CANADA-NEWFOUNDLAND
OFFSHORE
PETROLEUM
BOARD

Decision 97.02

December, 1997
St. John's, Newfoundland

Application for Approval

Terra Nova Canada–Newfoundland Benefits Plan

Terra Nova Development Plan

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Chapter 1

DECISION SUMMARY

1.1 Introduction

This report constitutes the decision of the Canada-Newfoundland Offshore Petroleum Board (the Board) concerning the application by Petro-Canada Inc. and its partners (the Proponent) for approval of its plans for the development of the Terra Nova oil and gas field (the Development). As required by the applicable legislation (the Accord Acts)[1], the Proponent has submitted both a Terra Nova Canada-Newfoundland Benefits Plan (the Benefits Plan) and a Terra Nova Development Plan (the Development Plan) along with other documents in support of its Application. The Board is required under the Acts to approve the Benefits Plan before approving the Development Plan.

In considering these plans, the Board, together with the Government of Newfoundland and Labrador and the Government of Canada, established a Terra Nova Project Environmental Assessment Panel, to conduct a public review of the Application. The Panel held public meetings and provided a report recommending approval of the Application subject to some 75 recommendations. The Board considered these recommendations and consulted relevant government departments and agencies as it developed its decision regarding the Application.

The Board has approved both the Benefits Plan and the Development Plan subject to the conditions set out in this Decision Report.

1.2 The Terra Nova Canada-Newfoundland Benefits Plan Decision

Any benefits plan is, in large measure, a commitment to principles. The Accord Acts contain provisions designed to ensure that the resources off Newfoundland's coasts are developed in such a way that maximum benefits accrue to Canada and in particular to the Province. Two fundamental principles are embodied in the legislation for this purpose. The first requires that Canadian enterprises and individuals be provided a full and fair opportunity to participate in the supply of goods and services to offshore oil and gas activities with first consideration being given to those located within the Province provided they are competitive in terms of fair market price, quality and delivery and the second requires that first consideration for training and employment be given to residents of the Province.

The Proponent has presented a Canada-Newfoundland Benefits Plan which addresses these principles. The Benefits Plan describes the Proponent's commitments to locate engineering and procurement activities in the Province, to employ residents of the Province in the development, to develop procurement policies which are aimed at supplier development in the Province, and to undertake expenditures on education and training and research and development in the Province.

Full and Fair Opportunity and First Consideration

The Proponent's Benefits Plan clearly states a commitment to these principles, but also notes that an alliance concept will be utilized for the project phase of the Development up to first oil. Both the Panel and the Board consider that the Benefits Plan commitments meet the requirements of the Accord Acts. In approving the Benefits Plan, the Board has developed conditions to help ensure that these commitments are met, and to ensure it will have access to the documentation necessary to corroborate this.

Newfoundland Office

The Proponent has committed to use its "best efforts" within the competitive bidding process to cause project management and engineering work for the production platform, associated subsea facilities, mooring and loading systems and production risers for the Development to take place in Newfoundland. The Board has made it a condition of its approval that such work be relocated to the Province as soon as practicable after official approval of the project by the Owners (Project Sanction).

Employment

The Board recognizes there are two distinct phases of the activity associated with the Terra Nova Development; the project and operations of phases; each of which offers rather different types of employment opportunities. The project phase provides an opportunity for the employment on a short-term basis of a workforce skilled in fabrication and construction. The recently completed Hibernia project demonstrated that this workforce is, for the most part, available locally. The operations phase provides more lead time for training personnel with the requisite basic skills and offers opportunities for long-term employment. As a condition of its approval, the Board requires the Proponent to address the human resources needs of both phases of the Development.

Technology Transfer and Supplier Development

The Board is satisfied that the approach the Proponent has proposed for engineering and procurement and for project management will lead to a significant development of technical expertise in the local community. The establishment of the procurement function locally and the other efforts that the Proponent has committed to undertake to make its requirements known on a timely basis will afford the local and Canadian supply communities a full and fair opportunity to participate in the supply of goods and services.

Education and Training and Research and Development

The Board believes the Proponent will undertake significant training and research in the Province and that it understands the education and training capabilities available within the Province. The Board will require regular forecasting and reporting of education and training and research and development initiatives and expenditures.

Monitoring, Reporting and Auditing

The Board believes the Proponent's commitments in the Benefits Plan will be fulfilled. However, the Board also has an obligation as the regulator to ensure that the Proponent's commitments are met. Accordingly, it will develop, in consultation with the Proponent, reporting mechanisms for the timely review of contracts, and appropriate reporting formats for tracking employment and expenditures. This Board will conduct periodic audits to confirm the accuracy of the reports.

It is the decision of the Board that the Terra Nova Canada-Newfoundland **Benefits Plan** is approved subject to the conditions set out herein.

1.3
The Terra Nova Development Plan Decision

The Terra Nova Development Plan sets out the Proponent's interpretation of the geology and reservoir characteristics of the Terra Nova oil field, provides estimates of hydrocarbon reserves, describes the approach and facilities the Proponent plans to use to recover those reserves, and includes a description of the environmental parameters governing the design of facilities. The Board's responsibility in reviewing this plan is to ensure that hydrocarbons are produced in accordance with good oil field practice with due regard for the efficient recovery of the resource and the prevention of waste; that the facilities are designed to operate safely throughout the expected life of the field; that a responsible approach is taken to environmental protection; and, that the safety of personnel is a primary consideration at all times.

The Board's overall response to the Development Plan has been positive. The work submitted by the Proponent was judged to be thorough and comprehensive, and the concepts, approaches, and preliminary designs have been accepted. This initial approval will be followed by more detailed analyses as plans evolve and other specific approvals by the Board are required for the execution of various components of the actual work. Lloyd's Register of Shipping has been appointed as Certifying Authority for the Project and will conduct such reviews of the design and surveys of the construction of the facilities as are necessary to enable it to issue a Certificate of Fitness attesting that the facilities have been designed in compliance with the applicable legislation and are suitable for their intended purpose.

Conservation of the Resource

The Terra Nova Oil and Gas Field is located on the southeastern margin of the Jeanne d'Arc Basin and comprises several fault bounded blocks in which the reservoir section consists of seven sandstone and five shale units. The presence of hydrocarbons in several of the major fault blocks has been confirmed by the exploration drilling. The nature of the resource in the North Graben and Far East blocks will be confirmed early in the development.

The Board believes the Proponent's Development Plan is appropriate given the present state of knowledge of the resource but has established several conditions to its approval of the portion of the Development Plan concerned with the conservation of the resource.

Safety of Operations

The prudent design of the production and extraction facilities is essential for the safety of the personnel and protection of the environment. The Board has accepted the design process outlined in the Development Plan. As noted above, the suitability of the design and its conformity to legislated requirements will be assessed by the Certifying Authority. Prior to issuing authorizations for the execution of the work in the field, the Board will satisfy itself that appropriate Safety Management Systems are established by the Proponent and its contractors. The Proponent is also required by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* to obtain the Board's approval for its Safety Plan and Training Proposal before obtaining an authorization to begin production. The Board has published guidelines in this regard and will rigorously examine the Proponent's submission to ensure the highest standard of safety is obtained.

Protection of the Environment

Through the approval of the Proponent's Environmental Protection Plan and its associated Environmental Effects Monitoring Plan, the Board will ensure that the facilities are operated in an environmentally safe manner. All routine discharges from the platform will be required to meet regulatory standards. The Board has attached several conditions to its approval to ensure the adherence to existing environmental standards and to investigate the implications of designing the facilities in a manner that enables them to accommodate future changes in regulatory requirements.

It is the decision of the Board that the Terra Nova **Development Plan** is approved subject to the conditions set out herein.

1.4
Cost Recovery

The Board has authority under the Accord Acts to require, as a condition of its approvals, "the payment of expenses incurred by the Board in approving the design, construction and operation of production facilities and production platforms"[2] These activities in relation to the Terra Nova Development will constitute a significant portion of the workload of the Board and its staff in the years ahead. The Board will negotiate the specific amount to be paid by the Proponent to cover the Board's expenses associated with those activities during the project and subsequent phases of the Terra Nova Development. The Board requires the Proponent to conclude an agreement regarding the amount to be paid during the project phase of the Development within 90 days of Project Sanction.

[1] *Canada-Newfoundland Atlantic Accord Implementation Act*, S.C. 1987, c.3 and the *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, R.S.N. 1990, c.C-2

[2] *Canada-Newfoundland Atlantic Accord Implementation Act*, Section 138(4)(c) and *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, Section 133 (4)(c).

Chapter 2
INTRODUCTION

2.1
Introduction

Proponents of development projects in the Newfoundland Offshore Area are required, under the *Canada-Newfoundland Atlantic Accord Implementation Act and the Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act* (the Accord Acts), to obtain approval of development plans for projects offshore Newfoundland and Labrador from the Canada-Newfoundland Offshore Petroleum Board (the Board). Before approving a development plan, the Board must have approved a Canada-Newfoundland Benefits Plan for the development project.

This report (Decision 97.02) constitutes the Board's decision with respect to the Terra Nova Development Application (the Application), comprising both the Terra Nova Canada-Newfoundland Benefits Plan and the Terra Nova Development Plan, and sets forth the terms and conditions of the Board's approval.

The conditions to the Board's approval should be read in the context of their supporting narrative wherein the Board has expressed its expectations regarding the manner in which the Proponent will conduct its affairs in executing the Terra Nova Development. While the Board has not expressed such expectations as explicit conditions to its approval of the two plans, its judgment of the Proponent's compliance with its undertakings and with the conditions which the Board has established will be made in consideration of these stated expectations.

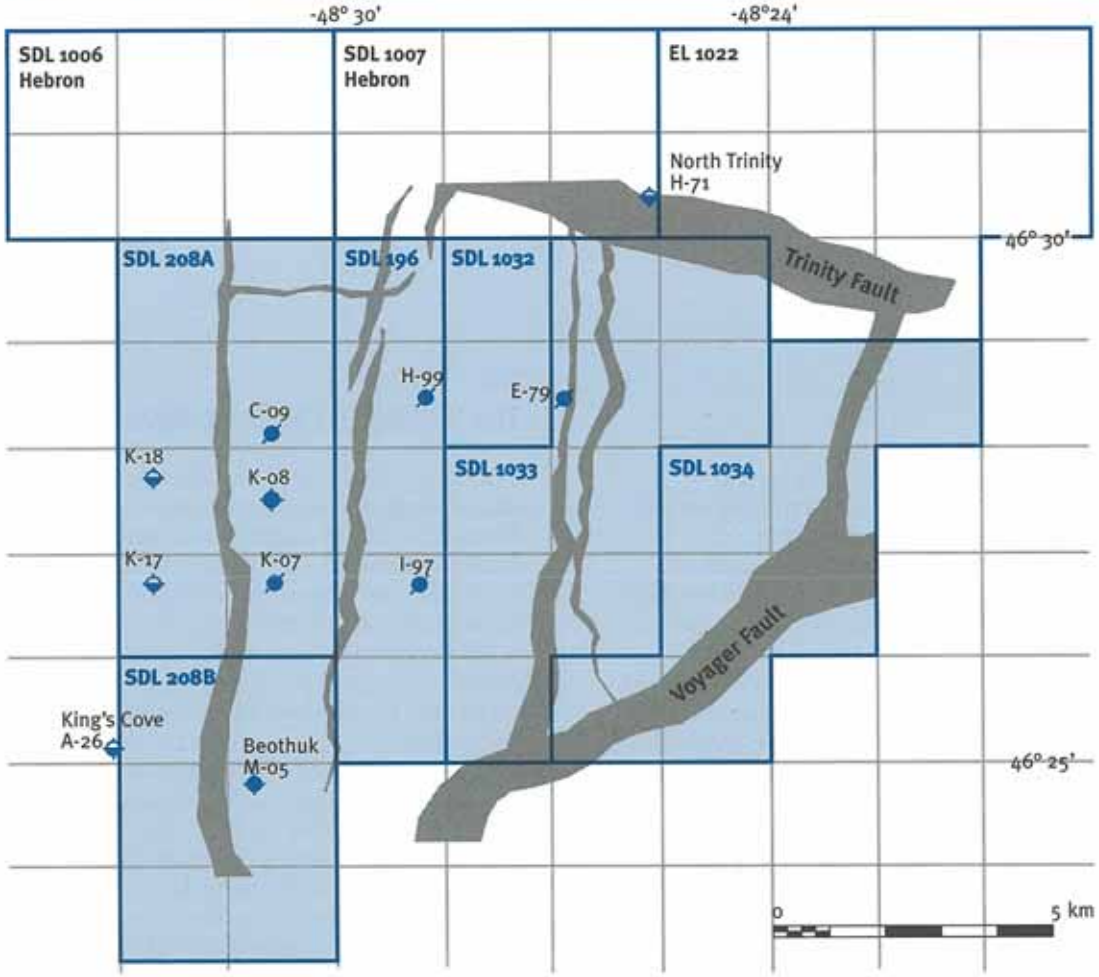
2.2
The History of the Terra Nova Project

The Terra Nova field was discovered in May 1984 by the drilling and testing of the Petro-Canada et al Terra Nova K-08 exploration well. Following the initial discovery, eight additional wells were drilled to define the structure and three 3-D seismic surveys, the most recent during the summer of 1997, were conducted. The wells and seismic surveys confirmed the presence of significant quantities of oil in the Terra Nova Member of the Jeanne d'Arc Formation.

A declaration of significant discovery was made by Ministerial Order and published in The Canada Gazette on October 2, 1985. On January 13, 1989, the Significant Discovery Area (SDA) was enlarged to 38 sections based upon the results of further drilling. At present, the Terra Nova Significant Discovery Area incorporates five Significant Discovery Licences (SDL) with ownership varying in each SDL (Figure 2.1). The overall equity interest of individual owners will be established with the conclusion by the owners of a unitization agreement covering the entire field. At the time of submission of the Development Application in August 1996, the pre-development costs were being shared as follows:

Petro-Canada	49.2%
Mobil Oil Canada Properties	20.7%
Husky Oil Operations Ltd.	15.8%
Murphy Oil Canada Ltd.	10.7%
Mosbacher Operating Ltd.	3.6%

FIGURE 2.1 **Terra Nova Field — Significant Discovery Area Ownership**



SDL 208A		SDL 208B		SDL 196, 1033		SDL 1032		SDL 1034	
Petro-Canada	66.666	Petro-Canada	62.50	Mobil	32.5446	Mobil	32.5446	Husky	37.5179
Norsk Hydro	15.000	Husky	17.50	Husky	18.7679	Murphy	16.8750	Mobil	15.1071
Husky	13.334	Norsk Hydro	15.00	Murphy	16.8750	Petro-Canada	15.5625	Norsk Hydro	15.0000
Mosbacher	5.000	Mosbacher	5.00	Petro-Canada	15.5625	Husky	15.2643	Talisman	14.0625
				Norsk Hydro	15.0000	Norsk Hydro	15.0000	Murphy	14.0625
				Mosbacher	1.2500	Mosbacher	4.7536	Petro-Canada	3.000
								Mosbacher	1.2500

Source: C-NOPB Land Registry

As a result of Petro-Canada's signing of a strategic alliance agreement with Norsk Hydro in December 1996, the pre-development cost sharing agreement was modified to provide for a 15% participation by Norsk Hydro and a reduction in Petro-Canada's participation to 34.2%.

On December 19, 1996, Petro-Canada announced its selection of a steel monohull floating production facility as its preferred option for the development of Terra Nova and its intention to enter into an alliance with a consortium of contracting companies known as the Grand Banks Alliance to execute the pre-production phase of the project. This phase of the work includes the design, construction and installation of all subsea and platform facilities and the provision of pre-production drilling services. The Grand Banks Alliance comprises SBR Offshore (a joint venture between Shawmont Newfoundland Limited and Halliburton Canada Inc.), Doris Conpro Limited, PCL Industrial Constructors Inc., Coflexip Stena Offshore International, FMC Offshore Canada Inc., and Halliburton Canada Inc.

2.3
A Description of the Terra Nova Project

The Terra Nova field is located approximately 350 km east southeast of St. John's, Newfoundland, 35 km southeast of the Hibernia oil field, in a water depth of 90 to 100 m. The total recoverable oil reserves in the field are estimated by the Board to be some 64 10^6 m^3 (400 million barrels). The Terra Nova reservoir is a sequence of medium to coarse-grained sandstones that were deposited about 140 million years ago in the Late Jurassic period. The reservoir units cover an extensive area and exhibit high productivity. The field is subdivided structurally into three major blocks: the Graben, the East Flank, and the Far East. The discovery well, K-08, and five delineation wells were drilled into the Graben and East Flank and identified five major and two minor oil bearing sands within the structure. The Far East block has not been tested by drilling but, based on the interpretation of the seismic data, the Proponent estimates it may contain as much as 16 10^6 m^3 (100 million barrels) of recoverable oil.

A total of 26 wells is planned for the Graben and East Flank: 15 production wells, 8 water injection wells and 3 gas injection wells. The open glory hole method will be used to protect the wells drilled in clusters around six manifolds. Many wells will be directionally drilled with hole inclinations up to 30° to achieve full drainage of the reservoir. A total of 10 wells is foreseen for the Far East portion of the field: 5 production wells and 5 water injection wells clustered around 2 manifolds.

The Proponent evaluated a number of production systems options for Terra Nova, including a Gravity Base Structure (GBS). It was concluded that, because of field size and water depth, the only viable option for Terra Nova is a floating production system capable of year-round operations. Floating production systems have two possible configurations: semi-submersible and ship-shaped. The Proponent has chosen to develop the field using a new-build, steel monohull, floating production, storage and offloading vessel (FPSO) moored by means of a disconnectable turret. It will have independent self-propulsion capability and a dynamic positioning system to provide a high level of station keeping. Wells will be drilled from separate, conventional offshore drilling units (Figure 2.2).

FIGURE 2.2 **Conceptual Layout of the Terra Nova Facilities**

Source: Petro-Canada, 1997

The proposed schedule foresees the first shuttle tanker load of oil being produced in 2001. However, work is proceeding in accordance with a fast-track approach which may result in first oil being produced by late 2000. According to this schedule, construction activities will commence immediately following sanction of the development late in the fourth quarter of 1997; the drilling program and construction of glory holes would start in 1998. It is anticipated that six wells will be drilled and completed prior to the commencement of production.

2.4 The Board's Authority

In February 1985, the Governments of Canada and Newfoundland and Labrador signed the Atlantic Accord which provided for the establishment of a joint-management regime respecting oil and gas exploration and development in the Newfoundland offshore area, including the formation of the Canada-Newfoundland Offshore Petroleum Board. Each government implemented the Atlantic Accord by respectively bringing into force the federal and provincial Accord Acts.

Under the Accord Acts, before any development activity can proceed in the offshore area, the proponent is required to submit for Board approval a development plan and a Canada-Newfoundland benefits plan. As part of the Board's review and approval process, the Accord Acts require the Board to conduct a public review of a proposed development unless the Board is of the opinion that it is not in the public interest to do so. The conduct of a public review is subject to any joint Ministerial directive which may be issued and to any terms of reference which may be established by the Board pursuant to the Accord Acts.

In addition to the Board's authority under the Accord Acts, the Board also has a responsibility under the *Canadian Environmental Assessment Act* (CEAA) to ensure that an environmental assessment of any proposed development is conducted.

2.5 The Board's Development Application Guidelines

To assist proponents of offshore hydrocarbon development projects in preparing development applications, the Board published, in 1988, its Development Application Guidelines: Newfoundland Offshore Area which describe the information required by the Board to process a development application and the review process followed in considering such an application.

The Guidelines specify that for all development applications three basic documents should be submitted by the proponent:

- a Development Plan
- a Canada-Newfoundland Benefits Plan
- a Development Application Summary.

The Guidelines also provide for the submission of a Socio-Economic Impact Statement and an Environmental Impact Statement in the event the Board should determine that such documents are necessary to carry out a comprehensive review of the development application.

2.6 The Approval Procedure for the Terra Nova Project

The Board informed Petro-Canada, the Proponent of the Terra Nova project, early in the planning stages of the project that a public review of the proposed development of the Terra Nova oil field would be required to complement its own internal review.

The Board recognized that a potential existed for conflict or duplication between the public review contemplated pursuant to the Accord Acts and similar processes which arise by virtue of the *Canadian Environmental Assessment Act* (CEAA) and other federal and provincial legislation. To eliminate any potential conflict or duplication, the Board, the Minister of Natural Resources and the Minister of the Environment of the Government of Canada, and the Minister of Mines and Energy, the Minister of Environment and Labour, and the Premier as Minister Responsible for Intergovernmental Affairs of the Government of Newfoundland and Labrador concluded a *Memorandum of Understanding Concerning Environmental Assessment of the Terra Nova Development* (the MOU) in July 1996. The MOU, published in draft form for public comment prior to signing, provides for the establishment of the Terra Nova Project Environmental Assessment Panel (the Panel) and describes a single joint public review process which satisfies the legislative requirements of all parties.

In January 1996, the Proponent held public "open house" meetings attended by Board representatives in eleven Newfoundland communities, at which it described the development concepts being considered for Terra Nova and solicited advice from participants on issues which they believed should be incorporated into the Terra Nova Development Application (the Application).

On August 5, 1996 the Proponent submitted its Terra Nova Development Application to the Board. It also provided some 100 copies of the Application to communities and public libraries in the Province, and distributed close to 800 copies of the Application Summary to schools, communities, and other interested groups and individuals. The Proponent also opened a project information office in St. John's, and placed its application documents on a home page on the World Wide Web.

In September 1996 the Proponent hosted public information sessions audited by Board and Panel Secretariat representatives in the same communities it visited in January 1996, to describe the contents of its Application and to answer questions from those attending.

Following the submission of the Application, the Board requested the advice of its advisory departments in the Governments of Canada and Newfoundland and Labrador and conducted its own internal review to determine whether the documentation was sufficiently complete to file with the Panel for public review. The Board identified a number of areas where it believed further information was necessary and requested this information from the Proponent. The Proponent responded by submitting Supplement A to its Application in December 1996.

The Panel was appointed on November 27, 1996, and the Board referred the Application to it on December 2, 1996. The Panel began by inviting comments from the public on whether further information should be requested of the Proponent prior to the scheduling of public hearings. The Panel also acquired additional information through two public meetings in early February 1997: a general discussion with the Province's Department of Mines and Energy regarding offshore petroleum resource estimation, exploration, and production methods; and a discussion with the Proponent regarding several benefits, safety, environmental and resource conservation issues relating to the Application.

On February 13, 1997 the Panel issued a request to the Proponent for additional information to which the Proponent responded on March 14, 1997.

Public hearings were held in seven Newfoundland communities between April 22 and May 6, 1997 and approximately 20 groups and individuals gave presentations to the Panel during these hearings. During the time the Panel was preparing for and conducting public hearings, the Board conducted its internal review of the Application.

The Panel submitted its report to the Board and to the other parties to the MOU on August 25, 1997. The Panel recommended [1][1] that the Project be permitted to proceed subject to the other recommendations in its report. The Board subsequently prepared its proposed response to the Panel's report and submitted it to the Minister of Natural Resources Canada. The Governor in Council approved the proposed response on December 4, 1997. The response to the Panel report and the results of the Board's internal review are reflected in this Decision Report.

2.7 The Terra Nova Development Application

The Terra Nova Development Application, which was filed with the Board on August 5, 1996, comprises five main documents:

- Development Application Summary – an overview of all aspects of the plans to develop the Terra Nova field including engineering, economic, environmental and socio-economic considerations.
- Development Plan Part I – a description of the reservoir depletion, development drilling, facilities development and operating plans for Terra Nova.
- Canada-Newfoundland Benefits Plan – a description of the Proponent's commitments and plans for the participation of Canadian, in particular Newfoundland and Labrador, businesses and the employment of Canadians, in particular residents of Newfoundland and Labrador, in the development.
- Environmental Impact Statement – a description of the physical and biological environments of the Terra Nova area and the impacts of the development on them.
- Socio-Economic Impact Statement – a description of the current socio-economic conditions in the predicted impact areas and the socio-economic impacts of the development.

The Proponent also filed with the Board numerous Part II documents which were used to prepare the Terra Nova Development Application. In total, 109 Part II documents were submitted, 13 of which were categorized by the Proponent as confidential.

Of the supplementary submissions made by the Proponent, Supplement A was submitted in November 1996 in response to the Board's request for additional information related to resource conservation and environmental matters. Supplement B, filed with the Board at the end of February 1997, provides additional information on the Proponent's preferred mode of development. An *Update to the Application*, which presented additional information arising from ongoing geosciences and engineering optimization activities by the Proponent, was submitted to the Board in June 1997. The Board is aware that the Proponent is continuing its optimization work and expects further changes to how the Proponent will execute the work. These changes will require Board approval.

2.8
Other Information Considered by the Board

In addition to the information contained in the Development Application, the Board considered the following in its review of the Application:

- Report of the Terra Nova Environmental Review Panel
- Advice of other Government Agencies
- Internal Board studies
- Discussions with the Proponent.

Panel recommendations which are within the Board's jurisdiction and which pertain to the Board's decisions regarding the Terra Nova Canada-Newfoundland Benefits Plan or the Terra Nova Development Plan are addressed in this report. The Panel made other recommendations regarding the development that dealt with matters outside the Board's jurisdiction. Those recommendations were directed to the Governments of Canada or Newfoundland and Labrador, or both. In addition, certain recommendations, while within the Board's jurisdiction, were general in nature and not explicitly related to either of the decisions described in this report. Those responses to the Panel's recommendations, not specifically addressed in the Board's decisions, are recited in Appendix B. The majority of the Panel's recommendations have been accepted outright. The intent of the remaining recommendations has been accepted; however, the means of implementing these recommendations differ somewhat from that envisaged by the Panel.

The Board's staff also consulted extensively with those departments and agencies of the governments of Canada and of Newfoundland and Labrador having responsibilities related to offshore oil and gas activities with whom the Board has concluded memoranda of understanding. The advice and assistance provided by these parties in reviewing the Application contributed to the consideration of the Panel's report and to this decision report. The Board intends to continue consultations with these departments and agencies as it carries out its regulatory duties with respect to the Project.

During its review of the Application, the Board's staff held extensive discussions with the Proponent to clarify certain aspects of the Application. In some instances, the Board's staff sought and received written clarification from the Proponent. Where these documents were provided before the Panel completed its public hearings, they were provided to the Panel and became part of its review as well.

[1]The designation [1] is used throughout this report to identify a Panel recommendation. The bracketed number corresponds to the Panel recommendation.

Chapter 3

The Terra Nova Canada–Newfoundland Benefits Plan Decision

3.1 Introduction

It is the decision of the Board that the Terra Nova Benefits Plan is approved subject to the conditions noted in this Benefits Plan Decision.

This chapter describes the Board's decision with respect to the approval of the Terra Nova Canada-Newfoundland Benefits Plan submitted by the Proponent. The Board's assessment of this Plan was guided by the requirements of the Accord Acts, specifically Section 45 dealing with the Canada-Newfoundland Benefits Plan. The specific provisions of the Plan related to the establishment of an office in the Province; the employment of Canadians, in particular residents of Newfoundland; the provision of goods and services; and, the conduct of research and development and education and training in the Province are assessed as a part of the Board's decision. To the extent that they relate to the Benefits Plan requirements of the legislation, the recommendations of the Panel have been considered by the Board as an integral part of its review of the Plan. The Board's position with respect to each of the Panel's recommendations related to the Benefits Plan is described in this decision.

As foundation for the Board's decision regarding the Benefits Plan, which is set out in the subsequent sections of this Chapter (Sections 3.2 to 3.6), this Introduction describes the Board's position regarding the application of the statutory requirements related to the employment of Canadians and Newfoundland residents and the provision of goods and services.

3.1.1 Employment

The statutory requirements related to the employment of Canadians and Newfoundland residents can be summarized by the following excerpts from the Acts:

Canada-Newfoundland benefits plan means a plan for the employment of Canadians and, in particular, members of the labour force of the Province ...[1]

consistent with the Canadian Charter of Rights and Freedoms, individuals resident in the Province shall be given first consideration for training and employment in the work program for which the Plan was submitted ...[2]

In the Board's view, these requirements are intended to ensure that employment opportunities arising from the conduct of an exploration or development project in the Newfoundland offshore area are provided to Canadians and, in particular, to residents of the Province. For the purpose of administering these requirements of the Accord Acts, the Board uses definitions established in other legislation:

Canadian – A person who was born in Canada and who has not relinquished his/her Canadian citizenship; or, a person who has been granted Canadian citizenship; or, a person who has been granted permanent resident (landed immigrant) status in Canada.

