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COMPARISON OF MAJOR CONSTRUCTION PROJECTS AND OFFSHORE HYDROCARBON DEVELOPMENTS IN ATLANTIC CANADA

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SUMMARY

Offshore oil and gas development will involve the construction of onshore facilities, as well as the onshore construction of structures for installation offshore. These activities will generate substantial levels of employment and may have significant impacts on communities in the Atlantic Provinces.

The nature and magnitude of these potential impacts are not well understood by the majority of people in the region. This is due in part to the general mystique surrounding offshore development, and in part to the limited access most people have to meaningful information about specific offshore projects. It is due also to the absence of any frame of reference for assessing the scale and implications of these projects.

This report is an attempt to provide just such a frame of reference. It contains a body of data allowing direct comparisons to be made among recent major construction projects familiar to residents of the Atlantic Provinces and the proposed Venture and Hibernia offshore developments. Included in the comparative data considered relevant for developing the frame of reference are project schedules, capital costs, employment requirements and social impacts. The report also contains descriptive profiles of each of the projects.

RESUME

L'exploitation du pétrole et du gaz au large des côtes comprendra la construction de bâtiments à terre, ainsi que la construction à terre de structures qui seront installées au large des côtes. Ces activités entraineront la création de nombreux emplois, et pourront avoir un impact important sur les communautés dans les Provinces Atlantiques.

La plupart des habitants de la région ne comprennent pas bien la nature et l'importance de cet impact potentiel. Ceci s'explique par plusieurs facteurs. D'abord, il existe un mystique général qui entoure l'exploitation au large des côtes. En plus, la majorité des gens n'ont qu'un accès limité aux renseignements significatifs concernant des projets particuliers d'exploitation au large des côtes. En dernier lieu, il manque un système de référence qui permettrait d'évaluer l'échelle et les implications de ces projets.

Le présent rapport tente justement de fournir un tel système de référence. Il contient un corpus de données qui permettent de faire des comparaisons directes entre les récents projets de construction, familiers aux résidents des Provinces Atlantiques, et les exploitations proposées d'Hibernia et de Venture. Les données comparatives que nous avons jugees pertinentes à l'élaboration d'un système de référence comprennent: le programme prévu des projets, les coûts en capital, les besoins de personnel, et l'impact social. Le rapport contient également un profil descriptif de chacun des projets.

PART ONE

COMPARATIVE ASSESSMENT OF MAJOR CONSTRUCTION PROJECTS AND OFFSHORE HYDROCARBON DEVELOPMENTS

INTRODUCTION

Background

Before the mid-1960's, the Atlantic Provinces had limited experience with major construction projects. Indeed, the facilities of most of the few heavy industries which existed then - pulp and paper, steel, electrical generation - were constructed early in the 20th century. Construction activity in the region was confined essentially to light industrial and commercial structures.

The nature of construction projects and industrial activity changed markedly during the 1960's. In three of the Atlantic provinces, a number of major construction projects were completed between the mid-1960's and mid-1970's:

- hydro-electric and thermal electric generating stations in Newfoundland, Nova Scotia, and New Brunswick;
- pulp and paper mills in New Brunswick, Nova Scotia and Newfoundland;
- oil refineries in Nova Scotia and Newfoundland;
- heavy water plants in Nova Scotia; and,
- major manufacturing facilities (ships, chemicals, tires) in Newfoundland and Nova Scotia.

To varying degrees, most of these projects have three common characteristics: they are located in relatively small communities, the workforce during construction was large in relation to the size of the local labour force; and the nature of the operation and the size, composition and skills of the workforce during production differed from the previous experience of these communities.

A number of these projects proceeded with little planning other than that related directly to the immediate needs of the project. To the extent that the environment was a factor relevant in the design of facilities and the approach taken to project implementation, attention tended to be limited to its bio-physical aspects. Socio-economic matters, if considered relevant at all, had a low priority.

From the standpoint of socio-economic impact, the experience with the region's major projects has been mixed. Some projects have proceeded without incident. Implementation was well managed and operations resulted in considerable net benefit to the surrounding communities. Other projects faced difficulties during construction. Problems were not confined to the construction sites, but spilled over to adjacent communities. A major source of impact was the size of the construction labour force in relation to local labour supply.

Offshore oil and gas development will involve the construction of onshore facilities, as well as the onshore construction of structures for installation offshore. These activities will generate substantial levels of employment and may have significant impacts on communities in the Atlantic Provinces.

The nature and magnitude of these potential impacts are not well understood by the majority of people in the region. This is due in part to the general mystique surrounding offshore development, and in part to the limited access most people have to meaningful information about specific offshore projects. It is due also to the absence of any frame of reference for assessing the scale and implications of these projects.

Objective

The main objective of this report is to present a general frame of reference which will contribute to a clearer understanding of the nature and magnitude of the impacts of potential offshore oil and gas developments. This is accomplished by developing a body of data allowing direct comparisons to be made among recent major construction projects in the Atlantic Provinces and the proposed Venture and Hibernia offshore developments.

Approach

The comparative data considered relevant for developing the frame of reference include the following:

Project Schedule. For each project, a schedule showing the dates and duration of construction activity is provided.

Capital Cost. Aggregate capital cost for each project is provided. In order to allow direct comparisons among projects constructed at different points in time, all cost data are adjusted to a common year, 1984.

Employment. Aggregate employment created by each project over its construction life is provided in terms of person-years of effort. Peak employment during construction and annual employment during operations in terms of persons are also provided.

Skill Requirements and Shortages. Where data permit, critical skill requirements are identified on a project by project basis. Any skill shortages are reported together with an indication of how shortages were overcome.

Labour Relations. A brief discussion of the approach taken to labour relations is provided for each project.

Community and Social Impacts. An overview of how the projects affected such socio-economic variables as housing and social and physical infrastructure is provided. Emphasis is placed on impacts that occurred during construction.

The Projects

The eleven major projects examined in this report are identified by geographic location in Figure 1 and are as follows:

- Wreck Cove Hydro-Electric Generating Station, Nova Scotia: The Wreck Cove project consists of dams, access tunnels and an underground power house with a generating capacity of 200 megawatts. It was completed in 1978.

- AECL Heavy Water Plant, Nova Scotia: The AECL plant consists of a single processing facility in Glace Bay. The subject of this report is the rehabilitation of the original Deuterium of Canada plant which encountered technical problems preventing its operation. The rehabilitated plant came on stream in 1976. It operated until 1985, when insufficient demand for heavy water forced its closure.

- CGE Heavy Water Plant, Nova Scotia: The CGE plant consists of a single processing facility in Point Tupper. It came on stream in 1970. It operated until 1985, when insufficient demand for heavy water forced its closure.

- Bay d'Espoir Hydro-Electric Generating Station, Newfoundland: The Bay d'Espoir project consists of seven major dams, three canals and a power house with an installed capacity of 580 megawatts. The project was carried out in three stages with the final stage completed in 1975.

- Gulf Canada Oil Refinery, Nova Scotia: The Gulf refinery consists of the refining facilities, storage tanks and a marine terminal. It has a refining capacity of 80,000 barrels per day. It was completed in 1971, and operated until 1980 when poor market conditions forced its closure.

- Lingan Thermal Electric Generating Stations, Nova Scotia: The Lingan project consists of four 150 megawatt coal-fired generating units. The project was carried out in four stages with the final stage completed in 1984.

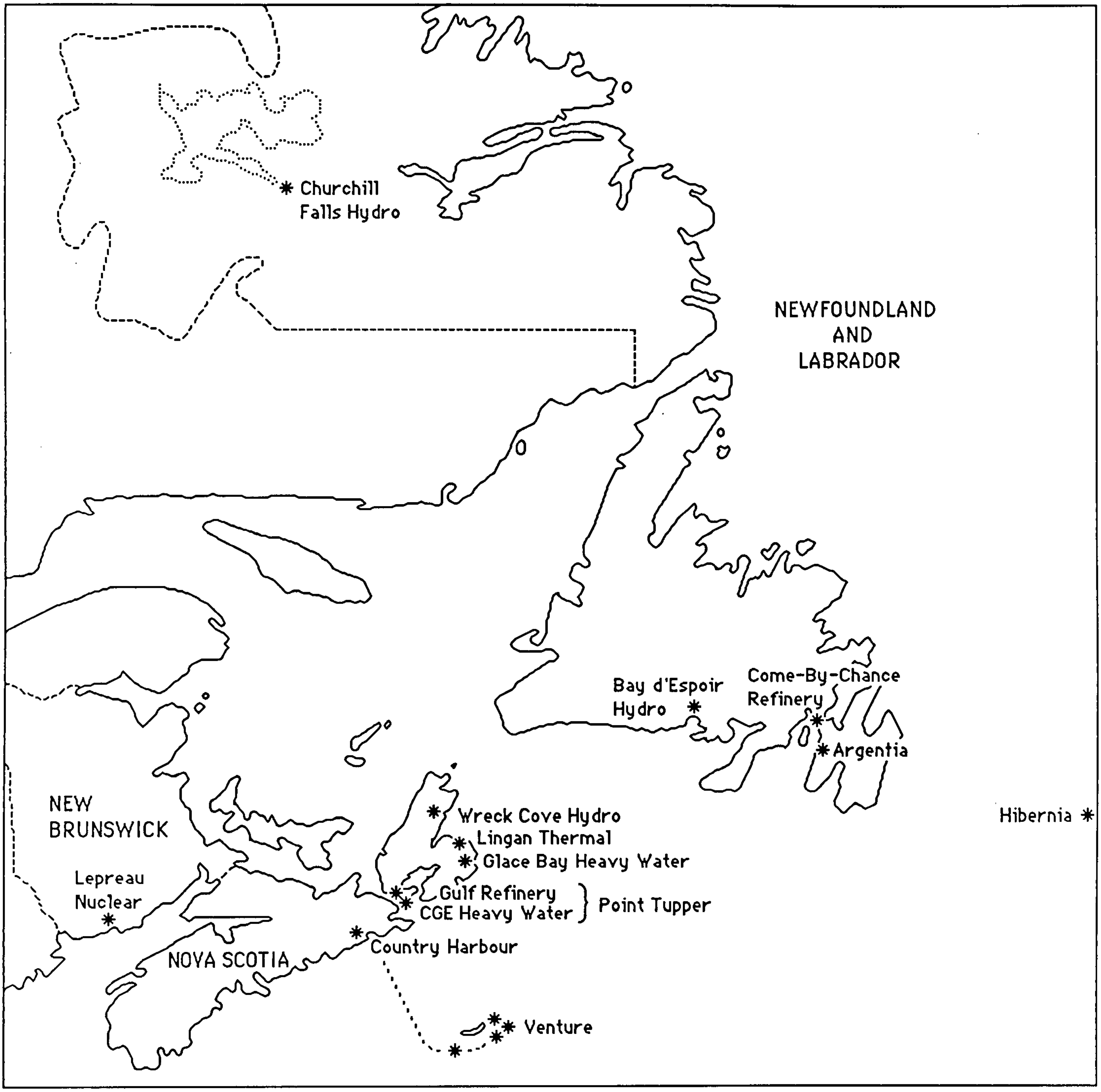

Figure 1. Location of Study Projects in the Atlantic Provinces

- Come-By-Chance Oil Refinery, Newfoundland: The refinery consists of the refining facilities, product and crude storage tanks and a marine terminal. It has a refining capacity of 100,000 barrels per day. The refinery came on stream late in 1973 and operated until 1976, when poor market conditions forced its closure.

