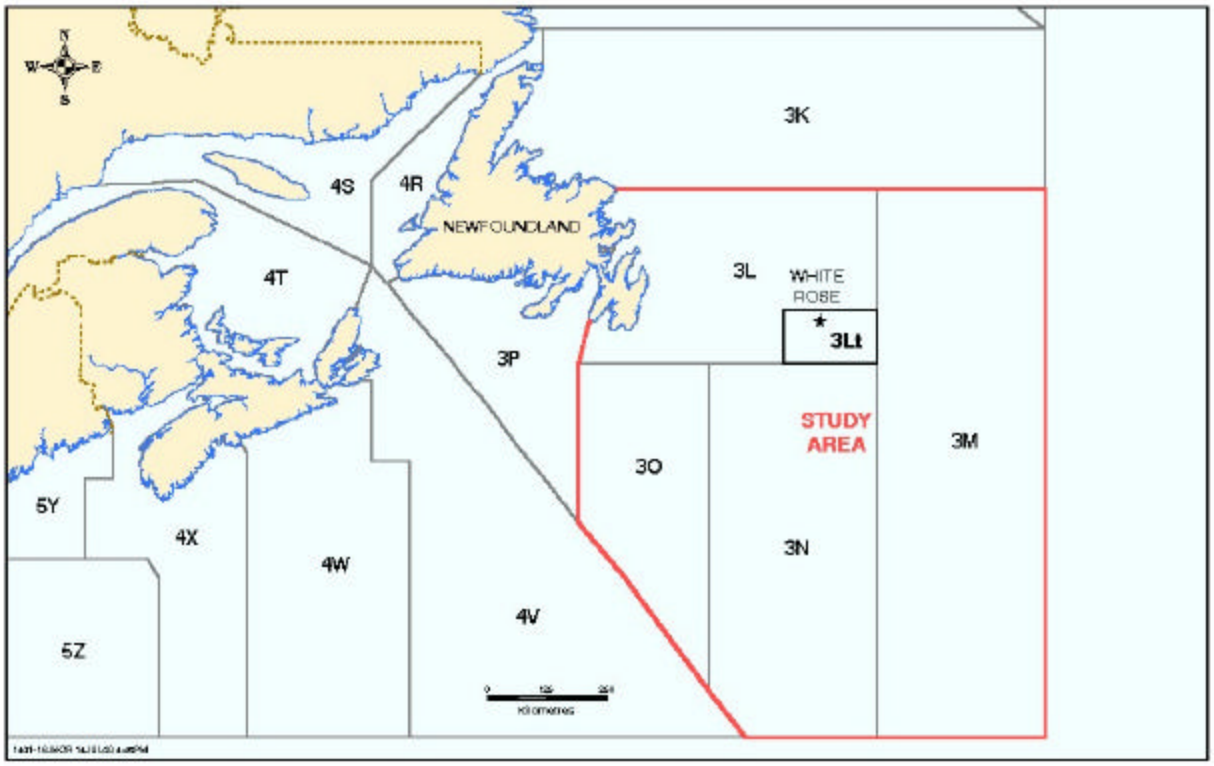
In Marystown, Friede Goldman Newfoundland Limited owns and operates the Marystown Shipyard, which handles boat construction and repair, refitting, conversion and maintenance for fishing fleet and offshore-related vessels, as well as rig component construction and outfitting. The Cow Head facility, completed in the early 1990s, handles a variety of offshore construction contracts.

6.1.4 Fisheries

Newfoundland and Labrador's fishing industry has undergone significant structural changes in the last decade following the closure of traditional groundfish fisheries, and is again highly viable. Among the Goods Industries in Newfoundland and Labrador, fisheries accounted for 35 percent of employment in 1998 and ranked second only to oil production, mining and quarrying in terms of contribution to GDP. The number of people employed in fish harvesting in Newfoundland has remained relatively stable since 1995. The annual average for 1999 was 8,700 employed, with peak employment at 10,300.

The Grand Banks fisheries have undergone substantial change since the collapse of groundfish stocks. Groundfish (mostly northern cod) accounted for 63 percent of the catch by weight on the Grand Banks in 1987. In 1998, catches of snow crab, capelin, yellowtail flounder and redfish made up the bulk of the catch (81 percent). Overall, the Grand Banks fishery was more lucrative in 1998 ($74 million landed value) than it was 11 years earlier (approximately $62 million). Grand Banks fisheries differ across NAFO Divisions (Figure 6.1-1) in terms of species harvested and their relative importance, landings, value and industry structure.

Figure 6.1-1 NAFO Divisions on the Grand Banks



The proposed White Rose project, along with the Terra Nova and Hibernia developments, is located in NAFO Division 3L, in NAFO unit area 3Lt (Figure 6.1-1). The fishery in 3L is predominantly a fixed gear fishery and is mostly conducted by Newfoundland vessels under 35 ft fishing closer to shore. The most intensive fishing activity typically occurs between June and September.