Newfoundland resident – A Canadian citizen (or landed immigrant) who meets the residency requirements of the Newfoundland Election Act; i.e., a person who has resided in the Province for the immediately preceding six-month period.

Where foreign and out-of-Province contractors are responsible for the execution of work in

Newfoundland or in other parts of Canada, the Board takes the position that the Proponent has a duty to ensure that its contractors comply fully with the above requirements. The Board accepts that these contractors must be able to bring into Canada or into Newfoundland a limited number of senior personnel from their existing organizations to discharge their contractual responsibilities for managing the work, as well as specialized technical personnel necessary for the execution of the work where personnel with the requisite skills and experience are not readily available locally. In assessing employment plans associated with the work, the Board will consider any efforts by these contractors to recruit Newfoundland residents and other Canadians for work outside of Canada on this or other projects. The Board will also take into consideration the duration of the work in reviewing employment plans associated with the conduct of the work.

Contractors proposing to use non-Canadian personnel in Canada must also satisfy the requirements of the *Canada Immigration Act*. The Board encourages the Proponent and its contractors to consult with the Department of Human Resources Development Canada (HRDC) on a timely basis in order to satisfy the procedural requirements associated with obtaining the requisite foreign worker permits. The Board will work closely with HRDC to ensure that the requirements of the Immigration Act and the Accord Acts are efficiently administered.

The Board also accepts that, to the extent that contracts such as those for large heavy fabrication and construction, may be executed outside of Canada, there will be limited opportunities for the employment of Canadian tradespersons in the work. In such instances, the Board requires the Proponent to ensure that its project management and engineering contractors provide for significant participation by Canadian and, in particular Newfoundland, engineering and technical personnel in the teams assigned to the fabrication site by the Proponent for management and oversight of the work undertaken by such fabrication contractors.

The 'first consideration' provision of the Acts clearly requires that the Proponent and its contractors look first to the Newfoundland labour market to meet their human resources requirements, particularly as those requirements apply to long-term operating and support positions. The Board acknowledges that employers have the right to establish, in advance of the recruitment process, the minimum qualifications required of candidates for employment. However, the 'first consideration' requirement means that once the specifications for a position have been established, a Newfoundland resident who meets that specification must be given employment preference over non-residents. In discharging its responsibilities in this area, the Proponent must identify its labour requirements in a timely manner and make reasonable provision for the training of Newfoundland residents who meet the basic qualification requirements to become fully qualified for the employment opportunities arising from the project. The Proponent and its contractors must develop systems and maintain detailed records of their recruitment and staffing activities to be able when necessary to demonstrate to the Board that their decisions are consistent with the requirements of the Accord Acts. The Board intends to review the systems design within a reasonable period after Project Sanction and to audit their implementation periodically during the life of the Project.

3.1.2 Goods and Services

The statutory requirements related to the provision of goods and services can be summarized by the following excerpts from the Acts:

> **Canada-Newfoundland Benefits Plan means a plan ... for providing manufacturers, consultants, contractors and service companies in the Province and other parts of Canada with a full and fair opportunity to participate on a competitive basis in the supply of goods and services ...[3]**
>
> **first consideration shall be given to services provided from within the Province and to goods manufactured in the Province, where those services and goods are competitive in terms of fair market price, quality and delivery.[4]**

With respect to these statutory requirements, the Board expects the Proponent to apply the following general principles in making its decisions related to the procurement of goods and services for the Development:

- For products and services normally acquired on an international competitive bidding basis, potential Canadian suppliers will be given a full and fair opportunity to participate in the procurement process. While it is the Board's opinion that the statutory requirements do not afford Canadian and Newfoundland suppliers an unfettered right to bid, it expects that Canadian suppliers who have expressed an interest will be given an opportunity to qualify to bid and, if successful, a full and fair consideration in the bidding process. The Board accepts that the Proponent must have the ability to limit the number of vendors invited to bid through a prequalification process and that it would be unfair to expose vendors to the costs of preparing a bid where they have already been assessed to be

unqualified to provide the required goods or services.
- Where there is a sufficient number of qualified and competitive suppliers in Canada, the Board expects that the Proponent and its major contractors will normally limit the bidding process to Canada, including any Newfoundland suppliers. In such cases, the Board recognizes that a small number (a minority) of foreign suppliers may appear occasionally on the bidders list.
- Where there is evidence that a competitive market for a product or service exists in Newfoundland, the Board expects the Proponent to focus the bidding process on Newfoundland-based suppliers with the inclusion of a minority of outside bidders. The Board recognizes that many of the goods required for the Terra Nova Development are not manufactured in the Province and that, to a lesser extent, the required services may not be available locally.

In each procurement decision, the Proponent must ensure that 'first consideration' is given to Newfoundland-based suppliers competitive in terms of fair market price, quality and delivery. In this regard, the Board considers fair market price to mean the tendered price at which goods or services in question are offered in this jurisdiction by qualified vendors who have each been provided the same information regarding the Proponent's requirements and with the same reasonable time in which to respond. It is also important that in assessing the bids, the prices at which the goods and services were tendered by competing bidders be evaluated in an objective and unbiased manner.

The Proponent and its contractors are expected to keep sufficiently detailed records to demonstrate, when required, to the Board that their procurement process and the decisions issuing therefrom are consistent with the Accord Acts requirements. The Board plans to audit the systems and procedures associated with the procurement process periodically.

3.2 Newfoundland Office

This section describes the Board's assessment of the Proponent's plans to satisfy the Accord Acts' requirement to establish an office in the Province where appropriate levels of decision making are to take place.

The Proponent has chosen to establish an alliance with a group of contractors and key suppliers to execute project-phase work up to first oil production. Work to be undertaken by the Terra Nova Alliance includes engineering, procurement, construction and modification, installation, commissioning and pre-drilling. In its report, the Panel stated its opinion that the alliance approach provided an improved contracting approach to ensure that the provisions of the Accord Acts were met. In its Benefits Plan, the Proponent committed to use its "best efforts within the competitive bidding process to cause the project management and engineering work for the production platform, associated subsea facilities, mooring and loading systems and production risers for the development to take place in Newfoundland."[5]

The Proponent has stated that during the project phase of the Development, individual alliance contractors will be responsible for the execution of particular portions of the work. Initial engineering and procurement work will be largely executed from the existing offices of these alliance contractors. It has also said that an integrated team will manage the work from its St. John's offices. This management team will include a procurement group with responsibility for managing and coordinating the procurement activities of individual alliance contractors. For longer term operations, the Proponent plans to establish an organization in St. John's to manage and execute all aspects of the Development.

The Board is generally satisfied that the Proponent will establish an organization in the Province with appropriate levels of decision-making to manage its interests in the Terra Nova Development. The Board recognizes that the Proponent's organization will evolve through the various phases of the Development, i.e., regulatory, project and operations. With regard to the Proponent's commitment to use its best efforts within the competitive bidding process to cause project management and engineering work to take place in the Province, the Board notes that the Proponent has already commenced engineering and procurement activities for the Project. This work, ongoing since early 1997, is now being executed by individual members of the Terra Nova Alliance from offices located outside the Province, primarily in

London, Houston and Paris. While the Board appreciates that it may be practical to undertake this work outside the Province during the period prior to official approval of the Project by the Owners, it nevertheless believes that the Proponent's "best efforts" commitment requires that all reasonable measures be taken to relocate engineering and procurement activities to the Province. The Board expects the Proponent to relocate these activities to Newfoundland as soon as practicable after the Project is sanctioned by the Owners and believes that the majority of the engineering and procurement workforce could be relocated in the Province within a few months. Accordingly, it is a condition of the Board's approval that:

Condition 1:
As soon as is practicable after Project Sanction, the Proponent relocate engineering and procurement activities for the Project to Newfoundland.

3.3 Employment

This section describes the Board's assessment of the Proponent's plans to satisfy the employment requirements of the Accord Acts highlighted previously in Section 3.1.2 of this decision.

In the Benefits Plan, the Proponent committed to ensure that Newfoundland residents are afforded a full and fair opportunity to obtain employment and related training, to provide for the succession of Newfoundlanders and other Canadians to higher levels of responsibility, and to use an appropriately skilled and safety-conscious workforce.
The Proponent has also committed to ensuring that residents of Newfoundland are given first consideration for employment and related training opportunities arising from the Development.
The Proponent's estimates of the labour requirements associated with the entire Development are shown in Table 3.1.

TABLE 3.1
Estimated Labour Requirements –Terra Nova Development
(Millions of work-hours)

FPSO Engineering, Fabrication, Construction, Assembly and Hook-up	4.7	to	6.2
Subsea Engineering, Fabrication, Construction and Installation	0.7	"	0.8
Drilling, including marine/air support	5.7	"	6.1
Operations offshore and onshore	5.6	"	6.4
Transportation	2.9	"	3.6
Total	**19.6**	"	**23.1**

Source: Supplement B to the Application, Table 4.7-1, p. 64

The Proponent has committed to employment policies including:

- providing timely information to Governments, industry associations, educational institutions and the public regarding the Project's labour requirements and employment information
- developing training programs and career development models
- encouraging participation of visible minorities and other disadvantaged groups or individuals
- requiring alliance contractors to fully adhere to the Proponent's employment principles and commitments.

In its report, the Panel presented a broad set of recommendations related to employment, some of which fall outside the Board's mandate.
In particular, recommendations related to industrial relations [14, 15] and hours of work [21] are exclusively within the regulatory purview of the Government of Newfoundland and Labrador.

The recommendation concerning the licensing of professionals [25] is also outside the ambit of the Board's authority. Such legislation is generally administered directly by the professional bodies involved. Nevertheless, the Board supports the thrust of this recommendation and will continue to encourage the Proponent's compliance with legislation governing the licensing of professionals.

The Panel also made broad recommendations related to compliance with the Atlantic Accord including the following:

- that the Board insist upon compliance with the spirit and intent of the Atlantic Accord so as to avoid the necessity for bringing personnel from outside the Province solely because the need was not identified early enough to permit training of local residents [18].
- that the Board monitor and review the qualifications required for all jobs to ensure that residents of the Province are not excluded by unreasonable qualification requirements or other artificial barriers, and that the maximum number of apprenticeships permitted by union constitutions are filled by local people [8].
- that, should deviations from the principle of first consideration for Newfoundland workers be necessary, the Proponents, with the full knowledge of concerned worker representatives, be required to seek written authorization from the Board[20].
- that the Board discontinue the practice of establishing employment targets for Canadian, and in particular, Newfoundland workers[17].
- that the Proponent be required to institute an appropriate system for providing regular information to the public, not only regarding job and business opportunities, but also regarding the extent to which it is adhering to all commitments made in the context of the benefits plan[22].

With respect to the Panel's recommendations related to compliance with the Atlantic Accord, the Board will continue to require operators of exploration and development projects offshore Newfoundland to comply fully with all of the requirements of the Accord legislation, including those related to the employment of Canadians and, in particular, Newfoundland residents. The Board agrees that the early identification of labour requirements is fundamental to ensuring that opportunities for training local people to meet the labour requirements of the Development are captured. It also notes the Proponent's commitment to provide timely information on employment to Governments, industry associations, educational institutions and the public. The Board believes, however, that it may not be possible, nor feasible, to initiate training of local people to fill all positions associated with the Development, especially those of short duration or requiring specialized skills and experience.

With respect to the Panel's recommendation to review the qualifications required for all jobs, the Board intends to review job qualifications on a selective basis, concentrating on those positions which the Proponent is proposing to fill with out-of-Province workers. To the extent that work on the Development will be executed under a union agreement and subject to such terms, the Board fully supports the principle that the maximum number of apprenticeships permitted by union constitutions be filled by local people. The Board recognizes that the number of apprenticeship positions available may be limited by job requirements.

The Board is generally satisfied that the Proponent's employment-related policies constitute a sound basis for maximizing the employment of Canadians, in particular residents of the Province, in all phases of the Development. The Board will monitor the participation of Canadians and Newfoundland residents in all phases of the Development and will not accept any deviations from the statutory requirement to give first consideration to residents of the Province for training and employment. The Board will not establish employment targets for the Development. The Board has never adopted such a practice in the past and stated in Section 2.2.1 (p. 9) of its Decision 86.01 approval of the Hibernia Project, that it "does not support the establishment of specific employment goals, expressed in either absolute or percentage terms for the Project". The employment targets which existed for the Hibernia Project were established in the Hibernia Binding Agreement among the Hibernia owner companies and the two governments.

The Board notes the Proponent's stated intention to institute a public information campaign and will work with the Proponent to ensure such plans provide for dissemination of information on its adherence to Benefits Plan commitments as well as on job and business opportunities.

3.3.1 Employment – Project Phase

It is the Proponent's assessment that the project phase, by its very nature, will provide short-term job opportunities, most of which will be with alliance contractors and sub-contractors. The flow of project-phase employment benefits will largely be based on the results of competitive bidding for contracts associated with the fabrication and construction of the platform and associated facilities.
The Proponent has identified in the Benefits Plan

the labour requirements for the fabrication and construction of these facilities. The Proponent has also acknowledged that while there should not be a major problem in acquiring appropriately skilled people from Newfoundland and other parts of Canada for this phase of the project, there is a potential for a labour supply shortfall in some areas identified in the Plan.

The Panel recommended that "the Proponent supply: a list of skills required for the various trades throughout the life of the Project; an explanation of where shortfalls of skills are anticipated when compared with the local labour force; and a plan for the cooperation with government agencies, training institutions and unions to develop and fund training programs for Newfoundland tradespeople to obtain the level and skill required for the Project. Such training programs should provide for periodic updating as the Project proceeds" [11] The Panel report gave particular emphasis to the need to confirm the Development's requirements for Remotely Operated Vehicles (ROV) and diving personnel and, as necessary, to initiate training in the Province in order to develop a qualified local workforce [9, 10].

The Board concurs with the view that the flow of employment benefits during the project phase will depend largely on the results of competitive bidding for fabrication and construction contracts. The Board will monitor the bidding process to ensure that the Proponent meets its obligation to require contractors proposing to undertake work in Canada, and in particular in Newfoundland, to adhere fully to the employment provisions of the Accord Acts. The Board expects that the Proponent will be in a position to award most, if not all, of its major fabrication and offshore construction contracts by early 1998. For those contracts to be executed in Canada, the Board intends to review the employment and training plans associated with the conduct of the work to ensure they provide for the maximum participation of Newfoundland residents and other Canadians.

The Board supports the thrust of the Panel's recommendations related to diving and ROV personnel but notes that responsibility for initiating institutional training resides with the Government of Newfoundland and Labrador. For its part, the Board will ensure that these requirements of the Development are identified by the Proponent and that the necessary information is provided to the responsible government department(s) by requiring, as a condition of its approval that:

Condition 2:
For each fabrication and construction contract to be executed onshore Newfoundland (or in another part of Canada) and for each construction and installation contract to be executed at the Terra Nova field, the Proponent, upon award of contract, provide the Board with a complete description of the labour requirements associated with the contract, an assessment of the availability of local people to meet the requirements, a description of its plans for implementing training programs, and an estimate, by trade or occupational group, of the required number of out-of-Province and foreign workers.

3.3.2 Employment – Operations Phase

The Proponent states in its Benefits Plan that most of the longer term employment opportunities associated with the Development will be during the operations phase. The typical skills and job types required for the operations phase including offshore production operations, tanker operations, marine and air support and onshore support personnel are identified in the Benefits Plan. The Proponent plans to submit at the beginning of the operations phase a Human Resources Plan outlining participation by Newfoundland engineers, geoscientists and other technical disciplines along with a plan for them to assume increasingly senior positions.

In its report, the Panel recommended "that the Proponent provide to the Board, to governments and educational institutions information on jobs in the operations phase, including specific qualifications required, to allow planning to take place regarding the development of any new training required" [13].

The Board concurs with the Proponent's view that most of the enduring employment opportunities are associated with operations, including development drilling and producing operations. The Board also agrees with the thrust of the Panel's recommendation in this regard which the Board believes is aimed at ensuring that, to the extent practicable, training programs are implemented to ensure that a pool of labour with the requisite training and experience is available for the operations phase of the Development. The Board recognizes that with increasing activity offshore Newfoundland the demand for offshore workers will increase, which may result in shortfalls in the number of qualified personnel available locally. The Board expects the Proponent to take measures to provide Newfoundland residents with the training

and experience necessary to qualify them for long-term employment opportunities. For example, recent technical school graduates or technical personnel with insufficient work experience could be hired well in advance of the commencement of producing operations and assigned to similar operations elsewhere to attain the necessary qualifications to fill positions associated with the operations phase of Terra Nova. The Board believes that the Proponent's commitment to provide a human resources plan associated with operations is a useful starting point. It is the Board's assessment that such a plan should cover all, not just engineering and technical, positions associated with operations. To ensure the timely development of a human resources plan, it is a condition of the Board's approval that:

Condition 3:
Within six (6) months of Project Sanction, the Proponent submit to the Board a comprehensive human resources plan, acceptable to the Board, for the operations phase of the Development covering all drilling, producing, crude transportation and support activities. The Plan should provide for the maximum practicable level of participation of residents of the Province in the operations phase workforce and, to the extent practicable, the succession of Canadians, and in particular residents of the Province, to positions initially held by non-Canadians.

3.4 Goods and Services

In the Benefits Plan, the Proponent committed to a broad set of policies and procedures in order to address the requirements of the Accord Acts related to the provision of goods and services. This section describes the Board's assessment of the proposed policies and procedures, particularly the proposed bid evaluation framework applying to the Development and the Proponent's supplier development initiatives.

3.4.1 Procurement Policies and Procedures

The Proponent has described in its Benefits Plan its procurement policies and procedures applying to the Development. The key policies and procedures are as follows:

- Timely and open communication with all stakeholders. At the time of submission of the Benefits Plan, detailed requirements for goods and services for the Development had not been established. The Proponent has committed to providing this information to supplier communities and governments as it becomes available.
- The Alliance will identify all major procurement contracts that could potentially offer significant long-term benefits opportunities to Newfoundland.
- Bid packaging, technical specifications, bidding procedures and bid follow-up will be such as to provide Newfoundland and other Canadian firms a full and fair opportunity to provide goods and services.
- The Proponent will not make packages artificially smaller than normal industry packaging practices.
- Technical specifications will be reviewed to ensure they do not unfairly prevent the participation of Newfoundland and other Canadian suppliers in the bidding process.
- All contractors and sub-contractors are required to adhere to the Proponent's principles, objectives and commitments related to benefits. The Alliance will follow the policies and procedures contained in the Benefits Plan.

In its report, the Panel presented recommendations which address the need for the implementation of appropriate measures to satisfy the Accord Acts requirements related to the provision of goods and services. In particular, the Panel recommended that "the Proponents use their best efforts to ensure that local fabrication yards have the information and support necessary to take

advantage of opportunities to upgrade project management, procurement and quality control systems to the highest recognized international standards" [5]. With respect to compliance with the Proponent's commitments, the Panel recommended "that the Proponents require their contractors and sub-contractors to educate their management staff, down through the supervisor level, about the rationale for the requirements of the Atlantic Accord so that decisions can be made in the context of that Accord" [16].

In the Board's view, the timely provision of information related to the Development's requirements to all stakeholders, in particular the Canadian and Newfoundland supply communities, is a key first step towards meeting these statutory requirements. It is also the Board's opinion that open and timely communication related to the Development's requirements is best achieved when management and support personnel are located in the community most directly affected by the Development. The presence of project engineering and procurement personnel in the local community would contribute significantly towards open and timely communication with the local business community during the project-phase of the Development. The Board notes that the Proponent has, since submission of its Benefits Plan, conducted supplier information seminars in St. John's and Halifax.

With respect to the Panel's recommendations, the Board is satisfied that the Proponent's Benefits Plan provides for ensuring that local fabrication yards have the information and support to take advantage of opportunities to upgrade their management systems. The Board is also satisfied that the policies and procedures outlined in the Benefits Plan will provide for all reasonable measures to be undertaken to ensure that contractors and sub-contractors comply with the requirements of the Accord Acts. Notwithstanding the foregoing, the Board intends to closely monitor the Proponent's performance in this regard.

It is the Board's assessment that, overall, the policies and procedures related to the acquisition of goods and services for the Development described in the Benefits Plan are consistent with the statutory requirements to give full and fair opportunity to Canadian suppliers and first consideration to goods and services provided from within Newfoundland. The Proponent's undertaking to identify all major procurement contracts that could potentially offer significant long-term benefits opportunities to Newfoundland should be expanded to include those procurement contracts that could potentially offer significant long-term benefits to Canada generally, not just specifically to Newfoundland. It is also the Board's assessment that, for the establishment of an efficient and workable procurement review process, these procurements should, to the extent possible, be identified early in the project phase, with provisions for updating the list as the Project evolves. Accordingly, it is a condition of the Board's approval that,

Condition 4:
Upon Project Sanction, the Proponent submit for the Board's review, a listing and description to be updated quarterly of all significant contracts for the procurement of goods and services identifying those which, in the Proponent's view, could potentially offer long-term benefits opportunities to Canada and, in particular, to Newfoundland.

3.4.2 Bid Evaluation Framework

In its Benefits Plan, the Proponent described a framework for the evaluation of bids for goods and services for the Development, which can be summarized as follows:

- Goods and services will be acquired on the basis of best value and Canada-Newfoundland benefits. Best value is defined by the Proponent as a blend of total cost, quality, technical suitability, delivery and continuity of supply and service. As well as the technical and commercial considerations inherent in best value, the level and quality of Newfoundland and Canadian benefits will be selection factors in the awarding of contracts.
- The Alliance will evaluate each bid in three general categories: technical, commercial and benefits. The weighting will be in accordance with the needs of the goods and services being acquired and any special considerations identified in the execution plan and development schedule.
- The Alliance will integrate the assessments of best value and benefits, and select the preferred vendor. Where bids are essentially equal on a competitive (best value) basis, first choice will be given to goods and services from Newfoundland. Where all of the development's technical and commercial considerations are satisfied in more than one bid, but those bids are not essentially equal (on a best value basis) and one bid yields significant incremental long-term benefits to Newfoundland relative to other bids, the Alliance will award the contract offering the most significant long-term benefits to Newfoundland.

While the Panel did not provide any specific recommendations related to the evaluation of bids for the provision of goods and services to the Development, it did express strong support for the principle of international competitive bidding. In its report, the Panel stated "that, looking at the long-term, it is a policy that makes economic sense."[6]

The Board has reviewed the Proponent's bid evaluation framework described in the Benefits Plan and believes that, fundamentally, it is consistent with the relevant provisions of the Accord Acts. The proposed "best value" criterion as described in the Plan is, in the Board's assessment, consistent with the fair market price, quality and delivery criteria referenced in the Acts.

The Proponent's plans to consider any significant incremental long-term benefits to Newfoundland in its evaluation of bids is, in the Board's view, a positive undertaking. However, the Proponent's approach to the integration of "best value" and benefits criteria is not well developed in the Plan and, accordingly, the proposed bid evaluation framework will be, in the Board's opinion, difficult for both Petro-Canada and the Board to administer. The Proponent's commitment to identify procurement contracts that could potentially offer significant long-term benefits opportunities to Newfoundland does, however, provide a good starting point for implementing the framework.

The Board recognizes that the weight assigned to individual evaluation criteria will vary somewhat from procurement to procurement, depending upon the kind of goods and services to be acquired and the requirements of the Project. For those procurement decisions selected by the Board for review, the Board will require the Proponent to identify its selection criteria and associated weighting sufficiently early in the procurement process, before bids are submitted, to enable those criteria to be discussed with the Board before evaluation begins. As the Project evolves, the Board will identify those procurement decisions that it wishes to review in consultation with the Proponent.

While the Board believes the overall bid evaluation framework is consistent with the requirements of the Accord Acts, the Board expects the Proponent to establish, in consultation with the Board, systems and procedures to effectively implement this framework. It is a condition of the Board's approval that:

Condition 5:
Upon Project Sanction, the Proponent establish, to the satisfaction of the Board, systems and procedures to implement the bid evaluation framework described in the Benefits Plan.

3.4.3 Supplier Development

The Proponent has described in its Benefits Plan a broad policy with respect to supplier development. In addition to providing timely information about the Development's requirements, the Proponent has committed to work with governments and industry to improve domestic supply capability, to jointly identify potential Newfoundland and other Canadian suppliers, and to encourage the establishment of new suppliers in Canada. The Proponent will encourage the formation of appropriate alliances involving Newfoundland and other Canadian firms that would enhance the ability of domestic firms to compete for project work. To help improve the domestic supply base and encourage new suppliers, the Proponent has committed to:

- evaluate new goods and suppliers and, where appropriate, provide an opportunity to participate in the supply process
- evaluate the quality and reliability of new products from suppliers where warranted
- debrief bidders, when requested, to provide feedback on their capabilities.

The Proponent has committed to encourage the use of existing Newfoundland and Canadian construction, fabrication and assembly infrastructure. The Proponent has further committed to undertake best efforts (in the context of international competitive bidding processes) to cause the fabrication, assembly and outfitting services associated with the construction of platform topsides, subsea facilities, mooring systems and production risers to be performed in Newfoundland.

The Proponent has committed to encourage, to the extent practicable, the formation of engineering alliances between qualified Newfoundland and other engineering firms to compete for the work. The Proponent has agreed that any consortium awarded an engineering, procurement and project services contract (or similar such contract) will have Newfoundland participation.

In its report, the Panel presented a number of recommendations related to supplier development and Newfoundland content:

- that the Proponents use their best efforts to promote supplier development throughout the Province [26].
- that the Board ensure that Newfoundland content in the Project is maximized and that such content includes technology transfer and support for existing and new industries in the service sector [27].

- that the Board develop a plan to ensure that technology transfer and new industrial development become a prime requisite for the approval of future development projects [28].

The Panel specifically recommended "that the Proponents be required to use their best efforts and bidding processes to cause the successful international supplier of subsea systems to set up assembly and fabrication facilities in Newfoundland, using local labour trained to produce quality products" [7].

It is the Board's overall assessment that the Proponent's policies related to the development of Newfoundland and other Canadian suppliers are consistent with the full and fair opportunity and first consideration provisions of the Accord Acts. The Board has noted the Proponent's undertaking to use its "best efforts" to cause the fabrication, assembly and outfitting services associated with the platform topsides and subsea facilities, mooring system and production risers be performed in Newfoundland. The Board believes that this work, which constitutes a significant portion of the work associated with the project phase of the Development, represents significant opportunities for the Province to further develop its offshore industrial infrastructure and to achieve the establishment of competitive world-class facilities for offshore projects.

While the Proponent's "best efforts" undertaking is qualified by certain conditions, in the Board's view it implies that a significant extra effort will be made to achieve the described outcomes, and the Board expects the Proponent to be able to demonstrate that such efforts have been made. The Board expects the Proponent to take all practicable measures to achieve the desired outcomes, including, but not necessarily limited to, the full disclosure of information related to the project's requirements and timely consultations with the Owners (or their representatives) of major fabrication facilities in Newfoundland in order to assist them in meeting the commercial and technical needs of the project. The Proponent's efforts to cause the establishment of a new labour agreement at the Bull Arm site are, in the Board's opinion, consistent with this undertaking. To enable it to ascertain that the Proponent is using its "best efforts" in this regard, it is a condition of the Board's approval that:

Condition 6:
As the Project evolves, the Proponent consult the Board regarding its decisions related to all contracts associated with the construction of topsides and subsea facilities, mooring systems and production risers from the initial prequalification of bidders to contract award to demonstrate that it is using its best efforts as described in the Benefits Plan to cause this work to be performed in Newfoundland.

With regard to the Proponent's initiative to require any consortium awarded an engineering, procurement, and project services contract to have Newfoundland participation, the Board has noted that the project-phase alliance contract awarded by the Proponent in December 1996 did provide for the participation of Canadian and Newfoundland engineering and construction companies. It is the Board's position that for such participation to be meaningful, it must result in the participation of Canadian and, in particular, Newfoundland engineering and technical personnel in the work to be performed by the individual members of the Alliance.

With respect to the Panel's recommendations related to supplier development, technology transfer and industrial development generally, the Board accepts that these objectives are important for the Province as a long-term development strategy. In administering the requirements of the Accord Acts, the Board will work cooperatively with the Proponent and governments to ensure that opportunities for the transfer of technology to the Province and for the development of suppliers are identified. The Board is confident that the Terra Nova Development presents significant opportunities for the transfer of technology and for advancing the development of local suppliers working in the offshore industry. The Board has established a condition to its approval (Condition 4) to effect the identification of such opportunities.

3.5 Research and Development and Education and Training

This section describes the Board's assessment of the Proponent's plans to satisfy the requirement of the Accord Acts that the Benefits Plan contain provisions for expenditures on research and development and education and training in the Province.