- Point Lepreau Nuclear Generating Station, New Brunswick: Lepreau consists of a single 630 megawatt power station. The facility came on stream in 1983.

- Churchill Falls Hydro-Electric Generating Station, Newfoundland: The Churchill Falls project is the largest undertaking in eastern Canada and one of the largest hydro-electric projects in the world. It consists of over 60 km of dykes and dams, several tunnels and an underground powerhouse with a generating capacity of 5,250 megawatts. It was completed in 1974.

- Venture Natural Gas Development, Nova Scotia: The proposed Venture project consists of offshore production platforms, several development wells, an offshore pipeline, onshore processing facilities and an onshore pipeline. Construction is tentatively scheduled to commence in 1988, with gas production starting in 1991.

- Hibernia Oil Development, Newfoundland: The proposed Hibernia project consists of a single concrete production platform, several development wells, offshore loading facilities and shuttle tankers to transport crude oil to onshore refining facilities. Construction is tentatively scheduled to commence in 1987, with oil production starting in 1992.

Descriptive profiles of each project are contained in Part Two.

Two main criteria were used to select major construction projects: that they be familiar to the general public; and, that they bear some similarity to prospective offshore developments in terms of the types of impacts the latter is expected to generate. The Venture and Hibernia developments may involve major onshore construction adjacent to relatively small communities. Among the characteristics of the selected major projects is that they had large construction and employment requirements relative to the size of nearby communities.

Other projects considered for inclusion but dropped due to data limitations or because they did not satisfy selection criteria were construction of the Michelin Tire plants in Nova Scotia and the ERCO phosphorus plant in Newfoundland, and fabrication of the SEDCO semi-submersible drilling rigs in Halifax, Nova Scotia, and the Bow Drill 3 semi-submersible rig in Saint John, New Brunswick.

A Note of Caution

The data used in this report are drawn from a variety of sources. These sources vary considerably with respect to data availability and data quality. While efforts have been made to overcome data gaps and consistency problems, budgetary limitations precluded any significant amount of primary research. The reader is therefore cautioned to interpret the results as indicative of the relative scale of the projects in question, rather than as definitive for any specific project.

Summary cost, schedule and employment data for each of the projects is presented in Table 1.

PROJECT SCHEDULES

The major construction projects were implemented between 1965 and 1984 (Figure 2). The decade between 1967 and 1977 was the period of greatest intensity, with activity on eight of the nine projects.

Figure 2 shows that project schedules are seldom met. Five of the seven projects for which information is available experienced schedule overruns. These overruns ranged from about six months in the case of Wreck Cove to three years for Point Lepreau. Incomplete engineering prior to commencing construction, logistical problems and inadequate construction management were the main causes.

Construction times for the major projects ranged from 29 to 102 months (this excludes the Lingan generating stations which were constructed as separate projects lasting a total of 153 months). The schedules in Figure 3 exclude time spent on preliminary and detailed engineering. Reliable information for this activity was not available for any of the projects. To maintain consistency, engineering is not included in the offshore project schedules. Venture development is expected to be completed over a 38-month period. Hibernia development is scheduled to be completed over a 75-month period.

CAPITAL COSTS

The projects were implemented at various times over the past 20 years. In order to allow a direct comparison of capital costs among projects, all amounts have been adjusted to, and expressed in, 1984 dollars. To maintain consistency, the index of non-residential construction for the Atlantic Provinces was used to adjust costs. The Venture and Hibernia capital costs are estimated using a 1984 base year.

The massive scale of the offshore developments is apparent from the comparative cost data presented in Figure 4. Seven of the nine major construction projects had capital costs in roughly the $300-$600 million range. Only two, Lepreau and Churchill Falls, had

TABLE 1

Major Projects and Offshore Developments
Summary Data

Project	Cost and Schedule: Capital Cost[1] Estimated ($1984 millions)	Capital Cost[1] Actual ($1984 millions)	Construction Time[2] Estimated (months)	Construction Time[2] Actual (months)	Labour Impact: Total Employment (person-years)	Peak Employment (persons)	Operations Employment (persons)	Construction Camp[3] (persons)
Wreck Cove Hydro-Electric Generating Station (1975-78)	250	280	24	29	1,600	900	5	600
AECL Heavy Water Plant-Glace Bay (1972-76)	280	300	36	48	2,800	1,400	330	250
CGE Heavy Water Plant-Point Tupper (1966-70)	230	360	33	54	2,500	1,200	360	500-700
Bay d'Espoir Hydro-Electric Generating Station Phase 1 and 2 (1965-70)	635	805	60	57	6,000	2,000	55	1,400
Gulf Canada Oil Refinery (1968-71)	270	410	24	33	2,900	1,800	140	800
Lingan Thermal Electric Generating Station (1976-84)	640	520	167	153	2,700	550	125	No Camp
Come-By-Chance Refinery (1971-74)	n.a.	630	24	30	4,000	2,400	500	1,200-1,400
Point Lepreau Nuclear Generating Station (1974-83)	890	2,200	66	102	14,000	2,400	300	500-600
Churchill Falls Hydro-Electric Generating Station (1967-1974)	3,175	3,130	108	84	26,000	6,200	330	6,000
Venture Offshore Development Project[4] (estimated)	2,900	-	38	-	9,000	5,500	365	2,000
Hibernia Offshore Development Project[4] (estimated)	4,340	-	75	-	21,500	8,000	1,100	2,000-2,500

Notes: 1. Capital costs for major projects are adjusted to $1984 using the non-residential construction index.

2. Due to data limitations, project schedules include only actual construction time. Engineering is excluded.

3. Construction workers at Bay d'Espoir and Churchill Falls were housed in multiple camps at various work sites. Onshore construction associated with Venture and Hibernia will require from two to three camps at each project.

4. Data for Venture and Hibernia are preliminary and subject to change once design engineering is completed.

Source: Part Two, Project Profiles

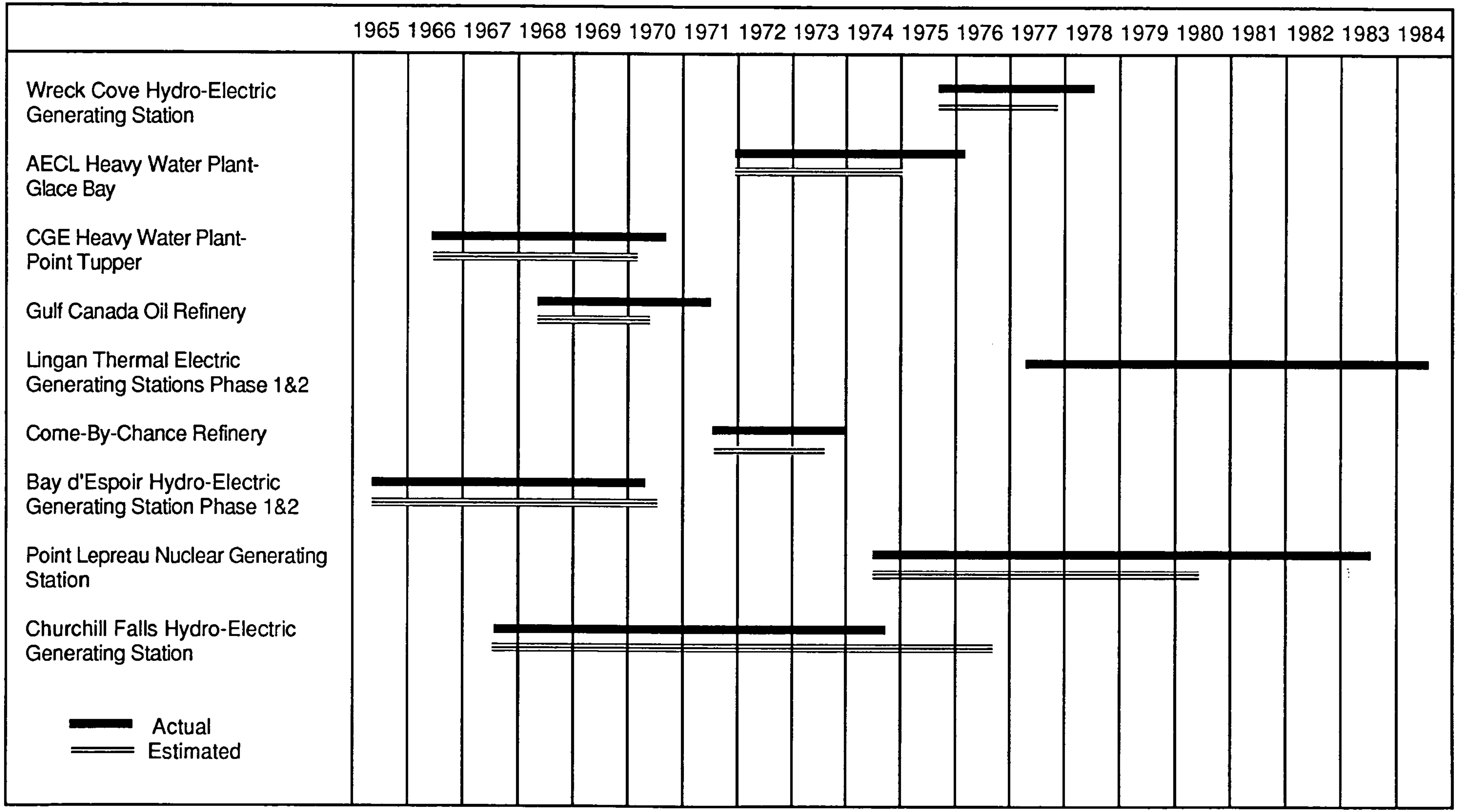

Figure 2. Major Project Construction Schedules: Estimated and Actual Duration

(Source: Table 1 and Part Two , Project Profiles)