In 3Lt, the groundfish fishery (northern cod and American plaice) made up 99 percent of the catch by weight in 1987. In 1998, the fishery in this area was dominated by snow crab (98 percent of landed value). Other important fisheries (existing and anticipated) near White Rose are shrimp, Greenland halibut, and perhaps American plaice and northern cod during the later part of the operation and decommissioning phases of the project. Fishing activity has generally not been predominant in the project area, with fish catches in the project area being lower than elsewhere in 3L. Between 1992 and 1998, fish catches in 3Lt made up only 1 percent of the total catches (by volume) in 3L.

6.2 Effects and Mitigative Measures

6.2.1 Business and Employment

White Rose will have a range of positive economic effects throughout the construction/installation and operations phases in particular, but also in terms of its cumulative effects in conjunction with other offshore and industrial projects. The positive effects anticipated reflect, in part, Husky Oil's commitment to Canada-Newfoundland benefits, which will ensure that a broad range of business, employment and industrial benefits result from the project during both the development and operations phases. These will affect the province as a whole, but mainly those areas containing companies that secure construction contracts, and the St. John's area, which will be the base for operations. During the operation phase for the project, direct employment is expected to require a permanent workforce of approximately 370 to 375 persons on-shore and offshore in the first four to five years of operations. Indirect and induced employment effects will add to this.

The potential for Canadian and Newfoundland involvement in project construction and operations activity could potentially be constrained by industrial and labour capability and capacity. The business and employment effects of the project will depend not only on the existing business capabilities and labour force and how they might be increased or enhanced, but also on other cumulative demands on them. However, given the current project schedule, there will be only limited conflicts between industrial and labour requirements of White Rose and those of other major projects. The project will likely not result in negative economic effects, such as wage or price inflation.

There will be similar demands on infrastructure and labour required for operations. However, this is not viewed as problematic, given that such demand provides long-term opportunities, justifying investments in infrastructure and training. There is a high level of awareness, within the federal and provincial government, industry and training institutions of the need to plan and prepare for future labour requirements.

There will also be important secondary or multiplier effects that can be wide-ranging and long-term. The oil industry as a whole is having a transformative effect on companies and workers as they develop new skills and capabilities that make them highly competitive in Newfoundland's oil industry and elsewhere. Similarly, oil industry-related industrial infrastructure, research and education are increasing the likelihood of and potential for Newfoundland benefits from further offshore petroleum projects. Overall, the project will further contribute to this growing industry and, hence, to the further development and diversification of the Newfoundland economy.

During the development phase of the project, the St. John's area will see administrative, engineering, training, regulatory, and supply and service activity. In addition, during the operational life of the field, the St. John's area will be the administrative, engineering, training, regulatory and supply and service centre for the project. This activity, and associated indirect and induced business and employment effects, will have an important beneficial effect on the St. John's area economy.

The Bull Arm site in Trinity Bay was originally developed as the construction and fabrication facility for the Hibernia project, and has been used for the Terra Nova Development. Depending on final decisions resulting from the competitive bid process, the site could also be used for similar White Rose FPSO activity. The main local business and employment effects of any project activity at Bull Arm will fall within the daily commuting range of the site. The White Rose schedule currently could see development activity following in a timely fashion after construction, fabrication and hook-up/commissioning activity associated with the Terra Nova project. This is advantageous to Husky Oil, since it means that equipment and skills could potentially be available at Bull Arm. This will also be beneficial to the Isthmus area, in that it will result in continuity in direct and spin-off employment and business activity related to the Bull Arm facility. There may also be local business and employment benefits as a result of project operations. It appears unlikely that there will be any significant cumulative effects at Bull Arm resulting from concurrent construction/fabrication of White Rose and other project components.

The Marystown area could also be positively affected by this project through involvement in project-related work, if success is achieved through the competitive bidding process. Any such work will both provide direct and spin-off benefits to the local economy and reinforce the shipyard's position as an important oil industry facility. Any cumulative effects will depend on other work that may be ongoing at the same time, although from the perspective of the yard's owner and operator, any likely cumulative effects would be beneficial rather than adverse.

For each project phase, the potential effects on business and employment are seen as positive for the economy as a whole, the specific regions, and the workers and businesses involved. No adverse effects are anticipated or mitigative measures suggested. Rather, Husky Oil's Canada-Newfoundland benefits approach should enhance these benefits. The project is expected to add further business and employment benefits to all regions and the province as a whole. Monitoring and reporting of Canada-Newfoundland benefits commitments will be undertaken by Husky Oil, as required by the C-NOPB.

6.2.2 Community Social Infrastructure and Services

6.2.2.1 Education

Direct project effects on education at the provincial level will be limited to post-secondary training. There is already a substantial supply of trained and experienced labour, however, ongoing training of new entrants to the industry and upgrading of those already in it will continue. It is expected that local institutions will be able to provide much of the required training. At this time, no problems are anticipated to arise from the project itself, or from cumulative activity, to which provincial post-secondary institutions could not respond.