3.5.1 Research and Development

The Proponent's support of research and development in Newfoundland has in the past focused on cold-ocean and ice-related research. The Proponent is a member and sponsor of the Centre for Cold Ocean Resources Engineering (C-CORE) located in St. John's. In addition to supporting the R & D programs of this organization, the Proponent has engaged C-CORE to undertake research related to ice-vessel interaction studies and iceberg impact assessment. The Proponent has sponsored research in Newfoundland related to groundwave radar, personnel evacuation systems, and cased glory hole technology.

The Proponent believes that the needs of the Terra Nova Development can be met with existing products and services and the extension of existing technologies through appropriate research and development programs. Follow-up to recent research work sponsored by Petro-Canada is anticipated as the project proceeds. The Proponent has identified three potential areas for which the project may find it appropriate to continue R & D work: iceberg detection, tracking and management; ice-vessel interactions; and ice-seafloor interaction.

The Board acknowledges the Proponent's support for R & D activities in Newfoundland in the past. It is the Board's assessment, however, that the Proponent's commitments vis-à-vis its future support of such activities are at best qualified, particularly inasmuch as there is no measure of the level of effort the Proponent intends to make in this regard (e.g., there are no expenditure estimates provided in the Benefits Plan). While the relevant provisions of the Accord Acts do not prescribe levels of expenditure, the Acts require that the Benefits Plan contain provisions intended to ensure that expenditures are made on research and development in the Province. In the Board's opinion, the Panel's recommendation [51] related to funding basic research is consistent with the thrust of this legislative requirement.

3.5.2 Education and Training

The Proponent has presented in the Benefits Plan a broad framework related to training. The Proponent views training as comprising on-the-job training, short-term assignments, internal and external courses, employee self-study, workshops, conferences and seminars, and secondments to affiliated organizations. The Board's assessment of the Proponent's plans related to training is described in Section 4.3.3.4 Training and Qualification, Chapter 4 of this report.

During the construction phase of the Development, most of the workers will be employees of the alliance contractors and their sub-contractors. Training for the construction-phase requirements will be the responsibility of these contractors and sub-contractors. To the extent construction work is undertaken in Newfoundland, education and training is expected to take place locally. Operations-phase training programs will be initiated by the Proponent before start-up to ensure that operations personnel will be fully prepared to perform safely and effectively from the outset. Safety training including marine emergency duties, first aid, workplace hazardous materials, basic survival training, well control and fast rescue craft will take place primarily in the Province.

The Board is satisfied that the Proponent understands the capabilities of local organizations in providing education and training programs, particularly programs related to safety offshore. The Board encourages the Proponent to commence early dialogue with local training organizations so that their facilities can be used in an optimal fashion to the benefit of both the Proponent and these organizations. The Board also encourages the Proponent to consider ways it can support education and training generally in the Province, beyond simply using local organizations and facilities to deliver the training needs of the Development. As an example, the Board notes the potential for work placements and/or secondment of individuals from local organizations to the Development. The Board acknowledges the recently announced contribution by Petro-Canada to support research chairs at Memorial University of Newfoundland.

3.5.3 Summary – Education and Training/Research and Development

The Board acknowledges that the Proponent's Benefits Plan indicates that opportunities exist for the conduct of research and development in the Province to continue in the future and that safety-related training will primarily take place in the Province. It is the Board's overall assessment, however, that the Plan does not fully satisfy the statutory requirement that the Benefits Plan contain provisions intended to ensure that expenditures are made on research and development and education and training in the Province. The Board appreciates the difficulty in providing, in advance, detailed research and development and education and training plans for the entire duration of the Development and, therefore, to provide a framework for monitoring the Proponent's activities in this regard, establishes as a condition to its approval of the Benefits Plan that:

Condition 7:
The Proponent report to the Board by March 31 of each year, commencing in 1998, its plans for the conduct of research and development and education and training in the Province, including its expenditure estimates, for a three-year period and on its actual expenditures for the preceding year.

3.6 Reporting and Auditing

The Board notes the Proponent's plan to submit an annual report to the Board on Canada-Newfoundland benefits including the following information:

- Work activities undertaken during the period
- Expenditure estimates by component and vendor classified by Newfoundland, other Canada and non-Canadian
- Employment reported by Newfoundland, other Canada and non-Canadian
- Research and development expenditures reported by program and total expenditure
- Summary of initiatives aimed at enhancing the opportunities for Newfoundland and other Canadian companies to participate in the development.

The Board concurs generally with the proposed scope of the annual benefits report but believes that it is necessary to report expenditures and employment information for the Development on a quarterly basis. The Proponent will be required to establish reporting systems and procedures to facilitate the accurate reporting of such information. The Proponent's reports will be subject to audit by the Board. Accordingly, access on a confidential basis to all relevant documentation necessary to substantiate the reported Canadian and Newfoundland content and employment will be required. As indicated in Sections 3.1.1 and 3.1.2 of this decision, the Board also intends to audit the Proponent's recruitment and hiring and procurement systems and procedures. It is a condition of the Board's approval that:

Condition 8:
The Proponent report on a quarterly basis, in a format satisfactory to the Board, expenditures and employment information, including Canadian and Newfoundland content.

[1] *Canada-Newfoundland Atlantic Accord Implementation Act* and *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, Section 45(1)
[2] *Canada-Newfoundland Atlantic Accord Implementation Act* and *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, Section 45(3)(b)
[3] *Canada-Newfoundland Atlantic Accord Implementation Act* and *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, Section 45(1)
[4] *Canada-Newfoundland Atlantic Accord Implementation Act* and *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, Section 45(3)(d)
[5] *Canada-Newfoundland Benefits Plan*, Section 2.4.5, p. 2-8
[6] *Report of the Terra Nova Project Environmental Assessment Panel*, Section 3.4, p. 16

Chapter 4

The Terra Nova Development Plan Decision

4.1 Introduction

It is the decision of the Board that the Terra Nova Development Plan is approved, subject to the conditions established in this Development Plan Decision.

The Plan describes the Proponent's interpretation of the characteristics of the hydrocarbon reservoirs in the Terra Nova field, its estimates of the petroleum reserves and the approach it proposes to take to recover, or conserve, those reserves. It also includes a description of the facilities it proposes to install to produce the hydrocarbon resource, the parameters upon which its facilities design will be based, and the measures it proposes to undertake to ensure the safety of personnel and protection of the environment.

The Board has reviewed the Development Plan to ensure that it conforms to the requirements established by the Accord Acts and the regulations promulgated pursuant to the Acts. The Board's duties are to ensure that:

- the production facilities are designed and operated in full consideration of the safety of personnel and the protection of the natural environment
- the resource is produced in accordance with good oil field practice, to maximize recovery and to prevent waste

The Board notes that the Terra Nova Development Plan is based upon preliminary engineering studies and that, consequently, its approvals are related to the concepts, approaches and undertakings described in the Plan. As detailed design and operational planning proceed, it will be necessary for the Proponent to obtain the additional approvals which are set out in:

- the *Newfoundland Offshore Petroleum Installations Regulations*
- the *Newfoundland Offshore Petroleum Drilling Regulations*
- the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*
- the *Newfoundland Offshore Area Petroleum Diving Regulations*
- the draft *Petroleum Occupational Safety and Health Regulations – Newfoundland.*

The *Newfoundland Offshore Certificate of Fitness Regulations* require that a recognized Certifying Authority undertake a detailed examination of the design of facilities to ensure that they are fit for purpose and that they comply with the regulations. The Scope of Work for the Certifying Authority must be submitted for Board approval. The Proponent has informed the Board that it has selected Lloyd's Register as the Certifying Authority for the project.

The remainder of this chapter presents the detailed results of the Board's review and is organized into three major areas: conservation of the resource, safety of operations, and protection of the environment. Each topic within these three broad areas will be introduced by describing first the Proponent's plans and proposals, then the main items of concern, including where applicable the recommendations of the Terra Nova Project Environmental Assessment Panel, and concluding the Board's assessment of the issue, including any conditions which it believes must be attached to its approval.

4.2
Conservation of the Resource

This section focuses on aspects of the Terra Nova Development Application which affect conservation of the resource. The statutes and regulations administered by the Board require that oil and gas resources be produced in accordance with good oil field practice, having proper regard for the efficient recovery of the resource and the prevention of waste. The development application presents the Proponent's interpretation of the geophysical and geological data, reservoir characteristics of the field, and the proposed approach to recovery of the oil reserves and the conservation of the gas resources. The Proponent is continuing its studies to optimize the development plan and on June 17, 1997 provided an update to the application regarding the proposed approach to production of the oil reserves and conservation of the gas resources.

In any oil or gas field development it is impossible to resolve all of the geological, geophysical and reservoir ambiguities prior to proceeding with development. Despite the delineation drilling which has occurred in the Terra Nova field and subsequent studies, several uncertainties may affect the depletion scheme to be employed and the recoverable reserves. The Proponent's plan provides for early resolution of these uncertainties and, in the Board's opinion, has sufficient flexibility to cope with any necessary changes.

The resource conservation aspects of the Application were reviewed utilizing the geoscientific interpretations and reservoir characteristics contained in the application and its updates and the Board's independent assessment. The Panel did not address any recommendations to this subject. The following sections of the report present the Board's review.

4.2.1
Regional Geology

The Terra Nova field is located on the southeastern margin of the Jeanne d'Arc Basin approximately 340 km east of St. John's and approximately 35 km southeast of the Hibernia field. The Jeanne d'Arc Basin is a northeast trending sedimentary basin bounded on the west by the Bonavista Platform, to the east by the Central Ridge Complex, and to the south by the Avalon Uplift. To the north, the Jeanne d'Arc Basin opens into the East Newfoundland Basin.

More than 20 km thickness of sedimentary rocks ranging in age from Triassic to Quaternary are preserved in the Jeanne d'Arc Basin. In contrast, the basin bounding, structural high features have a much thinner sedimentary section, a result of erosion and/or non-deposition.

The deposition sequence of the sedimentary rocks in the basin was strongly controlled by the regional tectonic events that have occurred on the North Atlantic continental margin. The initial deposition of sediments in the basin during the rifting which occurred in Early Triassic time comprised a sequence of continental red beds and evaporites within a northeast trending rift graben. This was followed by a Jurassic post-rift phase, during which the area subsided and sediments with characteristics typical of deep marine environments such as shale and limestone were deposited. The organic-rich shale, limestones and marlstones of the Rankin Formation which were deposited at the end of this phase are of particular importance as they are considered to be the source rock for most of the oil generated in the basin.

A second phase of rifting, oriented generally east-west, occurred in the Late Jurassic period. The uplift and erosion of the underlying Rankin Formation in this period was followed by the deposition of the fluvial sandstones and conglomerates of the Jeanne d'Arc Formation. Basinward, the Jeanne d'Arc Formation grades into shales of the Fortune Bay Formation. Moving forward in time into the Early Cretaceous period, braidplain and deltaic sandstones of the Hibernia Formation continued to fill the basin. Following this, a post-rift period of subsidence and deepening basin conditions occurred which is reflected by the "B" Marker and "A" Marker limestone, marine sandstones of the Catalina Formation and the Whiterose Formation shale.

The final phase of rifting, a southwest-northeast extension, occurred in the mid-Cretaceous period. During this time, the fluvial to marine sandstones of the Ben Nevis/Avalon Formations and basinward, the shales of the Nautilus Formation were deposited.

Since the Late Cretaceous time, the entire basin has undergone thermal subsidence and the sediments deposited include fluvial-deltaic and deeper marine clastics and minor limestones. This was followed in Quaternary time by glaciation and the subsequent transgression of the ocean into the area.

A detailed discussion of the regional geology is given in "The Geology, Geophysics and Petrophysics of the Terra Nova field, Jeanne d'Arc Basin", Petro-Canada 95-013, submitted to the Board as Part II documentation in support of the Terra Nova Development Plan.

4.2.2 Geophysical Interpretation

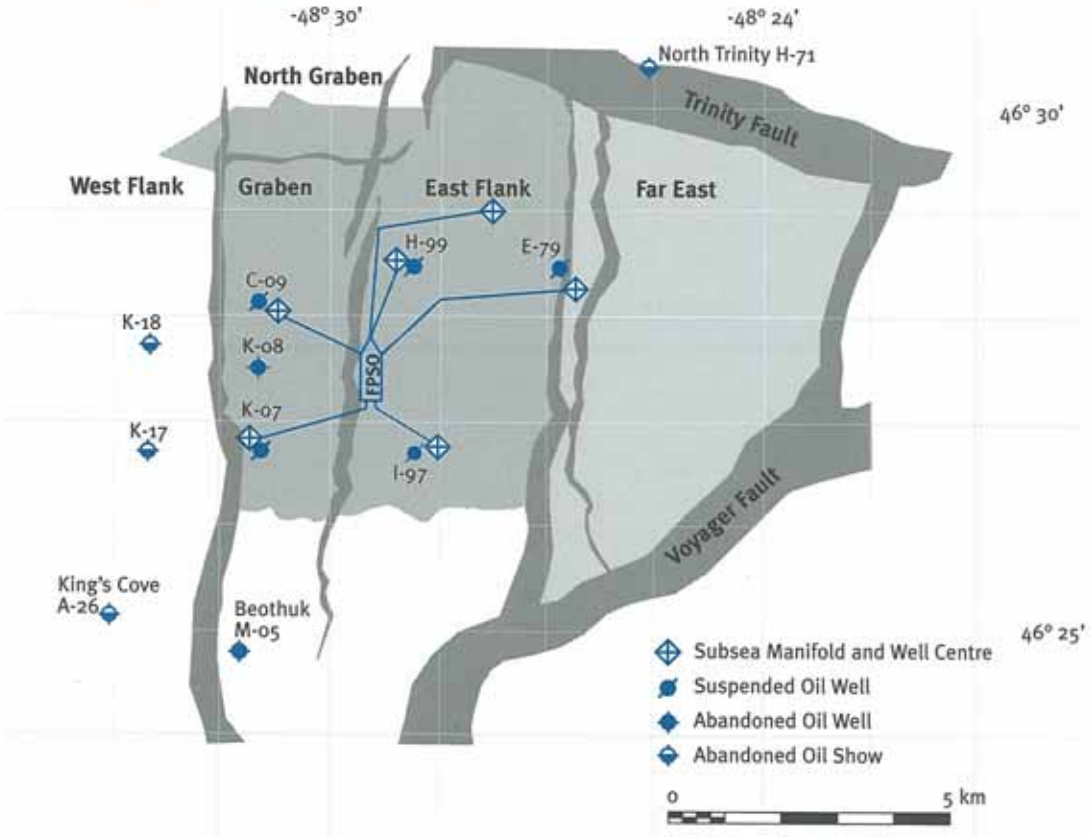
The Proponent used a 3-D seismic data set comprised of two surveys, one shot in 1984 and the other in 1988 to map the structure of the Terra Nova Field. The acquisition, processing and interpretation of the seismic data used are described in the Development Application and are detailed in the final reports submitted as required by the conditions of authorization of the surveys.

The seismic data have been interpreted using the well results as control points to confirm the correlated reflections, to convert time structure maps to depth structure maps, and to determine the thickness of reservoir units.

The structure at the base of the Jeanne d'Arc Formation formed the basis for subdividing the field into West Flank, Graben, East Flank and the Far East, with major north-south trending faults as boundaries (Figure 4.1). These regions are further subdivided by east-west trending faults. Transmissibility of fluids across the faults was assessed by the Proponent on the basis of sandstone juxtaposition across the fault planes and for the most part the faults are interpreted to act as flow barriers. Noteworthy exceptions are the two east-west trending faults between the I-97 and the H-99 fault blocks and the K-07 and the C-09 fault blocks. Faulting in the Far East block is more complex than in the rest of the field. A new 3-D seismic survey over the field was acquired in the summer of 1997 and this data, processed using techniques suitable for structurally complex areas, is expected to produce a more accurate structure map of the field, particularly in the Far East region.

The individual sand units within the Terra Nova reservoir are generally below the limit of seismic resolution. Furthermore, the sandstones and the shales in the reservoir zone have similar seismic properties and hence are not easily distinguishable in seismic sections. Therefore, the structure at the top of the reservoir cannot be directly mapped using seismic data and was mapped by subtracting the reservoir thickness, determined from wells, from the base of the Jeanne d'Arc Formation depth structure map. The interpretations are somewhat open to question in the Far East and the North Graben

FIGURE 4.1 **Preliminary Subsea Layout**



Source: after Petro-Canada, 1997

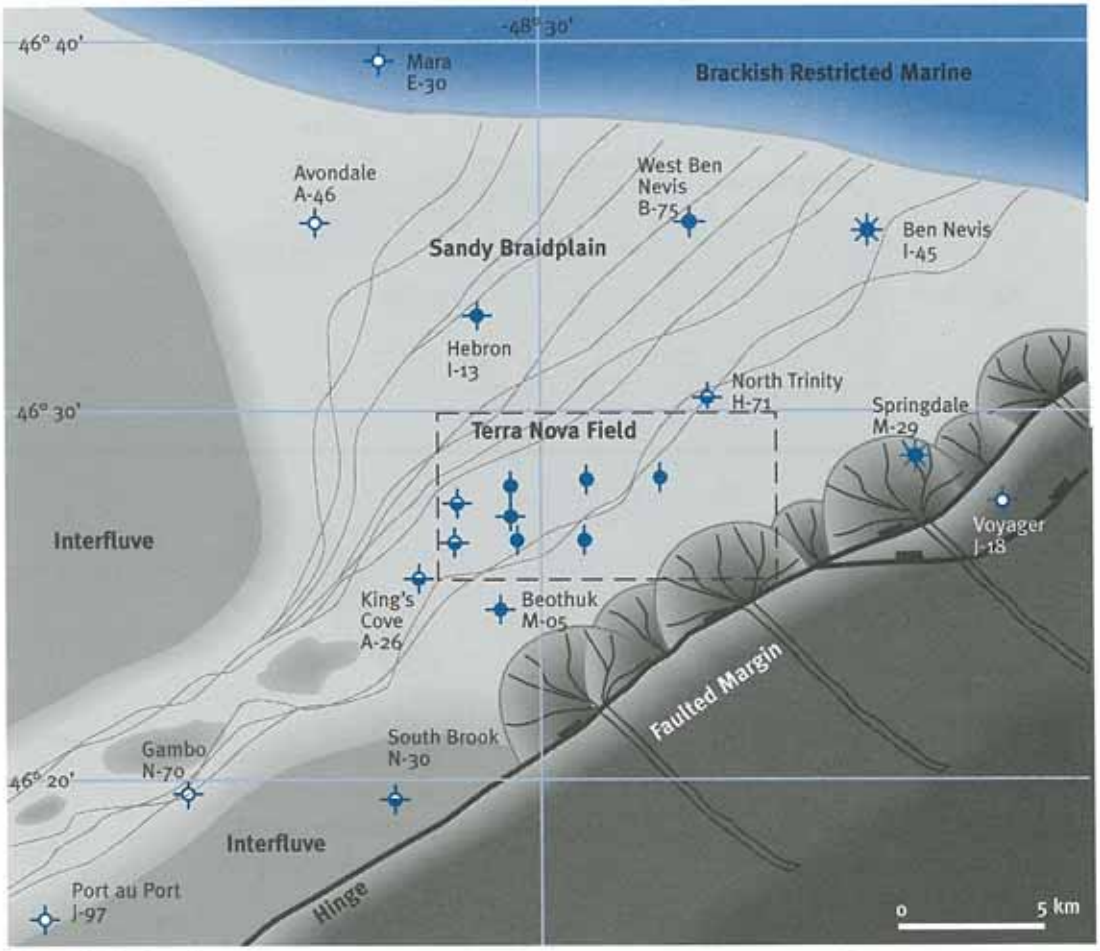
where no wells have yet been drilled. The Proponent plans to drill in the Far East region early in the development scheme and this will provide additional well control to support revised mapping of this area. The 3-D seismic survey shot in 1997 will also provide additional information.

4.2.3 Geological Interpretation

The Proponent has provided a comprehensive description of its geological assessment and interpretation. The reservoir sandstones are interpreted to have been deposited in a river-dominated to marginal-marine environment (Figure 4.2), to be highly productive, and to have good lateral continuity. The reservoir section of the Terra Nova field has been divided into seven sandstone and five shale units (Figure 4.3). The major reservoir sandstones, although locally separated by thick mudstone or shales, are stacked in various parts of the field and are interpreted to be in vertical communication.

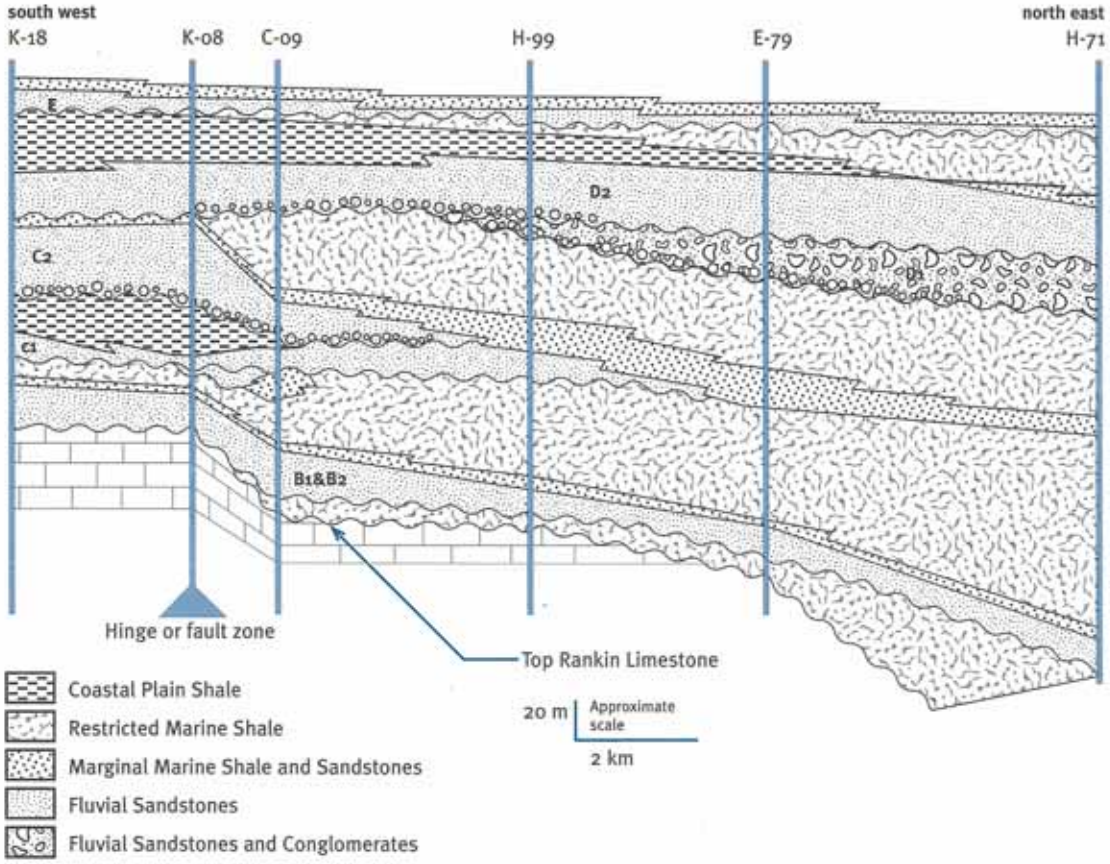
The Board considers the Proponent's geological model to be reasonable. However, alternate models have been proposed by the Proponent as well as by the Board. The Board's model for the upper sandstones is consistent with that of the Proponent. However, the Board interprets a fan delta type, conglomeratic sandstone to exist in the lower reservoir section extending northward beyond that area mapped by the Proponent in the Far East. This assumes that the E-79 well is the type section for assigning oil pay in the lower reservoir unit in the Far East Block. Consequently, the Board predicts more oil to be present in the Far East Block than does the Proponent. These alternate interpretations highlight the variation in possible depositional environments across the field. The Proponent's plan to drill a well in the Far East and North Graben early in its development drilling program will help clarify the geological interpretation of these areas.

FIGURE 4.2 **Jeanne d'Arc Formation Paleogeography**



Source: Petro-Canada, 1997

FIGURE 4.3 **Schematic Stratigraphic Cross Section, Jeanne d'Arc Formation, Terra Nova Field**



Source: after Petro-Canada, 1997

4.2.4 Reservoir Characteristics

4.2.4.1 *Formation Flow Tests*

The Proponent has conducted an extensive formation flow testing program to evaluate productive performance, acquire fluid samples and establish reservoir parameters for reservoir studies. The Proponent's analyses of the formation flow test data indicate that the field consists of highly permeable and productive sandstones and that only minor barriers to flow are present. According to the Proponent, neither a gas-oil contact nor an oil-water contact has been identified from the results of drilling, except for a 'perched' water leg in the K-08 well at 3414 m subsea. However, the Proponent postulates an oil-water contact at 3548 ± 33 m subsea for the field based on repeat formation tester data.

The Board has conducted an independent review and interpretation of the Proponent's formation flow test data. While there are minor differences between the Board's interpretation and that of the Proponent, they do not affect the development strategy for the field. The Board believes the Proponent's assessment is reasonable for planning purposes.

The location of the oil-water contact will affect the computed reserves and may affect the location of development wells. The Board acknowledges the uncertainty in determining the oil-water contact and notes the Proponent's proposed drilling schedule is designed to resolve this uncertainty.

4.2.4.2 *Petrophysics*

The Proponent conducted a comprehensive logging and coring program while drilling the Terra Nova exploration and delineation wells. In the Application, the Proponent described the petrophysical interpretation of this data, including the assumptions and procedures used in the interpretation, and summarized the reservoir parameters derived for each of the sand units.

The Board has conducted an independent review of the petrophysical data and, based on its analyses, believes the interpretation of the available data presented by the Proponent to be reasonable.

4.2.4.3 Fluid Characteristics

During testing of the Terra Nova exploration and delineation wells the Proponent conducted a thorough fluid sampling program. Analyses of the samples were conducted to define the fluid characteristics and select representative properties for engineering studies. The Proponent describes the characteristics of three types of oil which, based on analyses of fluids recovered during testing of Terra Nova exploration wells, it believes are present in the field. It also presents an analysis of a water sample recovered from a well drilled on the West Flank of the field. No formation water was recovered from wells drilled in the Graben and East Flank.

The Board considers the Proponent's oil characterization to be reasonable. The Board observes that, while the West Flank water sample may be typical of the remainder of the field, the composition of formation water in the Graben, East Flank and Far East regions remains uncertain until representative samples become available for analysis during development drilling. As part of the Terra Nova Field data acquisition and reservoir management program the Board believes it is important to obtain representative formation water samples from these regions as the opportunity arises and to conduct analyses to determine compatibility between the formation water and the proposed sea water to be injected.

4.2.4.4 Core Analyses

In the Application, the Proponent described studies conducted on short plugs cut from the cores recovered during exploration and delineation drilling and presented the results of its analyses. Among other factors, these studies indicate an average residual oil saturation to water and gas flood of 41 percent and 42 percent respectively. The Proponent noted that a long core displacement study was underway to evaluate the results of residual oil saturations observed from the short core special core analyses.

In its June 17, 1997 *Update to the Application*, the Proponent describes the results of a recently-completed long core displacement study. Three long core displacement tests were conducted to determine the residual oil saturation. According to the Proponent, two tests were conducted under gas injection; one with an injection gas composition of 21% C_2+ to investigate the displacement efficiency of gas injection and the second with an enriched gas composition of 40% C_2+ to investigate miscibility. A third test was run to investigate water injection. These tests suggest lower residual oil saturation under both water and gas flood conditions than previously predicted. The results of the tests are presented in Table 4.1.

The Board considers that the residual oil saturation observed during the tests conducted on the short plug samples seem abnormally high, and that the long core displacement study results are probably more typical of Terra Nova reservoir rocks. The Board notes that the residual oil saturation affects the reserves estimates and expects the Proponent to assess this matter further during its development drilling program.

