Petro-Canada

Arctic Pilot Project

CONTENT

Intent

Petro-Canada and Partners in the Arctic Pilot Project have prepared this document for the information of Ministers and Officials of the Government of Canada. We believe it to be essential to keep the Government accurately informed, therefore, this is the first of several presentations to be submitted as the Project unfolds. Specifically, a presentation will be forthcoming this Summer on the "Economical and Financial Considerations" pertaining to this project. Since this is a pilot project intended to precede any full scale system, it will be necessary to proceed rapidly. Accordingly, an application for necessary permits and/or licenses will be filed in the Fall of the current year after engineering, environmental and economic considerations prove favourable. In order that this project may be completed as scheduled in 1982, it will be necessary that these approvals be obtained early in (January) 1978.

The current presentation is not intended at this stage to be exhaustive in detail, but to portray the Project in general terms and to illustrate how the Partners have proceeded to test a system of production, processing and transportation of Arctic Island natural gas. Essentially, this document illustrates the fact that the Partners have ventured deeply beyond a concept into a Project.

The Partners consider this pilot project essential to provide exposure to cost factors, logistics, environmental considerations and operational performance of manpower/materials in an Arctic environment. These evaluations will form the basis for a project such as Polar Gas, or a large-scale LNG facility, to proceed with confidence. Phase One will conclude when appropriate permits and/or licenses have been secured. At that time the project will proceed to Phase Two, detailed engineering and construction. At the outset of that phase, interested outside parties will be invited to actively participate financially, and in all of the aspects of the Project.

Synopsis

The Arctic Pilot Project is designed to assist in the development of the natural gas resources of the Canadian Arctic Islands. To achieve this goal, the project will incorporate the essential engineering aspects and install pilot facilities required to evaluate and confirm costs, logistic requirements, environmental effects, construction and operational efficiency in the Arctic environment.

This document outlines the methods which will be used to develop these resources. Specifically:

- The drilling and completion of a subsea well and flowline.
- The installation of a gathering and transmission system.
- The installation of a liquefaction system with related marine transport facilities.

Additionally, this project will provide data which would assist in evaluating other projects which may be considered for the development of natural resources in the Arctic.

Objectives

The development of remote and high cost hydrocarbon resources requires very large projects to obtain economies of scale. Because of their magnitude, many such global projects have suffered delays in approval and in construction completion, resulting in formidable cost overruns. Such occurrences are more likely to develop in the remote areas of the Canadian Arctic without actual verification through Pilot facilities.

Canada's High Arctic is anticipated to contain significant reserves of gas and oil. To date approximately 16 trillion cubic feet of gas have been discovered; approximately 80% of these reserves are on the Sabine Peninsula, Melville Island, and most are off-shore. Extensive exploration work is yet to be performed.

The Polar Gas Project is currently studying a proposal to pipeline these gas resources to southern markets. Several aspects of a project of this magnitude will require more definition before it can proceed:

- Proving of threshold reserves.
- Securing markets.
- Accurate definition of capital and operating costs of pipelining in the Arctic Islands.
- Feasibility and costs of off-shore (under ice) production and gathering facilities.
- Financing the project.

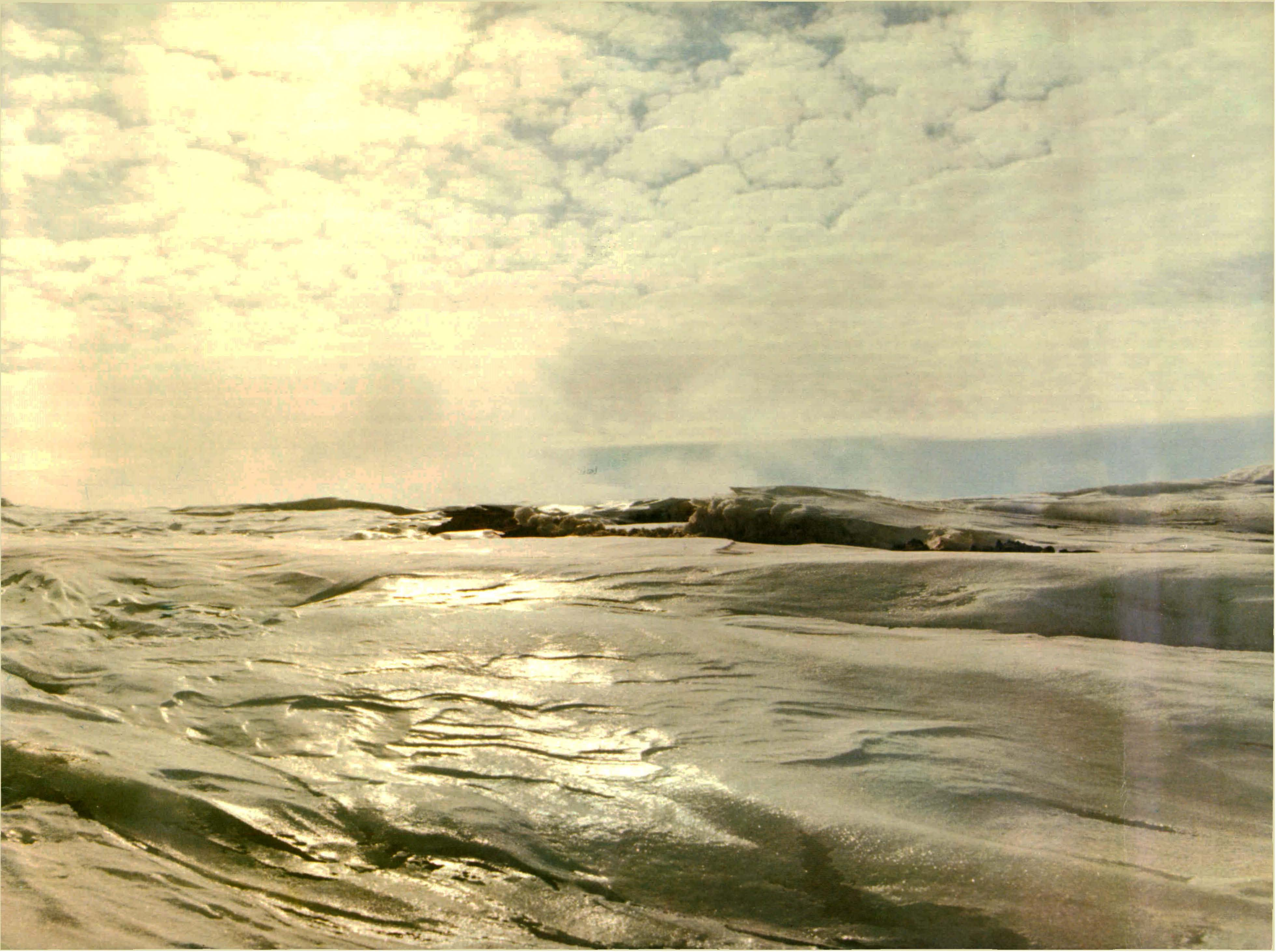
In addition to the first two fundamental requirements, the next two will require demonstration and proof in advance of this massive undertaking. In fact, that proof will be essential in order to obtain financing.

The objective of the Arctic Pilot Project is to obtain this demonstration and proof. A subsidiary objective will emanate from it, that is, the examination of an LNG marine transport system as a possible alternate mode to pipelining.