The Hibernia and Terra Nova projects have not resulted in significant effects on schools in the St. John's area. The White Rose project is similar in design to Terra Nova and is not expected to have any substantially different effects during the construction/installation or operations phases. When all three projects are in operation, there will be a large workforce located in the St. John's area, but any increased cumulative demand on the education system is unlikely to be problematic as the changing demographics of the area continue to lead to a reduced or, at best, stable (in most cases, at lower levels than the past), demands for services. In addition, White Rose is not expected to generate any substantial demands on education in the Isthmus of Avalon or Marystown areas that the existing systems cannot accommodate.

Through its Canada-Newfoundland Benefits Plan (Volume One), Husky Oil will actively promote the employment and training of Newfoundland residents. Insofar as such training will affect the post-secondary components of the provincial system, the outcomes should be beneficial or positive for those trained and for those individuals and institutions providing the training. No significant adverse effects on the primary and secondary elements of the education system are expected either from the White Rose project itself or cumulatively with other offshore projects or other activity. There will be no significant adverse effects on education, rather, any effects should be positive. No formal monitoring or follow-up is anticipated, beyond the normal processes that post-secondary institutions follow in tracking and anticipating demand for existing and potential courses and programs.

6.2.2.2 Health and Community Services and Infrastructure

The project will lead to some small increases in demands for medical services, but these are expected to be minimal given the typical age of the workforce and the fact that operators have medical programs in place. Project activities will result in an increased workforce in the province and the study areas, and some of that workforce and their families will, at times, require medical treatment and other services. Demands associated with the workforce engaged in construction and installation will be short-term and limited to this phase, while the smaller numbers engaged in the operation phase will have long-term demands. Most demands will be associated directly with the project, but there will be some cumulative effects during the operations phase given that Hibernia and Terra Nova operations will be ongoing along with other non-oil projects. Husky Oil will monitor work and health issues on a periodic basis.

6.2.2.3 Social Assistance and Employment Services

The project will generate a range of direct and spin-off employment opportunities, thereby reducing the need for financial support. However, there may also be negative effects as the benefits of economic growth will not be shared by all and any associated inflationary effects will particularly affect those with low incomes. This would potentially increase demands for income support services. The effects of the project on social assistance and employment services in each of the study areas is expected to be small, but primarily positive. Effects of this nature are expected to occur primarily in the operation phase, as a result of cumulative effects, and particularly in the St. John's area. No formal project monitoring is recommended. The provincial department responsible for social assistance and employment support programs have in place mechanisms to assess and address program needs.

6.2.2.4 Policing and Fire Protection

As with any other industrial or business activity, there is a potential for project-related activities to require policing or fire protection services. There has been no suggestion or evidence that Hibernia or Terra Nova have affected the nature or level of crime, or the demands for policing services or fire protection, in the St. John's, Isthmus of Avalon or Marystown areas. White Rose, even when the cumulative effects of multiple project operations are considered, is not expected to change this. Data on events and needs are collected on a regular basis by the relevant policing and fire-protection authorities as part of their normal mandate and planning activities. No additional monitoring or follow-up is anticipated or proposed.

6.2.2.5 Recreation Services and Facilities

The project will result in some in-migration and increased demand for access to recreation facilities and programs, primarily during the operation phase. These effects will mainly be experienced in the St. John's area. However, the magnitude of these effects will be small and existing facilities and programs are expected to be able to cope with any increases. Even with the cumulative effects of population growth associated with direct and indirect employment for the three major oil developments, the effects on recreation are not expected to be significant. No formal project monitoring is recommended. The authorities responsible for recreation facilities and programs have in place mechanisms to assess and project demand, and can be expected to respond accordingly.

6.2.3 Community Physical Infrastructure

6.2.3.1 Housing

There is the potential for increased demands for housing during construction activities and during the operations phase. Direct effects during construction activity could occur in any of the study areas, while effects from operation are expected only in the St. John's area. Some cumulative effects may also occur in the St. John's area as a result of multiple field development, growth of the offshore service sector and general economic growth.

Any project-specific direct effects on housing in the St. John's area are likely to be small and of short-term duration. Cumulatively, the three offshore projects, a growing offshore supply and service sector, and growth related to other economic activities, will increase the demand for housing. For the most part, however, these effects will be beneficial, especially from the perspective of home-builders and suppliers, home sellers, and municipal tax authorities. However, it could place a burden on those with low or fixed incomes who find higher prices for accommodations problematic. Similarly, the White Rose project is not expected to have any substantive effects on housing in the Isthmus of Avalon area. Decisions regarding the use of camps for construction have not yet been made. Husky Oil will work with the local community to plan the management of any workforce effects. In the Marystown area, there is presently a large excess of infrastructure capacity, including housing. Therefore, it is not expected that there will be any significant adverse effects on housing in the area. The overall project residual effects are considered to be primarily positive and not significant.

6.2.3.2 Ports and Airports

Effects of the project on both the Port of St. John's and St. John's International Airport are expected to be positive. Their greater use will generate increased revenues for both administrative authorities, but should have no negative effects on other users. No mitigative measures are considered necessary. The port and airport authorities monitor activities on an ongoing basis and can be expected to respond to any customer needs as they emerge.