TABLE 4.1
Summary of Long Core Displacement Tests

Displacing Fluid	Residual Oil Saturation (%)	Recovery Factor (%)
21% C_2+ Gas	16.5	77.7
40% C_2+ Gas	8.6	88.7
Water	26.9	63.7

Source: Update to the Application, Section 4.2, p. 41

TABLE 4.2
Original Oil-in-Place Estimates
(millions m³)

Area / Region	Case Category Low	Base	High
Initial Development Area			
Graben	49.64	64.05	98.98
East Flank	50.94	78.19	100.64
Subtotal	100.58	142.24	199.62
Potential Development Area			
North Graben	0.00	2.05	30.76
Far East	0.00	46.48	50.08
Subtotal	0.00	48.53	80.84
Total	100.58	190.77	280.46

Source: after Supplement A to the Application, Tables 2.1-2, p. 10; 2.1-5, p. 12 and 2.1-8, p. 14

4.2.5 Resource Estimates

4.2.5.1 Original Oil and Gas-in-place

In the Application submitted to the Board on August 5, 1996, the Proponent presents a range of original oil and gas-in-place estimates for the seven sandstone units based on alternative interpretations of the geological, geophysical and reservoir data. The original oil-in-place estimates range from 100 10^6 m^3 to 280 10^6 m^3. The base case original oil-in-place and gas-in-place estimates are 191 10^6 m^3 and 23 10^9 m^3 respectively for the entire Terra Nova Field. Details of the distribution of the original oil and gas-in-place estimates was provided by the Proponent in *Supplement A to the Application.* A summary of the original oil-in-place estimates is provided in Table 4.2.

Following submission of the Application the Proponent completed additional studies and provided, among other information, an update to the original oil-in-place estimates. The base case original oil-in place estimate was increased by 17 10^6 m^3 to 208 10^6 m^3. Based on an alternative geologic model the high original oil-in-place estimate was increased from 280 10^6 m^3 to 453 10^6 m^3.

The Board has conducted an assessment of the original oil-in-place and its estimate ranges from 105 10^6 m^3 to 241 10^6 m^3. The Board's assessment falls within the range presented by the Proponent although the Board and the Proponent differ somewhat in their estimates of the distribution of hydrocarbons throughout the field. This difference is partly because of the use of different geologic models and the exclusion of the E and B sandstones from the Board's estimates. The Board notes, however, that several analyses which support these estimates, particularly the geophysical, geological and petrophysical interpretations of the Far East block, are subject to uncertainty. However, the Board believes that the Proponent's oil and gas-in-place estimates presented in the update are reasonable for planning purposes.

The Board notes that the Proponent's geological model and the distribution of hydrocarbons throughout the field both influence the proposed development scheme and observes that both will be further clarified during the early stages of development drilling. Should the results of this drilling indicate any significant change in the premises upon which the present plan is based, the Proponent will be required to submit for the Board's approval an amended plan that takes this new information into account. The Board will establish the date by which such a submission must be made considering the timing of the availability of new information.

4.2.5.2 Reserve Estimates

In the Development Application, the Proponent presented estimates of recoverable oil reserves ranging from 32.1 10^6 m^3 to 82.9 10^6 m^3. Its base case estimate is 46.9 10^6 m^3 for the Graben and East Flank and a further 16.0 10^6 m^3 for the Far East and North Graben. The reserves in the potential area for development, North Graben and Far East, have yet to be confirmed by drilling. A summary of the Proponent's reserve estimates is provided in Table 4.3. In addition to the oil reserves, natural gas liquids will be extracted from processing the injection gas and added to the oil. The Proponent's estimates of natural gas liquid reserves range from 1.1 10^6 m^3 to 2.1 10^6 m^3, with a base case estimate of 1.6 10^6 m^3.

Since these estimates were prepared, the Proponent has revised its proposed depletion scheme and has undertaken additional reservoir engineering and geological studies. Studies discussed in Section 4.2.4.4 suggest the residual oil saturation for both water and gas flood are lower than the saturations which supported its previous reserve estimates. Also, an alternative geological model has been presented by the Proponent which provides for the possibility of a substantially higher volume of oil-in-place than accounted for in previous estimates. These studies are still in progress and revised reserve estimates have not yet been prepared.

The Board believes it is important that its use of the term "reserves" be clearly understood in relation to this section. "Reserves" is used to refer to those volume of hydrocarbons that are considered to be recoverable using current technology, and under present and anticipated economic conditions. This volume of hydrocarbons consists of that proven by drilling, testing, and that interpreted to exist from geological, geophysical or other information and deemed to be recoverable. Since the assessment of reserves depends on the interpretation of data available at a given time, the reserves are further classified to reflect the uncertainty in the interpretation and the lack of detailed geological and reservoir data. The following classifications are used by the Board:

Proven Reserves

Hydrocarbons that have been confirmed by drilling and testing or where sufficient geological and geophysical data exist to project the existence of hydrocarbons in adjacent fault blocks. A high confidence level is placed on recovery of these hydrocarbons.

TABLE 4.3
Comparison of Oil Reserve Estimates
(millions m³)

Area	Reserve Category					
Region	Proven		Proven plus Probable		Proven plus Probable plus Possible	
	Proponent[1]	C-NOPB	Proponent[2]	C-NOPB	Proponent[3]	C-NOPB
Initial Development Area						
Graben	14.44	12.40	21.12	15.00	28.68	24.80
East Flank	17.65	19.30	25.79	23.60	34.90	39.60
Subtotal	32.09	31.70	46.91	38.60	63.58	64.40
Potential Development Area						
North Graben	0.00	0.00	0.68	0.00	0.92	3.50
Far East	0.00	0.00	15.34	25.80	18.37	36.30
Subtotal	0.00	0.00	16.02	25.80	19.29	39.80
Total Field	32.09	31.70	62.93	64.40	82.87	104.10

[1] after: Supplement A to the Application, Table 2.4-10, p. 38
[2] Supplement A to the Application, Table 2.4-5, p. 36
[3] Supplement A to the Application, Table 2.5-15, p. 41

Probable Reserves

Hydrocarbons that are projected to exist in fault blocks adjacent to those that have been tested by wells and into which the geologic trends may extend. Also, where fluid contacts have not been defined within the area drilled, these contacts may reasonably be projected to exist. However additional drilling is required to substantiate the existence of hydrocarbons. These hydrocarbons may reasonably be expected to be recovered under normal operating conditions yet have a degree of risk, either geologic or reservoir performance related, associated with their exploitation.

Possible Reserves

Hydrocarbons that may exist based on geophysics and the extension of geologic trends. However, due to the lack of adjacent wells located within the region and reservoir engineering and geologic data, these hydrocarbons cannot be assigned a lower risk classification.

A detailed review of the Proponent's estimates of the Terra Nova Field reserves was conducted by the Board. The Board's independent estimate of Terra Nova field oil reserves ranges from 31.1 10^6 m³ to 104 10^6 m³ with a base case estimate of 64.4 10^6 m³. A comparison of the Board's and Proponent's reserve estimates on the basis of the Board's definitions is provided in Table 4.3. While reserve estimates vary for the Graben and East Flank in the initial development area, the range of total reserves is similar. Significant differences exist in the reserves assigned to the Far East and the North Graben. The Board's distribution of these reserves varies somewhat from that of the Proponent, partly because the Board has assigned only small oil reserves to the E sandstones and the Board's and the Proponent's geological models for the Far East region differ significantly. Given the uncertainty associated with this region, the Board nevertheless believes that the Proponent's geological model is reasonable. The reserve estimates presented do not incorporate the lower residual oil saturations determined from the Proponent's recent long core displacement studies, a factor that would further increase the Board's reserve estimates. The Board acknowledges that the Proponent is continuing to optimize its depletion scheme and to incorporate the results of its long core displacement, geological and reservoir simulation studies into a revised estimate of its reserves.

In addition to the oil reserves, the Board has estimated the natural gas liquids reserves to range from 1.09 10^6 m³ to 5.36 10^6 m³ with a base case

estimate of 2.2 10^6 m^3. The Board acknowledges that it will be possible to better define the natural gas liquids reserve potential following a period of production experience. Therefore, it is a condition of the Board's approval that:

Condition 9:
The Proponent submit to the Board its reserve estimates, including a breakdown of original oil-in-place estimates, reserves and recovery factors by fault block and sand unit, at the earliest opportunity and, in any event, before development drilling begins.

4.2.6 Reservoir Exploitation

4.2.6.1 Exploitation Scheme

Since submission of the Development Plan the Proponent has continued interpretation of the available geoscience data and has been conducting engineering studies in order to optimize hydrocarbon recovery. The June 1997 *Update to the Application* provided an overview of these activities and the proposed revision to the depletion scheme emanating from this process. The Proponent examined four development alternatives for the Graben and East Flank regions of the Field.

A summary of the oil recovered and the recovery efficiency for the development alternatives is provided in Table 4.4.

According to the Proponent, the evaluations showed that the pore volume in the I-97 and K-07 fault blocks is not sufficient to accommodate all of the field solution gas and that gas must therefore be injected into the H-99 block for the first two alternatives. Also, for the third alternative, there is insufficient solution gas within the Graben and East Flank to fully displace the C-09 block. About 2.0 10^9 m^3 of additional gas is required from the Far East beginning in year two of production. The Proponent noted an up-dip water and gas injection scheme could be used to make up any gas injection shortfall. According to the Proponent, water injection alone yielded recoveries approximately equal to the water-gas injection alternatives.

The Proponent reported that several reservoir simulation runs were performed to evaluate the impact of various uncertainties and operational strategies on reservoir performance. Sensitivities examined include, interlayer shales, relative permeability, original oil-in-place, stochastic permeability, fault transmissibility, sub-seismic faults and transmissibility, vertical communication and interventions. The Proponent noted that the Graben and East Flank recovery was most sensitive to the

TABLE 4.4
Terra Nova Development Alternatives
Comparison of Oil Recovery and Recovery Efficiencies

Development Alternative	Total Field		Fault Block							
			K-07		C-09		I-97		H-99	
	Cum. Oil 10^6 m^3	*Recovery Factor*	Cum. Oil 10^6 m^3	Recovery Factor	Cum. Oil 10^6 m^3	Recovery Factor	Cum. Oil 10^6 m^3	Recovery Factor	Cum. Oil 10^6 m^3	Recovery Factor
1	47.44	*0.315*	6.92	0.472	21.02	0.359	1.50	0.238	17.99	0.253
2	59.28	*0.393*	6.29	0.429	22.37	0.382	2.00	0.318	28.59	0.402
3	60.46	*0.401*	6.46	0.441	20.20	0.345	3.02	0.480	30.79	0.433
4	57.90	*0.384*	2.15	0.147	21.90	0.374	3.03	0.481	30.79	0.433

1 Vertical wells with I-97 and K-07 gas injection requiring 29 wells
2 Horizontal wells with I-97 and K-07 gas injection requiring 25 wells
3 Horizontal wells with C-09 gas injection requiring 26 wells
4 Horizontal wells with water injection only requiring 26 wells

Source: Personal Communication., J. Katay, Petro-Canada to W. Chipman, C-NOPB, July 16, 1997, Table 1

degree of sub-seismic faulting. According to the Proponent, a complete and balanced summary has not been finalized. Also, more sensitivities will be modelled to determine the complete range of recovery uncertainty and to provide the necessary input into the probabilistic risk and uncertainty evaluation. The Proponent also noted that when the horizontal well development option with gas injection into the C-09 block was compared with a vertical equivalent, the difference in recovery efficiency was substantial, i.e., vertical well development recovered only half of that recovered using horizontal wells.

The Proponent's preferred development scheme, Alternative 3 (Figure 4.4), is to develop the East Flank and the Graben K-07 fault block under water flood and the Graben C-09 block with up-dip gas injection. According to the Proponent insufficient gas exists in the Graben and East Flank to completely gas flood the C-09 Fault block. Gas will be required from the Far East or, in the absence of sufficient gas supplies, the Proponent noted that water injection could be used to supplement the gas injection in a WAG (water alternating gas) injection scheme. The Proponent proposes to allow the reservoir pressure to decline during the early production phase to establish volumetric criteria and evaluate compartmentalization. Following this period, the reservoir will be repressured to 34.5 MPa.

The Board concurs generally with the Proponent's proposed water and gas injection schemes for the Graben and East Flank but observes that reports documenting its supporting studies have not yet been completed. The Board observes that according to information provided by the Proponent and summarized in Table 4.4 the recovery efficiency in the C-09 fault block for gas injection is slightly lower than for water injection. The Board has conducted its own investigation of water and gas injection schemes for exploiting the Terra Nova oil reserves; its studies indicate that gas injection should achieve an oil recovery efficiency equivalent to water injection. According to the information presented by the Proponent, the Board observes for the K-07 fault block that vertical wells recover more oil than horizontal wells. The Board believes that further optimization of the Proponent's exploitation scheme may be possible and will review the results of the Proponent's work prior to approving development drilling.

The Proponent has provided little documentation in support of its proposed Far East exploitation scheme. The Board considers the Proponent's Far East exploitation scheme to be preliminary, given the absence of drilling in the area and because data from the 1997 3-D seismic survey of the area has yet to be evaluated. However, the Board approves of the Proponent's plan to drill an injector to support production in the Far East region.

4.2.6.2 Development Well Requirements

The Proponent's base case depletion strategy proposes 15 producing wells, 8 water injection and 3 gas injection wells for the Graben and the East Flank. The locations of the proposed wells are provided in Figure 4.4. Twelve of the producing wells will be horizontal wells ranging in length from 1000 m to 1500 m. The injectors will be vertical or deviated. The Proponent estimates that a further 5 producers and 5 injectors will be required if the Far East proves to be oil bearing. Six wells will be drilled prior to first oil. A pilot hole to the North Graben will be drilled from one of these wells and plugged back following evaluation. The second well following first oil will be drilled into the Far East.

The Board believes that the number and location of wells which the Proponent proposes for exploitation of the Graben C-09 fault block and the East Flank are reasonable, but considers oil recovery may be improved.

The Board is not convinced that the two wells proposed for the Graben K-07 block are sufficient to efficiently deplete the reserves in this area. Before the Board's approval of development drilling in this block, it will require the Proponent to submit studies which support its proposed well locations and to demonstrate to the Board's satisfaction that the proposed wells will efficiently deplete the oil reserves.

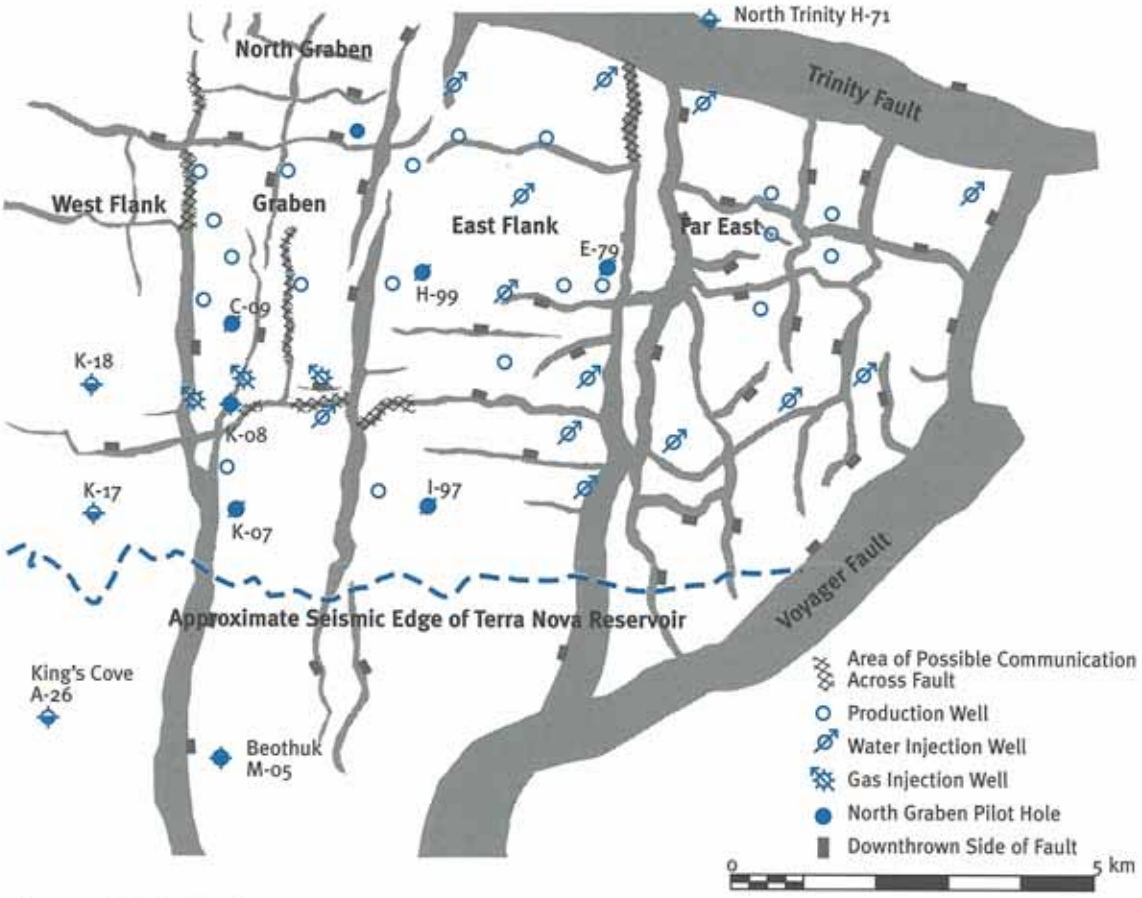
The Board notes that resolution of uncertainties affecting the geological and geophysical interpretations may change the proposed well locations and estimated number of wells required to deplete the oil reserves, particularly in the Far East, and acknowledges the Proponent's stated intention to acquire information to assist in this early in the life of the field. However, the Board believes it is likely that more than one well will be required to acquire sufficient information to adequately support a comprehensive development plan for the Far East region.

4.2.6.3 Production Forecast

The Proponent's production forecast for its base case depletion strategy for the Graben and East Flank is provided in Figure 4.5. It predicts that peak oil production of 16 000 m^3/d will be maintained for five years, and that production from the field will never exceed the design liquid handling capacity of the FPSO installation of 40 000 m^3/d.

The Board considers the Proponent's Graben and East Flank forecast to be reasonable and based on its own studies believes that the reservoir can support a peak oil production rate of 16 000 m^3/d. However,

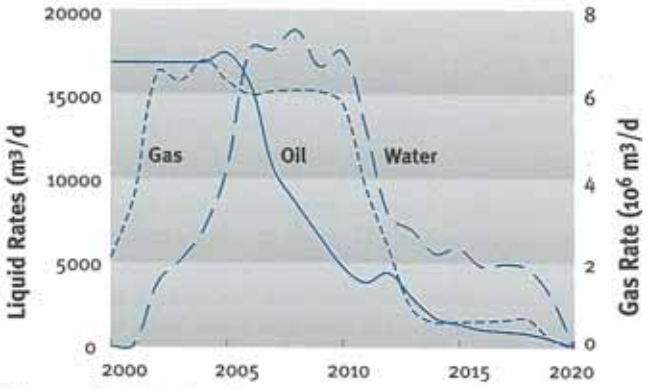
FIGURE 4.4 **Proposed Graben, East Flank and Far East Development Well Locations**



Source: after Petro-Canada, 1997

the Board notes that the presence of oil in the Far East and North Graben could significantly affect this forecast and extend the life of the field. Should the presence of oil in these areas be confirmed, the Board will require a revised production forecast which takes development of these areas into consideration. Also, the Board observes that the production forecast does not account for any natural gas liquids that will be produced when processing the gas for injection. The Board acknowledges the difficulty in preparing the production forecast given the uncertainty in some of the data. Nevertheless, it is important for the Board to have this information in order to discharge its duties. The Proponent will be required to update its forecast yearly as part of the reservoir management program.

FIGURE 4.5
Reference Case Production Profiles



Source: after Petro-Canada, 1997

4.2.6.4 Enhanced Recovery Schemes

The Proponent evaluated the potential for operating a miscible flood in the Terra Nova field and rejected this option because:

- A limited amount of gas is available for solvent and chase gas injection.
- The solvent is costly.
- The operation of such a closed system has constraints.
- Additional facilities would be required.
- Oil production would be reduced by solvent injection.[1]

The Proponent points out that in an isolated environment like the Terra Nova field the ability to institute a miscible flood is limited by the volume of gas available to provide the required solvent and chase gas for voidage replacement.

The Board concurs with the Proponent's conclusion that there is a limited supply of solvent gas available for a miscible flood. The Board observes that the results of the Proponent's long core displacement tests suggest that residual oil saturations under water and gas flood conditions may be much lower than previously estimated, and that this would reduce the incremental volume of oil which might be recovered by a miscible flood. However, the Board expects the Proponent to continue to evaluate miscible flood and other enhanced recovery schemes during production.

4.2.6.5 Gas Conservation

The Proponent's preferred option for gas conservation is to inject the produced gas into the C-09 fault block. In the event gas injection into the C-09 fault block proves to be detrimental to oil recovery, the Proponent proposes an alternative gas injection site in the Ben Nevis Formation in the structure around the King's Cove A-26 and the Terra Nova K-17 wells.

The Board concurs that the Proponent's plan to conserve gas by re-injecting it into the C-09 fault block is reasonable. The Board also acknowledges the Ben Nevis structure around the King's Cove A-26 and the Terra Nova K-17 wells as a possible alternative gas injection site but notes that a heavy oil accumulation has been identified in this area. It is important that the effect of gas injection in this area be assessed to ensure that future recovery of the oil is not adversely affected. Because a potential exists that gas injection into the C-09 fault block may adversely affect oil recovery, the Board will require the Proponent to thoroughly investigate the effects of gas injection into its alternative site and to report the results to the Board prior to first oil production. Gas injection at this site is an activity that will require the specific approval of the Board pursuant to the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations.*

The Board notes that even if it is technically feasible to use the Ben Nevis Formation for this purpose, other issues must be resolved before injection into this area can begin, including ultimate ownership of the gas and the consent of the interest owners in the King's Cove Significant Discovery Licence.

4.2.6.6 Concurrent Production

The Proponent believes the major reservoir sandstones to be in vertical communication over large areas of the field and proposes to complete both producing and injection wells in all porous sand intervals for concurrent production. In production wells, fluids produced from the various sandstone units will be commingled in the wellbore. The Proponent notes that zonal isolation may be required in the high water cut and high gas producing intervals at the producing wells to maximize oil recovery and proposes to use well testing, fluid sampling, production logging and possibly downhole flow meters for performance monitoring and intervention planning.

The Board observes that the degree of communication between the sandstone units is an important consideration in selecting the completion philosophy and is still not known with a high degree of confidence in the Terra Nova reservoir. There is evidence to suggest that the "E" sandstone unit, may not be in communication with the other sandstone units and that other units may not be in communication within certain fault blocks. The Board believes that oil recovery may be improved by selective completion and production of the sandstone units or through profile control of production from the sandstone units by completion practices. The Board will require the Proponent to submit a comparative assessment of selective and commingled production prior to approving the completion practices to be employed by the Proponent to exploit the oil reserves.

4.2.6.7 Reservoir Management

The Proponent proposes to conduct a comprehensive data acquisition program in all wells which provides for well testing, pressure surveying, fluid sampling, coring and open hole and cased hole logging. According to the Proponent, performance and pressure behaviour will be routinely monitored and analyzed and the data used to update the reservoir engineering studies and reservoir simulation models. The reservoir simulation models will be used as a reservoir management tool to guide the selection of injection and production well locations, well recompletions, and allocation of

production and injection rates. The Proponent, as part of its production optimization to enhance sweep efficiency, plans to investigate infill drilling including horizontal and multilateral wells and notes that these options may influence the number and location of wells required.

The Board believes that the data acquisition activities which the Proponent describes are consistent with the requirements of the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* and the *Newfoundland Offshore Petroleum Drilling Regulations.* Details of these programs will be subject to the approval of the Board as part of its Drilling Program and Production Operations Authorization approval processes.
The Board expects the Proponent to continue to investigate options to maximize recovery of the oil and gas reserves in the Terra Nova field. The Board notes the results of the Proponent's optimization efforts to date as provided in its application update including the proposal to use horizontal wells which could reduce the well requirement for the Graben and East Flank from 32 to 26 wells.

4.2.6.8 Summary

The various interpretations and analyses, both by the Proponent and by the Board, have clearly identified additional fundamental information which is necessary before final reservoir exploitation plans can be approved. These are:

- the nature of the east-west faults
- the location of the oil-water contact
- the residual oil saturation
- formation water characteristics
- the confirmation of the presence of oil in the Far East block

Each of these considerations affects both the reserve estimates and the exploitation strategy. Therefore, it is a condition of the Board's approval that:

Condition 10:
The Proponent submit to the Board by March 31, 1998 a report which fully describes its reservoir studies.

Condition 11:
The Proponent submit for the Board's approval an updated exploitation scheme for the Far East portion of the field no later than eighteen months following termination of the first well drilled into this area, as scheduled in the June 1997 *Update to the Application.*

Condition 12:
The Proponent conduct a study to investigate the effects of gas injection into its alternative site in the Ben Nevis Formation in the area around the King's Cove A-26 and Terra Nova K-17 wells and report the results to the Board prior to first oil production.

4.2.7 Field Hydraulics

The Proponent presented the results of the studies it performed to verify that the volume of fluid to be produced can be transported adequately through its proposed tubing and subsea flowlines from the wellbore perforations to the FPSO. The Proponent plans to use 178 mm tubing for its injection wells and for its first four horizontal production wells and to base its decisions on future production tubing size on experience gained from its first four production wells. A gas lift operating valve will be installed in all producing wells. The size of the injection lines to be chosen for each template will be based on an assessment of anticipated total injection rates and requirements for operating flexibility.
The Proponent states that it will conduct further studies before finalizing its flowline sizes.

The Board believes the results of the Proponent's studies are reasonable and approves the 178 mm tubing proposed for the injection and the four pre-drilled producing wells. Tubing sizes for the remaining wells will be subject to Board approval as part of its Approval to Drill a Well process.

The Board acknowledges the Proponent's intention to conduct additional technical studies to optimize the field's hydraulic performance.
The Board expects these studies to include an assessment of the effects of the proposed FPSO location on possible oil recovery from the Far East region. The Board will require submission of these studies and monitor the Proponent's proposed selection of flowline sizes as development of the field progresses to ensure that oil recovery is not adversely affected.

4.2.8 Deferred Development

The Proponent states that at this time the existence of significant hydrocarbon accumulations in the Ben Nevis Formation and in Jeanne d'Arc Formation in the North Graben is speculative. The Proponent believes that the quantity of oil-in-place in the North Graben is insufficient to justify its development. The Proponent notes that development of the heavy oil in the Ben Nevis Formation will be examined when identified mechanisms make commercial recovery possible. The Board notes that the hydrocarbon potential of the North Graben will be assessed early in the life of the field by the pilot hole that the

Proponent proposes to drill into this area prior to production. If commercial quantities of oil are confirmed in this area, the Board will require the Proponent to submit a revision to its development plan to provide for production of these reserves.

The Board acknowledges the potential oil resources in the Ben Nevis Formation, but observes that little is known about this accumulation. Nevertheless the Board believes that its development potential should be assessed in a timely manner to determine whether the resources can be exploited using the Terra Nova facilities. Therefore, it is a condition of the Board's approval that:

Condition 13:
The Proponent submit for the Board's approval an updated exploitation scheme for the North Graben no later than eighteen months following termination of the first well drilled into this area, as scheduled in the June 1997 *Update to the Application*.

4.2.9 Production Facilities Capabilities

The Proponent's Development Plan described the proposed oil, water and gas production facilities to be installed on the FPSO. The facilities include one test separator with space provided for installation of an additional separator of similar size if this becomes necessary. In addition, the design of the FPSO provides one swivel pass for test lines through the turret.

The Board believes that the Proponent's plans for oil, gas and water processing and injection facilities are generally reasonable, but that based on the Proponent's drilling schedule a second test separator may be required after the third year of production. The Board feels that it is prudent to design the facilities for the installation of an additional test separator, but also believes that a second swivel pass in the turret should be provided for testing purposes in the event this proves necessary. Therefore, it is a condition of the Board's approval that:

Condition 14:
The Proponent, prior to initiating construction on the FPSO and its turret, provide confirmation to the Board that it has made provision in its design for an additional test separator and for a second swivel pass in the turret for testing.

4.2.10 Unitization

The Proponent notes that the varying ownership across Terra Nova requires unitization of the field and that a process is underway which, when complete, will establish the equity interest of individual owners.

The Terra Nova Significant Discovery Area is comprised of five significant discovery licences with varying ownership. The Board notes that according to the information provided by the Proponent, it is also possible that the oil accumulation may extend into the Hebron Significant Discovery Area and Exploration Licence 1022. The land ownership in the Terra Nova field and surrounding area is shown in Figure 2.1.

The Board acknowledges the unitization efforts by the Proponent and believes that unitization of the field is important for conservation purposes and for effective administration of the regulations governing production of the resource. Therefore, it is a condition of the Board's approval that:

Condition 15:
The Proponent file with the Board a unit agreement and a unit operating agreement prior to initiating oil production.