Specifically, the objectives of the Arctic Pilot Project are:

1. to determine the logistics, costs, operational effectiveness and economic performance of production from off-shore and on-shore gas wells, gas gathering and overland pipeline transmission.
2. to determine the feasibility and costs of sub-sea pipelining (ie. off-shore flowlines and channel crossings).
3. to determine the logistic requirements, costs, operational effectiveness and economic performance of gas liquefaction facilities and transport to market by Arctic Class 7 ice-breaking vessels on a year-round basis in Arctic Zone 6.
4. to obtain all permits and/or licenses necessary to proceed with the construction and operation of a Pilot system to deliver gas from the Drake Point Field, Melville Island.
5. to construct and install pilot facilities to produce gas from the Arctic Islands which will provide actual cost experience and a return on investment.

Arctic Landscape



Development Group

The magnitude, complexity and remote location of this undertaking have induced Petro-Canada to assemble a group of companies to provide the necessary manpower, technical resources and expertise to bring this venture to successful fruition.

1. Definition

   Petro-Canada, in a joint venture with Alberta Gas Trunk Line Company Limited, will manage the project. Panarctic Oil Limited will act as the operator of the field(s) to be produced as well as performing advisory functions. It will also have the responsibility for drilling and completing the development wells included in the program as well as installing the required flow lines. Additionally, Panarctic will perform other field activities necessitated by the program as it evolves.

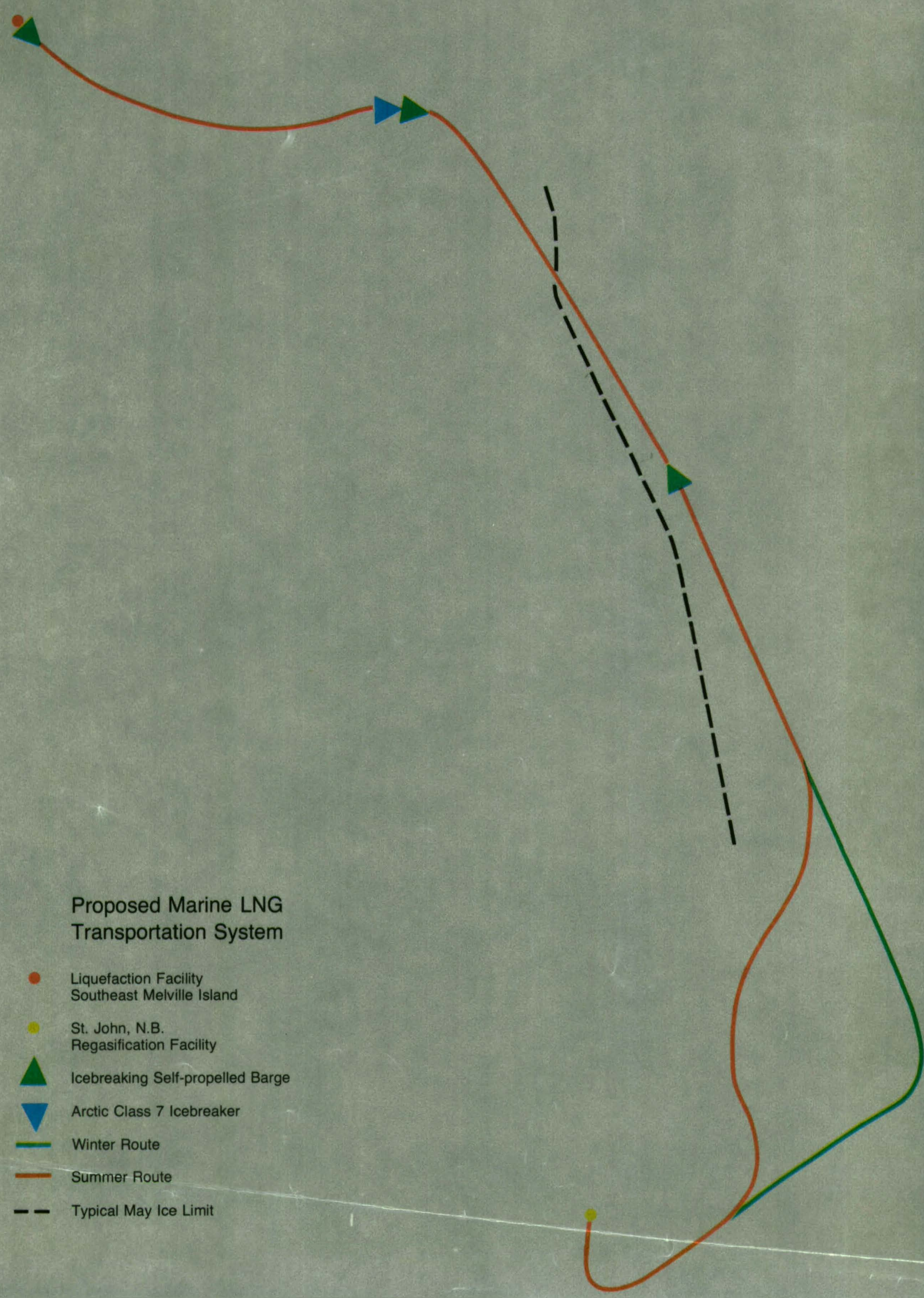
   Canada's largest shipping group, Melville Shipping Limited, has joined with Petro-Canada and Alberta Gas Trunk Line to provide the technical resources and expertise for the marine segment of the pilot project. The participants in this shipping group are Federal Commerce & Navigation Ltd., Montreal; Upper Lakes Shipping Ltd., Toronto; Canada Steamship Lines (1975) Limited, Montreal; Crowley Maritime Corporation, San Francisco; and Genstar Marine Limited, Montreal.

2. Experience

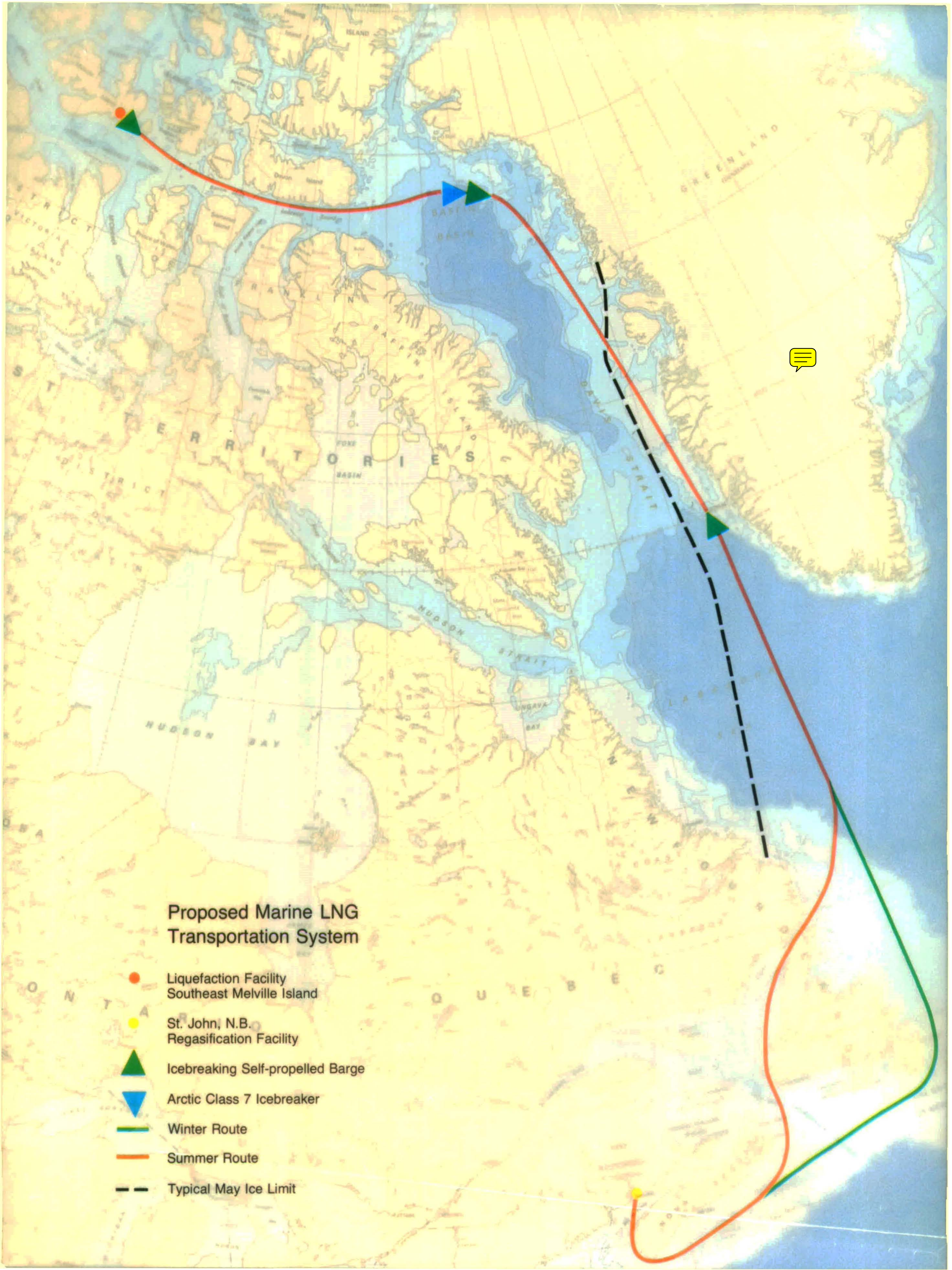
   Panarctic is the single most active oil and gas company operating in the Arctic Islands. During its ten years of operation in the Arctic it has accumulated varied and extensive experience which has become highly regarded in the hydrocarbon industry.