6.2.3.3 Industrial and Commercial Land, Warehousing and Office Space

Potential effects of the project on industrial and commercial lands, warehousing and office space will likely to be positive. Offshore operators, industry suppliers and contractors have and will continue to use industrial land and warehouse and office space in the St. John's area. These properties contributed to the local economy through their direct and indirect employment and business effects. Terra Nova and Husky Oil White Rose personnel presently occupy office space in downtown St. John's and may require additional industrial and warehouse space when their projects are operational. These will benefit the area and should not exceed the capacity or capability of the area to meet demand. In the Isthmus area, the use of the Bull Arm site by the oil industry has been beneficial to the local and provincial economies.

Any use made of it for the project would continue these benefits. No additional demands are expected to be placed on lands in Clarenville, Arnold's Cove or other Isthmus area communities. Similarly, the Marystown Shipyard and the Cow Head facility are capable of accommodating any demands placed upon them by the White Rose project. Additional work on the project would be welcomed and generate positive benefits for the area.

Municipal authorities and other public and private land developers track industrial and commercial occupancy characteristics and respond accordingly. No specific mitigative measures are considered necessary at this time and no monitoring beyond what is currently undertaken is considered necessary. The effects, including any cumulative effects, are predicted to be positive with no significant adverse effects.

6.2.4 Fisheries

Given the renewed strength of the fishing industry, issues have been raised regarding potential losses in catch and income as a result of the proposed White Rose project. The primary issues are those related to loss of access to fishing grounds, damage to fishing gear or vessels, biophysical effects to fish and possible oil spills. Effects on fisheries are expected to be consistent throughout all project phases. Only Canadian (commercial) catches are considered, and it is assumed that any effects on Canadian fisheries are representative of effects on international fisheries (at present there are no Aboriginal, recreational or subsistence fisheries in 3Lt).

A no-fishing zone will be in place around the glory holes and will cover an area of approximately 15.4 km^2. This no-fishing zone represents a small proportion of the total fishing area available in 3L (152,000 km^2) and a much smaller proportion of the total fishing area on the Grand Banks. An additional glory hole could be developed at White Rose, if ancillary pools prove commercial. This would increase the no-fishing zone to 45 km^2. Given the geographic distribution of fisheries in the area, it is unlikely that catch levels will decline. The no-fishing zone would allow a growth refuge for a proportion of the harvested fish and shellfish populations and/or food species, which may indirectly benefit the fishery.

Two to three supply boats are expected to travel between White Rose and St. John's weekly and four tankers are expected to travel between the project area and nearest shipping lanes each month. Increased vessel traffic on the Grand Banks as a result of White Rose is not expected to interfere with fisheries. Participants in the fishing industry currently operate in proximity to or encounter many other vessels during their operations, including increased numbers of vessels engaged in crab fishing on the Grand Banks. Therefore, increased vessel traffic is expected to have negligible cumulative effects on access to fishing grounds.

Damage to fishing gear or vessels may result from physical contact with White Rose vessels or installations, and small oil spills and materials lost from vessels, drill rigs or production facilities could

damage or foul gear. Any damage to fishing vessels or loss of gear could also lead to further economic loss due to reduced catches. However, this type of damage is not expected to occur frequently. To date, there has been no reported damage as a result of the Hibernia and Terra Nova operations. Compensation for lost or damaged gear or lost revenue will ensure cumulative effects are negligible.

Negligible or minor effects to fish are predicted as a result of construction, operation and decommissioning at the White Rose site. Effects on fish will not be directly transferred to the fisheries because additional variability will be introduced by changing fishing practices and management regimes. Therefore, effects on fisheries are anticipated to be negligible.

Increased and ongoing environmental data collection and monitoring programs for the White Rose project will enhance understanding of the Grand Banks ecosystem and may lead to the identification of new commercial species. Also, the White Rose production facility and supply vessels will be able to provide emergency services to a large portion of the Grand Banks.

Major oil spills are unlikely events, but have the potential to cause serious and long-lasting damage to the fishing industry. The most serious potential effects from larger spills are damage to fishing gear, fish tainting (real or perceived), temporary loss of access to fishing grounds and loss of market or market opportunities through prolonged absence. Oil spill trajectory model results indicate that an oil spill occurring in the immediate White Rose area would most often disperse offshore and to the south of the Flemish Cap. Given these dispersion patterns, major fisheries disrupted could include the Greenland halibut, tuna and swordfish fisheries around the Flemish Pass and the shrimp fishery on the Flemish Cap. Fisheries in the eastern portion of NAFO division 3L and 3N could be affected, but to a much lesser degree. The most serious effect would be a disruption of fishing activity and potential damage to gear rather than any serious effect on fish.