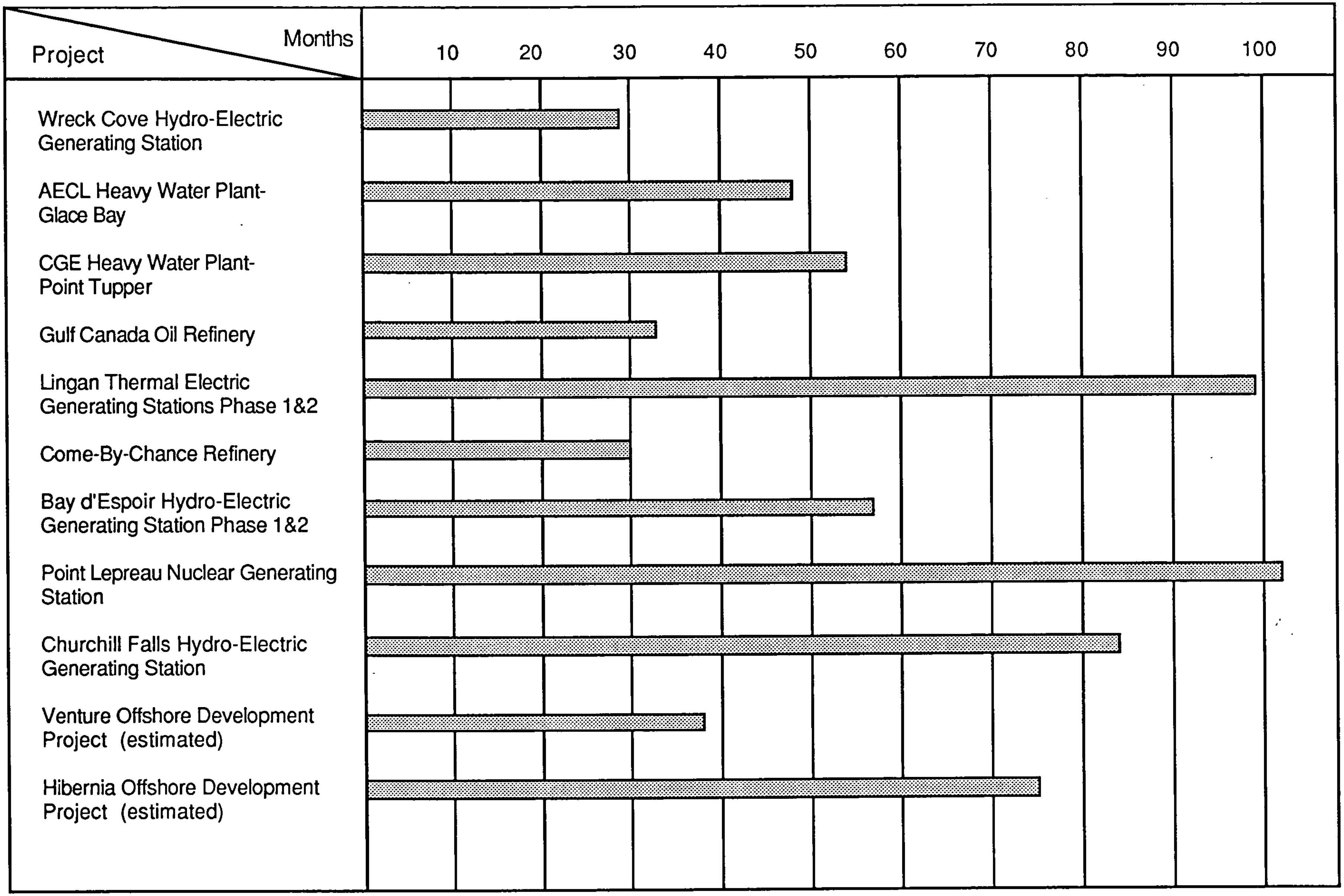

Figure 3. Major Projects and Offshore Developments, Construction Schedules
(Source: Table 1 and Part Two, Project Profiles)

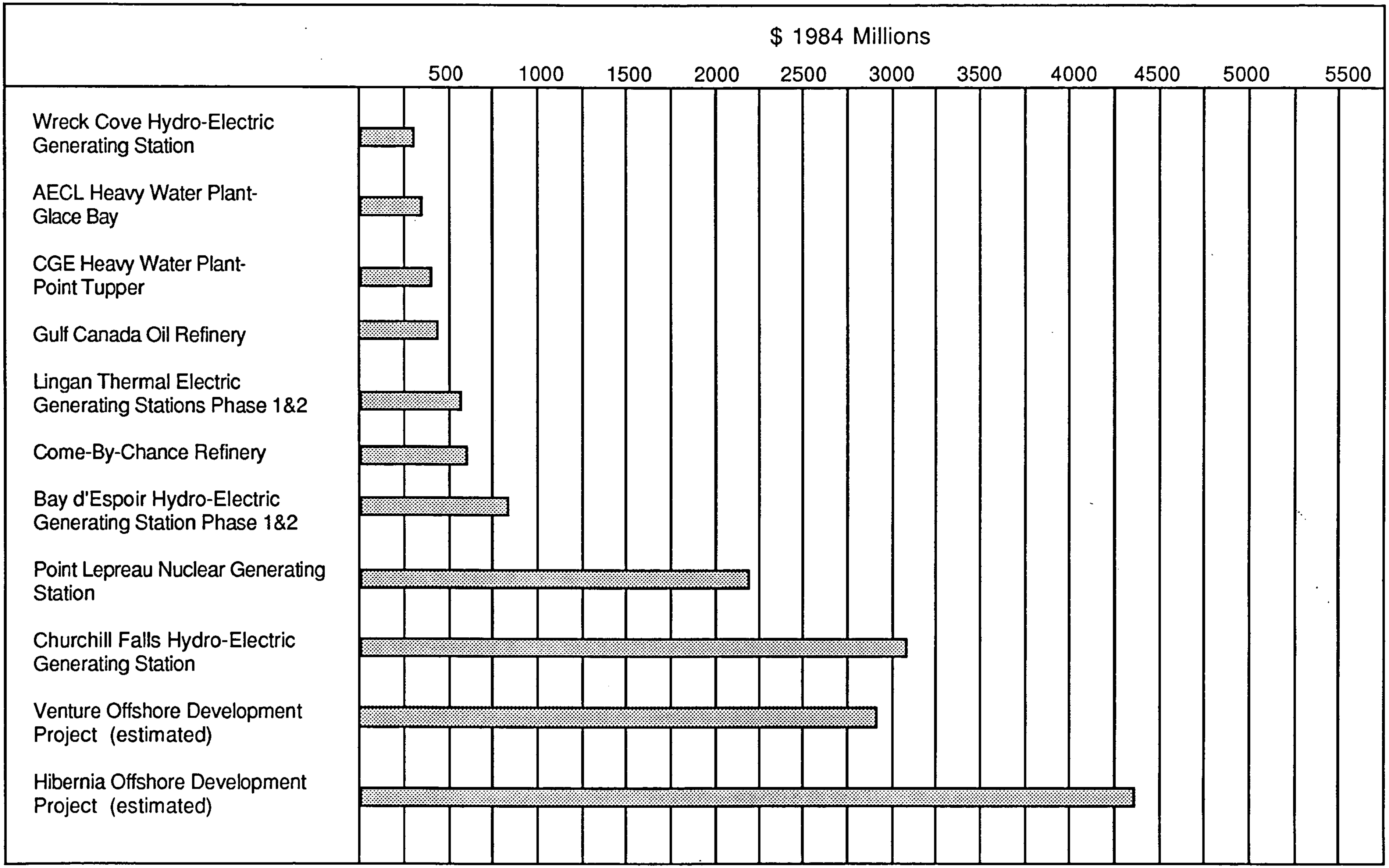

Figure 4. Major Projects and Offshore Developments, Capital Cost Comparison
(Source: Table 1 and Part Two, Project Profiles)

costs of the same order of magnitude as those estimated for the Venture and Hibernia developments. The Churchill Falls and Venture costs are fairly close (about $3 billion), but both fall far short of the $4.3 billion cost estimate for Hibernia.

It should be emphasized that the Venture and Hibernia costs are preliminary estimates and may change significantly (up or down) as the developments proceed through detailed engineering and construction. Differences between estimated and actual costs are not uncommon as the North Sea experience has shown. In the early stages of development, most North Sea projects had serious cost overruns. These overruns were accounted for by three main factors:

- inexperience of all parties which led to underestimation of the time and cost of completing work in the hostile offshore environment;
- the pressure to get into production as early as possible which resulted in concurrent engineering and fabrication/construction which in turn led inevitably to delays and missed "weather windows" for installation;
- excessive demands on the capacity of fabrication yards which, in the context of general inflation in the early 1970's, led to a rapid escalation in costs.

A difference between estimated and actual costs is not a characteristic unique to offshore developments. Six of the eight construction projects for which data are available experienced cost overruns (Figure 5). Two had overruns in the 10 percent range and two in the 50 percent range. The actual costs for Lepreau exceeded the estimate by 150 percent. These overruns are explained by a variety of factors including commencing construction before engineering is completed and inadequate management of the construction labour force. The degree by which the Lingan generating stations came in under budget is explained in part by use of escalation factors in the cost estimates that were substantially in excess of actual inflation rates.

EMPLOYMENT

Labour Requirements During Construction

Another significant indicator of the scale of offshore developments is the employment they generate. Preliminary estimates indicate Venture will create about 9,000 person-years of direct employment; the estimate for Hibernia is about 21,500 person-years. These estimates exceed by a substantial margin the employment generated by seven of the nine major projects (Figure 6). Lepreau and Churchill Falls are the exceptions. Both exceed the estimate for Venture, though without the problems that plagued Lepreau, its employment content would have been much lower. An interesting point to emerge from Figure 6 is the labour intensity of the Churchill Falls project. Though it ranks well below Hibernia and about equal to Venture in terms of capital costs, its labour content is three times that of Venture and slightly more than Hibernia.

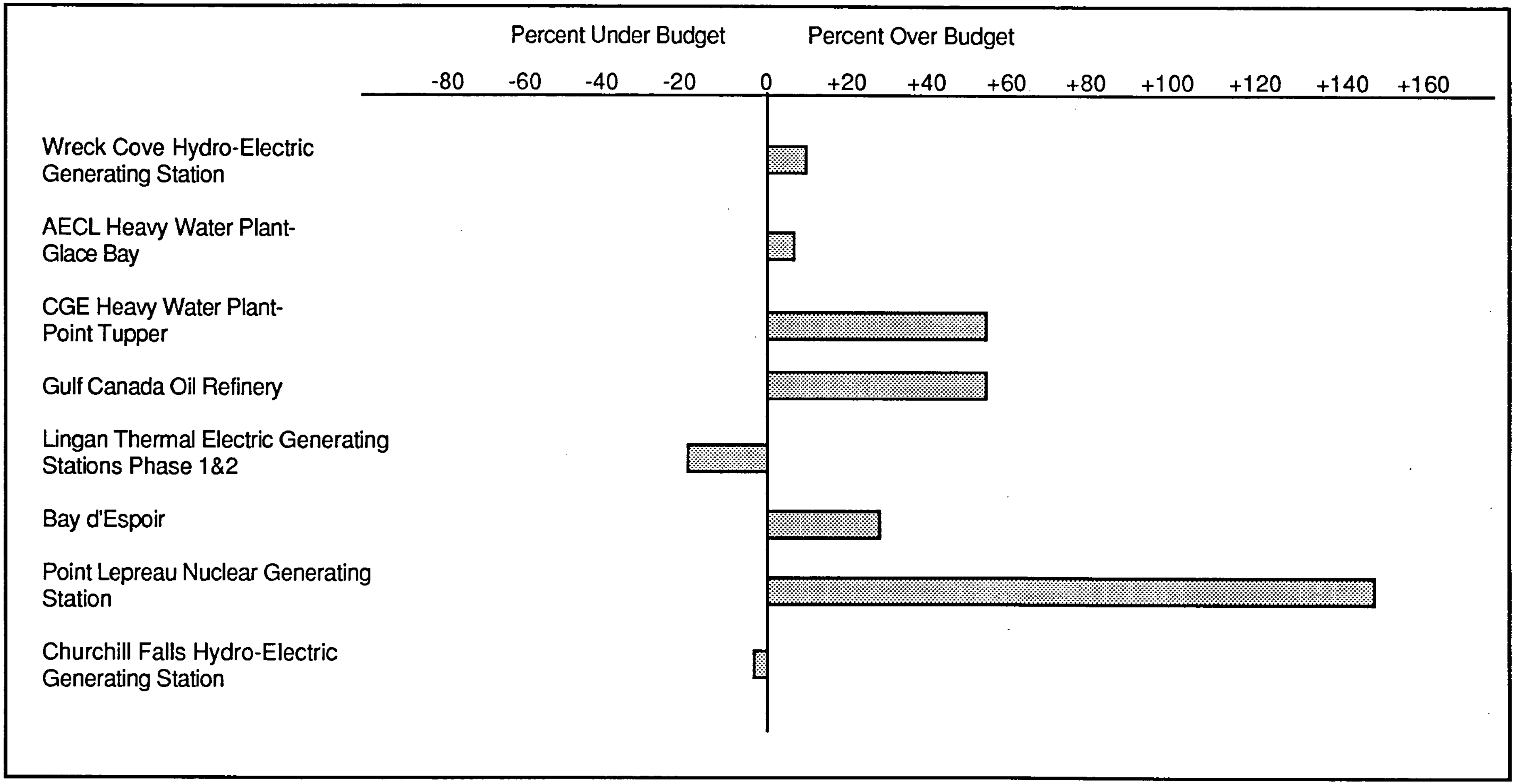

Figure 5. Major Projects, Estimated and Actual Capital Costs
(Source: Table 1 and Part Two, Project Profiles)