4.3 Safety Of Operations

This section describes the Board's review of the approach to safety of operations proposed by the Proponent in the Development Application. The Board considered the safety of the system as a whole and its components, including, to the extent information was available, its structures, facilities, equipment, operating procedures and personnel. The Panel's recommendations related to safety of operations are also discussed in this section.

4.3.1 Design

The facilities to be used in the extraction, production, storage and transport of hydrocarbons from the Terra Nova field must be designed to operate safely and efficiently to minimize the risk to both personnel and the environment. Given the complexity of the operation with its seabed components, its shipshape FPSO and the transport tankers, particular care must be taken. To ensure that appropriate Canadian standards, or in their absence, the most rigorous worldwide standards are met, the Board requires the Proponent to engage a Certifying Authority for whom the Scope of Work must be approved by the Board.

In this section, various factors which have an impact on the design are discussed with reference to Panel recommendations and regulatory requirements.

4.3.1.1 Design Standards for FPSO Vessel

A key design feature of the FPSO vessel proposed for Terra Nova is its ability to disconnect from its moorings in the event of ice encroachment. The Proponent has also decided to design a vessel that is capable of independent self-propulsion, and will be registered in Canada. When disconnected from its mooring system, the FPSO installation will be considered a "ship", as defined by the *Canada Shipping Act*, and consequently will fall under Transport Canada jurisdiction.

The current Memorandum of Understanding between the Board and Transport Canada (Ship Safety) provides the basis for cooperation between the two agencies and the means to establish an offshore regulatory regime within which marine safety is the prime concern. *The Canada Shipping Act* will apply to the hull of the FPSO vessel and all marine equipment (as defined within that Act) that is not part of the industrial process equipment. The FPSO vessel as a whole, including the marine and industrial plant, must also comply with the Atlantic Accord legislation, compliance with which will be verified by the Certifying Authority, Lloyd's Register of Shipping.

If there is a variance between the two sets of regulatory requirements, the more rigorous requirement will take precedence. The Board will coordinate discussions related to these matters.

Applications for acceptance of equivalencies to specific regulatory requirements, if submitted for review by the Proponent with appropriate documentation, will be considered by C-NOPB, Ship Safety, or both jointly, as is appropriate.

4.3.1.2 Quality Management

The Proponent states in its *Development Plan – Part I* that it intends to apply quality management principles throughout the Project which are based upon an international quality assurance system such as ISO-9000, and that this system "will apply to all activities at all levels of the organization, and to all alliance members and to participating contractors and suppliers"[2].

The Panel recommended [6] that the Board approve construction of project facilities in foreign countries only if the quality assurance and quality control of that country are equal to or better than in Canada, and also where the means for monitoring and control of quality are in place.

The Newfoundland Offshore Petroleum Installations Regulations require an installation to be designed, constructed, installed and commissioned in accordance with standards respecting quality assurance published by the Canadian Standards Association. In addition, the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* require that, before production operations may be authorized, the installation have a Certificate of Fitness issued by a recognized Certifying Authority (CA). The *Newfoundland Offshore Certificate of Fitness Regulations* define the bodies which may act as a CA and require the CA to determine whether the design, construction and establishment of installations are in accordance with the regulatory requirements. The CA reviews the design and surveys the installation during all phases of its development to determine compliance with the quality standards and regulations. Pursuant to these regulations, the Board's Chief Safety Officer is responsible for approving the scope of work for the CA where it is determined that such scope will provide the means for determining, among other things, that the installation has been constructed in accordance with an acceptable quality assurance program.

As noted in Section 4.1, the Proponent has chosen Lloyd's Register of Shipping to be the Certifying Authority for the Terra Nova Development and has submitted a draft Scope of Work for the Board's approval.

The Board will monitor and audit the activities of the CA to ensure that it carries out its work in accordance with the approved Scope of Work. The Board notes the Panel's concerns and will ensure that sufficient surveillance is carried out on work undertaken in foreign yards.

4.3.1.3 Physical Environmental Design Criteria

(i) General

The *Newfoundland Offshore Certificate of Fitness Regulations* require at Section 6(2)(b), that the project's Certifying Authority determine "whether the environmental criteria for ... the site and the loads assumed for the installation are correct".

Pursuant to the *Newfoundland Offshore Petroleum Installations Regulations*, the design of production installations, including subsea installations, which are intended for use in the Newfoundland Offshore Area must be consistent with elements of the Canadian Standards Association CAN/CSA S471-92, General Requirements, Design Criteria, the Environment, and Loads. This standard describes the loading conditions which different types of structure are expected to resist at specified levels of reliability.

(ii) Meteorological and Oceanographic Design Criteria

Wind, Wave and Current Design Criteria

The Proponent's wind, wave, and current design criteria are summarized in Table 4.5. Its 100-year values for mean wind speed and significant wave height are 39 m/s and 16.0 m respectively.

The Panel recommended [37] that the Board ensure that the design criteria take into account the possibility of extreme wave values higher than those which were predicted. The Panel also recommended [42] that operational planning should allow for the simultaneous occurrence of two or more 100-year events, involving combinations of wind, sea, and ice, and that planning also should fully describe the decision-making process for the timely removal of the production facility and all other vessels from the area.

The Board notes that CAN/CSA S471-92 requires that during the development of design parameters, a factor be applied to the calculated design loads to take into account the variability of these loads and load patterns, as well as any uncertainties which are inherent in the analysis of their effects.

The Standard also requires that, when determining these loads, the simultaneous occurrence of environmental processes be taken into account. The manner in which this is done depends upon whether one environmental process is dependent on, independent of, or exclusive of

TABLE 4.5
Summary of Terra Nova Oceanographic and Meteorological Design Criteria

Parameter	Return Period (Years)		
	1	10	100
1-hour mean wind speed at 10 m above MSL*	29 m/s	32 m/s	39 m/s
3-second gust wind speed at 10 m above MSL	39 m/s	43 m/s	55 m/s
Maximum astronomical tide range	1.04 m	1.04 m	1.04 m
Storm surge level above MSL	0.50 m	0.61 m	0.73 m
Storm surge depression below MSL	0.54 m	0.66 m	0.79 m
Tsunami level above MSL	negligible	0.10 m	1.20 m
Tsunami current	negligible	negligible	0.35 m/s
Significant wave height	10.9 m	13.2 m	16.0 m
Peak period	14.1 s	15.5 s	17.0 s
Maximum individual wave height	20.7 m	25.1 m	30.4 m
Period of maximum wave	12.5 s	13.5 s	15.0 s
Maximum current speed 20 m below surface	1.00 m/s	1.15 m/s	1.30 m/s
Direction of near-surface current (towards)	W	W	W
Maximum current speed 45 m below surface	0.86 m/s	0.97 m/s	1.09 m/s
Direction of mid-depth current (towards)	SW	SW	SW
Maximum current speed 70 m below surface	0.70 m/s	0.83 m/s	0.96 m/s
Direction of near-bottom current (towards)	SE	SE	SE

*mean sea level

Source: Supplement B to the Application, Table 3.4-1, p. 16

another. For example, the Standard suggests that waves and wind-driven current are dependent upon wind, whereas tidal currents are not. Limiting environmental criteria for operations are reviewed by the Certifying Authority.

In this regard, the Board notes that wind, wave and current criteria which are proposed for the design of the Terra Nova facilities are consistent with, and in some cases more conservative than, independent estimates of those values of which the Board is aware.

Atmospheric and Sea Spray Icing Design Criteria

The Proponent states in its *Development Plan – Part I* that it will consider the icing loads prescribed in the *Large Fishing Vessel Inspection Regulations* of Transport Canada in its design of facilities. It also states in Supplement B to its Application that heat tracing and steam generation facilities will be provided on the FPSO for the purposes of de-icing.

The Panel recommended [35] that measures proposed by the Proponents to ameliorate icing be coupled with a research program designed to expand current knowledge and to refine existing models with the objective of establishing completely reliable design load estimates for the extreme conditions that may be encountered in the Terra Nova Development area.

The Board notes that the Proponent has not explicitly identified 100-year design criteria for superstructure icing loads, and that CAN/CSA S471-92 requires icing to be considered in the design of installations.

The Board will require that the Certifying Authorities pay particular attention to icing-related design parameters during review of the design of the drilling and production installations, and will ensure that the functional specifications for support vessels adequately take into account the icing conditions which may be expected in the course of their duties.

The Board notes that research programs on spray icing and freezing rain icing have been funded in the past under the federal Panel on Energy Research and Development. The Board observes that the development of design load criteria in this area is hindered by the difficulty in calibrating present icing models using the scarce and simplified observational data which are presently available. The Board agrees that ongoing research in this area is required.

The Board will encourage the Proponent to incorporate in its weather monitoring program any measurements which are reasonable and practical and which will aid in research into the phenomenon of ice accumulation on structures.

(iii) Sea Ice Design and Operating Criteria

The Proponent states that the FPSO vessel "will be designed with nominal ice strengthening ... to operate in at least five-tenths ice cover"[3] and "will be designed to be disconnected from moorings and risers when confronted by excessive sea ice"[4]. The Proponent also states that "thrusters will also be provided ... for relocation in the event of disconnection" and that "in total 30 MW of thruster capacity will be installed"[5].

The *Newfoundland Offshore Area Petroleum Installations Regulations* require, at Section 54(1), that the Project Certifying Authorities determine that the FPSO vessel and the drilling unit are designed, constructed and established in such a manner that they will be able to:

> *withstand, without major damage, the ice loads to which [they] may be subjected ..., stay on location in the ice concentration and under the ice forces to which [they] may be subjected ..., and be moved from the production ... site in the ice concentration to which [they] may be subjected,*

and, at Section 59)6), that their mooring systems;

> *incorporate a primary quick release system ... and at least one back-up system and have been demonstrated to be capable of permitting the quick release of the platform[s] from their moorings and risers."*

The Board observes that the Proponent has not fully articulated its criteria for operating in sea ice and is conducting model tests to substantiate these criteria. The Board expects the Proponent to provide the results of its investigations as they become more fully defined; these studies will be required to support the Safety Plan for operation of the facilities which the Proponent must submit for the Board's approval in order to obtain authorization to begin production. The Board will pay close attention to the Certifying Authority's review of the FPSO vessel's ability to operate in 'design' ice concentrations and to disconnect and move away when more severe ice conditions are anticipated.

(iv) Iceberg Design and Operating Criteria

The Proponent describes an analysis, based in part upon computer simulation, which it has undertaken to estimate the probability of iceberg collision with surface installations and with facilities installed on or below the sea floor. The Proponent states in Section 16 (p.107) of its Response to the Additional Information Request from the Terra Nova Environmental Assessment Panel that the "ice strengthening of the [FPSO] vessel will offset the high velocity impact of small glacial ice pieces which are less easily detectable by radar."

The Proponent proposes to install subsea wells and manifolds in large "glory holes" in the seabed at a sufficient depth to avoid contact of the equipment with scouring icebergs. It states that flowlines which connect these facilities with the FPSO will be trenched "to locate the top of the flowlines 0.5 m below the seabed"[6]. The Proponent also states that its ice management plan for the Project will provide for the flushing of flowlines which contain oil when these are threatened by icebergs with scouring potential.

The Panel recommended [40] that the designs for Project vessels take into account the potential hazards posed by growlers and bergy bits and that they "meet the highest standards for navigation in ice as presented by the appropriate authorities".

The Board believes that the Proponent's design concept provides for the protection of wellhead components from scouring icebergs. The Board expects that the Proponent's ice management plan will provide for the shut-in of producing wells when an iceberg that has a potential to scour approaches the facilities.

The Board believes that the Proponent's approach to the design, installation and operation of subsea flowlines can provide an acceptable degree of environmental protection and therefore accepts the concept, in principle. The CA will be responsible for confirming that the Proponent's proposed design and operating arrangements are consistent with the CAN/CSA S471-92 *General Requirements, Design Criteria, the Environment, and Loads.*

The Board observes that the Proponent has not quantified the magnitude of glacial ice interaction which the FPSO vessel will be designed to resist.

The Board will require that the design criteria for glacial ice impact with the FPSO vessel be examined in detail by the Certifying Authority during its review of the design of the vessel, with particular attention to the detail of the methods used to calculate the probability of an iceberg incursion and the assumptions or calculations used in assessing the probability of detection of smaller pieces of glacial ice. For its part, the Board will examine this element of the CA's work closely during its monitoring of the CA's activities.

As in the case of sea ice discussed above, the Proponent's ice management plan will be a component of the Safety Plan for which the Board's approval must be obtained before production operations can begin.

4.3.2 Authorization of Construction and Installation Activities

The Proponent plans to locate its development wells in large sea floor excavations, called "glory holes", which likely will be excavated by a dredging vessel using a heavy clam shell. The drilling installation will install a modular manifold centre in each glory hole prior to drilling the development wells.

Prior to installation of the risers and umbilicals which will connect the FPSO vessel to the subsea flowlines, a riser buoy will be installed to facilitate quick connection and disconnection of the risers and umbilicals. The risers and umbilicals will typically be installed by reeling them, with buoyancy modules attached, from an installation vessel. Each riser will be secured to a gravity base on the sea floor and a flowline attached to it. The installation vessel will continue laying the flowline or umbilical on the seabed and will abandon the last end fitting near the manifold centres.

Following tie-in of the risers to the riser buoy by saturation divers, the flowlines will be trenched to locate the top of the flowlines 0.5 m below the seabed. The trenching operation will be conducted using jetting equipment operated from the diving support vessel. Once the flowlines have been trenched, the flowline end connections at manifolds will be completed by saturation divers. A survey will follow the installation of the subsea facilities.

The Board considers it important that a consistent approach be applied to safety management and environmental protection throughout the execution of construction activities. Therefore the Board intends to administer its approval of these activities by grouping them into packages and to treat each as a program requiring separate authorization:

- a Glory Hole Excavation Program
- a Development Drilling Program, which will include the installation of the modular manifold centres
- a Subsea Production Systems Installation Program which will include installation of the riser buoy, risers, flowlines and umbilicals
- a Diving Program which will include the trenching-in of flowlines.

The specific regulatory requirements which apply to the various work activities may vary but the general requirements of the Accord Acts will apply to all work authorizations.

4.3.3 Operations

The operation of a complex processing facility such as that at the Terra Nova site depends both on the inherent safety incorporated into the design and construction of the facilities, and also on the presence of a skilled, well-trained workforce, all of whom are committed to safe operations. To ensure that the operations are conducted with due attention to safety, the Board also requires that the Proponent develop and adhere to safe operating procedures. These considerations are discussed in the following section.

4.3.3.1 *Concept Safety Analysis*

Section 43 of the *Newfoundland Offshore Petroleum Installations Regulations* requires the Proponent, at the time of submission of its Development Plan, to provide to the Board its definition of target levels of safety concerning its production installation, and a Concept Safety Analysis (CSA) respecting the installation. The Proponent submitted both documents, as Part II development studies, with its Development Application.

The Proponent summarizes its CSA in Section 9 of its *Development Plan – Part I* and provides an update to the CSA in Supplement B. The CSA describes the results of a major hazards review of the FPSO vessel which was conducted by the Proponent, and evaluates whether the proposed development concept meets the Proponent's stated target levels of safety. It concludes that the FPSO vessel meets the individual risk criteria for a modern offshore installation and that risk levels are comparable with those for similar installations. The Proponent states that it will document and implement a safety assessment plan during the project phase of the Development. The Board notes that the Proponent's CSA proposes a number of recommendations to ensure that the target levels of safety are achieved. The Board will require that it be informed of the actions which the Proponent proposes to take to satisfy these recommendations, and that the Certifying Authority ensure that the recommendations have been properly satisfied.

A number of targets, which the Proponent defines as "impairment criteria", are statements of objectives rather than specific, numerical criteria. For example, the Proponent defines four targets relating to installation integrity and to escape and evacuation, but has not confirmed the period during which integrity is to be retained or escape or evacuation will be possible. Prior to detailed design these periods must be stated and the detailed design verified to ensure that each target is achieved. Similarly, specific targets must be established for the construction and installation phases of the Project.

The Proponent states that risks below its "intolerable individual risk" level of 1×10^{3} occurrences per year will be demonstrated to be as low as reasonably practicable (ALARP). However, it does not define a "tolerable" level of risk. The Board believes that the effort which may be expended to demonstrate that "tolerable" risks are ALARP could be better utilized in mitigating risks that are closer to its "intolerable" level.

The Board believes that the elements which are identified in the Proponent's target levels of safety document are acceptable and that the CSA provides a reasonable description of the means by which these levels may be achieved.

The Board requests the Proponent to provide the details of its Safety Assessment Plan at an early date and believes that the Plan should include the Proponent's schedule for satisfying the recommendations presented in its CSA and for further defining its "impairment criteria".
The Board will require the Certifying Authority to review this Plan, and the studies undertaken under it, to ensure appropriate safety assessment is undertaken and implemented in the design, construction, installation and operations phases of the Project.

The Proponent has stated in Section 9.4.3 of its *Development Plan – Part I* that it will document a safety assessment plan for implementation during the design phase of the project. This plan is to conform to good quality management and audit procedures, with audits being carried out.
The Proponent has also stated that a systematic and continuous approach to the elimination or reduction of risks to people, the environment, assets and production based on its total loss management (TLM) procedure will be implemented. TLM encompasses all programs and activities associated with health, safety, environment, reliability, process hazard management, risk assessment and loss prevention. The Proponent has stated that TLM will be part of the Safety Plan for the Terra Nova Development. The Board believes it is necessary for it to be kept apprised of the design development, including the provision of key design philosophy documents, specifications and drawings. Therefore, it is a condition of the Board's approval that:

Condition 16:
(i) The Proponent submit to the Board its Safety Assessment Plan within 90 days of Project Sanction.
(ii) The Safety Assessment Plan include a schedule acceptable to the Board for satisfying the recommendations provided in the Proponent's Concept Safety Analysis, and for further defining the impairment criteria presented in its Target Levels of Safety document.

4.3.3.2 Corporate Safety and Loss Control Program

The Proponent reports its use of a comprehensive loss management system based upon its total loss management (TLM) system framework. TLM is a systematic and continuous approach to the reduction or elimination of risks to personnel, the environment, assets and production. TLM encompasses all programs and activities associated with health, safety, environment, reliability, process hazard management, risk assessment and loss prevention. The Proponent's intention is to ensure that safety management systems to be employed by alliance contractors and the drilling contractor during the project development phase will eventually be the same as those employed during drilling and production operations.

The Board considers it important that a consistent approach be applied to safety management and environmental protection throughout the execution of the Project. This is especially important for activities that may be completed by short-term contractors and not directly managed by the Proponent.

The Board accepts the Proponent's approach to safety management and intends to conduct an ongoing audit of the Proponent's implementation of its loss management system during which the Board will seek to verify that the Proponent ensures its contractors are fully apprised of, and adhere to, its safety management policies and procedures.

4.3.3.3 Safety Plan

The Proponent, in its *Development Plan – Part I*, provides an outline of the Safety Plan which it will submit to satisfy the requirements of the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, and states that the Plan will include:

- a corporate safety management policy
- an organizational structure
- occupational safety and health considerations
- training and qualifications of personnel
- contingency and emergency plans
- production and drilling operational procedures
- a description of safety facilities and equipment

The Panel recommended [31] that the Safety Plan for the Project be released to the public for information, that the Board allow sufficient time for receipt and consideration of public comment before issuing its approval, and that, for future projects, the Safety Plan be a required element of a proponent's environmental impact statement. The Panel also recommended [32] that the Board ensure that the Safety Plan for the Terra Nova Project include the highest standards for materials, design and operational procedures; that safe refuge areas and escape routes be designed with worst-case scenarios clearly in mind; that evacuation systems represent the best available technology; and that workers be made partners in developing and monitoring safety procedures.

The *Newfoundland Offshore Petroleum Production and Conservation Regulations* require that a Safety Plan must be approved by the Board and a Certificate of Fitness issued by a recognized Certifying Authority before the Board authorizes an operator to begin oil production. The development of a Safety Plan commences with the safety studies conducted during detailed design and proceeds as the Proponent develops policies and procedures, selects equipment and defines personnel responsibilities to manage and reduce the level of risk associated with the Project. The Safety Plan must provide for a comprehensive systematic approach to safety management, and be continually updated during the life of the project. All of the information that is required to be included in the Safety Plan is not available at the time of the submission of the Development Application. Hence, only a general philosophy for the Safety Plan can be presented at the time a development plan is submitted.
The Safety Plan is available for public review and comment and can be modified at any time to take into account relevant contributions from public commentators. The Board will ensure that any comment offered is evaluated and, where appropriate, taken into account in the Plan.

The Board notes that its *Development Application Guidelines and Safety Plan Guidelines* provide guidance on the types of safety information that should be submitted by the Proponent in its Development Plan and Safety Plan. Prior to their publication, these guidelines were reviewed by interested parties and are public documents upon which comment continues to be welcome.

The Safety Plan is intended to provide a comprehensive compilation of safety-related information regarding the production installation and its operation. The Board's *Safety Plan Guidelines* suggest in Section 3 (p. 13) that the "design features and equipment that are intended to eliminate identified hazards, reduce risk or mitigate consequences" be included in the plan and that "it should also describe ... provisions aimed specifically at the safety of personnel such as the temporary safe refuge, escape routes, lifesaving appliances, evacuation and rescue systems". Studies that evaluate the safety of these systems, and that demonstrate that risk to personnel has been reduced to a level that is as low as reasonably practical, will be reviewed as part of the Safety Plan approval process.
The Certifying Authority will also review safety studies and will monitor the "close out" of recommendations arising from these studies.

The Board notes that the Joint Occupational Health and Safety Committee which is required pursuant to the provincial *Occupational Health and Safety Act* provides a mechanism by which workers participate in the continuing development and the monitoring of the safety policies and procedures that are an integral component of the Safety Plan.

4.3.3.4 Training and Qualifications

The Proponent states in its *Development Plan – Part I* that the Installation Manager for the FPSO vessel will have appropriate "marine qualifications" or that "another competent and qualified individual may be assigned in a support role to the OIM"[7]. It also states that a "marine group" with the appropriate Transport Canada qualifications will be onboard to operate the marine systems. The Proponent's proposed Safety Plan will include a description of its methodology for personnel selection, the mechanisms which it will use to ensure their continued competency, and the types of training which each individual will be required to undergo.

The Panel recommended [43] that the marine captain should be ultimately responsible for the safety of the FPSO vessel and its crew in respect of all weather or sea-state hazards, that a mechanism for formal and continuous consultation between the captain and the offshore installations manager should be clearly in place, and that the marine captain be assigned the duty to implement, when necessary, the protocols to disconnect the vessel and remove it to a safe area. The Panel also recommended [41] that all marine crews be properly trained and certified in safety and marine emergency procedures and that the Proponent make appropriate arrangements with relevant establishments in the Province for such training.

The *Canada-Newfoundland Atlantic Accord Implementation Act* requires, at Section 193.2(1), that the operator put in command of the installation a manager who "meets any prescribed qualifications" and is responsible for the safety of the installation and its personnel. In addition, the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* require, at Section 51(1)(f), that the Safety Plan for the Project include "a description of the command structure on the installation, and for the operator's shore base and the relationship to each other." The Board will review the qualifications of the installation manager, the command structure on the FPSO and the procedures put in place for transfer of authority between the installation manager and the senior marine person (if they are not the same person) prior to approving the Safety Plan.

The Board notes that the Proponent does not explicitly state that it intends to comply with the marine crewing requirements of the Canada Shipping Act. The FPSO will be classed as a ship under the terms of the Canada Shipping Act and must, pursuant to this Act, have onboard a full marine crew to enable the vessel to disconnect from its mooring and function as a ship.

The *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* require that the Proponent submit for the Board's approval a Training Proposal consisting of a description of the training, qualifications and competencies of all individuals to be employed at its production facility, including individuals on support craft, along with a description of how the training will be provided and their competencies established.

The *Petroleum Occupational Safety and Health Regulations – Newfoundland* require all offshore personnel to be instructed and trained in the procedures to be followed by each employee in the event of an emergency; and to be informed of the location, use and operation of emergency and fire protection equipment.

The Board will audit the design of the Proponent's training program and its implementation for compliance with the above requirements and will consult its advisory departments and agencies which have interests and expertise in this area respecting the design of its audit program.

The Proponent states in its *Development Plan – Part I* that the Safety Plan will incorporate training as a key initiative within the Total Loss Management (TLM) framework. The Proponent also stated in its *Response to the Additional Information Request from the Terra Nova Environmental Assessment Panel, March 1997*, that a systematic needs-based training matrix is anticipated that would establish specific training requirements for various levels of personnel and occupations. This training matrix would list precisely what training is needed over a given time frame. The Board believes that a description of the training requirements incorporating this training matrix should be submitted as a component of the Training Proposal required by the regulations not later than one year prior to the FPSO vessel being installed on location. The Proponent will be required to keep the Board informed as the training matrix is updated over the life of the project. Therefore, it is a condition of the Board's approval that:

Condition 17:
No later than one year prior to the scheduled installation of the FPSO vessel on location, the Proponent submit the Training Proposal required by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* for the approval of the Board's Chief Safety Officer.

4.3.3.5 Safety Facilities and Equipment

Evacuation Systems

The Proponent has not identified specific evacuation systems for its facilities. In its *Development Plan – Part I*, the Proponent commits to completing an "Escape, Evacuation and Rescue Study".

As part of its development of the Safety Plan required by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, the Proponent will be required to demonstrate to the satisfaction of the Board that the best practicable evacuation technology available will be utilized on the FPSO vessel and on the drilling units used in developing the Terra Nova field.

Standby Vessels

The Proponent has not yet finalized the configuration of its support vessel fleet. Vessel(s) will be available at all times in the field to perform standby duty as required by regulations.

The standby vessels must meet the requirements of the Standards Respecting Standby Vessels. In addition to the general requirements of the Standards, the standby vessels should be designed for the specific duties envisioned for the chosen installation and be compatible with the evacuation systems and procedures to be employed on the installation. The vessel design must also consider the environment, particularly the sea ice and icing conditions in which the vessels will be required to operate. Features such as the propulsion and station keeping systems, the number of fast rescue craft and other types of rescue equipment, and the nature and size of first-aid facilities to be provided should be carefully considered. Consideration also should be given to the configuration of the support vessel fleet. The proponent will be required to submit the functional specifications for the proposed standby vessels, along with a rationale for these specifications, to the Board for approval before contracting for these vessels. Therefore, it is a condition of the Board's approval that:

> **Condition 18:**
> **The Proponent obtain the approval of the Board for the configuration of the support vessel fleet and for the functional specifications for its proposed standby vessels prior to contracting for these vessels.**

4.3.3.6 Marine Traffic Management

The Proponent states in its *Development Plan – Part I* that it intends to employ vessel surveillance and collision avoidance procedures to ensure that external vessels which represent a potential collision threat are detected and communicated with at an early stage, and that a pre-planned, staged response to unauthorized vessel approach is in place.

The Panel recommended [34] that the development plan include a program devised in consultation with the Canadian Coast Guard and other appropriate authorities for monitoring and controlling marine traffic and for the development of a set of protocols to obviate the danger of collision.

The Board notes that a safety zone for the production installation is prescribed by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, and that the *Newfoundland Offshore Petroleum Installations Regulations* require that installations be fitted with navigation lights and sound signal systems which comply with the *Canada Shipping Act, Collision Regulations*. The *Newfoundland Offshore Petroleum Installation Regulations* also require the installation to be designed to withstand certain accidental impacts with a support vessel. As part of its work, the Certifying Authority will verify that the design of the FPSO vessel is in compliance with those requirements. The *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* require that an operator of a production installation submit for the Board's approval a Safety Plan that must include a description of the facilities and procedures in place to track ice and vessel traffic and provide a staged response designed to avoid or mitigate the consequences of a collision. A "collision avoidance plan" is a standard requirement for drilling and production activities carried out under the Board's administration.

The Board notes that the safety zone prescribed under the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* is not completely consistent with that prescribed by the *Canada Shipping Act, Collision Regulations*. The Board and the Canadian Coast Guard of the Department of Fisheries and Oceans have agreed to resolve this discrepancy.

4.3.3.7 Ice Management Plan

The Proponent states that it will develop a comprehensive ice management plan for field operations, and describes in general terms the contents of this plan. The Proponent asserts that its past exploration drilling on the north-east Grand Banks has provided it with experience which will be useful in ice operations during development drilling and production operations on the Terra Nova field.

The Proponent states that the FPSO, as well as any drilling units which may be operating in the field, will operate on the principle of iceberg avoidance. It further states that its ice management plan will provide for the orderly suspension of operations, and the flushing of production risers, prior to the FPSO vessel moving off site.