Cumulative effects on fisheries might occur as a result of oil development at the Hibernia and general marine transportation (existing), Terra Nova (approved) and White Rose (proposed) oilfields, and future exploration activities. Negligible cumulative effects on the fishery are predicted with respect to loss of access to fishing grounds or as a result of increased vessel traffic on the Grand Banks. The total no-fishing zone for Hibernia (5 km^2), Terra Nova (13.8 km^2) and White Rose (15.4 km^2) is approximately 34.2 km^2, a small fraction of the total fishing area available in 3L. Further, the bulk of current fish catches are made either well on the landward side of oil development sites or on the shelf margin rather than in 3Lt. As discussed above, the presence of such no-fishing zones could also indirectly benefit fisheries. With respect to vessel traffic, the total number of trips per week by supply vessels supporting offshore oil operations will remain a very small fraction of total traffic on the Grand Banks.

Although each operator has or will have mitigation measures in place to deal with damage to fishing equipment, there could be delays in compensation for lost or damaged gear and lost revenue if there is disagreement about which project is responsible. Negligible cumulative effects on fish catches are anticipated as a result of biophysical effects of oil operations on fish. A positive cumulative effect is

expected with respect to information, communication and emergency response as a result of oil development on the Grand Banks.

Proposed measures to mitigate the potential effects of the project on commercial fisheries include:

- a no-fishing zone at the White Rose development site;
- compensation for damage resulting from project and industry activities either through Husky Oil's program or the overall industry unattributable damage programs;
- all reasonable efforts will be made to accommodate fishing activity over portions of the field not under development;
- a sequential approach to reservoir development, which will allow for sequential fishing over portions of the White Rose oilfield during pre-drilling, before production or as wells are abandoned;
- using common traffic routes for Hibernia, Terra Nova and White Rose supply boats to reduce overall interference with the fishing industry;
- beyond the no-fishing zone, Husky Oil will keep the fishing industry fully informed of the timing and sequence of field development and of the exact location of potential hazards; and
- oil spill prevention and response procedures.

6.3 Residual Effects and Benefits

6.3.1 Business and Employment

For those project activities and other events where substantial levels of business activity and new employment can be expected, the outcomes will be positive for the whole economy, specific regions, and the workers and businesses involved. No adverse effects are anticipated or mitigative measures suggested, as any changes will be within the capacities of the local economies. In fact, Husky Oil's Canada-Newfoundland benefits approach should enhance these benefits. Residual, including cumulative, socio-economic effects are expected to be positive. No significant adverse effects are predicted.

6.3.2 Community Social Infrastructure and Services

Employment and training promoted by Husky Oil through its Canada-Newfoundland Benefits Plan (Volume One) should be beneficial or positive for those trained and for those individuals and institutions providing the training. The White Rose project itself or cumulatively in conjunction with other offshore projects or activity is not expected to have significant adverse effects on education infrastructure or services. No formal monitoring or follow-up is anticipated beyond the standard tracking processes used by post-secondary institutions to assess demand for offshore-related programs.

The White Rose project will lead to some increases in demands for medical services, but these are expected to be minimal given the typical age composition of the workforce and the fact that operators

have medical programs for their operations. There will be some cumulative effects during the operations phase, but overall, these demands are expected to be small and within the capabilities of the current system. Husky Oil will monitor work and family issues on a periodic basis.

The St. John's area, and in particular the City of St. John's, is the most likely to experience any effects on social assistance and employment services. However, no significant adverse effects are predicted and some benefits are expected. The cumulative effects on social assistance and related services due to population growth associated with the direct and indirect employment in three major oil developments and other economic activity are not expected to be significant in an adverse sense and may in fact have some positive effects. Furthermore, the White Rose project and associated direct and spin-off business and employment will contribute to government revenues through resource rents and business and personal taxes. No formal project-related monitoring is recommended. The provincial government has mechanisms in place to assess and address program needs.

Effects on security and safety services anticipated from White Rose by project phase are not considered significant. No additional monitoring or follow-up is anticipated beyond that regularly performed by policing and fire protection authorities as part of their normal mandate and planning activities.

The project will result in some in-migration and increased demand for access to recreation facilities and programs, primarily during the operations phase. These effects will mainly be experienced in the St. John's area, and the magnitude is expected to be small with existing facilities and programs accommodating any increases. Even with the cumulative effects of population growth associated with direct and indirect employment in three major oil developments, the effects on recreation are not expected to be significant. No formal monitoring is recommended, as authorities responsible for recreation infrastructure have appropriate programs in place.

6.3.3 Community Physical Infrastructure

No significant residual effects on housing are expected in the St. John's, Marystown or Isthmus of Avalon areas. The market is considered capable of responding to demand as it has in the past to much greater and less anticipated changes. The effects of increases in demand will have an overall positive economic effect. While the issue of increases in rental accommodation costs for persons with low or fixed incomes is a potential concern, if the appropriate authorities take the necessary action, the overall project residual effects are considered primarily positive and not significantly adverse.

Effects of the project on both the Port of St. John's and St. John's International Airport are expected to be positive. Their greater use will generate increased revenues for both administrative authorities, but should have no negative effect on other users. No mitigative or project-specific measures are considered necessary for ports and airports.