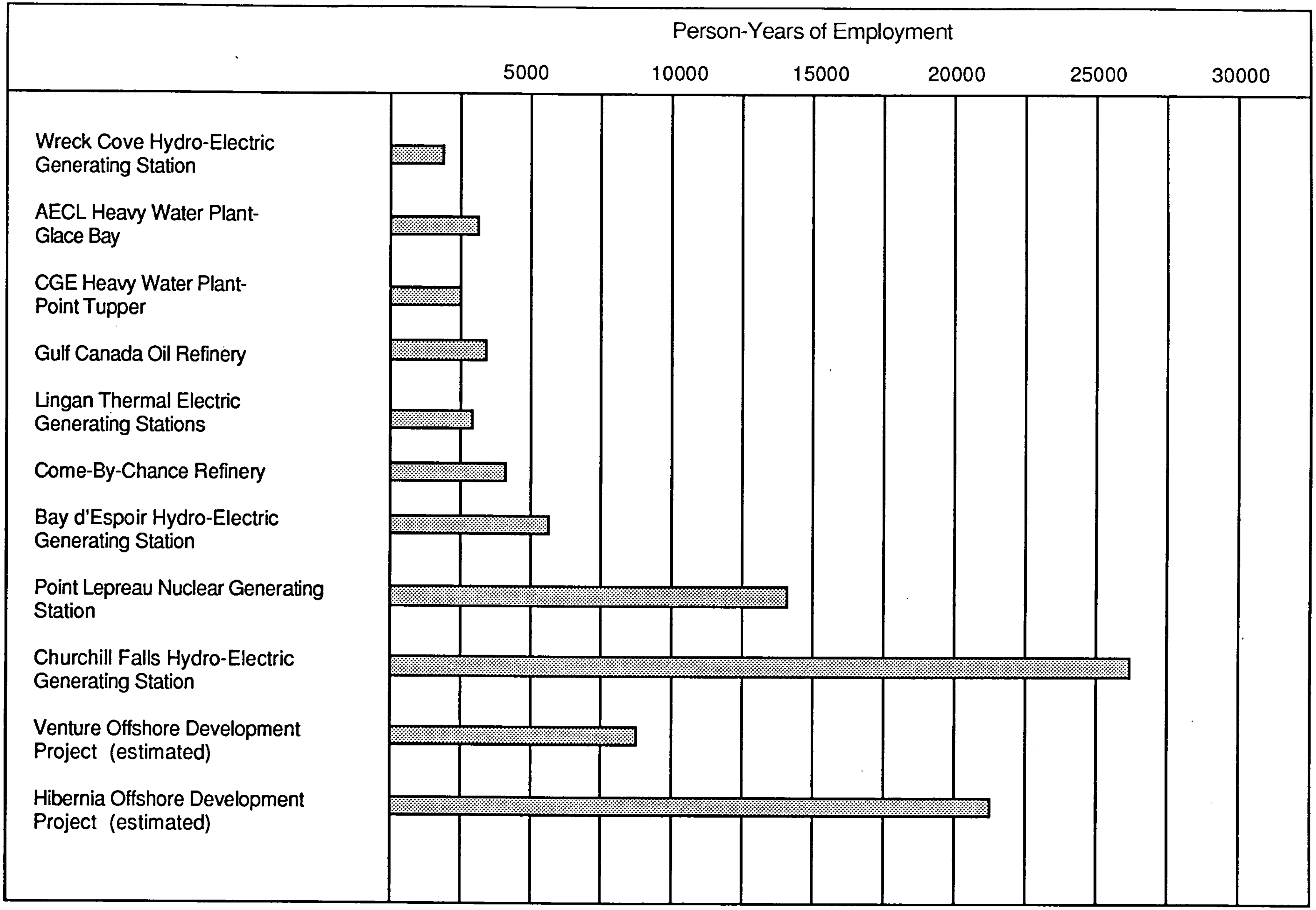

Figure 6. Major Projects and Offshore Developments, Total Employment
(Source: Table 1 and Part Two, Project Profiles)

The contrast between the construction projects and the proposed offshore developments is less marked when peak employment is considered (Figure 7). Venture and Hibernia are typical of offshore developments in that they consist of several distinct activities occurring simultaneously in different locations. This accounts for their high peak employment. Churchill Falls, with the highest peak employment of the projects under consideration, shares this characteristic. In addition to the construction of its massive underground powerhouse, the project entailed construction of several dams and dykes at various locations.

An offshore project generally consists of three types of activity:

- fabrication of offshore structures and facilities in existing yards;

- on-site construction of onshore facilities or construction at a greenfield site of facilities for use offshore; and,

- work offshore such as development drilling and installation of platforms and pipelines.

On-site and greenfield construction usually require recruitment of a substantial workforce and are often located in a remote area. In terms of community and social impacts, it is these aspects of offshore development that are most directly comparable to the major construction projects described in this report.

When viewed solely from this perspective, the offshore developments correspond more closely in scale to the major construction projects (with the exception of Lepreau and Churchill Falls). The aggregate construction labour requirements (person-years) for the major projects in the Maritimes are compared with the estimated onshore construction labour requirements for Venture in Figure 8. The Venture estimates include construction of the processing facilities and marine terminal in eastern Nova Scotia, offshore construction support for the offshore pipeline, as well as installation of the sales gas pipeline through Nova Scotia and New Brunswick. Venture ranks second to Lepreau among Maritime projects in terms of site-specific construction employment.

Corresponding data for Newfoundland major projects and Hibernia are shown in Figure 9. The Hibernia estimates include construction of the gravity base structure, assembly and hook-up of topside facilities, and fabrication of flowlines. Hibernia ranks second to Churchill Falls in terms of site-specific construction employment.

From the perspective of community impacts, the most relevant comparison to make is that of peak employment at a single location arising from the major projects and the corresponding onshore construction activities of the offshore developments. Included in the Venture comparison in Figure 10 are three activities: construction of the gas plant and marine terminal (assumed at Country Harbour), and installation of the Nova Scotia and New Brunswick portions of the sales gas pipeline. Peak employment is greatest at County Harbour, but is exceeded by the peaks for Lepreau and the combined total for the Strait of Canso projects at their coincident peak in 1969.

Included in the Hibernia comparison in Figure 11 are three activities: construction of the gravity base structure (assumed at Come-By-Chance), assembly and hook-up of

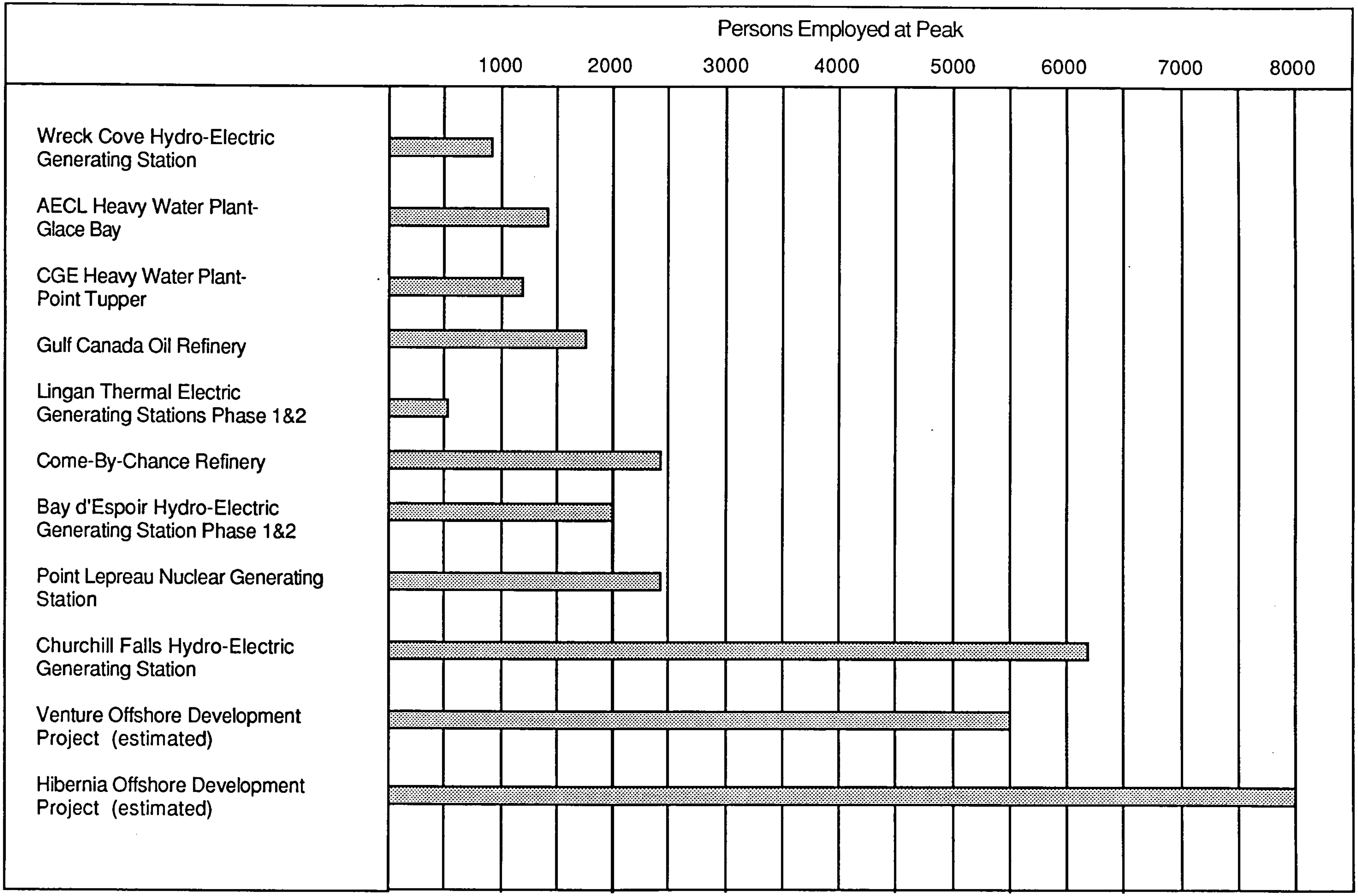

Figure 7. Major Projects and Offshore Developments, Peak Employment During Construction
(Source: Table 1 and Part Two, Project Profiles)