   Alberta Gas Trunk Line is a widely known gas transmission company with many years of operating experience in Alberta.

   The shipping companies as a group have extensive experience in ship design, procurement and marine operations, including those of ice-breaking vessels. Most of Melville's participants are deeply involved in Arctic shipping. This is the largest marine consortium ever assembled in Canada.


Proposed Marine LNG
Transportation System
Liquefaction Facility
Southeast Melville Island
St. John, N.B.
Regasification Facility
Icebreaking Self-propelled Barge
Arctic Class 7 Icebreaker
Winter Route
Summer Route
Typical May Ice Limit

GREENLAND
BAFFIN BASIN
DAVIS STRAIT
LABRADOR SEA
FRANKLIN
BAFFIN ISLAND
TERRITORIES
FOXE BASIN
DISTRICT OF KEEWATIN
Southampton Island
HUDSON STRAIT
UNGAVA BAY
HUDSON BAY
JAMES BAY
NEWFOUNDLAND
COAST OF LABRADOR
QUEBEC
ONTARIO
GULF OF ST. LAWRENCE
ISLAND OF NEWFOUNDLAND
PRINCE EDWARD ISLAND
NEW BRUNSWICK
NOVA SCOTIA
LAURENTIAN CHANNEL
LAKE SUPERIOR
LAKE HURON
MICHIGAN
Devon Island
Somerset Island
Prince of Wales Island
VISCOUNT MELVILLE SOUND
Lancaster Sound
Jones Sound
Melville Island
Foxe Channel
Belcher Islands
ST. LAWRENCE RIVER
QUEBEC
MONTREAL
OTTAWA
HALIFAX
CHARLOTTETOWN
FREDERICTON
ST. JOHN'S
Cabot Strait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ONTARIO

Program

This section describes a scheme to extract natural resources from the Canadian High Arctic. The project currently recognizes five major phases of significant importance:

1. Well Completion
2. Flowline
3. Gathering and Transmission Systems
4. LNG Facility and Terminal
5. Shipping

These will be documented later in more detail in a technical presentation.

1. Well Completion

This phase of the program includes the engineering design and specifications for sea-bottom well completion, and provides for the drilling of a demonstration well. This phase, now well into the procurement stage, is of major importance in that no such well completion has ever been performed under ice conditions. Of equal significance is the design of the surface backup equipment necessary to ensure that this aspect of the program is successful. Specifically, a modified off-shore drilling rig to complete off-shore wells will be developed and will be documented in the design and specifications stages of the project.

2. Flowline

The engineering design and installation requirements of the flowline bundle have been completed and are currently advancing into the procurement stage. This is an exceedingly important facet of the program in that no such installation has ever been performed under ice conditions. It will establish a precedent for future development of off-shore hydrocarbon resources.

3. Gathering and Transmission Systems

This section of the program, currently in the engineering stage, will design and prepare specifications for a typical gathering system. It will include detailed pipeline work, which will assist in establishing future requirements for Arctic pipeline transmission systems. Provisions have also been considered for the inclusion of a conceptual design and specifications for the construction of gathering systems with sub-sea designs, foreshore trenching and/or tunnelling (to prevent ice-scouring of pipelines in shore areas) and pipeline construction.

4. LNG Facility and Terminal

This part involves the development and subsequent evaluation of a medium-size LNG project. The gas from Sabine Peninsula fields will be pipelined to a South-East Melville Island plant location. It will then be processed to LNG and shipped to markets (regasification terminal at St. John, New Brunswick) via a marine mode of transportation. The development of the LNG project, with its supporting marine transport, will be considered as a pilot project and as the first step in the production and delivery of gas from the Arctic Islands. As well, the LNG project will be developed as a typical integral system with a view to using it for the extraction of smaller resources that may be encountered in other remote Arctic areas.

5. Shipping

Because of limited navigational knowledge and experience, year-round operations in the Arctic present problems which have to be addressed. The first phase of the project is to identify these problems and to task appropriate groups to seek their solution. A shipping group has been formed and, among other functions, is testing a number of possible hull designs in various Arctic ice conditions. The results of this comprehensive aspect of the program will prove the feasibility of year-round navigation in Arctic waters in those zones requiring Arctic Class 7 ice-breaking vessels. Vessels of this class have been designated as the selected mode of LNG transportation.

Activities

I. TECHNICAL CONSIDERATIONS

1. Well Completion

The detailed engineering for all of the elements of the drilling rig and well completion system has been finalized. The complete technical presentation with related costs for each component will be made available in a forthcoming report.

a) Drilling Rig

The drilling rig will be designed to drill and complete off-shore wells from ice island platforms where the ambient air temperature may be as low as −50°F, and where water depths are in excess of 1,500 feet. The well depth capacity is 5,000 feet with large diameter tubulars and 10,000 feet for exploratory tests. In addition, because of the relatively short season available for floating ice drilling, the rig will also have the capacity to drill exploratory wells down to 10,000 feet on land. This design maximizes the utilization of the rig.

b) Wellhead Equipment

The "Wet Tree" has been selected as the sub-sea production equipment most suitable for this type of application.

The most significant advantage of the wet tree system is the cost. The low cost inherent in this system is due to its configuration and design. Its design does not change with water depth; consequently, its size is compatible with air freighting and can be shipped with minimal dismantling of components.

The control equipment used on the wet tree is intended for sub-sea usage and has been proven in that environment. It is installed and serviced using the basic drilling rig equipment; thus, additional shelters and lowering equipment are not required. This reduces the installation complexity considerably. Furthermore its simplicity minimizes the necessary installation and operational manpower requirements. The need for submersibles and sub-sea cellar operating crews is eliminated. It can be installed, tested, operated and worked over using drilling and workover crews which will not necessarily have to be specialized.

2. Flowline

The engineering design and the installation manual for the flowline from the proposed Drake C-56 demonstration well to the shore have been completed.

a) General

The proposed flowline bundle will be installed by a bottom pull from the shore.