The Panel recommended [39] that the

Proponent's ice management plan should:

- rely principally upon real-time data because of the difficulties in forecasting iceberg trajectories
- include a clearly-defined process for setting ice management priorities when multiple ice pieces, including growlers, were present and for retreat from the production site
- take into account the potential hazards to shipping associated with growlers and bergy bits
- recognize the potential for a substantial increase in the number of icebergs crossing the 48th parallel as a concomitant of global warming
- include provision for a third-party audit of its effectiveness
- include a continuous program of observation and research that leads to the improvement of radar and other remote sensing devices that will make possible the early detection of even low-lying masses of floating ice

The Board acknowledges the Proponent's experience with ice management during its exploration drilling on the Grand Banks in the mid-1980s, a period which included some of the most severe iceberg conditions on record. The Board nevertheless observes that the Proponent's accumulated experience with exposure to iceberg risks is relatively small in comparison with the many years of exposure to other types of potential hazard which it, and other operators, have worldwide. The Board also observes that the presence of multiple facilities over a relatively large area, and the proposal for FPSO operations in partial sea ice cover, present an operating challenge yet to be experienced in the Newfoundland Offshore Area.

The Board notes that the preparation and submission of ice management plans have routinely been required of operators of drilling or production installations in areas prone to ice encroachment. The Board monitors operators' implementation of these plans on a continuous basis when ice is present, as part of its ongoing monitoring of offshore operations. Because of the perceived inaccuracies of iceberg trajectory forecast models, these plans have incorporated ice avoidance procedures for installations and decision-making strategies for ice deflection, both of which have been based almost exclusively upon real-time iceberg observations. These procedures include protocols for assigning priorities to response actions, and therefore are sufficiently robust to cope with the presence of multiple pieces of potentially hazardous ice.

The acceptability of the ice management plan for the Project will be examined by the Board during its review of the Safety Plan which the operator is required to submit for approval pursuant to the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations.*

The Board will ensure that the ice management plan explicitly identifies the ice conditions in which the drilling and production installations are designed to operate, and the conditions in which disconnection of each installation and avoidance of ice is required. The Board expects that the Proponent's plan will include the provision of both enhanced ice detection equipment and carefully-designed surveillance procedures which will ensure that adverse ice conditions are detected in time to permit an orderly withdrawal of each installation from site. The Board also will ensure that the functional specifications for support vessels take into account the ice conditions in which these vessels are intended to operate. The Board will assess the effectiveness of the ice management plan as part of its regular monitoring of offshore operations.

Finally, the Board notes that the ice information which is acquired by the operator during the course of its ice management activities is submitted periodically to the Board, whereupon it is transmitted to the Marine Environmental Data Service of the Department of Fisheries and Oceans and to Environment Canada for archiving. Subsequently, the data are available to researchers and to members of the general public.

4.3.3.8 Physical Environmental Monitoring

The Proponent states in Section 8.1 (p. 8-2) of its *Environmental Impact Statement* (EIS) that it will develop a plan for monitoring the physical environment which "will provide accurate and reliable real-time measurements to support operational decisions ... to the meteorological forecasting program ... to wave forecasting, the ice management program and to real-time oil-spill trajectory modelling (if and when required). Measurements ... will also contribute to the climatological database available for future scientific and operational studies on local, regional and global scales."

The Panel recommended [33]that the Project be an important centre for collection of weather data and for the support of research designed to improve observational and forecasting techniques; [36] that the Proponent regularly collect wave data to assist in the updating of wave hindcast data bases; and [38]that a continuous surface current monitoring program be established which would be capable of supporting oil spill trajectory modelling.

The Board understands that Environment Canada plans to undertake a program in its Atlantic region entitled the Atlantic Environmental Prediction Research Initiative, through which it will participate

with other interested parties in conducting research and development to enhance present capabilities to forecast potentially hazardous weather, wave, ice and icing conditions. The Board will encourage the Proponent and other operators in the Newfoundland offshore area to participate in this initiative.

The Board notes that operators of offshore exploration and production installations are required by the *Newfoundland Offshore Petroleum Drilling Regulations* and the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* to monitor and record weather data. These data are transmitted to Environment Canada on a timely and routine basis. Operators are also required to acquire site-specific weather forecasts for drilling and production sites. Past operators have been willing to accommodate the field components of weather research programs in their data acquisition activities provided this did not unreasonably interfere with or jeopardize their operations. The Board will encourage the Proponent and future proponents to continue the practice of accommodating weather research instrumentation on their platforms provided this does not unreasonably interfere with or jeopardize their operations.

The Board also notes that the operator is required by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* to collect wave and other oceanographic data. These data are provided to the Marine Environmental Data Service of the Department of Fisheries and Oceans and are used, in conjunction with other offshore measurements, by Environment Canada in updating the comprehensive PERD-funded East Coast wave hindcast data base.

Operators of production installations also are required by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* to have an oceanographic monitoring program in place which includes the measurement of surface currents. Data from these programs are made available on a yearly basis to the Marine Environmental Data Service of Fisheries and Oceans for archival purposes. These data are also available on the installation in real time for operational use. Oil spill trajectory models which are used in support of spill response operations are able to incorporate the real-time data from these measurement programs.

4.4 Protection of the Environment

This section describes the Board's review of the potential effects of the Terra Nova Project upon the natural environment, and of the measures which the Proponent plans to put in place to prevent or minimize these effects.

The Panel devoted a considerable portion of its work to this element of the Development Application and its "fundamental findings" included the recommendation [2] that all environmental management respecting the Project be undertaken in accordance with a precautionary approach.

The Board wishes to emphasize that in all of its decisions respecting the approval of activities in the Newfoundland Offshore Area, it has adopted an approach which is consistent with the definition of the precautionary principle enunciated in Principle 16 of the *Rio Declaration on Environment and Development* which states, inter alia, that

> *When there are threats of serious or irreversible damage, lack of full scientific certainty must not be used as a reason for postponing cost effective measures to prevent environmental degradation.*

The Board will continue to use this approach in its decision making relative to the Terra Nova Project.

4.4.1 Effects of Routine Discharges

Any hydrocarbon operation offshore generates routine discharges into the marine environment. Regulations exist to specify the level of discharge which the regulator considers, on the best scientific and technical advice, to be acceptable. This section considers the routine discharges which may emanate from the operation and sets out the conditions the Board will require the Proponent to meet.

4.4.1.1 Regulation of Discharges

The Proponent states in its EIS that it will ensure that discharges associated with the routine operation of its offshore facilities are handled, treated, and disposed of in accordance with the 1996 *Offshore Waste Treatment Guidelines* co-published by the Board, the National Energy Board and the Canada-Nova Scotia Offshore Petroleum Board. It also stated during the Panel's public hearings that, should discharge standards change during the life of the Project, its facilities likely would be capable of adapting to those standards.

The Panel recommended [45] that, as regulations, standards or guidelines are updated over the life of the Project, these updated instruments be applied to the Project. The Panel

also recommended that the Proponent's facilities design be sufficiently flexible to permit retrofitting to accommodate changes in discharge standards.

The Board notes that existing projects or installations are subject to the most recent regulatory instruments. Therefore, any changes to regulatory standards which take place during the life of the Terra Nova field will apply to the Project. As a matter of policy, the Board encourages operators to make provisions in their designs to accommodate changes in technology, where such changes are anticipated, and where potential advances in practicable treatment technology can be reasonably foreseen. This will be done in the Terra Nova case.

4.4.1.2 Greenhouse Gas Emissions

In a response to an information request from the Panel, the Panel estimated that during peak production its facilities would emit greenhouse gases equivalent to approximately 300 000 tonnes of carbon dioxide per year.

The Panel acknowledged the Proponent's corporate commitment to participation in the national Climate Change Voluntary Challenge and Registry Program, jointly sponsored by Environment Canada and by Natural Resources Canada, respecting reductions in greenhouse gas emissions. Notwithstanding this commitment, the Panel recommended [64] that the Proponent be required to modify the FPSO vessel to permit the installation of new technology which may permit the reduction of emission of these gases.

The Board notes that the predicted effects of greenhouse gases upon the atmosphere arise on a global, rather than a local or site-specific basis. Nevertheless, the Board believes that the Proponent should evaluate the potential for incorporating provisions to reduce the emission of these gases from the FPSO vessel during the design of its facilities. The Board also believes that a decision to invest in such equipment should be considered as part of a larger review which evaluates the cost-effectiveness of such an investment against a wide variety of investment alternatives to meet the Proponent's undertakings under the Government of Canada's Voluntary Challenge Program for the reduction of greenhouse gas emissions. Therefore, it is a condition of the Board's approval that:

Condition 19:

The Proponent evaluate and report to the Board the technical and economic feasibility of incorporating measures into the design of its production facilities which will reduce the amount of greenhouse gases released from these facilities.

4.4.1.3 Drilling Discharges

The Proponent estimates that between 26 and 48 wells drilled from four to six drill centres will be required to develop the Terra Nova field. Production wells will be horizontal or highly deviated, whereas injection wells will be vertical or deviated. The Proponent believes that drilling deviated or horizontal well sections will require the use of oil-based drilling fluid, or a fluid with similar rheological properties. During the Panel's public hearings, the Proponent indicated that it is considering the use of a recently-developed, synthetic, oil-based drilling fluid which contains virtually no aromatic fractions, is somewhat more biodegradable than conventional oil-based drilling fluids and is sufficiently low in toxicity to be classed as "food-grade".

In its *Environmental Impact Statement* (EIS) and in further information which it provided in Supplement A to its Application, the Proponent predicts that the zone of effects of drilling discharges will be somewhat larger than those previously observed at single-well exploratory drill sites, but considerably less than those observed at fixed production platforms from which a large number of wells were drilled. The Proponent also predicts that effects upon benthic organisms will be minor to major and medium-term in duration within several hundred metres of each drill centre, and minor and short-term over the 50 to 70 square kilometre development area. Impacts upon fish and fisheries are predicted to be negligible.

The Proponent states in its EIS that prior to discharge it will treat oil-based mud cuttings to the levels specified in the 1996 *Offshore Waste Treatment Guidelines*. It further stated during the public hearings that it plans to install improved solids-control equipment on the drilling unit which it contracted to drill its development wells. Recent experience with this type of equipment in the North Sea indicates that it may achieve discharge levels lower than those recommended in the *Guidelines*.

The Proponent states in its EIS that a component of its environmental effects monitoring program for the project will include monitoring seabed sediments and organisms for potential effects. It also states that its program will include testing of fish in the development area for taint due to oil.

The Proponent has taken the position that neither the re-injection of drill cuttings nor their transport to shore for treatment is technically or economically feasible for the Terra Nova Project.

The Panel recommended [54] that the Proponent re-examine the feasibility of re-injecting oil-based drill cuttings from its drilling unit, and, if re-

injection was not possible, that the best available technology be applied to the treatment of drilling discharges from the Project. The Panel also recommended that, if future standards were beyond the capability of treatment technology, that the cuttings be transported to shore for disposal.

The Board believes that the relatively low number of wells to be drilled at each drill centre, combined with the Proponent's proposed use of a newer-generation drilling fluid and improved cuttings treatment equipment, should result in lesser effects upon the seabed environment in the vicinity of the Terra Nova field than have been observed surrounding many fixed platforms in the North Sea. However, it also acknowledges the variance in scientific opinion, both at the public hearings and in the international scientific literature, concerning the scale and severity of effects of discharged oil-based drill cuttings upon benthic organisms.

The 1996 *Offshore Waste Treatment Guidelines* recommend that operators planning development drilling programs evaluate the feasibility of re-injecting drill solids from the portions of these programs which utilize oil-based drilling fluid. The Board observes that during the public hearings the Proponent asserted that neither the re-injection of oiled drill cuttings nor their transport to shore is technically or economically feasible at Terra Nova, but that its application documents do not contain technical or economic information in support of this assertion.

The Board will require as a condition of its approval of the Development Plan that, prior to beginning drilling operations, the Proponent submit for the Board's review a report evaluating the technical and economic feasibility of re-injecting oiled drill solids and of their transport to shore for subsequent disposition in an environmentally responsible manner.

In the event that re-injection of oiled drill solids is unfeasible, the Board is prepared to permit their discharge following treatment in accordance with established regulations, standards and guidelines. The Board notes that the Guidelines recommend that an operator continue to evaluate new technologies and procedures which may permit reduction of the oil content of discharged drill cuttings below the levels specified therein. It commends the Proponent's commitment during the public hearings to install state-of-the-art cuttings treatment equipment on the drilling unit which will drill its development wells, urges the Proponent to continue to evaluate technological progress in the field and expects the Proponent to adopt improved treatment methods where it is practical to do so. The Board will monitor this aspect of the Proponent's performance.

The Board notes the Proponent's commitment to the inclusion of seabed monitoring in its environmental effects monitoring program and observes that results from this program should provide advance warning of effects on the seabed greater than those anticipated in the *Environmental Impact Statement*. Therefore, it is a condition of the Board's approval that:

Condition 20:
(i) The Proponent, prior to beginning drilling operations, submit to the Board a report evaluating the technical and economic feasibility of the re-injection of oiled drill solids and of transporting them to shore for disposition in an environmentally responsible manner.
(ii) The Proponent re-inject oiled drill cuttings if, in the opinion of the Board, the results of this evaluation indicate re-injection is technically and economically feasible.

4.4.1.4 Production Discharges

Produced Water

The Proponent states in its Development Application that the results of delineation drilling on the Terra Nova field indicate that little formation water is present in the reservoir. Therefore, produced water likely will consist primarily of sea water which will be injected into the formation to maintain formation pressure and to enhance oil recovery.

The Proponent states that produced water will be treated to meet levels recommended in the *Offshore Waste Treatment Guidelines* and will be discharged more than ten metres below the sea surface. The Proponent predicts that environmental effects due to this discharge will be negligible some tens of metres beyond the discharge point.

The Proponent stated during the public hearings that the predicted effects due to produced water discharge do not justify more stringent discharge restrictions than those which it proposes to adopt. It also expressed concern that a requirement to re-inject produced water into a producing reservoir could lead to early plugging and loss of oil recovery, and expressed the view that the disposal of produced water into dedicated disposal wells was economically prohibitive.

The Proponent indicates that its production phase environmental effects monitoring program will include the measurement of oil concentrations at varying distances from the produced water discharge, and that it will measure the respective compositions of injection water and produced water.

The Panel recommended [55] that the Proponent should not be permitted to discharge produced water unless re-injection should prove unfeasible,

and that the Proponent be required to re-examine this feasibility. The Panel also recommended that, in the event re-injection was not feasible, the Proponent be required to treat the discharged water to "standards that are the most stringent achievable ... for floating production facilities".

The Board observes that the discharge levels recommended by the 1996 *Offshore Waste Treatment Guidelines* are consistent with those currently in effect in the North Sea.

Based upon the preponderance of evidence available to date, the Board believes that discharge of produced water from Terra Nova in the concentrations and quantities which are estimated in the Environmental Impact Statement is unlikely to cause significant effects upon the receiving environment. The Board also believes that the produced water treatment technology which the Proponent stated, during the Panel's public hearings, that it plans to employ represents the best practical technology currently available.

The Board notes, however, that emerging evidence from the older, heavily-developed areas of the North Sea indicates that large-volume produced water discharges may be responsible, in whole or in part, for regional-scale biological effects, although the significance of these effects is not yet clear.

The Board believes it to be prudent, therefore, that the capability be provided in the design of the facilities to further mitigate the effects of these discharges if the results of effects monitoring programs on the Grand Banks, or relevant experience in other jurisdictions, indicate that such measures are appropriate. Such capability should include the allocation of sufficient space and motive power for additional water treatment facilities and for injection pumps.

Finally, the Board observes that, notwithstanding the Proponent's statements at the public hearings respecting the technical and economic feasibility of re-injecting produced water, it has not as yet provided any technical documentation specific to the Terra Nova field to substantiate its assertion. The Board believes that the technical feasibility of produced water re-injection into the reservoir will not become clear until sufficient water has been produced from the field to permit its properties to be analyzed. Therefore, it is a condition of the Board's approval that:

Condition 21:

(i) The Proponent provide in the design of its facilities for the re-injection of produced water, should this be required in the future.

(ii) The Proponent undertake and submit to the Board an analysis of the feasibility of produced water re-injection, following the recovery of sufficient volumes of produced water to permit the conduct of such an analysis.

(iii) The Proponent proceed with re-injection of produced water if, in the opinion of the Board, it is technically and economically feasible.

Cooling Water

The Proponent states that cooling water used in the FPSO vessel will be chlorinated to a level of 1–2 mg of chlorine per litre of seawater to control biological growth. It also states that that it will design its cooling water system to be "as closed as possible" to minimize discharges of the water and states that some cooling water may be usable as injection water.

The Panel noted that chlorinated cooling water has been designated a "toxic substance" pursuant to the *Canadian Environmental Protection Act* and recommended [56] that the Proponent be required to submit a plan for the mitigation of this discharge using either dechlorination facilities or alternatives to chlorination.

The Board notes that, although chlorinated wastewater has been designated as a "toxic substance" by Environment Canada under the *Canadian Environmental Protection Act*, no regulations have yet been proposed limiting its discharge from applications such as those described by the Proponent. It also observes that no evidence was presented to the Panel to rebut the Proponent's assertion that the effects of discharged cooling water will be negligible. It is aware, however, that the Government of Canada has adopted a Toxic Substances Management Policy which includes effluents of this type, and that the development of a federal-provincial agreement on management of chlorinated wastewater effluents is under consideration.

Notwithstanding the above, the Board agrees that the Proponent's plans respecting this discharge have not been fully defined, and notes that the Proponent stated during the Panel's public hearings that, during the design of the facilities, it would investigate alternative means of controlling biological growth. The Board observes that cooling water systems can be designed with a "feedback" monitoring system so that the amount of chlorine added to the cooling water input is controlled by the quantity which is measured "downstream" of the process equipment so that a minimal quantity of chlorine actually is released, that it may be possible to incorporate dechlorination facilities into the cooling water system, and that the Proponent states in its *Environmental Impact Statement* that some cooling water may be used as injection water.

The Board will require the Proponent to evaluate and report to the Board the feasibility of using methods alternative to chlorination for the control of biological growth in the cooling water systems used on the FPSO vessel. In the event that

chlorination remains the preferred method, the Board will require that the design of the production facilities provide for the minimization of chlorine use by means of an in-line analyzer near the point of discharge which controls the quantity of chlorine which is added to the cooling water, and for the use of dechlorination facilities if it is practicable to do so. The Board also will require that the Proponent investigate the feasibility of injecting cooling water into the reservoir for pressure maintenance, and if feasible to incorporate provisions for such injection into the design of its facilities.

The Board observes that both waste management and environmental compliance monitoring plan are components of the Environmental Protection Plan which the Proponent is required to submit pursuant to the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations.*

In consultation with Environment Canada and with Fisheries and Oceans, the Board will ensure that the waste management and environmental compliance monitoring plans which the Proponent submits as part of its Environmental Protection Plan fully describe its plans for control of biological growth in its cooling water system, the measures it will use to minimize biocide use and to mitigate any discharge. Therefore, it is a condition of the Board's approval that:

Condition 22:
(i) The Proponent evaluate and report to the Board the feasibility of using methods alternative to chlorination for the control of biological growth in the cooling water systems used on the FPSO vessel.
(ii) In the event that chlorination remains the preferred method for control of biological growth in cooling water, the Proponent design its production facilities so that chlorine use is minimized by means of an in-line analyzer near the point of discharge which controls the quantity of chlorine which is added to the cooling water, and incorporate dechlorination facilities if it is practicable to do so.
(iii) The Proponent investigate the feasibility of using cooling water for re-injection, and to provide for this in the design of its facilities, if in the opinion of the Board, the evaluation indicates that this is feasible.

4.4.2 Effects of Accidental Discharges

The operation of a hydrocarbon production facility in a marine environment in which there are severe environmental operating conditions can lead to incidents in which hydrocarbons are accidentally discharged to the sea. While the Proponent has indicated its commitment to "zero tolerance" for such events, the Board recognizes that, improbable as their use may be, appropriate contingency plans must be prepared. This section discusses the nature of the risks and their remediation.

4.4.2.1 Oil Spills

In Section 5.7 of its *Environmental Impact Statement,* the Proponent evaluates the probability of occurrence of oil spills and their subsequent effects during drilling and production operations.

The Proponent predicts, based upon experience in other jurisdictions, that the probability of a large crude oil spill associated with its development drilling and production operations is low, but that smaller batch spills of ten cubic metres or less are likely to occur over the producing life of the field. In addition, the limited experience with offshore tanker loading operations indicates a 50 percent probability that a spill of as much as 1000 m^3 could occur in association with these operations. The Proponent believes that the latter risk may be greatly reduced through the use of state-of-the-art loading equipment and procedures, and states that it will employ a "zero tolerance" policy regarding spills of any size.

The Proponent states that should one occur, the effect of an offshore oil spill upon fish and fish stocks will be negligible, but that the potential exists for significant seabird mortalities under some spill scenarios. Furthermore, it points out that the distance of Terra Nova from shore, the relatively high sea states in the area, and generally low water temperatures, are likely to preclude successful rehabilitative efforts should seabirds become oiled.

The Proponent has reiterated the conclusions of the Hibernia Environmental Assessment Panel that spill countermeasures are likely to be constrained by the harsh offshore environment of the Grand Banks, and that in view of these limitations, spill prevention efforts should be emphasized. The Proponent also has stated that its contingency plans for the project will include provisions for spill surveillance and monitoring, for on-water response using equipment appropriate for the conditions likely to be encountered, and for appropriate training of response personnel.

The Panel noted the potentially severe effects which could be associated with a major oil spill and acknowledged the limitations which the harsh environment of the Grand Banks placed upon countermeasures which might be applied following such an event. It recommended [57] that the Board require that the Proponent adhere to its stated "zero-tolerance" policy regarding oil spills, and [62] that the Proponent ensure all Project staff are properly informed of spill reporting procedures.

In the area of spill-related effects monitoring it recommended [74] that plans be developed for

effects monitoring following an oil spill which include provision for the deployment and recovery of drifters to simulate the drift of oiled birds and to assist in estimation of oil-induced mortality. It also recommended [75] that the Department of Fisheries and Oceans design programs to be incorporated into the Proponent's response to measure potential effects upon fish larvae and to measure fish tainting.

The Panel's recommendations respecting preventative measures are discussed in Section 4.4.4.

The Board generally concurs with the Proponent's statements respecting the potential for offshore oil spills, and the likely effectiveness of physical countermeasures. The Board acknowledges the risk of small batch spills occurring during the life of the project, particularly during tanker loading operations, and commends the Proponent for its stated "zero tolerance" policy toward these spills. The Board notes that the Accord Acts take a "zero tolerance" approach to oil spillage, forbidding the spillage of oil and by declining to define any "minimal acceptable" amount in this context.

The Board notes that a contingency plan for oil spill response is a component of the Environmental Protection Plan and will ensure that this plan incorporates provisions to ensure that appropriate personnel are properly trained in their respective duties in the event of a spill and that drills and exercises are periodically held to inculcate these duties.

The Board believes that thorough advance planning for monitoring effects of an oil spill is a necessary precaution and will ensure that this is addressed in the Proponent's contingency plans. The Board notes, however, that the level of detail captured by the monitoring plans established for routine discharges will not be achievable in spill monitoring plans, since the detail that can be captured in the latter case inevitably will depend upon the specific nature of an individual spill event.

The Board also notes that oil spill contingency plans typically provide for the deployment of drifting buoys following a spill. These are designed to move with the spilled material and to be remotely tracked to give an indication of the spill location. The deployment of a larger number of 'drifters' to simulate the movement of dead oiled birds as suggested by the Panel may be feasible in most cases; however, their recovery may not be possible in many instances on the Grand Banks because of weather or sea state conditions, and therefore they may be less useful in estimating seabird mortalities than those which are deployed during spills occurring in sheltered waters. Nevertheless, the Board will ensure that the Proponent's spill response plan provides for the provision of a stockpile of 'drifters' to simulate the movement of dead oiled birds and for their deployment when conditions permit. The Board understands that the Government of Canada under the Panel on Energy Research and Development plans to undertake research to evaluate the usefulness and efficiency of these drifters in establishing the mortalities of oiled birds.

The Board believes that provision for monitoring effects of a large oil spill upon organisms dwelling in the oceanic surface layer, and for taint testing following such a spill, as urged by the Panel, is a necessary feature of responsible contingency planning. The Board believes, however, that the responsibility for designing this program rests with the Proponent as part of its contingency planning obligations, and notes that the Department of Fisheries and Oceans can be a major source of advice to the Proponent during the design of the program and will be consulted by the Board during its consideration of the acceptability of the Proponent's spill response plan.

4.4.3 Field Abandonment

A producing facility such as that designed for Terra Nova will not be in situ in the marine environment forever. When the hydrocarbons it is designed to extract are depleted and when it cannot be economically used for other fields, the facilities must be decommissioned. The several components of this decommissioning are now discussed.

4.4.3.1 *Floating Production, Storage and Offloading Vessel*

The Proponent states that, following the depletion of the Terra Nova field, the FPSO vessel will be decommissioned and made safe offshore. Wastes recovered during these operations will be transported to shore for treatment and disposal.

The vessel will be removed from the field and brought to shore, either for conversion and re-use or for scrapping. All associated anchors and mooring lines or chains also will be removed from the field.

The Board believes that the Proponent's plans for decommissioning the FPSO vessel are acceptable and notes that, under the requirements of the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, approval of the Board is required at the commencement of decommissioning.

4.4.3.2 *Subsea Facilities*

The Proponent states that individual wells will be abandoned as each is no longer useful. Production wells will be purged of hydrocarbons; all wells will be plugged, will have surface equipment removed, and will have casing cut below the sea floor. It also states

that all subsea facilities, including flowlines which are located on or above the sea floor, will be removed during field abandonment, but that trenched flowlines may be purged of hydrocarbons and left in place. The Proponent predicts that effects due to abandonment, and those associated with post-abandonment conditions, will be minor to negligible.

The Panel opined that the Proponent's plans for abandonment were adequate. It nonetheless recommended [69] that the Board require the Proponent, when the end of production approaches, to re-evaluate its options for decommissioning and abandonment in light of then-existing technologies and standards. It also recommended [70] that the Proponent be held financially responsible for any harmful effects which can be unequivocally linked with the Project, even after field abandonment.

The Board acknowledges the Proponent's statements respecting abandonment of its development wells, and notes that pursuant to the *Newfoundland Offshore Petroleum Production and Conservation Regulations* the specific approval of the Board is required prior to the final abandonment of each well.

The Board also acknowledges the Proponent's commitment to remove all subsea facilities which are located on or above the sea floor.

The Board agrees that the proposed purging and abandonment in place of trenched flowlines likely will not result in significant adverse effects upon the natural environment nor interfere with other users of the seabed. The Board also agrees that a further assessment of this matter should be performed at the time of abandonment, in consideration of regulations and national policies which may exist at that time.

The Board notes that the Proponent will be required pursuant to the Accord Acts to seek the Board's approval prior to abandoning any subsea equipment in place on or below the sea floor.

The Accord Acts address the question of the limitation period as follows:

> *Proceedings in respect of claims ... may be instituted within three years after the day when the loss, damage, costs or expenses occurred but in no case after six years after the day the spill or the discharge, emission or escape of petroleum occurred or, in the case of debris, after the day the installation or structure in question was abandoned or the material in question broke away or was jettisoned or displaced.*[8]

Because of the statutory time limitation (6 years maximum) respecting claims arising from a 'spill' or 'debris', the Board cannot apply the 'polluter pays' principle in perpetuity.

4.4.4 Environmental Protection Plan

The Proponent has stated that it will prepare an Environmental Protection Plan (EPP) respecting all phases of the Terra Nova Project, which will include the policies, standards and procedures which it will employ in order to ensure that appropriate mitigative measures are in place during the project; that project personnel and contractors are properly trained in these policies, standards, and procedures; and that internal inspection and audit procedures are established to ensure compliance.

The EPP will also include the following major elements:

- an Environmental Effects Monitoring program to detect and determine adverse environmental effects which may be associated with routine operations
- an Environmental Compliance Monitoring plan to ensure that the composition and characteristics of substances which are discharged into the marine environment are within regulatory limits
- a Waste Management Plan encompassing all wastes which are generated by field facilities
- fishing industry agreements and compensation procedures
- a chemical management plan
- contingency plans for environmental emergencies

The Proponent states that it has in place a "Total Loss Management" (TLM) system which includes matters relating to environmental management and which, the Proponent asserts, complies with the requirements of the ISO 14001 standard *Environmental Management Systems – Specifications with Guidance for Use.*

The Proponent plans to submit the portions of the EPP which deal with field development (including drilling), production, and abandonment at least six months prior to beginning these activities.