Potential effects of the project on industrial and commercial lands, warehousing and office space are considered positive. The capacity to accommodate most requirements is already in place. Land is available for additional development, should it be required. Increased activity will generate direct and indirect employment and income benefits both from the project itself and cumulatively with developments in other sectors. The residual effects with respect to these infrastructure components, including any cumulative effects, are predicted to be positive, with no significant adverse effects. No specific mitigative measures or monitoring are considered necessary at this time.

6.3.4 Fisheries

For the most part, potential effects on fisheries can be further decreased by implementing various mitigation measures. The majority of mitigation measures involve discussion and collaboration between Husky Oil and the fishing industry. The overall residual effect of the project on commercial fisheries is adverse, but not significant, while the effect of an accidental event, such as a large oil spill, on fisheries would be adverse and significant. However, the probability of a large oil spill occurring is extremely low.

Compensation issues for lost revenue resulting from loss of access to fishing grounds and damage to fishing gear or vessels will be determined through ongoing discussions and liaison between Husky Oil and fisher groups over the life of the project. To minimize conflicts, strategies will be employed including common routes to be used by supply boats, sequential approach to reservoir development, and communication to the fishing industry of timing and sequence of field development and the exact location of potential hazards. Husky Oil is committed to working with fisher groups to enhance the systems for multiple-use areas over the life of the project.

7 SAFETY PLAN AND CONCEPT SAFETY ANALYSIS

Husky Oil is committed to its belief that the safety of personnel is of the highest priority in its operations. A comprehensive safety plan will be in place to address all activities associated with all project phases from design to abandonment. Husky Oil has outlined a preliminary safety plan for the White Rose oilfield development that considers the recommendations and conclusions of the concept safety analysis conducted for the development. The safety analysis assesses the safety and environmental hazards and risks associated with the basic design concepts, layout and intended operations.

7.1 Preliminary Safety Plan

The safety plan is a vital part of an extensive Loss Control Management system and is integrated into Husky Oil's Health, Safety and Environment framework. This framework encompasses all activities associated with health, safety, environment, reliability, hazard management, risk assessment and loss prevention, as it relates to personnel (both company and contractors), the asset, production and the environment. The preliminary safety plan outlines key components that will be embodied in the project safety plan prior to the start of operations.

The safety plan is built on the foundation of continuous improvement and the project's maturing safety culture. As a minimum requirement, the safety plan will comply with all safety legislation. However, many of the company's current programs already exceed these minimum requirements. The plan and/or specific components will be modified and updated as necessary to reflect any changes in facilities, processes, management systems or organizational structure.

The preliminary safety plan outlines approaches for addressing:

- safety management policies and procedures;
- facilities and equipment;
- operations and maintenance procedures;
- training and qualifications;
- command structure; and
- contingency planning.

7.1.1 Safety Management Policies and Procedures

Husky Oil will operate within a framework of laws, standards, procedures and instructions with regular monitoring of certification and licensing requirements. Safe operations will be achieved by complying with the law, selecting and meeting the right standards, applying the correct procedures and following the right instructions.

Project management has the primary responsibility for ensuring the Health, Safety and Environment Loss Control Management system is implemented and maintained. Supervisors are responsible for implementing the system in their respective areas of responsibility and ensuring that operations meet the system requirements. All line employees also have clearly defined individual responsibilities under the Health, Safety and Environment Loss Control Management system. Husky Oil will allocate appropriate resources to support its managers in the implementation of their loss control duties.

All employees of Husky Oil and contractors have the right to know of any working conditions that may pose a health or safety hazard, and all have the right to participate in identifying and managing health, safety and environment issues. As well, all personnel have the right to refuse to do any work that they feel, based on reasonable grounds, is dangerous to their health and safety or the health and safety of other persons at the site. Employees will be encouraged to assume personal responsibility for their health and safety and for that of their colleagues on the facility. A medical support program will be in place at all times.

Husky Oil has developed Health, Safety and Environment Loss Control Management performance standards for its East Coast operations that mirror company standards across the country and recognize the unique nature of the marine environment. Contractors will be required to meet or exceed these standards. All accidents/incidents and near miss incidents resulting in personal injury/occupational illness, environmental releases, equipment damage or failure, fire, lost equipment or criminal acts will be reported, investigated and followed up by the managers and applicable area supervisors. Safety audits will be conducted on a regular basis.

Rules, policies and standards for health, safety and environment will be developed and maintained on an ongoing basis, with management being responsible for reviewing and updating these items as required. Health, safety and environment material will be posted in locations readily accessible to all employees. Employees will be required to review and demonstrate understanding of the rules on an annual basis. Training will be provided to those employees with specific responsibilities for health, safety and environment policies and procedures.

Husky Oil's staffing philosophy is consistent with the intent and spirit of the *Atlantic Accord Acts.* Employment development and competency assessments will be conducted on an ongoing basis.

7.1.2 Facilities and Equipment

The safety plan addresses existing and future facilities/operations including production wells, drilling units, production facility, support vessels, supply base and helicopter support. A current Certificate of Fitness will be maintained for the production facility and drilling unit during operations.