The bottom pull installation technique was selected for a number of reasons. First, the stresses induced in the pipeline during installation are relatively low compared to other methods of installation. Additionally, the pipe is on the seabed at all times and consequently is less susceptible to damage or overstressing. Finally, the loads exerted on the ice sheet are acceptable and the operation can be interrupted at any stage without risk to the pipeline.

b) Engineering Design

i) Location

The wellhead at Drake C-56 is located approximately 3400 feet off-shore in water depths of about 175 feet. This water depth virtually eliminates any possibility of ice damage to the wellhead, yet in emergencies it allows divers to make short working dives without the support of extensive saturation diving facilities.

The bathymetry along the route of the proposed flowline to its on-shore tie-in point was obtained from seismic operations.

ii) Bundle Description

The flowline bundle contains two-6 inch gas production lines, one-2 inch annulus access line, one-1 inch glycol injection line, two-1 inch hydraulic lines, and two-1 inch heat tracer conduits. These flow and service lines are to be installed within a common carrier pipe to facilitate their installation and to reduce the submerged weight of the bundle. The selected size of this carrier pipe is 18 inches.

iii) Internal Pressure Requirements

The pipewall thicknesses required from the standpoint of internal pressure are established according to the Canadian Standards Association (CSA)-Z 184.

According to CSA-Z 184, the flowline location will be installed in an area that is assigned a Class 1 rating, for which a design safety factor of 0.72 is assigned.

iv) Foreshore Protection

The flowline bundle needs to be protected against damage by grounding ice. Damage could be caused by ice rafting and pile-ups close to shore, and by pressure-ridge keels and large ice masses further off-shore. A review of the literature on ice scour has indicated that a trench depth of 5 feet up to 13 feet, depending upon the specific location, will provide adequate protection.

v) Wellhead Connection

The procedure for connecting the flowline bundle into the wellhead was established by model simulation. Model simulation has been used extensively to predict the behavior of large diameter pipelines during installation and service, and the theories-relating model and prototype are well established.

3. Gathering and Transmission Systems

The Arctic Pilot Project proposes to gather gas from 5 to 9 on-shore wells, and one off-shore well (C-56), in the Drake Point Field. The off-shore well completion is included as a necessary evaluation and is intended to be typical in scope. "Necessary" here expresses the consideration given to the fact that approximately 60% of the Melville Island gas found to date of writing has been established as proven off-shore reserves. This gas will be locally treated prior to transmission from the Drake Field to the pilot LNG facility. The preliminary treatment of the gas is to remove its water content and traces of other undesirable components.

Two possible locations for the LNG facility have been selected. One at Bridport Inlet on Melville Island, the other at Lacey Point on Bathurst Island. The Bridport Inlet location will require approximately 120 miles of land pipeline and, hence, will not involve a marine pipeline crossing, but would involve a longer ocean shipping route. The Lacey Point location will require approximately 300 miles of pipeline and a pipeline crossing(s) of the Byam Martin Channel. These two sites will be evaluated in the preliminary engineering phase of the pipeline transmission system, and the most advantageous site, based on economic, environmental and technological benefits, will be selected.

The pipeline from Drake Point Field to the pilot LNG site will be designed to provide the lowest cost of service possible consistent with good engineering and environmental considerations. The preliminary engineering on the phase of this Arctic Pilot Project is expected to be completed by July 31, 1977.

4. LNG Facility and Terminal

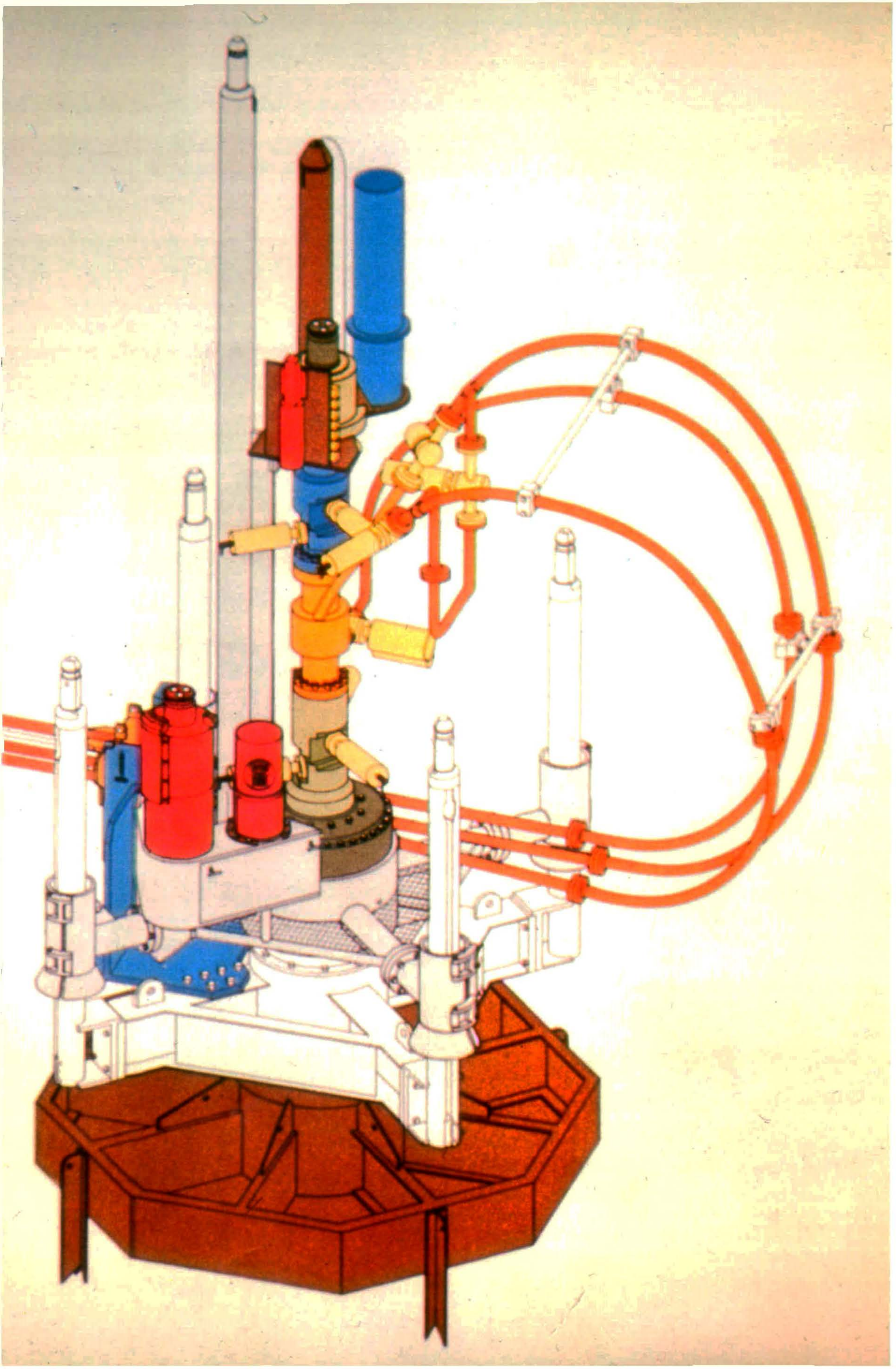
The liquid natural gas (LNG) facility is proposed to be located at Bridport Inlet on the southeast coast of Melville Island or possibly, the Lacey Point area of Bathurst Island. The pipeline from the Drake Point Field will supply the facility with sufficient gas for 250 MMCFD of liquid product in addition to the system fuel requirements. The purpose of the facility is to evaluate field production methods, gathering and pipeline transmission operations, and a marine mode of transportation to southern markets, while proving LNG economic feasibility.