The Panel recommended [58] that the Proponent implement a program of continuing education for marine crews involved with the Project to ensure they are sensitized to environmental sensitivities in the Project area and the consequences of failures to adhere to environmental protection procedures.

The Panel also recommended [59] that the Board require the Proponent to establish a set of protocols which will constrain the transfer of crude oil or of refined products during unfavourable environmental conditions.

The Panel's recommendations respecting environmental effects monitoring are described in Section 4.4.4.1.

The Board believes that the scope of the EPP which the Proponent describes is generally consistent with the requirements for such a plan contained in the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations.*

The Board acknowledges the statements of the Proponent respecting its Environmental Protection Plan for the project, and notes that, pursuant to the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, an EPP approved by the Board's Chief Conservation Officer is required prior to issuance of a Production Operations Authorization.

The Board commends the Proponent on the development and implementation of its Total Loss Management National Standards and encourages it to seek third–party ISO 14001 certification with respect to its Terra Nova activities.

The Board also acknowledges and accepts the Proponent's plans to submit those portions of the EPP which deal with field development and drilling, production, and decommissioning and abandonment at least six months prior to commencement of each of these activities.

The Board concurs with the Panel's opinion that environmental awareness programs should form a regular part of ongoing training programs for offshore employees. The Board will ensure that provisions for the delivery of this training are included in the training package delivered to workers.

The Board expects the Proponent's EPP to explicitly describe the equipment and operating procedures it intends to employ to ensure that marine operations, such as tanker loading, are undertaken in a prudent manner. The Board intends to monitor closely the Proponent's adherence to these procedures during the production operation, to investigate fully any lapses which occur, and to apply the sanctions provided for by the Accord Acts where this is warranted.

Additional comments on certain elements of the EPP are provided in the following sections.

4.4.4.1 Environmental Effects Monitoring

The Proponent states that, as part of its environmental protection planning for the Terra Nova Development, it will design and implement an Environmental Effects Monitoring (EEM) program for the drilling and production phases of the project. The EEM program will include provision for the collection of baseline data prior to the commencement of field development activities.

The Proponent notes that the EEM program design will be developed in consultation with the Board and with other relevant government agencies, but that it anticipates the program will include monitoring of the following parameters:

- effects of drilling discharges, as measured by oil concentrations in sediments and effects upon benthic animals
- effects due to produced water, as measured by oil concentrations at various distances from the discharge point
- effects of oily water upon fish, as measured by a taint testing program.

The Panel was strongly of the view that effective monitoring will be essential to prudent environmental management of offshore production operations in general, and the Terra Nova Project in particular. It offered a series of recommendations respecting the contents of the Proponent's EEM program, the process by which it will be developed, and the availability of the resulting data and analyses.

With respect to the spatial scale of sampling, the Panel recommended [53] that the Board ensure that the effects monitoring program for Terra Nova utilize a sufficiently extended sampling grid so that the zone of influence of discharges would be fully defined.

The Panel recommended [66] that the Proponent be required to undertake a study of seabird attraction to lights on offshore facilities, and suggested that the Hibernia platform would be a suitable position from which observers could watch for this effect.

The Panel also recommended [67] that observers be placed on the production vessel and on shuttle tankers until such time that "comfort is achieved" that minimal impacts upon seabirds result from these activities.

The Panel cited a suggestion from the Department of Fisheries and Oceans that the effects of noise upon marine mammals had been underestimated by the Proponent, and recommended [68] that the abundance and activities of marine mammals be monitored in relation to noise emitted by Project activities.

The Panel recommended [71] that the Board convene a workshop to identify the details of the EEM program for Terra Nova, including baseline studies, and to review the final proposed EEM program prior to its approval by the Board. It also recommended [72] that the Proponent seek a synergistic relationship with the Hibernia project in designing its program, and [73] that the Board, through provision of funding where appropriate, promote opportunities for collaborative research

among the Proponent, other operators, and researchers in government and academia, which may arise in connection with the EEM program.

Finally, the Panel recommended [52] that the results of environmental monitoring programs be made available by the Board to both experts and the public for review, and that such reviews be conducted in recognition of the results of basic research.

The Board observes that an EEM program is a component of the Environmental Protection Plan required pursuant to the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, and observes that the precise elements to be included in the program will be discussed in greater detail during the review of the proposed program.

The Board agrees with the Panel's recommendation that the EEM sampling grid extend sufficiently far to fully capture the "zone of influence" of Project discharges.

The Board will ensure that the sampling grid which is proposed for the Terra Nova EEM program is based upon modelling results specific to Terra Nova conditions and that these results are examined in the light of international monitoring experience. The Board will also ensure that the grid is expanded if monitoring results indicate that the zone of influence is approaching the grid boundary.

The Board believes that the design process for the EEM program should include provision for input and review by outside experts and by interested groups or individuals in the general public, and intends to ensure that the results of EEM are made publicly available in a prompt manner following the completion of individual survey programs. The Board notes that it routinely consults with federal and provincial environment and fisheries departments on these matters and that these working relationships are described in Memoranda of Understanding with these departments. During its consideration of environmental effects monitoring data, the Board will consult with federal and provincial fisheries and environment departments and will welcome input from external experts or other interested parties.

The Board will require, as a condition of its development plan approval, that the Proponent provide, during the design of the environmental effects monitoring program, opportunity for the general public to obtain input into, and to review, the design.

The Board observes that no scientific evidence was offered to the Panel review to support the concerns of some participants respecting seabird interaction with lights. However, the Board has since been informed by an official of Environment Canada of an incident of Leach's storm petrels being attracted to the lights of vessels passing close to Baccalieu Island and of a similar occurrence involving the Hibernia platform. The Board believes that, in the interests of safety, personnel complements on offshore drilling and production facilities should be kept to the minimum necessary for prudent operations and has concluded that insufficient evidence has been presented to justify requiring the placement of additional, dedicated personnel on drilling or production platforms as observers.

The Board will explore with the Hibernia Management and Development Company and with representatives of the Canadian Wildlife Service of Environment Canada whether the potential attraction of seabirds to lights on offshore platforms may be credibly investigated using existing platform personnel. The Board also will propose a literature study through the auspices of the Environmental Studies Research Fund to investigate further the level of information on this topic available worldwide. The Board will expect the Proponent to participate in these studies as appropriate and to take their results into account in the design of its facilities.

The Board observes that seabirds may be affected by oil spills which may be associated with the Project, and that the severity of these effects may not be directly related to the size of an individual spill. The Board also notes that because of the wide-ranging movement patterns of seabirds, their monitoring does not easily fit within the scope of typical site-specific EEM programs, except perhaps in the case of a dedicated program mounted following a large spill. The Board believes, rather, that routine seabird monitoring may be better accomplished by means of placing observers on supply vessels during their regular transits as part of a regional monitoring effort. The Board notes that the Proponent expressed a willingness during the public hearings to consider making space available on its vessels for such a purpose. In consultation with the Proponent, the Hibernia Management and Development Company, the Canadian Wildlife Service of Environment Canada, and other interested parties, the Board will sponsor a project under the auspices of the Environmental Studies Research Fund to determine the feasibility of developing a scientifically defensible seabird monitoring program of this type, and if such a program is deemed feasible, to facilitate its implementation on the north-east Grand Banks.

The Board observes that no evidence was presented to the Panel to support the claim that the Proponent's estimation of the effects of noise, which were presented in the EIS with considerable reference to published literature, were

inappropriate. The Board can see no reason at this time to conclude that effects of Project-related noise upon marine mammals are likely to be significant, nor to require inclusion of marine mammals in the EEM program for routine Project operations. The Board acknowledges, however, that marine mammal monitoring may be appropriate following an oil spill. The Board will ensure that the Proponent's spill response plan provides for the monitoring of potential effects upon marine mammals following a major spill.

Drilling discharges form a substantial portion of the wastes which are likely to be discharged into the marine environment. The potential effects of drilling discharges also were the subject of considerable concern to a number of participants in the public hearings. The Board notes that, although the Proponent has stated that it will submit the portions of its EPP which deal with drilling matters six months in advance of drilling, it may be impractical to artificially separate those elements of the EEM plan from those associated with production discharges. The Board believes, therefore, that the full EEM program design should be ready for implementation shortly after the commencement of drilling operations.

The Board believes that the Panel's suggestion that the Proponent, during development of its EEM program, seek synergies with the Hibernia project is a sensible one, and will encourage the Proponent to do so during the EEM design process. The Board notes that its budget does not include provision for the direct funding of general research. However, it participates in setting the priorities of the federal Panel on Energy Research and Development and provides a representative to the Management Board of the Environmental Studies Research Fund. The Board will use its good offices in these fora and in its relations with the petroleum industry to encourage the collaboration which the Board describes. Therefore, it is a condition of the Board's approval that:

Condition 23:

(i) The Proponent submit its environmental effects monitoring program respecting the drilling and production phases of the Terra Nova project prior to commencing drilling operations.

(ii) The Proponent provide, during the design of its environmental effects monitoring program, opportunity for the general public to obtain input into, and review, the design.

4.4.4.2 Fishing Industry Agreements

The Proponent states that its Environmental Protection Plan will include fishing industry agreements and compensation procedures. It predicts that routine drilling and production activities will not significantly affect commercial fishery activities since the Terra Nova Development area has not historically been heavily fished, and since the safety zone established pursuant to the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations*, from which all unauthorized vessels will be excluded, represents a small fraction of the NAFO Unit Area 3Lt, the smallest fishing zone which contains the Terra Nova area. The Proponent observes that fishing activities do not need to be excluded from those portions of the development area in which facilities have not yet been installed, nor in areas which have been abandoned following cessation of production.

The Proponent also states that, although a large oil spill would be unlikely to significantly affect fish stocks, it may exclude fishing operations temporarily from a portion of the Grand Banks, and therefore could cause an economic loss to fishers, and possibly to onshore fish processing plants and other fishery enterprises.

The Proponent also commits to engaging in an ongoing consultation process with fisheries interests during project operations, and to cooperate in this regard with other active operators on the Grand Banks, most notably the Hibernia Management and Development Company.

The Board acknowledges the Proponent's commitments respecting consultation with fishing interests, and respecting their compensation in the event of accidental oil spillage or other damage. The Board urges the Proponent to consult with representatives of fisheries interests to develop a system of agreements on these matters which are mutually acceptable to both industries.

The Board concurs with the Proponent's estimates, based upon historical data, of the relative insignificance to the fishery of the Terra Nova Development area and the concomitant lack of need for loss-of-access compensation. However, the Board expects the Proponent to enter into discussions with fishing interests with a view to compensating them for loss of access should future information indicate a substantial increase in the prospectivity of the Terra Nova Development area for fishing activity.

The Board also notes that the safety zone prescribed by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* only comes into effect when the relevant facilities are in existence, and that therefore the zone will not cover areas of the Terra Nova field which have not had facilities installed, or which have had them removed.

4.4.5 Cumulative Environmental Effects

The Proponent predicts in its EIS that cumulative effects upon the environment associated with the Terra Nova Development will be negligible, and asserts that the likely zones of influence associated with the Terra Nova and Hibernia developments were sufficiently circumscribed as not to overlap nor to augment one another, and that effects of the Terra Nova Development were not of a sufficient scale to cause any adverse effects on present or future fishery activities.

The Panel stated that it believed the consideration of cumulative effects is an important part of the environmental assessment of projects such as Terra Nova, but also that the area of cumulative effects assessment is a relatively new field of endeavour which is continuing to evolve. It expressed the opinion that a proper consideration of cumulative effects would be necessary for the future environmental management of anthropogenic activities, including those associated with the offshore petroleum industry, on the Grand Banks. It recommended [46] that the Board convene a workshop to examine the potential for cumulative impacts due to petroleum development in the Newfoundland Offshore Area and to develop approaches to monitoring them; [47] that the Board identify the factors necessary for monitoring cumulative effects associated with offshore activities and design a plan for implementing a monitoring program which included these factors; and [48] that reviews of regulatory instruments explicitly take into consideration cumulative impacts and that future environmental impact statements be explicitly required to incorporate a consideration of cumulative effects. It also recommended [49] that the cumulative effects workshop include a discussion of present criteria for determining the "significance" of environmental effects and the development of any additional criteria which would assist in prudent environmental management.

The Board observes that the difficulties associated with the proper scientific assessment of cumulative effects are not limited or unique to the Grand Banks, nor for that matter to petroleum-related activity. The Board believes that experience which is gained in other applications and jurisdictions will assist the Board, its advisory agencies, and the Proponent in developing techniques which are appropriate for the particular case of the Grand Banks.

The Board believes that the time is right for an examination of the topic, with particular application to present and potential future petroleum developments on the Grand Banks.

The Board will propose a study which will incorporate a workshop similar to that recommended by the Panel through the Environmental Studies Research Fund to examine experience elsewhere in the area of cumulative effects assessment and to evaluate the applicability of this experience to the Grand Banks in light of actual environmental conditions and realistic development scenarios. The objectives of the study will include the provision of recommendations for "best-science" approaches to cumulative effects monitoring, and a consideration of appropriate criteria for determining the "significance" of environmental effects. The Board will ensure that effects monitoring programs of present and future petroleum producers on the Grand Banks are consistent with any scientifically credible principles or criteria devised.

The Board's 1988 *Development Application Guidelines*, which were appended to the Panel's terms of reference, state on page 30, that a Proponent's assessment of environmental effects should include a discussion of

> *any cumulative effect of the proposed project together with the demonstrated or predicted effects of other existing or confirmed offshore projects.*

Further, Section 16 of the Canadian Environmental Assessment Act, which also was reflected in the Panel's terms of reference, requires that any environmental assessment which is carried out pursuant to that Act include a consideration of

> *any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out.*

The regulatory structure, therefore, already requires consideration of cumulative effects in the manner which the Panel recommends.

The Board, when it participates in the review of regulations, standards, or guidelines, considers applicable experience in other jurisdictions (including Canadian jurisdictions where such experience exists) which indicates the potential for cumulative impacts or synergistic effects under conditions which prevail, or which are likely to prevail, in the Newfoundland Offshore Area.

[1] *Terra Nova Development Application* – Supplement A to the Application, Section 2.2.2, p. 16.
[2] *Development Plan* – Part I, Section 7.6, p. 9-23
[3] *Development Plan* – Part I, Section 6.2.1, p. 6-17
[4] *Development Plan* – Part I, Section 6.2, p. 6-9
[5] Update to the Application, Section 6.4, p. 100
[6] Supplement B to the Application, Section 5.4.2, p. 79
[7] *Development Plan* – Part I, Section 8.1.2, p. 8-10
[8] *Canada-Newfoundland Atlantic Accord Implementation Act*, Section 162(5) and *Canada-Newfoundland Atlantic Accord Implementation Newfoundland Act*, Section 155(5)

Appendix A

CONDITIONS OF APPROVAL

of the Terra Nova Canada–Newfoundland Benefits Plan and the Terra Nova Development Plan

It is a condition of the Board's approval that:

Condition 1

As soon as is practicable after Project Sanction, the Proponent relocate engineering and procurement activities for the Project to Newfoundland.

Condition 2

For each fabrication and construction contract to be executed onshore Newfoundland (or in another part of Canada) and for each construction and installation contract to be executed at the Terra Nova field, the Proponent, upon award of contract, provide the Board with a complete description of the labour requirements associated with the contract, an assessment of the availability of local people to meet the requirements, a description of its plans for implementing training programs, and an estimate, by trade or occupational group, of the required number of out-of-Province and foreign workers.

Condition 3

Within six (6) months of Project Sanction, the Proponent submit to the Board a comprehensive human resources plan, acceptable to the Board, for the operations phase of the Development covering all drilling, producing, crude transportation and support activities. The Plan should provide for the maximum practicable level of participation of residents of the Province in the operations phase workforce and, to the extent practicable, the succession of Canadians, and in particular residents of the Province, to positions initially held by non-Canadians.

Condition 4

Upon Project Sanction, the Proponent submit for the Board's review, a listing and description to be updated quarterly of all significant contracts for the procurement of goods and services identifying those which, in the Proponent's view, could potentially offer long-term benefits opportunities to Canada and, in particular, to Newfoundland.

Condition 5

Upon Project Sanction, the Proponent establish, to the satisfaction of the Board, systems and procedures to implement the bid evaluation framework described in the Benefits Plan.

Condition 6

As the Project evolves, the Proponent consult the Board regarding its decisions related to all contracts associated with the construction of topsides and subsea facilities, mooring systems and production risers from the initial prequalification of bidders to contract award to demonstrate that it is using its best efforts as described in the Benefits Plan to cause this work to be performed in Newfoundland.

Condition 7

The Proponent report to the Board by March 31 of each year, commencing in 1998, its plans for the conduct of research and development and education and training in the Province, including its expenditure estimates, for a three-year period and on its actual expenditures for the preceding year.

Condition 8

The Proponent report on a quarterly basis, in a format satisfactory to the Board, expenditures and employment information, including Canadian and Newfoundland content.

Condition 9

The Proponent submit to the Board its reserve estimates, including a breakdown of original oil-in-place estimates, reserves and recovery factors by fault block and sand unit, at the earliest opportunity and, in any event, before development drilling begins.

Condition 10

The Proponent submit to the Board by March 31, 1998 a report which fully describes its reservoir studies.

Condition 11
The Proponent submit for the Board's approval an updated exploitation scheme for the Far East portion of the field no later than eighteen months following termination of the first well drilled into this area, as scheduled in the June 1997 *Update to the Application.*

Condition 12
The Proponent conduct a study to investigate the effects of gas injection into its alternative site in the Ben Nevis Formation in the area around the King's Cove A-26 and Terra Nova K-17 wells and report the results to the Board prior to first oil production.

Condition 13
The Proponent submit for the Board's approval an updated exploitation scheme for the North Graben no later than eighteen months following termination of the first well drilled into this area, as scheduled in the June 1997 *Update to the Application.*

Condition 14
The Proponent, prior to initiating construction on the FPSO and its turret, provide confirmation to the Board that it has made provision in its design for an additional test separator and for a second swivel pass in the turret for testing.

Condition 15
The Proponent file with the Board a unit agreement and a unit operating agreement prior to initiating oil production.

Condition 16
(i) The Proponent submit to the Board its Safety Assessment Plan within 90 days of Project Sanction.
(ii) The Safety Assessment Plan include a schedule acceptable to the Board for satisfying the recommendations provided in the Proponent's Concept Safety Analysis, and for further defining the impairment criteria presented in its Target Levels of Safety document.

Condition 17
No later than one year prior to the scheduled installation of the FPSO vessel on location, the Proponent submit the Training Proposal required by the *Newfoundland Offshore Area Petroleum Production and Conservation Regulations* for the approval of the Board's Chief Safety Officer.

Condition 18
The Proponent obtain the approval of the Board for the configuration of the support vessel fleet and for the functional specifications for its proposed standby vessels prior to contracting for these vessels.

Condition 19
The Proponent evaluate and report to the Board the technical and economic feasibility of incorporating measures into the design of its production facilities which will reduce the amount of greenhouse gases released from these facilities.

Condition 20
(i) The Proponent, prior to beginning drilling operations, submit to the Board a report evaluating the technical and economic feasibility of the re-injection of oiled drill solids and of transporting them to shore for disposition in an environmentally responsible manner.
(ii) The Proponent re-inject oiled drill cuttings if, in the opinion of the Board, the results of this evaluation indicate re-injection is technically and economically feasible.

Condition 21
(i) The Proponent provide in the design of its facilities for the re-injection of produced water, should this be required in the future.
(ii) The Proponent undertake and submit to the Board an analysis of the feasibility of produced water re-injection, following the recovery of sufficient volumes of produced water to permit the conduct of such an analysis.
(iii) The Proponent proceed with re-injection of produced water if, in the opinion of the Board, it is technically and economically feasible.

Condition 22
(i) The Proponent evaluate and report to the Board the feasibility of using methods alternative to chlorination for the control of biological growth in the cooling water systems used on the FPSO vessel.
(ii) In the event that chlorination remains the preferred method for control of biological growth in cooling water, the Proponent design its production facilities so that chlorine use is minimized by means of an in-line analyzer near the point of discharge which controls the quantity of chlorine which is added to the cooling water, and incorporate dechlorination facilities if it is practicable to do so.
(iii) The Proponent investigate the feasibility of using cooling water for re-injection, and to provide for this in the design of its facilities, if in the opinion of the Board, the evaluation indicates that this is feasible.

Condition 23
(i) The Proponent submit its environmental effects monitoring program respecting the drilling and production phases of the Terra Nova project prior to commencing drilling operations.
(ii) The Proponent provide, during the design of its environmental effects monitoring program, opportunity for the general public to obtain input into, and review, the design.

Appendix B

RECOMMENDATIONS

of the Terra Nova Project Environmental Assessment Panel

1. Fundamental Findings

Recommendation 1
The Panel recommends that the Government of Canada, the Government of Newfoundland and Labrador and the Board give approval for the Terra Nova Development to proceed subject to the recommendations in this report.

Recommendation 2
The Panel recommends that a precautionary approach govern all aspects of the Terra Nova Development.

Recommendation 3
The Panel recommends to the Government of Canada and the Government of Newfoundland and Labrador that adequate resources be allocated to the Board for the implementation and follow-up of the recommendations of this report.

Recommendation 4
The Panel recommends that the Board take a more active role in the exercise of its full mandate.

2. Socio-Economic Impacts Of the Project

Recommendation 5
The Panel recommends that the Proponents use their best efforts to ensure that local fabrication yards have the information and support necessary to take advantage of opportunities to upgrade project management, procurement and quality control systems to the highest recognized international standards.

Recommendation 6
The Panel recommends that the Board approve construction of project facilities in foreign countries only if the quality assurance and quality control of that country are equal to or better than in Canada, and also where the means for monitoring and control of quality are in place.

Recommendation 7
The Panel recommends that the Proponents be required to use their best efforts and bidding processes to cause the successful international supplier of sub-sea systems to set up assembly and fabrication facilities in Newfoundland, using local labour trained to produce quality products.

Recommendation 8
The Panel recommends that the Board monitor and review the qualifications required for all jobs to ensure that residents of the Province are not excluded by unreasonable or unnecessary qualification requirements or other artificial barriers, and that the maximum number of apprenticeships permitted by union constitutions are filled by local people.

Recommendation 9
The Panel recommends that the Proponents be required to identify to the Board the level and type of qualifications required for positions on their remote operating vehicle crews and indicate where such training can be obtained and that the Board initiate arrangements for establishing appropriate training in the Province.

Recommendation 10
The Panel recommends that the Proponents be required to reassess their need for deep-sea diving throughout the life of the Project and report the findings to the Board and that, if a need for divers is demonstrated, the Board initiate arrangements for appropriate training in the Province.

Recommendation 11
The Panel recommends that as part of the benefits plan approval process, the Proponents supply: a list of skills required for the various trades throughout the life of the Project; an explanation of where shortfalls of skills are anticipated when compared with the local labour force; and, a plan for co-operation with government agencies, training institutions and unions to develop and fund training programs for Newfoundland tradespeople to attain the level of skill required for the Project. Such training programs should provide for periodic updating as the Project proceeds.

Recommendation 12
The Panel recommends that the Board and the Proponents work with school boards to promote an interest in careers in the oil industry, through participation in career days, guest lecturing in science courses, providing scholarships, and the like.

Recommendation 13
The Panel recommends that the Proponents provide to the Board, to government and to educational institutions information on jobs in the operations phase, including specific qualifications required, to allow planning to take place regarding the development of any new training required.

Recommendation 14
The Panel recommends that the Proponents require contractors and subcontractors to work towards developing a true partnership with workers and their representatives.

Recommendation 15
The Panel recommends that, if a union agreement is negotiated for offshore workers, it should be between single entities and should clearly provide for a flexible workforce that is not hidebound by the existence of rigidly narrow trade classifications.

Recommendation 16
The Panel recommends that the Proponents require their contractors and subcontractors to educate their management staff, down through the supervisor level, about the rationale for and the requirements of the Atlantic Accord, so that all decisions can be made in the context of that Accord.

Recommendation 17
The Panel recommends that the Board discontinue the practice of establishing employment targets for Canadian, and in particular, Newfoundland workers.

Recommendation 18
The Panel recommends that the Board insist upon compliance with the spirit and intent of the Atlantic Accord so as to avoid the necessity for bringing personnel from outside the Province solely because the need was not identified early enough to permit the training of local residents.

Recommendation 19
The Panel recommends that the Government of Canada and the Government of Newfoundland and Labrador require the Board to prepare an assessment of the effectiveness of the Accord Acts in securing first consideration for employment of Newfoundland residents, together with recommendations, if necessary, for strengthening the provisions of the Accord Acts or its regulations so that benefits accrue to Newfoundlanders according to the original spirit and intent of the Accord. Furthermore, the Board should carry out regular periodic reviews of the effectiveness of the Accord Acts in the future.

Recommendation 20
The Panel recommends that, should deviations from the principle of first consideration for Newfoundland workers be deemed necessary, the Proponents, with the full knowledge of the concerned worker representatives, be required to seek written authorization from the Board.

Recommendation 21
The Panel recommends that a work week of 40 hours and maximum levels for overtime of 10 hours per week be established by the Board as the norm for the Terra Nova Development.

Recommendation 22
The Panel recommends that the Proponents be required to institute an appropriate system for providing regular information to the public, not only regarding job and business opportunities, but also regarding the extent to which it is adhering to all commitments made in the context of its benefits plan.

Recommendation 23
The Panel recommends that the Board commence a regular public information program to update the people of the Province on the results of its compliance monitoring efforts and other matters of interest to the public concerning activities of the offshore oil industry.

Recommendation 24
The Panel recommends that the Government of Newfoundland and Labrador improve its public information efforts concerning the offshore oil industry, in particular by releasing full information concerning any changes in existing petroleum policies or the adoption of new ones, together with clear explanations of policies in place.

Recommendation 25
The Panel recommends that the Proponents, their contractors and subcontractors be required to honour any statutory obligations respecting the licensing of professionals who work in the Province of Newfoundland.

Recommendation 26
The Panel recommends that the Proponents use their best efforts to promote supplier development throughout the Province.

Recommendation 27
The Panel recommends that the Board ensure that Newfoundland content in the Project is maximized and that such content includes technology transfer and support for existing and new industries in the service sector.

Recommendation 28
The Panel recommends that the Board develop a plan to ensure that technology transfer and new industrial development become a prime requisite for the approval of future oil development projects.

Recommendation 29
The Panel recommends that, while the Government of Newfoundland and Labrador may decide to renew the funding for the Bull Arm Area Co-ordination Committee, the Terra Nova Development should not be considered as a reason for such renewal.

Recommendation 30
The Panel recommends that administration of the Bull Arm site remain under the jurisdiction of the Department of Industry, Trade and Technology.

Recommendation 31
The Panel recommends that the safety plans for the Project be released to the public for information and that the Board allow sufficient time for receipt and consideration of public comment before proceeding to approval. For future projects, the Panel recommends that the safety plan be a required element of the environmental impact statement.

Recommendation 32
The Panel recommends that the Board ensure that the safety plan for the Project is built upon the highest standards for materials, design and operational procedures to ensure life safety; that safe refuge areas and escape routes be designed with worst-case scenarios clearly in mind; that evacuation systems represent the best available technology; and, that workers be made partners in developing and monitoring safety procedures.

3. Impact of the Environment on the Project

Recommendation 33
The Panel recommends that the Terra Nova Development should become, in collaboration with the Atmospheric Environmental Service of Environment Canada and the Hibernia platform, an important centre for the collection of weather data both to enlarge and improve current data sets and to aid in the early identification of intense winter storms; and, that a collaborative weather program with a research component be designed and implemented to improve observational techniques and operational forecasting.

Recommendation 34
The Panel recommends that the development plan should include a program devised in consultation with the Canadian Coast Guard and other appropriate authorities for monitoring and controlling marine traffic and for the development of a set of protocols to obviate the danger of collision.

Recommendation 35
The Panel recommends that measures proposed by the Proponents to ameliorate spray icing or icing from freezing rain should be coupled with a research program designed to expand current knowledge and to refine existing models with the objective of establishing completely reliable design load estimates for the extreme conditions that may be encountered in the Terra Nova Development area.

Recommendation 36
The Panel recommends that the Proponents, in collaboration with Environment Canada and other relevant institutions, collect data and regularly update wave hindcast data bases.