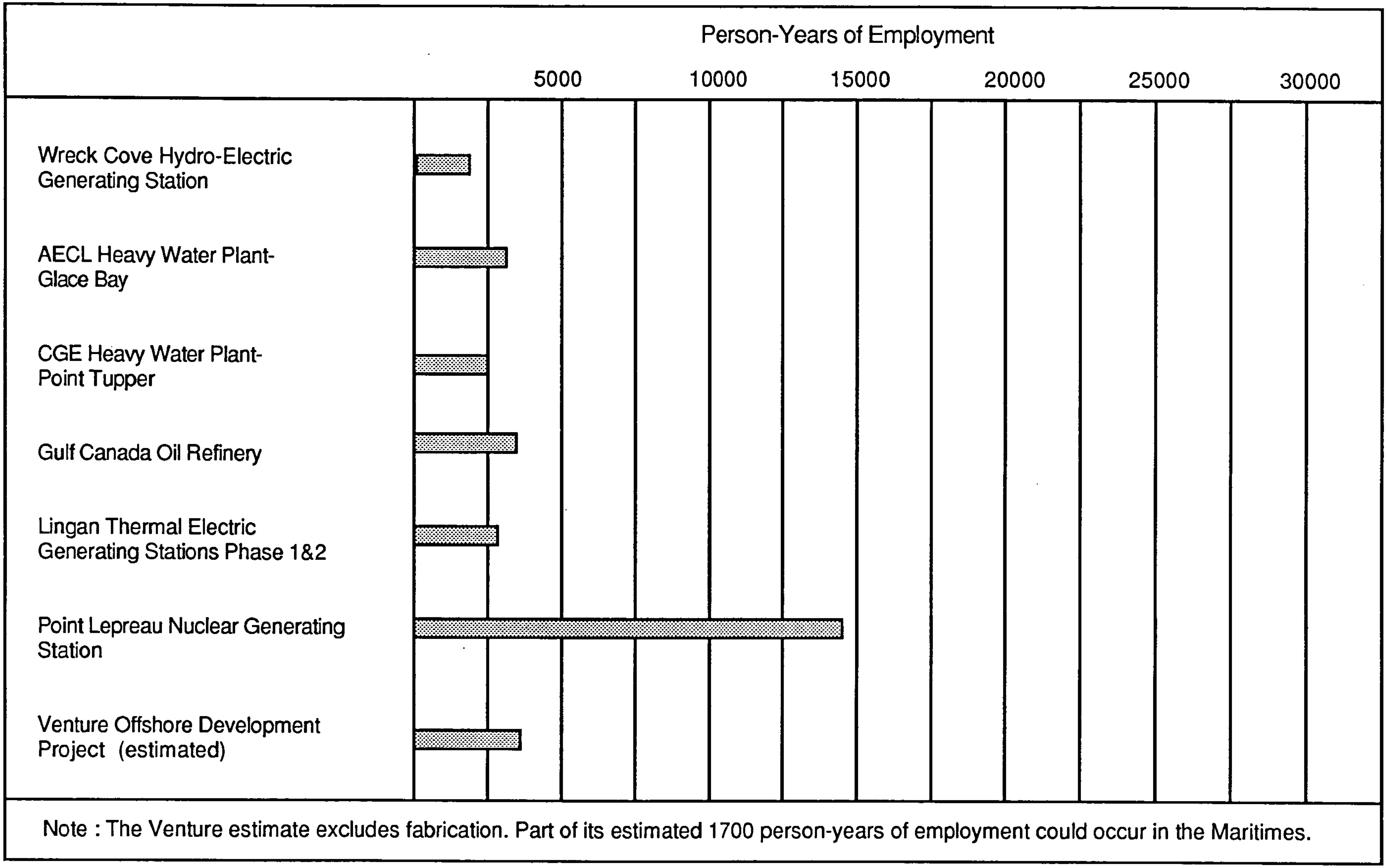

Figure 8. Major Projects and Venture Development, Maritime Provinces On-site Construction Employment
(Source: Table 1 and Part Two, Project Profiles)

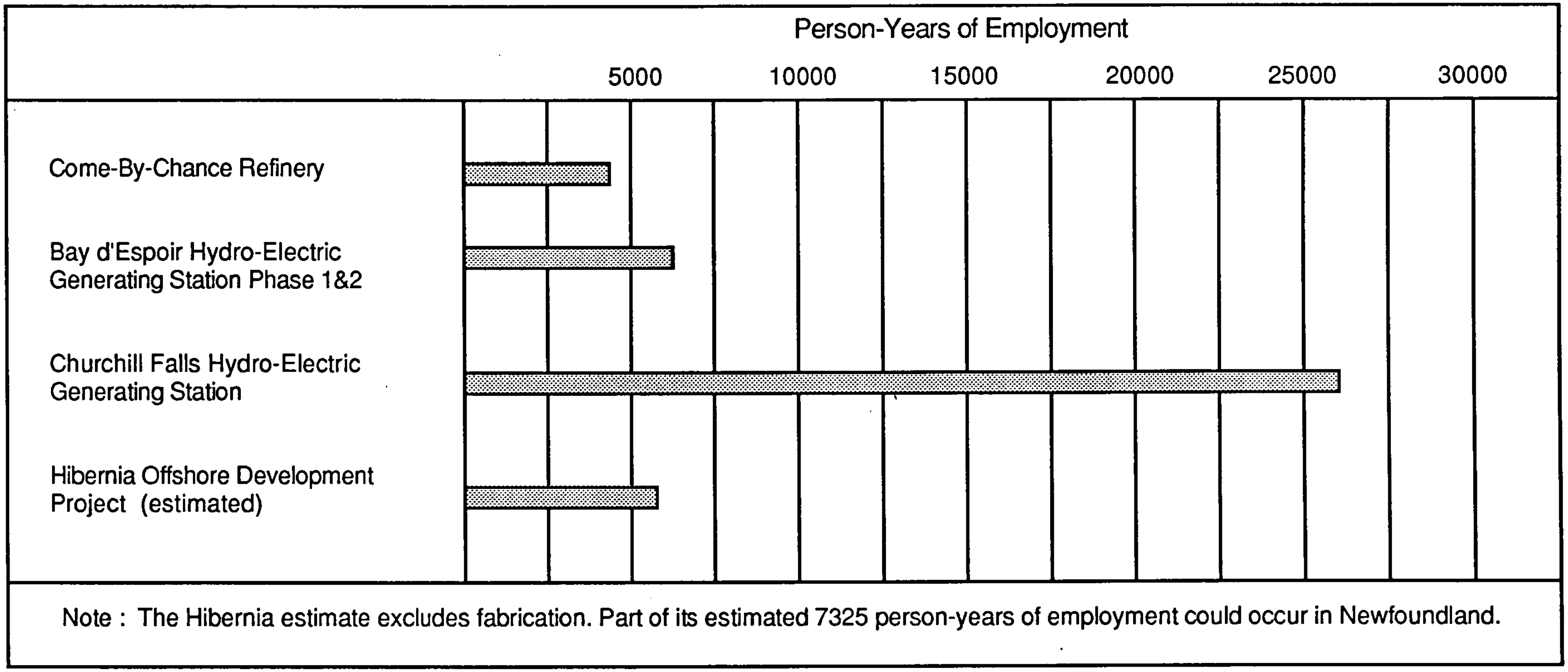

Figure 9. Major Projects and Hibernia Development, Newfoundland On-site Construction Employment

(Source: Table 1 and Part Two, Project Profiles)

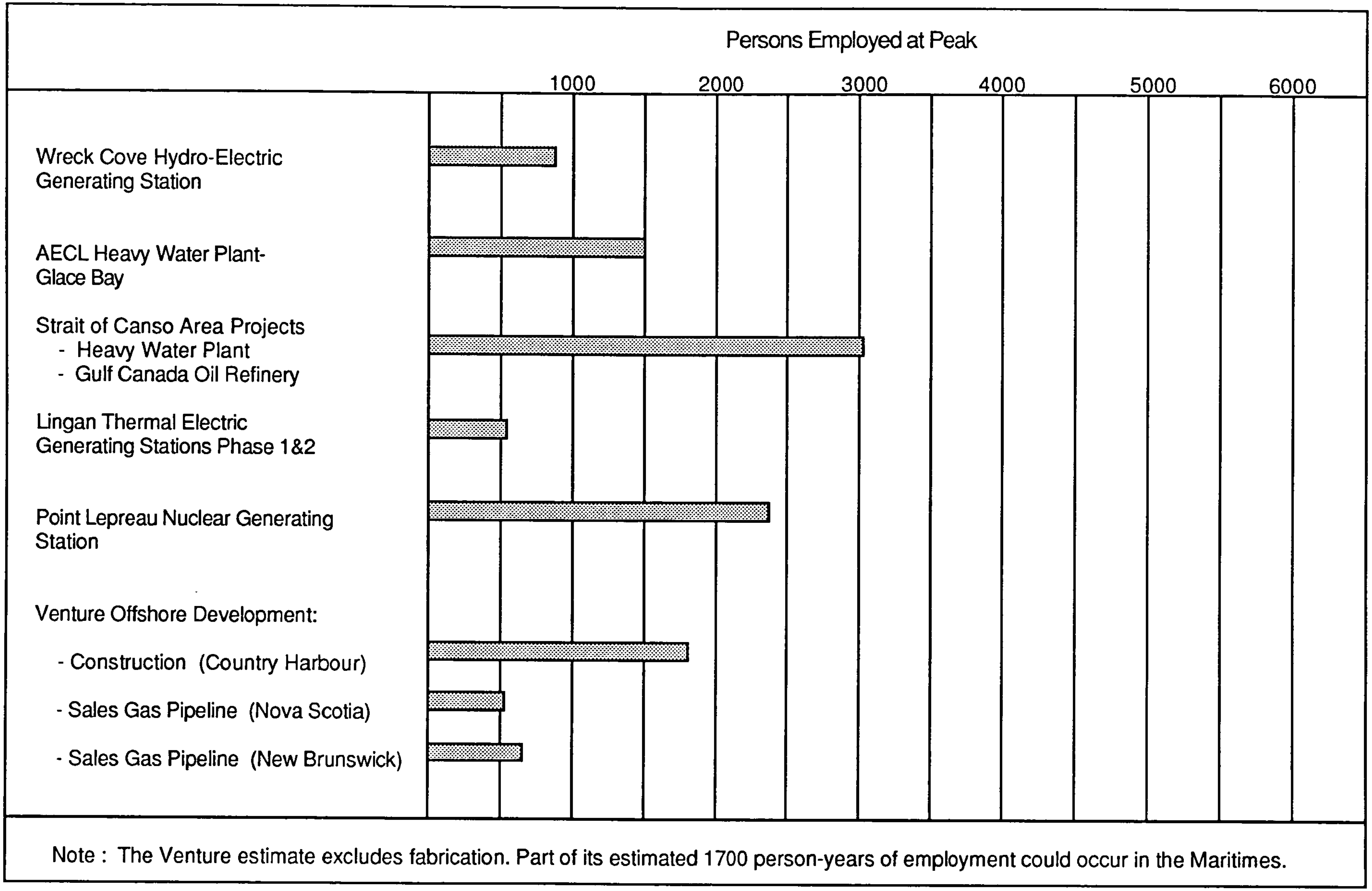

Figure 10. Major Projects and Venture Development, Maritime Provinces On-site Construction Peak Employment by Location