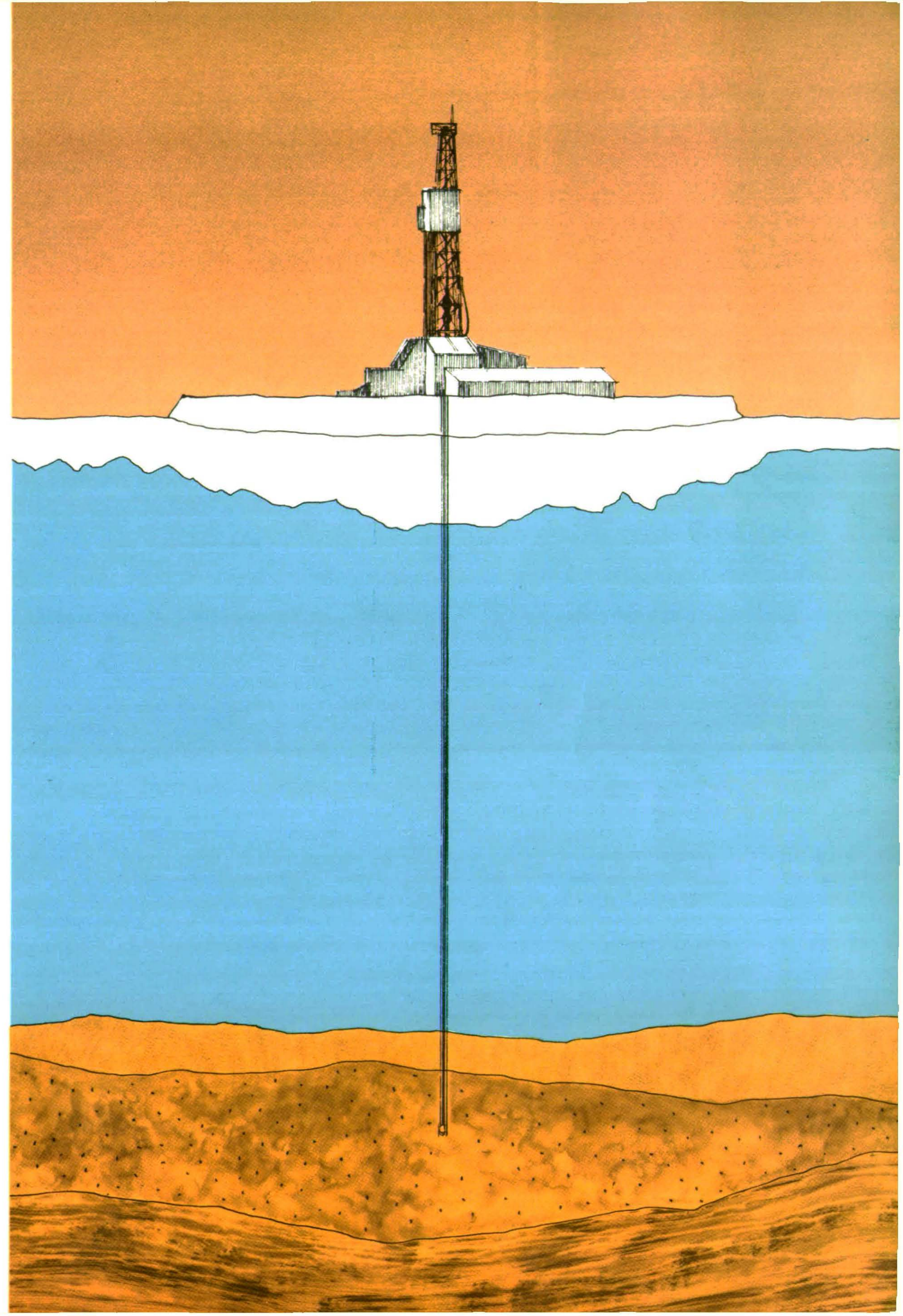
Liquefaction of natural gas is a proven process with major installations operating in Alaska, Algeria, Brunei and, this summer, Abu Dhabi and Indonesia. Drake Point gas is an ideal feedstock for liquefaction, being free of hydrogen sulfide and heavy ends. A capacity of 250 MMCFD can be obtained in a single process "train". Large existing facilities are simply modular multiples of such trains. Accordingly, the size of this facility approaches the optimal economical size of existing installations.

The facility will be permanently erected on a barge. This concept will utilize the advantages of efficient construction at a southern industrial port, with its highly predictable construction periods, quality control and relatively lower costs. The facility would also be precommissioned before transporting to its northern location to ensure its operability.

Sub-sea Wellhead ▷

Ice Platform Drilling ▷▷





Storage for approximately one month's production of LNG would be provided at the site. This storage will also be barge mounted and towed to the site, and may take the form of insulated spheres. Alternatives are being investigated to prove the feasibility of barge movement which could reduce storage cost and liquid transfer losses. Another investigation will consider the possible usage of the LNG regasification energy in the production of liquid air. The liquid nitrogen resulting from this process would be shipped north in the otherwise empty vessels to assist in minimizing the energy required to produce additional LNG.

The entire complex could also include housing accommodation, accordingly, it would become a self contained system. The entire complex could be maintained in a floating position, or alternatively it could be set on prepared foundations on-shore or off-shore. The mode of installation will dictate the type of loading terminal associated to or integral with the facility.

Contractors will complete the preliminary engineering and cost estimates on or before September 1, 1977. Liquefaction economics will be determined at that time which, combined with the economics of the other segments, will indicate the overall project viability. The preliminary engineering will, of course, provide the basis for the detailed engineering expected to follow.

Selection of the most suitable harbour site for the processing, storing and loading of the product is fundamental to the successful achievement of a project using shipping as the means of transportation. The site for the complex must be accessible, safe, and well protected from the elements. Potential harbours have been identified in both Bridport Inlet and Lacey Point. At present inadequate chart data is available to warrant confidence in safe passage and a haven for arctic vessels. With interest from Petro-Canada, the Dominion Hydrographer is conducting a through-ice reconnaissance (hydrographic/bathymetric survey) of Bridport Inlet this spring.

Environmental considerations will be stressed throughout the duration of this phase of the project. These will ascertain the interaction of the LNG facility with the natural environment.