Hazard prevention, detection and mitigation will be considered in the installation layout and design. The design will provide the necessary separation between the living quarters and process units, and there will be a minimum of two escape routes from most locations on the facility.

All areas on the facility will be subject to a Hazardous Area Classification scheme. There will be facilities and systems to control and monitor hazardous areas during both normal operation and potential hazardous situations.

There will be multiple independent heating, ventilation and air conditioning systems on the facility that will be separated to minimize the possibility of back flow of hazardous vapours into non-hazardous areas. A fire and gas detection system will monitor the installation for fire, smoke and flammable gases. Personnel will automatically be alerted to any detected fires or gas. Fire protection systems and emergency alarm systems will be activated automatically.

The oil reservoirs will be capable of being isolated from the process areas by separate and independently controlled valves for each well. Emergency shutdown will be initiated upon detection of a hazardous condition. Blowout preventer systems will prevent an uncontrolled release of well fluids during drilling or workover operation. All marine systems on the facility will be designed to operate safely during an emergency situation.

The production facility will have the following hazard mitigation and response systems:

- fully equipped sick bays;
- active and passive fire protection systems;
- explosion protection;
- blowdown and flare system;
- power generation systems for normal and emergency situations;
- internal and external communication systems to provide effective and efficient links with helicopters, vessels and on-shore facilities;
- temporary safe refuge for personnel to safely muster during an emergency;
- evacuation, escape and rescue systems;
- life supporting and life saving equipment; and
- emergency survival packs.

Husky Oil currently has in place a physical environment data collection program to support its drilling operations, and a similar program will be in place for White Rose production facility operations. Program components include physical oceanographic monitoring, regularly schedules marine weather observations and forecasting, and ice observation.

7.1.3 Operations and Maintenance Procedures

Operation and maintenance procedures will be used to support all aspects of the White Rose oilfield development. These procedures will be implemented specifically for the White Rose project and will incorporate all regulatory requirements. Personnel will be trained in using the appropriate manuals and procedures. Manuals will outline the design rationale and operating parameters for the production monitoring and control systems.

The maintenance system is an integral part of the safety system in that it ensures the physical integrity of the individual components of the production system. Critical equipment and systems will be inspected on a regular basis in keeping with the facility's regular inspection program.

All process, engineering, procedural and organizational changes will be handled in a timely and effective manner. Relevant engineering regulations, codes, classification rules and industry standards will be reviewed on an ongoing basis to ensure compliance. A review system will incorporate Loss Control Management considerations into design, construction and commissioning of vessel modifications and repairs. All shorebased and offshore facilities will be required to carry out inspections on a regular basis to identify any potential health, safety or environmental hazards. Formal hazard identification systems will be in place.

Requirements and needs for personal protective equipment will be identified on an ongoing basis by Husky Oil and its contractors. Supervisors will be responsible for ensuring that such equipment is available and used as appropriate by all personnel. Proper facilities and expertise will be provided for maintaining, cleaning and storing protective equipment.

7.1.4 Training and Qualifications

A definitive organizational structure will be established for project operations. There will be a systematic approach to recruiting personnel and providing initial orientation. The operations and maintenance procedures manuals will be vital in promoting safe and efficient operations. Personnel will be trained in using these manuals.

Individuals and work groups will be assigned specific offshore responsibilities for safety and emergency response preparedness. Specialized training will be provided prior to going offshore to ensure that personnel are sufficiently competent to perform effectively in these areas. All contractors will be required to demonstrate their compliance with essential training prior to any person going offshore. A command structure will be established to handle offshore emergencies.

Husky Oil will implement a system for documenting all employee qualifications and training records. Where certified safety training is specifically required by regulation or company policy, ongoing compliance monitoring systems will be in place. Training needs will be identified on an annual basis.

7.1.5 Command Structure

The command structure will clearly outline both the on-shore and offshore management structures. Duties, responsibilities and authorities of all management personnel will be defined for both normal operations and emergency situations. This will include lines of reporting and information flow, and lines of authority, and it will extend to both Husky Oil and contractor personnel. The OIM is the person in charge of the floating production facility and is responsible for coordinating all activities in the field.

7.1.6 Contingency Planning

Husky Oil will implement contingency procedures to serve as the guide for Husky Oil's response to address possible emergency situations. The plans will outline the necessary personnel, equipment and logistical support and procedures for responding to an emergency incident in a safe, prompt and coordinated manner. Contents of the contingency plan are outlined in Table 7.1-1.

Table 7.1-1 White Rose Project Contingency Plan Content

Section	Description
Introduction	C Purpose and scope of plan C Geographic coverage C Definition of emergencies covered
Action Plan	C Conditions leading to emergencies C Stages of alert and response C Roles and responsibilities C Notification procedures C Specific response activities
Emergency Telephone List	C Emergency services groups C Company personnel C Contractors and suppliers C Government contacts
Area Considerations	C Location maps C Facility and vessel diagrams C Sensitive areas near the emergency scene
Emergency Support	C Medical services C Logistics support resources C Media guidelines C Family support C Communication systems
Emergency Preparedness	C Plan maintenance C Personnel training C Exercises
External Assistance	C Mutual Aid arrangements C Canadian Coast Guard assistance C Well relief resources C C-NOPB Emergency Response Plan

Additional contingency plan materials will address:

- oil spill response and monitoring strategies, equipment requirements and locations, and personnel;
- collision avoidance procedures;
- ice management; and
- authority and chain of command responsibilities.