(Source: Table 1 and Part Two, Project Profiles)

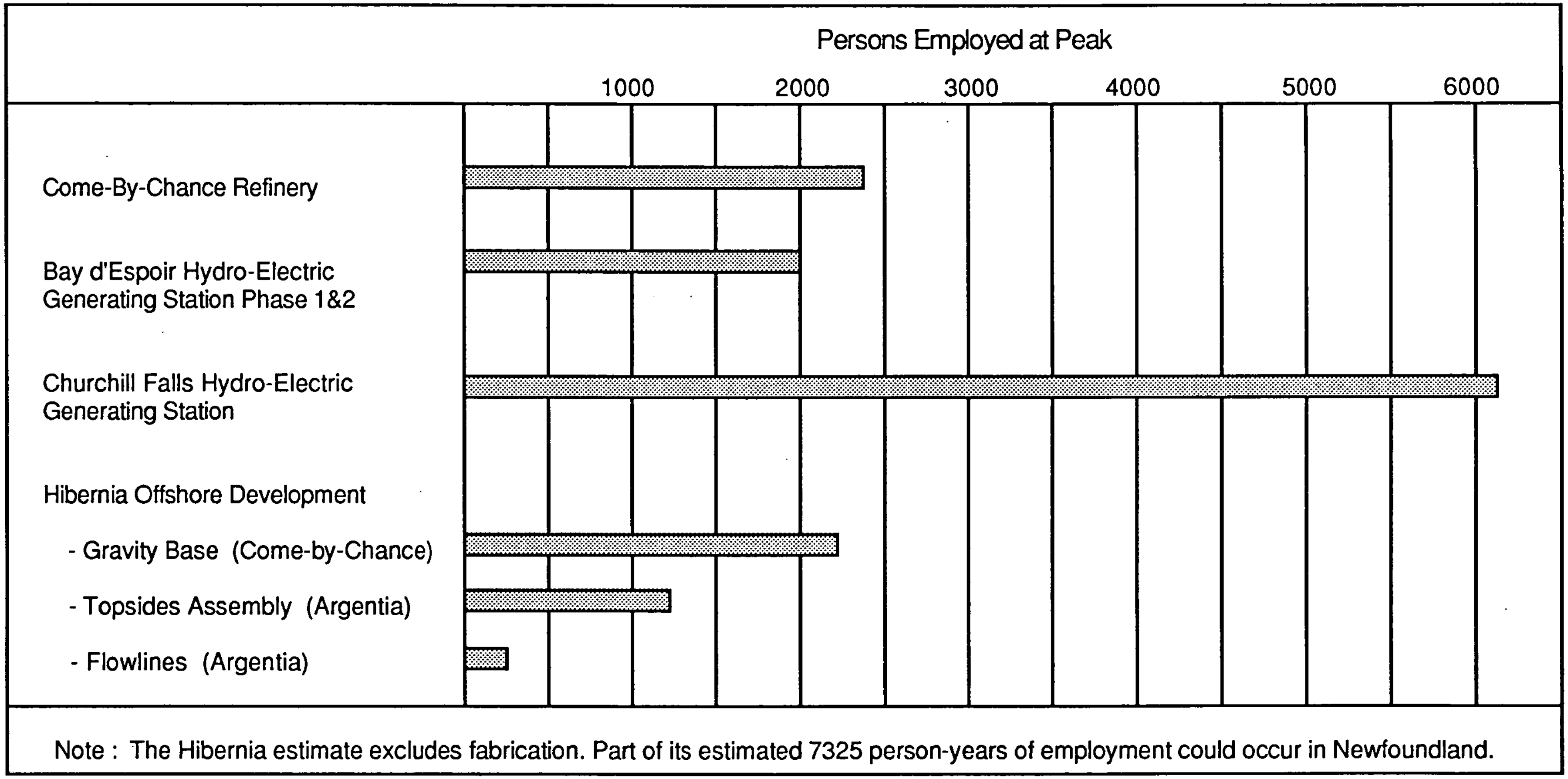

Figure 11. Major Projects and Hibernia Development, Newfoundland On-site Construction Peak Employment by Location

(Source: Table 1 and Part Two, Project Profiles)

topside facilities (assumed at Argentia), and fabrication of flowlines (assumed at Argentia). Peak employment is greatest for the gravity base structure, but is exceeded by the peak for Churchill Falls and is roughly comparable to the peak for the Come-By-Chance refinery.

It must be emphasized that site-specific construction represents the lower limit of Maritime-based employment arising from Venture and Newfoundland-based employment arising from Hibernia. Our attention is confined to this type of employment because the impacts associated with it correspond most closely with those associated with recent major construction projects. Total employment in the Maritimes and Newfoundland will be higher when such activities as development drilling, project management, engineering, and fabrication are considered. With the exception of development drilling, these activities are non-site-specific. The location of the employment they generate will not be known until contracts for the work are awarded to specific suppliers. For this reason, and because the impacts of such activities differ from those under consideration in this report, no estimate is provided of the local employment they may generate.

Labour Requirements During Production

For all projects, employment during production is considerably less than during construction. With an estimate of 365 production personnel, Venture is on a par with five of the nine major projects. Production phase employment with Hibernia is estimated at 1,100 persons annually, and is clearly far greater than the other projects. Production phase employment is expected to last about 20 years for both developments. For both Venture and Hibernia, most of the production phase jobs are located on offshore platforms or are related to marine transportation. Annual employment levels during production are depicted in Figure 12.

Skill Requirements and Labour Supply

Each major project required the full range of civil, mechanical and electrical construction trades:

- carpenters
- concrete workers
- labourers
- equipment operators
- iron workers
- plumbers and pipefitters
- boilermakers
- electricians
- insulators
- mechanics

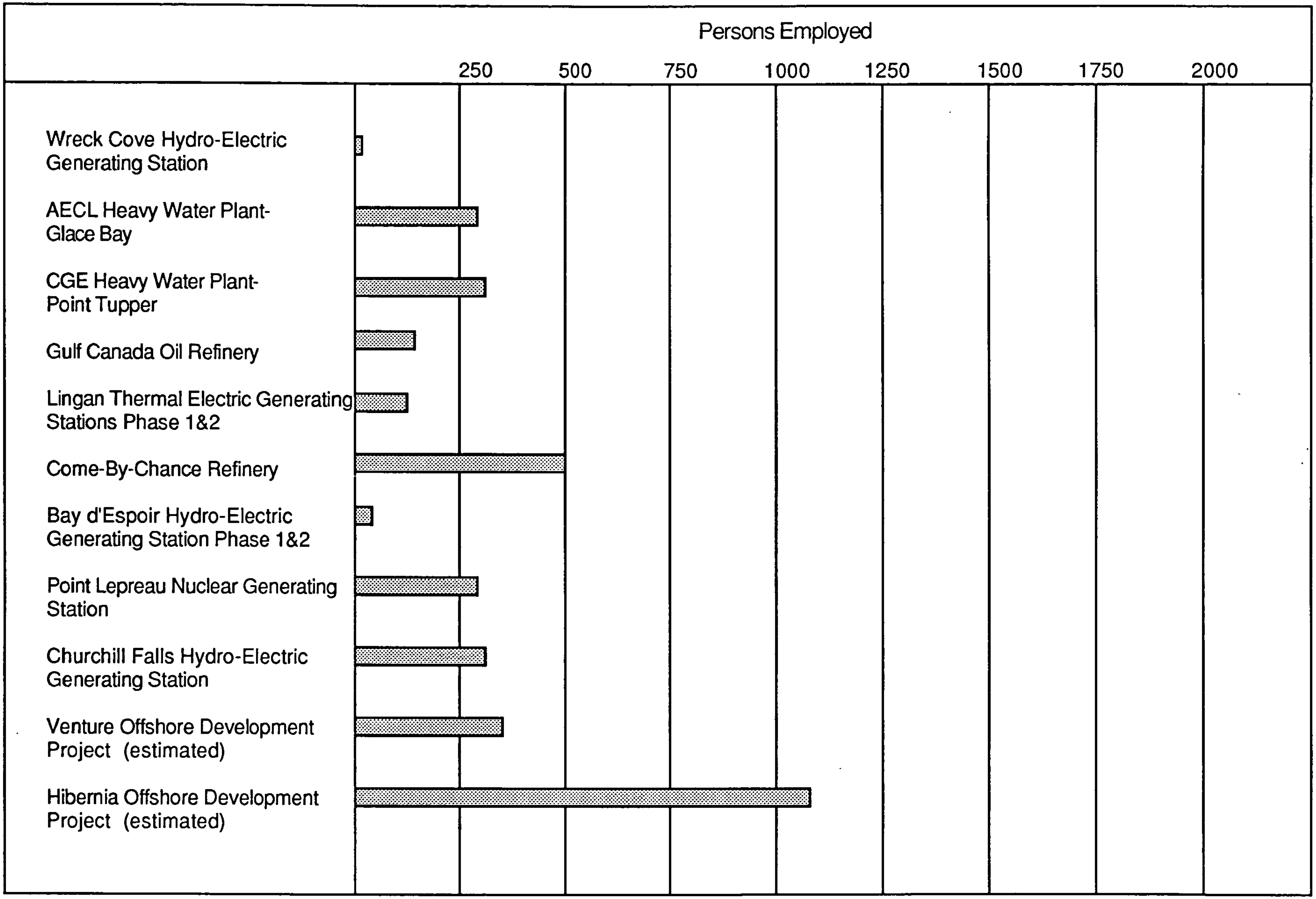

Figure 12. Major Projects and Offshore Developments, Annual Employment During Production

(Source: Table 1 and Part Two, Project Profiles)

The number required by trade and the requisite skill levels in certain trades varied according to the nature of the project. At the risk of over-simplification, the projects may be divided into two categories: refining or liquids processing (Come-By-Chance, Gulf, AECL, CGE), and electrical generation, which in turn may be divided into two sub-categories: hydro (Churchill Falls, Wreck Cove, Bay d'Espoir) and thermal (Lingan, Lepreau).

The refining/processing projects involved considerable amounts of pipe and pressure vessel fabrication. The mechanical trades (pipefitters, pipewelders, boilermakers) dominated these projects. The hydro-electric projects involved both extensive civil works (dams, dykes, waterways) and powerhouse construction. With the labour intensiveness of civil works, these projects were dominated by civil trades (carpenters, labourers, equipment operators, truck drivers). Trade requirements for the thermal electric projects varied considerably. Lingan had a reasonable balance among the civil, mechanical and electrical trades, while the mechanical and electricals (pipefitters and electricians) dominated Lepreau, accounting for about 60 percent of the peak labour force.

Whether the projects experienced difficulties in recruiting adequate supplies of qualified labour depended primarily on three factors: the proximity of the projects to major population centres, the skill levels required and the existence of concurrent projects.