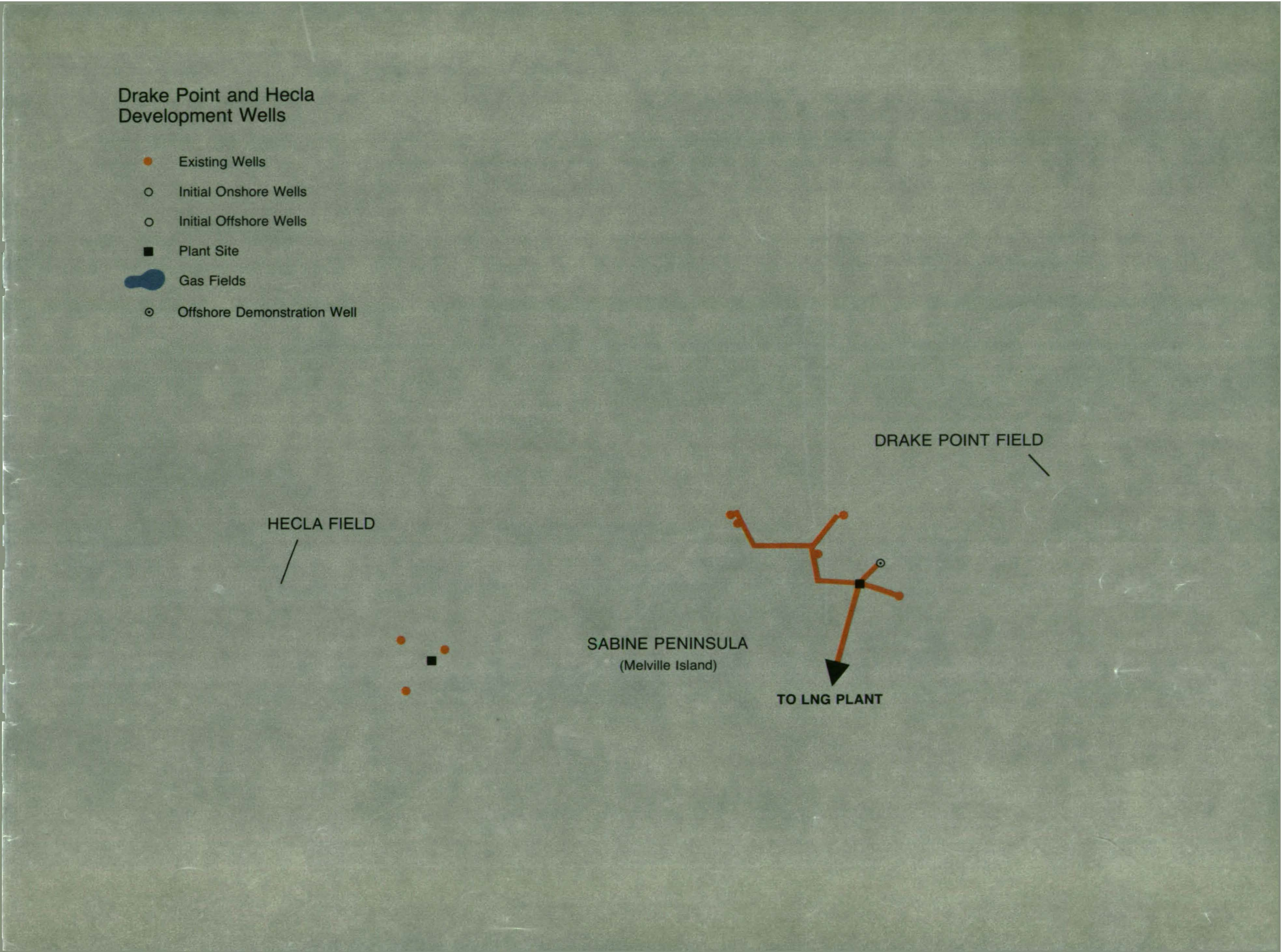
5. Shipping

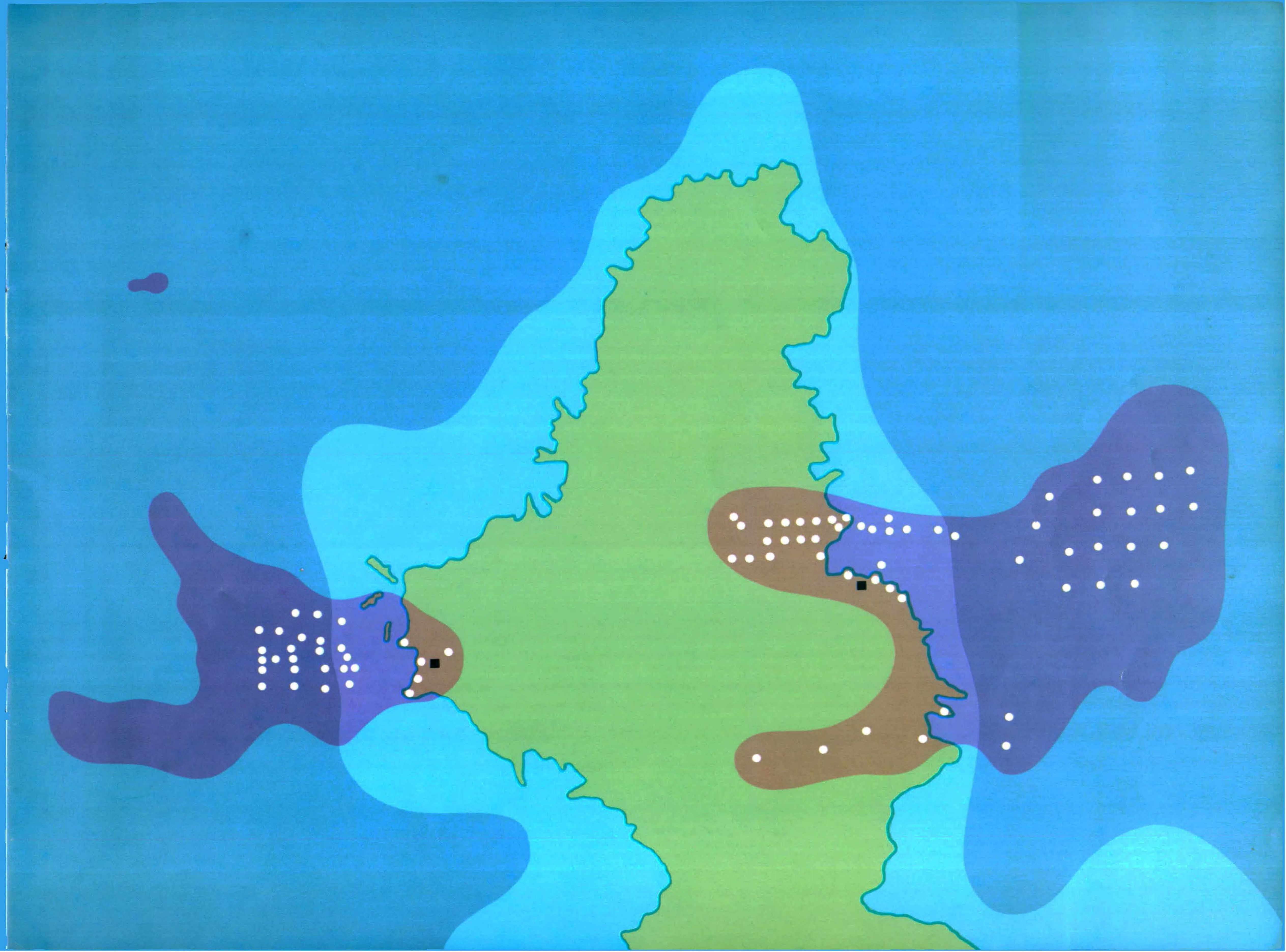
A marine group, Arctic Petro-Carriers (APC), has been formed to undertake the feasibility of shipping LNG from the southeast coast of Melville Island to the eastern seaboard. APC is a consortium of Petro-Canada, Alberta Gas Trunk Line and Melville Shipping Ltd. A summary of the group's major activities is presented below. Detailed information is referred to in the addendum "Arctic Petro-Carriers Project" enclosed herewith.