Recommendation 37
The Panel recommends that the Board ensure that design criteria for vessels that will be on site for two decades or more must clearly recognize the possibility of extreme wave values higher than those predicted by the current model.

Recommendation 38
The Panel recommends that the Proponents be required to maintain a continuous surface current monitoring program at the Terra Nova site to enhance the predictability of oil dispersal patterns. The Panel further recommends that serious consideration be given to the incorporation of the data from the monitoring exercise with drift modeling.

Recommendation 39
The Panel recommends that the ice management plan should:
a) allow for the difficulties in forecasting iceberg trajectories and provide for the acquisition of adequate real-time data that can add a substantial pragmatic element to model-driven projections;
b) clearly indicate a process for selecting the icebergs to be managed by towing, for example, when multiple icebergs are in the immediate area;
c) recognize that collisions with small growlers and bergy bits are definite hazards to shipping;
d) include a process for timely identification and management of threatening growlers;
e) recognize the potential for a substantial increase in the number of icebergs crossing the 48th parallel as a concomitant of global warming;
f) include provision for a third-party audit of its effectiveness;
g) clearly establish a set of protocols that will determine the conditions which will dictate disconnection and removal of all surface vessels to a safe area; and,
h) include a continuous program of observation and research that leads to the improvement of radar and other remote sensing devices that will make possible the early detection of even low-lying masses of floating ice.

Recommendation 40
The Panel recommends that ship designs for the Project clearly recognize the hazard to hull integrity posed by growlers and bergy bits and meet the highest standards for navigation in ice as presented by the appropriate authorities.

Recommendation 41
The Panel recommends that all marine crews be properly trained and certified in safety and marine emergency procedures and that the Proponents make appropriate arrangements with relevant establishments in the Province for such training.

Recommendation 42
The Panel recommends that operational planning should allow for the simultaneous occurrence of two or more 100-year events, involving combinations of wind, sea, and ice. This should include a well-designed and clearly understood decision-making process for the timely removal of the production vessel and all other vessels from the area.

Recommendation 43
The Panel recommends that the marine captain should be ultimately responsible for the safety of the vessel and her crew in respect of all weather or sea-state hazards. A mechanism for the formal and continuous consultation between the captain and the offshore installations manager should be clearly in place. The marine captain should be the one to implement, when it is necessary, the protocols to disconnect the vessel and remove it to a safe area.

4. Environmental Effects of the Project

Recommendation 44
The Panel recommends that the Board undertake a new, thorough, immediate review of the adequacy of present regulations on discharges. The review should take full account of monitoring and management experiences in other offshore petroleum areas, and should proceed on the basis of a precautionary approach that considers the impact of specific projects and cumulative effects as well.

Recommendation 45
The Panel recommends that, if regulations, standards and/or guidelines are updated over the life of the Terra Nova Development, the new requirements should be applied to the Project. Flexibility in the Project's design is required to allow for retrofitting during the life of the Project in order to comply with updated requirements. Use of facilities that do not incorporate retrofitting provisions in the initial design should not be permitted on the Grand Banks.

Recommendation 46
The Panel recommends that the Board convene in the near future, a workshop of recognized experts to examine the potential for cumulative impacts in the Newfoundland offshore due to petroleum development and other activities, and to develop best-science approaches to monitoring them.

Recommendation 47
The Panel recommends that the Board identify the factors necessary for a cumulative effects monitoring program on the Grand Banks and design an implementation plan for such a program; and that future projects be required to incorporate measures consistent with this program into their monitoring efforts.

Recommendation 48
The Panel recommends that reviews of regulations, standards and guidelines by the Board and relevant government departments explicitly take into account cumulative impacts of all petroleum projects and other probable developments on the Grand Banks, and potential synergistic effects of other activities in the area; and that the Board advise all future proponents that it will not accept environmental impact statements that do not include a thorough and broad analysis of possible cumulative impacts.

Recommendation 49
The Panel recommends that in the context of the workshop on cumulative effects, the Board should discuss with experts the adequacy of present criteria for significant impact and additional criteria which would be helpful in a precautionary approach to prevent environmental harm.

Recommendation 50
The Panel recommends that Environment Canada and the Department of Fisheries and Oceans identify specific relevant gaps in existing information pertaining to the Grand Banks which limit their ability to identify and predict typical impacts of offshore petroleum activity. This information should be made available to proponents, the Board and others. The Board must consider such information deficits when reviewing regulated standards.

Recommendation 51
The Panel recommends that the Board require operators of offshore oil projects to fund basic research. This initiative should include support of the Department of Fisheries and Oceans to conduct basic research on the mechanisms and processes by which chemicals in produced water may have impacts on the biological community. Also, support for research on cumulative and sub-lethal effects should be included.

Recommendation 52
The Panel recommends that the Board ensure that monitoring data from the Terra Nova Development be subjected to full scientific peer review at regular intervals. Notification and invitation to participate in these reviews should be extended to qualified experts and the public. The reviews conducted by the Board should examine relevance of information that becomes available from basic research studies. The Board should make the data and the results of these reviews available in the public domain. The Board should also regularly present information from on-going monitoring programs and reviews to the public through effective information programs.

Recommendation 53
The Panel recommends that, because of accumulating data summarized in recent studies which extend the zones of local impacts, the Board ensure that the monitoring program for the Terra Nova Project extend sampling gradients beyond the limits where effects have been previously demonstrated. In the instances where these gradients overlap with potential influences from the Hibernia project, careful standardization of methodologies is necessary.

Recommendation 54
The Panel recommends that the Proponents re-evaluate the potential for reinjection of drill cuttings as a viable disposal option for the Terra Nova Development. If reinjection is not possible, the Panel recommends that the discharge levels obtainable with best available technology for floating systems be applied to the Terra Nova Development, and that if during the life of the Project standards are developed that cannot be met at sea, the cuttings be transported to shore for safe disposal.

Recommendation 55
The Panel recommends that the Proponents be required to re-examine the option of reinjection of produced water. Only if they can demonstrate to the clear satisfaction of the Board that reinjection into the Terra Nova formation is not a practical or economically feasible proposition should they be permitted to proceed with discharge after treatment. In that eventuality, the Proponents should be required to meet standards that are the most stringent achievable with best available technology for floating production facilities.

Recommendation 56
The Panel recommends that the Board require the Proponents to submit a plan for mitigation of discharged chlorinated water that includes the use of alternatives to chlorination or of dechlorination facilities.

Recommendation 57
The Panel recommends that the Board require the Proponents to adopt a zero-tolerance policy for oil spills.

Recommendation 58
The Panel recommends that the Proponents implement a program of continuing education for marine crews to keep them sensitive to the ocean environment within which they are working and fully alive to the potentially disastrous consequences of even momentary failures through carelessness, complacency or incompetence.

Recommendation 59
The Panel recommends that the Board require the Proponents, in accordance with a zero-tolerance policy for oil spills, to establish a set of protocols to determine when oil transfers are unsafe.

Recommendation 60
The Panel recommends that the appropriate authorities undertake a comprehensive review of the transport of oil produced on the Grand Banks.

Recommendation 61
The Panel recommends that the Government of Newfoundland and Labrador establish a coastal zone management plan for the Avalon Peninsula and the west side of Placentia Bay.

Recommendation 62
The Panel recommends that the Proponents ensure that all staff associated with the Terra Nova Development be fully informed about the procedures required for reporting all spills, whatever their size.

Recommendation 63
The Panel recommends that the relationships between relevant government departments during an oil spill response situation be reviewed and clarified so that each co-operating agency has a role that is clearly defined and clearly understood.

Recommendation 64
The Panel recommends that the Proponents be required to modify the production vessel as new technology emerges to reduce the emission of greenhouse gases at the Project site.

Recommendation 65
The Panel recommends that the Government of Canada assume a leadership role in the international community in seeking substantial reductions in greenhouse gas emissions and take immediate action to meet, at the very least, those targets set under the United Nations Framework Convention on Climate Change.

Recommendation 66
The Panel recommends that the Board require the Proponents to undertake a study of seabird attraction to, and collisions with, offshore petroleum facilities, and in this effort should seek co-operation with the Hibernia project so that early evaluation of light effects might be possible, and so that there might be opportunity to test any mitigation procedures which might be required.

Recommendation 67
The Panel recommends that the Board routinely require observers on the production vessel and on shuttle tankers that use transshipment facilities in Newfoundland until comfort is achieved that there will be minimal impact on seabirds on the Grand Banks or in breeding colonies along the Newfoundland coast.

Recommendation 68
The Panel recommends that the Board ensure that monitoring of the abundance and activities of marine mammals, and especially of identified individuals, be conducted and be related to specific activities and attendant emitted noise of the Terra Nova Development.

Recommendation 69
The Panel recommends that the Board require the Proponents, when the end of the Project approaches, to review and evaluate their plans for decommissioning and abandonment in light of new technologies and standards that are then current.

Recommendation 70
The Panel recommends that the Board apply the polluter pays principle even after the Project ends provided that harmful effects can be linked unequivocally to the Project.

5. Monitoring

Recommendation 71
The Panel recommends that the Board convene a workshop to identify critical monitoring program details, including baseline studies, and to review the final proposed program before it is approved by the Board.

Recommendation 72
The Panel recommends that the Board urge the Proponents to seek a synergistic relationship with the Hibernia project to the end of devising the best possible monitoring programs.

Recommendation 73
The Panel recommends that the Board use every reasonable opportunity, including the provision of funding as appropriate, to promote collaborative research among the Proponents, other petroleum projects, and university and government researchers.

Recommendation 74
The Panel recommends that the Board ensure that preparations to evaluate the effects of oil spills be done in advance of actual events. Planning should include preparedness to release drifters in the area of the spill and to provide for their collection at sea and on beaches. In the event of a spill, evaluation of the impact must begin with dispersal of drifters and the careful collection of all oiled seabirds and drifters in the area of the spill and on beaches.

Recommendation 75
The Panel recommends that the Department of Fisheries and Oceans, in collaboration with the Proponents and the Board, design a program to measure possible larval effects and fish tainting which result from released oil, and that such measures be incorporated in the Project's monitoring program.

Appendix C

RESPONSE TO CERTAIN RECOMMENDATIONS

of the Terra Nova Project Environmental Assessment Panel

This Appendix presents the response to recommendations of the Terra Nova Project Environmental Assessment Panel which are not explicitly disposed of in either the Canada-Newfoundland Benefits Plan Decision (Chapter 3) or in the Development Plan decision (Chapter 4). For those recommendations which deal with matters outside the Board's jurisdiction, the Governments of Canada and of Newfoundland and Labrador have described to the Board their respective positions concerning the recommendations. These responses have been recited without substantive change.

1. Fundamental Findings

Recommendation 3:

The Panel recommends to the Government of Canada and the Government of Newfoundland and Labrador that adequate resources be allocated to the Board for the implementation and follow-up of the recommendations of this report.

Accept intent. In allocating the resources with which it is provided by the federal and provincial governments, the Board will ensure that the spirit of this recommendation is followed.

The Board understands that the federal and provincial governments will continue to review annually the resource requirements of the Board as part of their overall budget considerations.

In accordance with collaborative arrangements with industry and universities, the Federal Government has suggested that the Board act as a facilitator of those recommendations which pertain to research initiatives.

Recommendation 4:

The Panel recommends that the Board take a more active role in the exercise of its full mandate.

Accept. The Board has always vigorously exercised its mandate within the limits of its statutory authority. It recognizes that a contrary perception may sometimes arise in the public mind, and notes that the Panel has addressed this matter in another recommendation (23), suggesting that the Board implement a regular public information program regarding its activities. The Board will, in exercising its mandate with respect to offshore activities, seek to operate in a manner that is compatible with the intent of these recommendations.

2. Socio-Economic Impacts of the Project

Recommendation 12:

The Panel recommends that the Board and the Proponents work with school boards to promote an interest in careers in the oil industry, through participation in career days, guest lecturing in science courses, providing scholarships, and the like.

The Board's staff have in the past visited numerous schools and post-secondary institutions in the province to provide information on the offshore industry and the Board's activities. The Board intends to continue this practice, within the limitations of its resources, and will encourage the Proponent to undertake similar initiatives.

In addition, the federal government has committed to work with the provincial government in this regard.

Recommendation 14:

The Panel recommends that the Proponents require contractors and subcontractors to work towards developing a true partnership with workers and their representatives.

This recommendation is directed to the Proponent, but is related to the conduct of industrial relations, which is governed by the provincial Labour Relations Act. This Act is administered by the Department of Environment and Labour of the Government of Newfoundland and Labrador.

Recommendation 15:

The Panel recommends that, if a union agreement is negotiated for offshore workers, it should be between single entities and should clearly provide for a flexible workforce that is not hidebound by the existence of rigidly narrow trade classifications.

This recommendation pertains directly to labour relations, which are governed by the provincial Labour Relations Act, administered by the province's Department of Environment and Labour.

Recommendation 19:

The Panel recommends that the Government of Canada and the Government of Newfoundland and Labrador require the Board to prepare an assessment of the effectiveness of the Accord Acts in securing first consideration for employment of Newfoundland residents, together with recommendations, if necessary, for strengthening the provisions of the Accord Acts or its regulations so that benefits accrue to Newfoundlanders according to the original spirit and intent of the Accord. Furthermore, the Board should carry out regular periodic reviews of the effectiveness of the Accord Acts in the future.

Accept intent. The *Accord Acts* require project proponents to submit a Benefits Plan to the Board for approval. The Board must satisfy itself that there is full and fair opportunity for Canadians to compete for access to employment and to participate in the provision of goods and services related to the project. The *Accord Acts* do not set out targets or quotas, nor do they guarantee employment or the awarding of contracts.

The federal and provincial governments have noted that, pursuant to sub-section 17(2) of the *Accord Acts*, the Board may make recommendations to both governments with respect to proposed amendments to the *Accord Acts* and the regulations. Therefore, the Board may decide on its own motion, at any time to undertake such a study.

The governments of Canada and of Newfoundland and Labrador, also are aware of the diversity of issues that can arise with respect to the application and administration of the benefits provisions in the *Accord Acts*. In this regard, the federal department of Natural Resources and the Newfoundland department of Mines and Energy together with the Board will convene a technical conference on benefits in 1998.

Recommendation 21:

The Panel recommends that a work week of 40 hours and maximum levels for overtime of 10 hours per week be established by the Board as the norm for the Terra Nova Development.

Hours of work are governed by the provincial Labour Standards Act, which is administered by the province's Department of Environment and Labour.

Recommendation 23:

The Panel recommends that the Board commence a regular public information program to update the people of the Province on the results of its compliance monitoring efforts and other matters of interest to the public concerning activities of the offshore oil industry.

Accept Intent. The Board has a program by which it regularly releases information to the public and will continue to improve its communications with the public concerning the activities of the Board and the offshore oil industry generally.

Recommendation 24:

The Panel recommends that the Government of Newfoundland and Labrador improve its public information efforts concerning the offshore oil industry, in particular by releasing full information concerning any changes in existing petroleum policies or the adoption of new ones, together with clear explanations of policies in place.

This recommendation is directed to the Government of Newfoundland and Labrador.

Recommendation 25:

The Panel recommends that the Proponents, their contractors and subcontractors be required to honour any statutory obligations respecting the licensing of professionals who work in the Province of Newfoundland.

Various provincial Acts require the licensing of individuals engaging in certain professions within the province. These Acts are administered by the various professional bodies involved. The Board will encourage the Proponent to cause all individuals in these professions who are working on the project and who are located in the Province to be licensed in accordance with these Acts.

Recommendation 29:

The Panel recommends that, while the Government of Newfoundland and Labrador may decide to renew the funding for the Bull Arm Area Co-ordinating Committee, the Terra Nova Development should not be considered as a reason for such renewal.

This recommendation is directed to the Government of Newfoundland and Labrador.

Recommendation 30:

The Panel recommends that administration of the Bull Arm site remain under the jurisdiction of the Department of Industry, Trade and Technology.

This recommendation is directed to the Government of Newfoundland and Labrador.

4. Environmental Effects of the Project

Recommendation 44:

The Panel recommends that the Board undertake a new, thorough, immediate review of the adequacy of present regulations on discharges. The review should take full account of monitoring and management experiences in other offshore petroleum areas, and should proceed on the basis of a precautionary approach that considers the impact of specific projects and cumulative effects as well.

Accept. A re-examination of the discharge levels and practices recommended in the 1996 *Offshore Waste Treatment Guidelines*, in consultation with other Canadian regulatory agencies will be undertaken by the Board. As a matter of course, the Board periodically reviews and considers experience in other jurisdictions when evaluating the adequacy of regulated discharge levels. The review of the Guidelines will take into account the precautionary principle, recent advances in waste treatment technologies for offshore oil exploration and development, and the results of cumulative effects monitoring.

Recommendation 50:

The Panel recommends that Environment Canada and the Department of Fisheries and Oceans identify specific relevant gaps in existing information pertaining to the Grand Banks which limit their ability to identify and predict typical impacts of offshore petroleum activity. This information should be made available to proponents, the Board and others. The Board must consider such information deficits when reviewing regulated standards.

Accept. The Board is informed that Fisheries and Oceans and Environment Canada will review the issue of existing gaps in order to assist the proponent in developing monitoring plans and to assist the Board in its review of regulated standards. The results of the review will be available as recommended by the Panel.

The Board, on a routine basis, solicits the opinions of the federal and provincial fisheries and environment departments on these and other matters pursuant to its Memoranda of Understanding with these departments, and takes the advice provided into account during the performance of its regulatory duties.

Recommendation 51:

The Panel recommends that the Board require operators of offshore oil projects to fund basic research. This initiative should include support of the Department of Fisheries and Oceans to conduct basic research on the mechanisms and processes by which chemicals in produced water may have impacts on the biological community. Also, support for research on cumulative and sub-lethal effects should be included.

Accept intent. The federal government has stated that, in accordance with the "polluter pay" principle, it will seek to have this work supported through the Environmental Studies Research Fund.

The Proponent, under its Canada-Newfoundland Benefits Plan, is required to undertake research and development expenditures. The Board will lend its support to any well-conceived program of research into the effects of offshore platform discharges. With respect to cumulative and sub-lethal effects, the results of the cumulative effects monitoring workshop described in Section 4.4.5 of this Decision Report should provide a "road map" regarding the most likely candidate topics for research funding.

Recommendation 60:

The Panel recommends that the appropriate authorities undertake a comprehensive review of the transport of oil produced on the Grand Banks.

Accept intent. The federal government has noted that the transport of oil from the Grand Banks, as well as from international markets, is a concern. The Canadian Coast Guard of the department of Fisheries and Oceans will take necessary actions to help address this recommendation.

Recommendation 61:

The Panel recommends that the Government of Newfoundland and Labrador establish a coastal zone management plan for the Avalon Peninsula and the west side of Placentia Bay.

Accept. The Government of Newfoundland and Labrador has agreed with this recommendation, and in consultation with various other provincial and federal government departments will take the necessary steps to ensure that there is a coastal zone management plan for the shores of the Avalon Peninsula and the shores of Placentia Bay.

The federal government has stated that it recognizes the sensitivity of the Avalon Peninsula and the west side of Placentia Bay and that it will work with the province on any initiatives towards the integrated management of adjacent areas.

Recommendation 63:

The Panel recommends that the relationships between relevant government departments during an oil spill response situation be reviewed and clarified so that each co-operating agency has a role that is clearly defined and clearly understood.

Accept. The Board notes that the respective statutory responsibilities of the Board and various government agencies in a spill response situation are defined by legislation, regulations, memoranda of understanding, and the contingency plans of the various departments and agencies, and that the description of spill-related jurisdictions, duties and responsibilities is consistent among these documents.

Notwithstanding the above, the federal government has stated that, in keeping with its commitment to effective and efficient regulatory regimes, it will work with the Board to ensure that a review of the duties of various government agencies during a spill response will be undertaken in consultation with other necessary and relevant parties.

Recommendation 65:

The Panel recommends that the Government of Canada assume a leadership role in the international community in seeking substantial reductions in greenhouse gas emissions and take immediate action to meet, at the very least, those targets set under the United Nations Framework Convention on Climate Change.

Accept intent. The federal government has noted that this recommendation is actually outside the scope of this project. However, Canada and the rest of the international community have accepted that climate change poses growing challenges to the globe's environmental and economic well-being which must be addressed. This is based on the majority view of the scientific evidence to date. Accordingly, Canada is pursuing a responsible, precautionary approach in dealing with climate change through mitigative and adaptive actions. Signatories of the Framework Convention on Climate Change (FCCC) will be deciding in Kyoto, Japan, in December 1997, on legally-binding greenhouse gas emissions commitments for the post-2000 period. Canada is participating constructively in the international process with the objective of effectively coming to grips with this issue, making serious progress and meeting our global commitments.

Appendix D

GLOSSARY

abandonment
The decommissioning of facilities and removal of offshore structures
benthic
Pertaining to organisms living on or in the seabed
bergy bit
A small iceberg having a sail greater than 1.0 m but less than 5 m and a water plane area greater than 20 m2 but less than 300 m² size approximates that of a small house
best value
A blend of total cost, quality, technical suitability, delivery and continuity of supply and service
biocide
A chemical substance that is lethal to some or all organisms
biodegradable
Pertaining to a substance that can be broken down by micro-organisms
casing
Steel pipe used in oil and gas wells to seal off fluids from the borehole and to prevent the walls of the hole from caving in
Certificate of Fitness
A certificate issued by a Certifying Authority stating that a design, plan or facility complies with the relevant regulations or requirements and is fit for its intended purpose
clastic
Pertaining to a rock or sediment composed principally of individual fragments or grains
commingle
To produce oil or gas from two zones through the same tubing
completion
The activities necessary to prepare a well for the production of oil and gas or the injection of a fluid
conglomerate
A clastic sedimentary rock composed of fragments larger than 2 mm in diameter; the consolidated equivalent of gravel
core
A cylindrical boring of rock from which composition and stratification may be determined
CSA
(a) Concept safety analysis. (b) Canadian Standards Association
cuttings
Chips and small fragments of rock that are brought to the surface by drilling mud as it circulates
delineation well
A well that is drilled to assess the aerial extent of an accumulation of petroleum
deltaic
Pertaining to, or like a delta
Development
(Terra Nova Development)
"Development" refers to all phases of the project, from the decision to proceed with construction to abandonment of the field
development well
Well drilled for the purpose of production of oil or gas or for the injection or disposal of fluid into or from a petroleum reservoir
discovery well
An exploratory well that encounters a new and previously untapped petroleum deposit; a successful wildcat well
formation flow test
An operation to induce the flow of formation fluids to the surface of a well for the purpose of procuring reservoir fluid samples and determining reservoir flow characteristics
EEM
Environmental effects monitoring
effluents
Liquid waste discharges containing sewage or waste from an industrial process
EIS
Environmental Impact Statement; a document that attempts to predict the effects of a project or activity on the environment
EPP
Environmental Protection Plan
exploration well
A well drilled to find an oil- or gas-bearing formation

fault
In the geological sense, a break in the continuity of rock types
First Oil
Milestone achieved when the first shuttle tanker has been filled with oil from the Terra Nova production system and is disconnected from the offloading system
floating production system
A monohull or semisubmersible vessel upon which equipment suitable for producing hydrocarbons is installed
flowline
(a) A pipeline that takes fluids from a single well or a series of wells to a gathering centre. (b) Seabed piping that connects field components such as wells, manifolds and riser bases
fluvial
Of or pertaining to a river
glory hole
A seabed excavation into which subsea equipment is installed
graben
A fault-bounded elongate crustal block that is lower in elevation relative to adjacent crustal blocks
growler
The smallest category of iceberg, with a sail extending less than 1.0 m above sea level and a water plane area of less than 20 m2. Comparable in size to a car
iceberg
A large piece of ice that has broken away from a glacier
iceberg scour
Seafloor trench caused by the ploughing action of a moving iceberg grounding on the ocean floor
impact
An observable and measurable response of a population, individual or biological element to an external source of disturbance
impact area
The geographic area in which the human and natural environments may be affected by a project or activity
injection
The process of pumping gas or water into an oil-producing reservoir to provide a driving mechanism for increased oil production
injection water
Water pumped into the formation to maintain reservoir pressure; offshore, injection water is filtered seawater treated with biocides, oxygen scavenging and scale inhibiting agents
ISO-9000
International Standards Organization Quality Assurance Standard
interfluve
The area between adjacent streams flowing in the same direction.
jetting
Using high-pressure water to remove surficial soils for pipeline burial
larva
The first immature phases of many animals; after the hatching of eggs before assuming the adult form and habit
logging
The systematic recording of data using a variety of specialized tools during and after the drilling of a well in order to ascertain the properties of the rocks and fluids of the formation through which the well is drilled
manifold
A piping arrangement containing the valving to divide a flow into several parts, combine several flows into one, or reroute a flow to one of several possible destinations
monohull
A single-hulled ship-shaped vessel
Natural gas liquids (NGLs)
Liquid hydrocarbons produced with natural gas that separate from the gas as a result of decreases in temperature and pressure
OIM
Offshore Installation Manager
Operations Phase
The period following First Oil until cessation of all oil production from the Terra Nova Field
Operator
When capitalized in this document, refers to Petro-Canada
PERD
Panel on Energy Research and Development
permeability
The capacity of a rock to transmit a fluid
Petrophysics
The study of reservoir properties using data obtained from various logging methods
pile
A long, heavy wooden, steel or reinforced concrete post driven, jacked, jetted or drilled into the ground to support a load.
porosity
The ratio of void spaces to the total volume of a rock
production platform
An offshore structure equipped to receive oil or gas from offshore wells where primary processing, compression and pumping are carried out before transportation of the oil or gas to shore
produced water
Water associated with oil and gas reservoirs that is produced along with the oil and gas.

Project Phase
The period beginning with regulatory approval of the Development Application and the Proponents' decision to execute Terra Nova Development and continuing until First Oil

Proponents
Those Terra Nova asset owners who are sharing in the predevelopment costs and who have authorized Petro-Canada to prepare a Development Application in its capacity as Operator

recoverable reserves
That part of the hydrocarbon volumes in a reservoir that can be economically produced

reservoir
A subsurface, porous, permeable rock body in which oil or gas has accumulated; most reservoir rocks are limestones, dolomites, sandstones, or a combination of these

rift
An elongate structural trough bounded by normal faults formed during crustal extension

riser
A flowline carrying oil or gas from the seabed to the deck of a production platform or a tanker loading platform

ROV
Remotely operated vehicle

sandstone
Sedimentary rock composed of sand-sized particles.

scour
Seafloor erosion caused by strong currents, resulting in the redeployment of bottom sediments and formation of holes and channels

SDL
Significant discovery licence

sea ice
Any form of ice found at sea that originated from the freezing of sea water

sediment
Solid material, both mineral and organic, that is being or has been transported from its site of origin by air, water or ice

sedimentary rock
Rocks formed by the accumulation of sediment. The sediment may consist of rock fragments or particles, the remains of animals or plants, the product of chemical action or evaporation, or of mixtures of these materials

SEIS
Socio-Economic Impact Statement; a document that attempts to predict the social and economic effects of a project or activity on the affected society

seismic
Pertaining to or characteristic of earth vibration. Also, process whereby information regarding subsurface geological structures may be deduced from sound signals transmitted through the earth

separator
A cylindrical or spherical vessel used to separate the components in mixed streams of fluids

shale
Sedimentary rock consisting dominantly of clay-sized particles, an appreciable amount of which are clay minerals

shuttle tanker
A ship with large tanks in the hull for carrying oil or water back and forth over a short route

source rock
Sedimentary rock in which organic material under pressure, heat and time was transformed into liquid or gaseous hydrocarbons (usually shale or limestone)

stock
A species, group or population that maintains and sustains itself over time in a definable area

tectonic
Of, or relating to the deformation of the earth's crust; the forces involved in, or producing, such deformation

template
A design pattern with built-in guides for specific equipment and structures to assure their usefulness

Terra Nova Development
"Development" refers to all phases of developing the oil resource, from the decision to proceed with engineering and construction through to producing operations to abandonment of the field

TLM
Total loss management

topside (or topsides) facilities
The oil- and gas-producing and support equipment located on the top of an offshore structure

tsunami
A long-period sea wave produced by a submarine earthquake, also known as a seismic sea wave or tidal wave

turret
A low, tower-like structure capable of revolving horizontally within the hull of a ship and connected to a number of mooring lines and risers. It allows the ship to rotate while connected to a fixed mooring system

umbilical
A conduit or group of conduits providing communications between a floating production facility and a facility located on the seafloor for the purposes of power and control

wellbore
The hole drilled by the drill bit

wellhead
The equipment installed at the top of the wellbore used to support the casing strings installed in the well and the rate of flow of fluids from the well