The projects were located in one of three types of areas:

Adjacent to <u>Large Community</u>	Adjacent to <u>Small Community</u>	<u>Remote Area</u>
AECL	Come-By-Chance	Wreck Cove
Lepreau	Gulf	Churchill Falls
Lingan	CGE	
	Bay d'Espoir	

Those located adjacent to large communities tended to have little difficulty recruiting labour from within commuting distance. Where supply constraints existed, these were related to skill levels not concurrent projects. AECL and Lingan were completed almost entirely with the resident labour force in the industrial area of Cape Breton. Even Lepreau, where there were substantial underestimates of requirements in highly skilled trades, managed to meet demands with minimal recruitement from outside the Saint John area.

Those projects located adjacent to small communities relied heavily on regional labour markets to meet their needs. These communities had small construction labour pools. Moreover, a substantial proportion of labour requirements at three of the four projects consisted of highly skilled trades. To add to the local labour supply difficulties of the Strait of Canso area, construction of the Gulf refinery and CGE heavy water plant overlapped to a significant degree. The construction camps housing non-resident labour for these projects accommodated from 45 to 60 percent of the respective labour forces.

The projects located in remote areas had to develop extensive camp facilities and recruit most of the labour outside the project area. The labour force for Churchill Falls was housed entirely in construction camps at the various project sites in Labrador. Between 65 and 70 percent of the labour force was composed of residents of Newfoundland. In the case of Wreck Cove, about two-thirds of the labour force was housed in a camp, despite the project's remote location. Many workers commuted daily from the industrial area of Cape Breton, a distance of some 80 km. Overall, about 90 percent of the workforce was from Cape Breton.

While the record of meeting labour requirements from local or regional labour markets was good for all projects, there were supply problems in a number of cases. These problems were confined to the highly skilled trades, and in particular, metal working trades where work involving high standards of fitting and welding was required. Among the key trades where shortages were experienced are:

- pipefitters and pipewelders
- plate welders
- electricians
- insulators

Labour Relations

All major projects were carried out by unionized construction workers. Project agreements governed labour relations on most projects. These agreements tended to be carved out of existing collective agreements. A number of the project agreements had no strike/no lock-out provisions.

The labour relations experienced on the major projects was mixed. On four of the eight projects for which information is availale (Wreck Cove, Lingan, Churchill Falls and Bay d'Espoir) labour relations have been described as very good. Few, if any, days were lost to strikes. This has been attributed largely to the quality of construction management.

The experience with the other four projects (AECL, Gulf, CGE and Lepreau) was less than satisfactory. There were numerous walk-outs and in some cases a significant number of days lost. These problems have been attributed to several factors, but most importantly, incomplete design and engineering and the inexperience of management and unions in dealing with complex projects. For example, a major cause of the walk-outs was jurisdictional disputes. These resulted from inadequate pre-project planning and allocation of work.

Community and Social Impacts

Project experience with community and social impacts varied. To a substantial degree, this was a non-issue for projects such as Churchill Falls and Wreck Cove located in remote areas. For projects adjacent to large communities, the experience was generally positive. The Lepreau, Lingan and AECL projects fall into this category. The Come-By-Chance refinery also falls into this category, not because the community of Come-By-

Chance itself was large, but because a combination of factors caused circumstances to be particularly favourable for the project.

The projects themselves made no demands on physical infrastructure that could not readily be met. By maximizing the recruitment of local residents for jobs during production, the pressure on housing markets and additional demands on community and social services were kept to a minimum. In general, spending by workers during construction and operation of plant facilities represented a welcome injection into the local economies.

For projects adjacent to small communities, the experience was mixed. It was not a happy one in the Strait of Canso area. The community of construction workers was large in relation to the closest town, Port Hawkesbury. The town itself was undergoing a rapid expansion and had difficulty meeting physical and social infrastructure requirements. To add to these problems, the costs of accommodation (rental and real estate) rose rapidly during the construction period and through the early stages of plant operations.

In-migration to the Strait area included not only workers with construction jobs, but people hoping to acquire such jobs. The speculative job-seekers were generally not successful because the projects were unionized and workers were hired through union channels. Although the union hiring procedure usually works smoothly in terms of ensuring a supply of qualified workers, the practice has been a source of frustration for people in local communities who have relevant skills and are willing to work, but who are not union members. This issue arose not just in conjunction with the Strait area projects, but with all projects, even to a degree those in remote areas.

While all communities faced to a varying degree the "boom" and "bust" problem typically associated with major construction projects, for three communities the problem presented itself with an added twist. After less than two years operation, the Come-By-Chance refinery ceased production. The AECL heavy water plant in Glace Bay is shutting down after operating for nine years. Port Hawkesbury has suffered doubly: the Gulf refinery ceased operations after nine years in production, while the heavy water plant is shutting down after operating for about fifteen years.

The direct and indirect employment generated by each of these operations was large in relation to total employment in adjacent communities. The negative impacts resulting from the refinery closures were significant for Come-By-Chance and Port Hawkesbury, and similar impacts can be expected for Glace Bay and Port Hawkesbury when the heavy water plants finally cease operations. Among these impacts are a general shrinking of the economic base of the communities due to lost employment income and tax revenue, a depressive effect on real estate markets and, of course, increased unemployment and dependence on unemployment insurance and social assistance.

CONCLUDING OBSERVATIONS

It is likely that offshore hydrocarbon activity on Canada's east coast will move into the development phase in the late 1980's with production commencing in the early 1990's. At present, two projects are planned, Venture and Hibernia. More may follow as exploration continues and further discoveries are made.

The perception held by many Canadians about the nature, magnitude and implications of offshore development is based on North Sea activity during the 1970's. We associate offshore development with massive and technically complex projects, a rapid expansion of industrial activity and employment, economic disruption resulting from competition for goods and services, and undesirable social impacts caused by the substantial migration of people to areas of development activity. While these perceptions may be accurate, it is important to recognize that the economic and social consequences of North Sea development were based on a pace of activity far greater than is foreseeable for Canada's east coast.

The pace of North Sea activity was dictated mainly by three factors: the early discovery of a number of large oil and gas fields, conditions in global energy markets, and domestic fiscal considerations. During the 1970's, thirty major oil fields were developed in the U.K. and Norwegian sectors of the North Sea alone.

Canada faces a different situation in the mid 1980's. With a glut of oil on world markets and softening energy prices, there is less urgency to proceed with offshore development than in the 1970's. Canada, moreover, does not have the balance of payments problems that drove Britain to adopt a policy of rapid oil development. Lastly, and perhaps most significantly, drilling off the east coast has not produced results as encouraging as those made in the North Sea.

What all this means is that when assessing the onshore impacts of offshore development, care must be taken in identifying lessons from the North Sea experience that are relevant in the Canadian context. Unfortunately, lessons about economic and socio-economic impacts of specific projects tend to be obscured by the cumulative effects of the many projects that have been implemented. The more relevant lessons concern the way in which specific types of projects are implemented, the onshore activities involved, the industrial capacity and infrastructure required, and the nature and magnitude of employment opportunities that arise. While this information provides an important starting point for understanding the onshore impacts of offshore development, more is required.

Recent major construction projects in the Atlantic Provinces provide a useful frame of reference in this regard. When compared with proposed offshore projects, they provide a sense of scale. Venture and Hibernia are characterized by a number of onshore and offshore components and a variety of site-specific construction and non-site-specific fabrication activities. The major construction projects tend to be more focussed and consist essentially of onshore construction activity. This accounts in part for their generally lower capital costs and labour content. A major contributing factor to the relatively high costs and labour content of the offshore projects is the very fact that much project activity takes place offshore. The stringency of design and construction standards for offshore facilities also explains the relatively high costs.

In addition to providing a means of appreciating the scale of the Venture and Hibernia developments, the major projects also provide useful insights into how communities in the Atlantic Provinces have been affected by construction activity. In considering the onshore aspects of offshore development, the experience with major construction projects is particularly significant since it points up the importance of careful planning.

With the major projects, deficiencies in planning were evident in three areas: design and implementation, construction management and community impacts.

Design and Implementation

A key rule in implementing technically complex projects is to ensure that engineering is more or less complete before construction begins. The wisdom of this rule is best exemplified in instances where it is not followed: Lepreau and the heavy water plants are cases in point. With Lepreau, poor planning and scheduling are reported as fundamental sources of problems. Detailed drawings were often non-existent, inaccurate or incomplete. Government's over-anxiousness to commence construction may account for these sources of difficulties. Similar problems during construction of the heavy water plants were compounded by deficiencies in the designs themselves and the need for design changes as work progressed. Difficulties with design and implementation led inevitably to confusion on the construction sites, delays and cost overruns. Schedule delays and cost overruns were undoubtedly made worse by the "cost-plus" type of contracts used on some of the projects.

It is interesting to note that commencing construction before engineering was complete and introducing design changes during construction were not uncommon practices with offshore projects in the North Sea. Pressure from government to get on with development accounted in part for the "premature" construction starts. Practical scheduling considerations also played a role. In most cases construction had to be timed so that completion coincided with favourable weather conditions for installation of structures offshore. These weather windows were often very short. Rather than risk a year's delay if the window were missed, construction would begin earlier than desirable from an engineering standpoint. Ironically, when coupled with design changes, this in some cases let to the very problem that managers were trying to avoid.

Construction Management

A second key rule in implementing major projects is to ensure that construction is well managed, particularly with respect to labour relations. This was an area of deficiency on five projects: Lepreau, the CGE and AECL heavy water plants, the Gulf Refinery and Come-By-Chance. Special agreements were in place with the construction unions in each case, but little effort appears to have been made to plan the allocation of work among unions before construction actually began. The lack of such planning resulted in several jurisdictional disputes.

Jurisdictional disputes are disagreements between unions over work assignments. They are one of the most common causes of work stoppages in the construction industry. They are a common problem due to the temporary nature of construction work and the natural tendency of trade unions to try to expand or retain employment opportunities for their members.

The work assignments for which the trade unions claim jurisdiction are specified in the constitutions of the respective international unions. These claims are set out in considerable detail, often occupying several complete pages of text. There is no formula for establishing jurisdiction. It is based on industry practice and evolves with changes in construction technology and types of projects. It is precisely because jurisdiction is based on precedent that trade unions are anxious to retain established work assignments and capture new ones.

Jurisdictional disputes, while common, are not inevitable, even on major construction projects. The main causes of disputes may be summarized as follows:

- Poor Planning. One of the most prevalent causes is the failure to carry out a comprehensive pre-job conference or "mark-up" meeting at which relevant details of the project are explained and work assignments established.

- Inconsistency. Contractors are not consistent in work assignments. Local contractors are not always familiar with international standards.

- Expediency. Work assignments are based on convenience rather than established practice.

- Unfamiliarity. Projects can involve novel technology or equipment for which no work assignment precedents exist in the local area. This source of dispute could be eliminated with a careful mark-up meeting. But this may not be possible if construction commences before designs are complete.

As on any major construction project, the potential for jurisdictional disputes exists on the Venture and Hibernia projects. The potential varies depending on the complexity of the construction activity in question and the number of trades involved. For example, in the case of Venture, the gas plant would appear to have the greatest potential for disputes because it may involve equipment and construction methods with which union locals are unfamiliar: the installation of pre-assembled or pre-fabricated modules and equipment packages. This source of dispute is not without precedent in Canada. The sales gas pipeline should be the least dispute-prone since it involves conventional technology with well established work assignments.