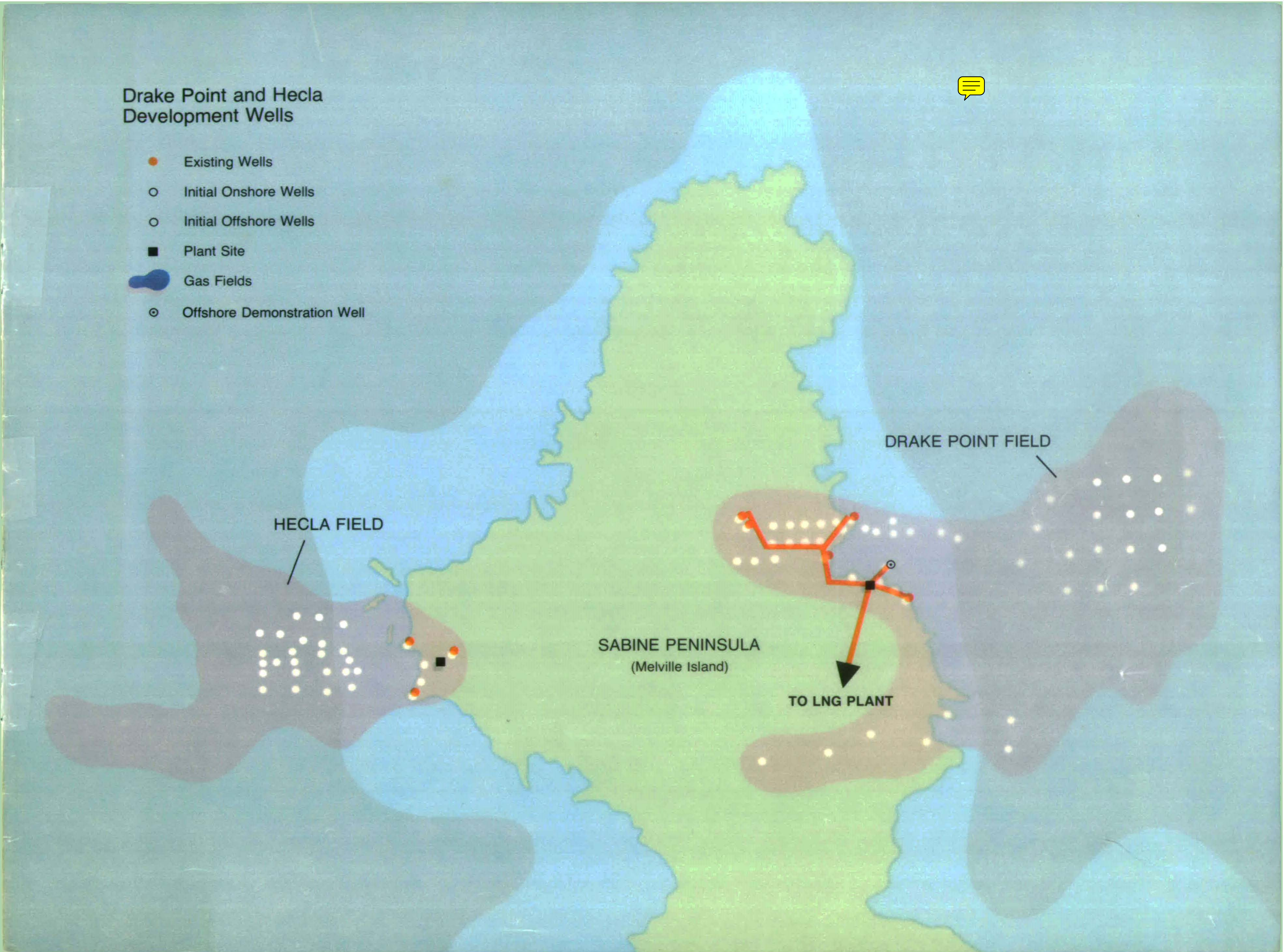
At present, limited knowledge exists on navigation in the Arctic, specifically, the prospect of year-round operations faces tasks which are currently being addressed. Therefore, one of the main functions of the group will be to test a number of possible hull designs in various arctic ice conditions. Another major function will cover environmental studies to assess the impact of the shipping operation.

The first step in the analysis has been to collect data on all aspects of navigation through ice along the prescribed route. Forty-eight different sources of information on this topic have been identified and all pertinent data is being collated into an environmental model. A series of tank tests will simulate the conditions developed in the model, and will establish how rapidly a vessel of a certain size, power and shape can travel through level saline ice of varying thicknesses. Additional research will simulate the forces that will be encountered when the vessels strike multi-year ice ridges at high speeds. Most of these tests will be programmed into the most advanced computer simulation model ever created for ice-transit of large vessels.

Simultaneously with the ice technology research and simulation, a design group is analyzing two alternative vessel concepts. Both concepts are designed to comply with the Canadian Arctic Shipping Pollution Prevention Regulations for Arctic Class 7 vessels. The first of the two schemes provides for two or three Arctic Class 7 LNG "barges" of 125,000/170,000 cubic metre capacity and equipped with conventional propulsion of 50,000/80,000 horsepower. Associated with these vessels will be an ice breaking pusher tug ("Kodiak") of 80,000/100,000 horsepower. The tug will push from a stern "notch" on the vessel and will provide the additional power required to penetrate thick Arctic ice, even during the most difficult periods of navigation. The vessels of course, will navigate under their own propulsion in relatively thin-ice (3 feet) and in open water, thus, the horsepower requirements are optimized. This operational concept has the great advantage of permitting the entire shipping system to be operated by relatively conventional LNG vessels (modified for arctic tasks) supported by an independent ice breaker (Kodiak). Being independent, both vessels are capable and free to perform separate functions which could improve the economic viability of the system.


Drake Point and Hecla Development Wells
Existing Wells
Initial Onshore Wells
Initial Offshore Wells
Plant Site
Gas Fields
Offshore Demonstration Well
DRAKE POINT FIELD
HECLA FIELD
SABINE PENINSULA
(Melville Island)
TO LNG PLANT

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(Melville Island)
TO LNG PLANT

The second scheme, which is carried out in conjuction with the barge/Kodiak study, will consider the design of LNG tankers of the same capacity but with full Arctic Class 7 propulsion of 150,000/180,000 horsepower.

The ice simulation team, the design team and an economics team will then combine to determine the most cost effective of the two concepts.

Within the design group, a series of associated subordinate research projects are being conducted to select and test the best designs for such items as propulsion, steering, linkage (between LNG vessel and Kodiak) and, most importantly, the best LNG containment system for Arctic operations. To help identify this latter system, consultants in Canada, the U.S.A. and Europe have been contacted and extensive computer calculations are being undertaken by Lloyds of London.

Further study groups are working on project financing requirements and other economic analyses that will enable management to determine optimum vessel size, storage requirements and approximate transit costs per cubic metre of LNG.

II ENVIRONMENTAL CONSIDERATIONS

ENVIRONMENTAL AND SOCIAL AFFAIRS

As a Crown corporation, Petro-Canada has a significant responsibility to be an industry leader in environmental conservation and social responsibility. Accordingly, environmental and social aspects are an integral part of the Arctic Pilot Project, and have a major influence on planning decisions.

Before permission can be granted by Government to build and operate this project, Petro-Canada will be required to demonstrate an indepth knowledge of the environmental resources of the areas to be affected, and to provide a detailed discussion of the interaction of the proposed project with these resources. Further, Petro-Canada will have to demonstrate that the proposed project will cause minimal environmental disturbance, that feasible reclamation will be completed, and that any realistic beneficial influences on the environment will be designed into the project.

To this end, environmental programs have been initiated to describe with accuracy the physical and biological resources of the terrestrial and marine areas adjacent to the project. Specifically, studies are planned for Melville and Bathurst Islands on terrain, vegetation characteristics, and mammal and bird distributions. The studies will develop an overview of knowledge along proposed pipeline routes and will be used for final route selection. More intensive studies will concentrate on the areas of Bridport Inlet on Melville Island and Lacey Point on Bathurst Island.

Oceanographic and marine biological information will be gathered at each of the Bridport Inlet and Lacey Point areas, and some studies will concentrate on the marine ecosystem structure at the two proposed terminal locations.

A detailed description of the biology of the proposed marine route will be synthesized, with emphasis being given to populations of marine mammals and birds, particularly those of economic importance to native northerners.