7.2 Concept Safety Analysis

Husky Oil has conducted a concept safety analysis of the major personnel safety and environmental hazards and risks associated with the two viable options being considered for developing the White Rose oilfield. The options are:

- a steel FPSO facility (with integral storage); and
- semi-submersible facility with a separate floating storage unit.

The analysis assesses the preliminary basic design concepts, layout and intended operations with respect to safety and environmental hazards and risks. The results of this analysis have been incorporated into the preliminary safety plan.

The quantitative estimates of risk to personnel and the environment are based on event tree modelling of major hazards associated with each option. Where quantitative assessment methods are not appropriate, qualitative methods are used. The quantitative estimates of risk are then compared to Husky Oil's target levels of safety to determine if these targets are being met.

The *Newfoundland Offshore Petroleum Installations Regulations* requires target levels of safety to be identified for offshore projects to ensure that the risks from major hazards are acceptable. Husky Oil's target levels of safety are in keeping with other offshore operations and contain both risk-based and impairment-based criteria. Risk-based criteria include individual, group and environmental risk. Impairment-based criteria outline criteria for the facility's safety functions, including the facility's primary structure, temporary safe refuge, escape routes and evacuation systems. Husky Oil must subsequently demonstrate as part of the design process that the risks to personnel and the environment are as low as reasonably practicable by implementing risk reduction measures, if required. Husky Oil is committed to following this process.

Risk to individuals is a primary criterion that must be met in the final design of the facility. It is measured by the fatality rate per individual per year. The risk to the environment is expressed in terms of oil spillage associated with various accident scenarios and the likelihood of these scenarios occurring. Impairment-based criteria are used during the concept and design phase to provide guidance during design, as well as to identify the potential for major accidents.

7.2.1 Major Hazard Identification

The major hazards considered in the analysis are:

- process and non-process loss of hydrocarbon containment (fire and explosion);
- subsea process loss of hydrocarbon containment (fire and explosion);
- blowout;
- ship impact;
- iceberg impact;
- dropped objects;
- helicopter operations;
- fishing gear impact;
- structural failure;
- mooring failure; and
- seismic event.

The main fire and explosion hazards on the White Rose facility are associated with pressurized hydrocarbons within the process train and riser system. However, lesser fire hazards exist in the form of non-process hydrocarbons (such as diesel oil used to fuel various utilities) and non-hydrocarbon fires (such as fires in electrical equipment or the accommodation module).

7.2.2 Safety Analysis Results

Final demonstration that risks to personnel and the environment on the selected production option are as low as reasonably practicable and meet the target levels of safety can only be done at the detailed design phase, at which point various risk reduction options should be considered and studies performed to determine which reduction options are required. Cost-effective risk reduction options should only be implemented in the final design provided that risks to personnel and the environment are shown to meet the target levels of safety and to be as low as reasonably practicable. Many of the assumptions used in the concept safety analysis will be reviewed and refined during the detailed design phase.

7.2.2.1 Individual Risk

Both the FPSO and semi-submersible options have an average individual risk that falls well below the target safety levels specified for the White Rose project.

7.2.2.2 Group Risk

Specific group risk has not been quantified at this stage due to the number of unknowns associated with the design. However, based on the low level of individual risk being predicted for the development, it is highly likely that the group risk criteria will be met at the detailed design stage.

Statistical estimates of probable loss of life for both the FPSO and semi-submersible options are predicted to be primarily related to loss of hydrocarbon containment (fire, explosion and related evacuation fatalities). Other possible contributions to probable loss of life on both the FPSO and semi-submersible options are a helicopter crash, ship collision or structural failure. Highest risks relate to loss of hydrocarbon containment or helicopter crash. However, in both cases, the statistical risks are low and within parameters of other existing offshore operations.

7.2.2.3 Environmental Risk

The frequency of occurrence for a significant oil spill (that is, a spill exceeding 8 m^3 (50 barrels)) is similar for both the FPSO and semi-submersible options, with the estimated frequency for both options being well within the specified target levels of safety for the project.

7.2.2.4 Safety Function Impairment

Impairment frequencies have been calculated for the temporary safe refuge, with the estimated frequency being lower than the target safety level. Impairment of the refuge is minimized by placing a firewall between the temporary safe refuge and the process modules.

Impairment frequencies for the primary structure, escape routes and means of evacuation have not been quantified at this stage due to the many design uncertainties that remain. The requirements of the safety function impairment criteria for these features will all be met during the detailed design stage through appropriate selection of materials, components and design features.

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APPENDIX A

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