Finally, the distribution, dynamics, and behavior of sea ice and icebergs are basic environmental factors affecting the proposed project. While it is not likely that ice-breaking activities would significantly alter the marine environment in the north, all available knowledge of ice conditions on the marine route is being collected and analysed for input to the project design.

All of this information will be analysed to evaluate the possible environmental effects of construction and operations of the proposed project. Plans will be formulated to minimize adverse effects and enhance beneficial effects. In addition, a research plan will be prepared to outline environmental research and monitoring activities that will be undertaken following project approval during both pre-start-up and initial operation phases. Such research will enable the optimization of operating strategies during project operation to minimize environmental disturbance.

Consistent with this approach, consultations with native northerners were initiated at the same time the study was announced. These discussions will cover native involvement in environmental and socio-economic baseline and impact assessment phases, and training and hiring of northerners on the pilot project should it be approved.

Arctic Flora and Fauna

Projections

III ECONOMICS

The economics established by the Partners for the various segments of the Arctic Pilot Project are still in a preliminary stage. These require verification due to lack of established precedent on costs. Addressing and identifying costs within each of the components inherent in the project is a part of the scope of the current program. The pilot project has progressed rapidly in this direction. Costs figures have already been established for some segments of the program. The figures shown below reflect 1977 committed expenditures as budgeted by the Partners.

1. Well Completion
   a) For the well completion the Engineering Design and Specifications have been finalized at a cost of $300,000.
   b) Material for the BOP and "Wet Tree"system has been ordered at a cost of $2,900,000.
   c) The balance of funds required to complete this segment of the program is $5,091,000.
2. Flowline
   a) For the flowline the Engineering Design and Specifications have been finalized at a cost of $325,000.
   b) Materials have been placed on order at a cost of $500,000.
   c) The balance of funds required to complete this segment of the program is $3,680,000.
3. Gathering and Transmission Systems

   The Engineering Design and Specifications and cost estimates for the Gathering and Transmission System will require $400,000. This work is currently in progress.
4. LNG Facility and Terminal

   $1,200,000 will be required to complete the LNG Facility and Terminal Engineering Design, Specifications and cost estimates. Engineering contracts have been released and work is currently in progress.
5. Shipping

   The shipping segment of the program will require $1,300,000 to complete. Approximately $700,000 has already been accounted as expenditures.
6. Environment

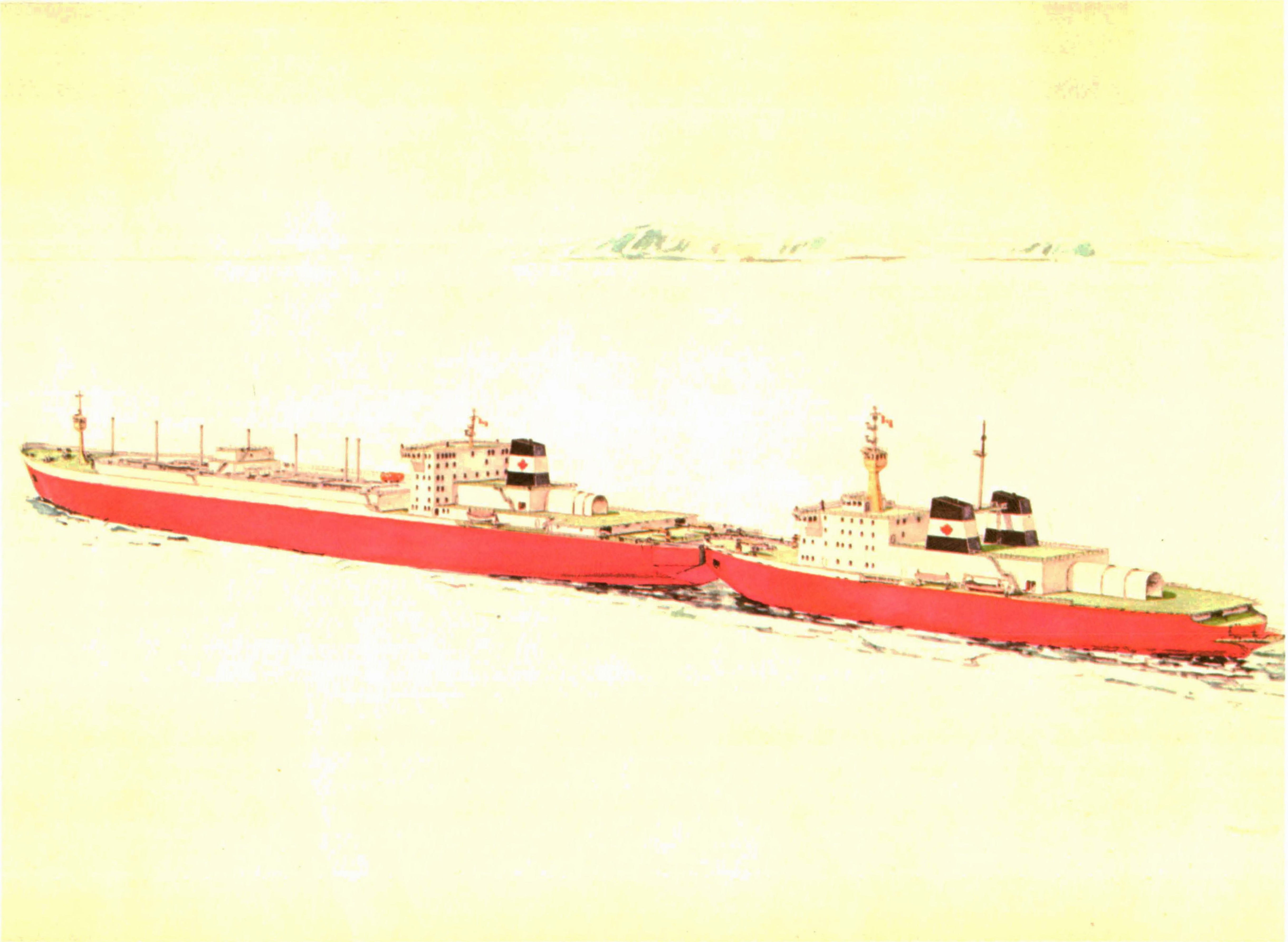
   $1,000,000 has been allocated to this segment of the program of which $400,000 will be committed shortly.

For centuries the Arctic Islands have remained remote and almost forbidding. Even in the recent past the idea of year-round navigation through the Arctic Archipelago was dismissed as science fiction. Today this idea is rapidly becoming a distinct possibility. A series of events, covering years of research on the Arctic environment, have developed knowledge to an extent that year-round transport in the Arctic Archipelago can be viewed with confidence.

The Arctic Pilot Project is an essential instrument in the unfolding of this challenging venture. This development will provide benefits with far-reaching implications beyond the acquisition of knowledge. It will reveal a series of events as follows:

1. The remote and resource-rich Arctic Islands will finally be provided with the accessibility required for their development.
2. Canadian Sovereignty will be established beyond a doubt over the Arctic Islands.
3. Canadian technology will be vastly enriched by a significant quality and quantity of experience. Subsequently, Canada would become a world authority in an extensive new range of Arctic development such as:
   a) Commercial transportation in ice-infested waters.
   b) Development and exploitation of hydrocarbon and other natural resources.
   c) Acquisition of extensive information on flora, fauna and other related environmental considerations.
   d) Will provide the necessary input components required to establish reliable costs. These costs are essential in any economic viability study relating to projects in this and other similar areas of the world.
   e) Involvement of local Inuit from the inception of a major resource project to enhance environmental and socio-economic consequences.

Barge / Kodiak System



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