Community Impacts

Consideration of how communities would be affected during construction and operation of the major projects did not feature prominently in the planning of the latter. Fortunately, serious problems did not arise in most cases. This was due either to the remote location of projects and the use of self-contained construction camps, or to the particular circumstances of the communities in question. Where problems did arise they tended to be of a serious nature. With the type of planning that now accompanies major projects, it is arguable most could have been anticipated and either avoided altogether or at least minimized.

In brief, the more serious problems were as follows:

- The concurrent projects at the Strait of Canso resulted in a large influx of people during construction, and again as production began. The community of Port Hawkesbury in particular experienced a severe strain on social services and physical infrastructure. Land and housing prices rose rapidly. Had it been possible to schedule the projects with less overlap, these problems would not have been so severe.

- On projects in remote areas and adjacent to small communities, few jobs were available to local residents. This is because labour was supplied through the construction unions and union membership tends to be low in such areas. While the practice of hiring union members first and only expanding membership once full employment is reached is well established, it is nonetheless a sore point for persons with relevant skills who are unable to obtain work at a project on their doorsteps. A more flexible hiring policy under these circumstances would make a valuable contribution to the acceptance of projects by adjacent communities.

- Shortages of high skill mechanical trades (i.e., pipefitters and welders) were experienced at the Gulf Refinery and Lepreau projects. The shortages at Gulf were not satisfactorily resolved. The unions in question were reluctant to allow out of province workers onto the site given the high unemployment rates in Cape Breton. Local workers without the proper qualifications were admitted into the union instead. Productivity at the site suffered and delays resulted. At Lepreau the shortages were overcome by hiring away workers from industrial employers. One of the hardest hit, Saint John Shipbulding and Dry Dock, reported turnover rates in some metal working trades in excess of 100 percent during the peak construction period. In both cases, the problems might have been avoided through better project and labour force planning.

- The concentration of heavy industrial operations at Point Tupper posed a health and safety threat to nearby residents. Residents eventually were relocated away from the plants. Prior to construction, no indication had been given to residents of the potential hazards.

To conclude, the major construction projects implemented in the Atlantic Provinces over the past twenty years provide a useful frame of reference for understanding the onshore impacts of the proposed Venture and Hibernia developments. While in general the offshore projects are characterized by relatively higher capital costs and employment content, their onshore construction elements tend to be broadly similar in scale and duration to certain of the major projects. From the perspective of community and social impacts, this point is of considerable relevance. Planners should not lose sight of this when the offshore projects are prepared for implementation.

PART TWO

PROJECT PROFILES

WRECK COVE HYDRO-ELECTRIC GENERATING STATION

BACKGROUND

The Wreck Cove Hydro-Electric project was the last major hydro source available in Nova Scotia. Implemented by the Nova Scotia Power Corporation (NSPC), the project is located in the northern part of Cape Breton Island about 25 km south of the town of Ingonish. The 200 megawatt facility is utilized primarily for peaking purposes, that is, the water is stored and only utilized at times when electricity demands are highest. Water from a drainage area of about 220 km^2 was diverted for the project. The development has been described as a miniature Churchill Falls, because in effect a waterfall inside a mountain was created. Water cascading through the access tunnel to the underground powerhouse generates the electricity.

This hydro development was the subject of great environmental concern. Two separate environmental impact assessments were completed and several public meetings were held. Given the nature of the project and the large geographic area it affected, careful attention to the biophysical environment was necessary.

CONSTRUCTION PHASE

The construction site was located in the wilderness of Cape Breton. The development involved the construction of 19 dykes and dams, 15 canals and 3 tunnels totalling 10.5 km in length. A power house with two hydraulic turbines, two 100 Mw generating units and auxiliary equipment were constructed almost 25 m vertically below the surface.

Scheduling

According to the original schedule, the project was to start in the fall of 1975 and to conclude in the fall of 1977. The construction of access roads to the wilderness areas of the water shed was started in 1975. The first 100 megawatt unit began generating power in March of 1978 with the second unit coming on stream a month later. The main factor causing the delay was a strike by NSPC's operating engineers in the early stages of the project. The other factor was the late delivery of equipment for the power house.

Capital Costs

The final project capital cost was $147 million. This was approximately $19 million over the budgeted amount of $127.8 million. There was much controversy in the latter stages of the development as to what the original estimated cost was. A figure of $80.6 million was initially publicized, based on a feasibility study of the project. After the detailed engineering was completed, the actual cost was estimated at $127.8 million. The most significant factor in the cost overrun was related to price inflation. Planners of the development used a 10 percent inflation rate when estimating equipment costs. The actual rate of inflation was in the order of 20 percent per year. It is estimated that this added $14 million to the project. The work delay and the late delivery of key pieces of equipment resulted in an additional $5 million in cost overruns. It was estimated that for every month the project was delayed, an additional $1 million was added to the total cost.

Employment

Wreck Cove construction created about 1,600 person-years of employment for the Cape Breton economy. A peak workforce of nearly 900 was reached in 1976, almost 200 persons higher than originally estimated. The work force was subject to great seasonal variation. The normal summer workforce consisted of 500-700 tradespeople but during the winter months it dropped to 200-300.

The worksite was unionized, and contractors on this job were required to hire personnel through the unions' business agents. It is estimated that over 90 percent of the tradespeople did originate in Cape Breton. In fact, a significant number of persons were reported to have been hired from the immediate project area. Initially, there had been fears that local people would not benefit from the employment opportunities due to established union hiring practices. It appears that at least some local persons wishing to work on the project were able to do so.

Skill Requirements

This project involved the development of a large watershed area and the excavation of tunnels leading to the powerhouse. For these reasons, the project workforce was dominated by civil trades, particularly operating engineers, labourers and miners. The miners were the highest paid workers on the job site; they were compensated for danger and also received bonuses for meeting production objectives.

Skill Shortages

There were no reported skill shortages and as noted over 90 percent of the work force came from the Island. During construction, there were no major projects competing in the local labour market. The project started just after the rehabilitation of the Glace Bay Heavy Water Plant was completed and before the construction labour force at the Lingan Generating Station reached its peak.

Labour Relations

Labour relations were governed by an area industrial agreement signed in 1975 between the Cape Breton Island Building and Construction Trades Council (on behalf of the unions) and NSPC, DEVCO and the prime contractor at the Glace Bay Heavy Water Plant. A notable feature of this agreement as it related to Wreck Cove is that it was negotiated by NSPC, not the contractors undertaking the work. This agreement contained provisions for very generous wage increases, effectively allowing for a 35-40 percent rise over the period June 30, 1975 to January 1, 1977.

The Wreck Cove Project experienced excellent construction labour relations. There were no work stoppages related to activities of the construction unions. The only labour problem on the work site involved the NSPC's own employees. The corporation's operating engineers went on strike across the province in late 1975 and work at the Wreck Cove site was halted.

Community and Social Impacts

Prior to project implementation, concerns were expressed about the potential negative socio-economic impact it would have on this region of Cape Breton. These initial fears were not borne out. The characteristics of the workforce and the way they were housed contributed to this result. Two construction camps provided housing for up to 500 single workers and 65-100 families. These camps provided the personnel with a full range of recreational facilties. Since most of the workforce was from the Island, most workers returned home on weekends. The result was that residents in nearby Ingonish reported that very few construction workers visited their town. This also meant that very little of the construction workers' income was injected into the local economy.

OPERATIONS PHASE

The operation of the Wreck Cove Hydro Project created very few permanent jobs for the Cape Breton economy. The facility employs five people on a year round basis. This small number of people was absorbed into the local economy without putting any undue strain on local community infrastructure and services.

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GLACE BAY HEAVY WATER PLANT

BACKGROUND

In the early 1960's, Atomic Energy of Canada, Ltd. (AECL) anticipated it would need considerable quantities of heavy water by the late 1960's. In 1964, AECL awarded a contract to Deuterium of Canada Limited (partnership of Deuterium Corporation of New York and Industrial Estates Ltd., Nova Scotia) to begin construction of a heavy water plant at Glace Bay. The project was beset with labour and technological difficulties. In 1966, the Nova Scotia government purchased the Deuterium Corporation's interest in the project. By early 1969, technical problems prevented the plant from coming on stream. Construction work stopped and the plant was operated on a maintenance basis. In 1971, the decision was made to dismantle the original plant and rehabilitate the project to a modified design. This was expected to take until late 1974. It is the rehabilitation of the Glace Bay Heavy Water Plant that is the subject of this report.

CONSTRUCTION PHASE

The rehabilitation of the plant took place over the 1972-1976 period. The project suffered several delays which led to serious cost and schedule overruns. The delays were attributable to the following factors:

- problems with delivery of equipment and supplies;
- design was modified during course of construction;
- bad winter conditions between December, 1974 and May, 1975;
- general nature of the project, i.e., dismantling and reconstructing without accurately knowing the plant's condition;
- worker productivity was lower than expected; and,
- some time was lost due to work stoppages.

Schedule

The initial rehabilitation project was scheduled to be completed in 36 months, between January 1972 and December 1974. In fact, AECL entertained hopes that the project could be completed in much less time. The project was completed in early 1976, about twelve months later than the original schedule.

Capital Costs

The initial capital cost estimate was $100 million. The final capital cost was 30 percent higher at $130 million. The reason for the cost overrun is partly explained by the factors which caused delays. The cost of materials and equipment were originally estimated to increase by 12-15 percent over the life of the project, but increases in the 30 percent range were experienced. It is estimated that this was directly responsible for $10 million of the $30 million cost overrun. The cost estimate was also based on the condition of the plant in June 1971, and did not allow for further deterioration of the plant before construction actually began.

Employment

It is estimated the rehabilitation of the Glace Bay heavy water plant generated a total of 2,500-3,000 person-years of employment. Peak employment occurred in July, 1974 when 1,240 tradespeople were on the work site. There is no documentation available as to how these employment levels compared with anticipated levels. The fact that this project started after the major projects in the Strait of Canso were completed, helped alleviate many of the labour problems which plagued the original construction of the heavy water plant. Much of the labour force that had worked in the Strait was available to work on this project. Also, throughout the duration of the project, no other major construction jobs competed in the same labour market.

Skill Requirements

The range of skills required are typical of major construction projects. Peak requirements by trade and month in which they occurred are set out in Table 1. Most of the tradespeople came from the Cape Breton labour market. At peak, fewer than 300 of the 1,240 person labour force came from the Nova Scotia mainland, other parts of Canada or from abroad. The requirements for pipework increased by 50 percent during the course of the project due to the incorporation of improved safety standards. This increased the requirements for pipe trades such as pipefitters and pipe welders.

TABLE 1

AECL Heavy Water Plant
Peak Employment of Trade (persons)

Trade	Peak Employment Number	Month
Ironworkers (rod)	26	May/1973
Carpenters	135	June/1973
Cement finishers	23	July/1973
Boilermakers	160	Sept/1973
Sheetmetal workers	44	Nov/1974
Labourers	144	Dec/1973
Hoisting engineers	27	Jan/1974
Truck drivers	18	Jan/1974
Millwrights	13	April/1974
Ironworkers (structural)	62	May/1974
Pipefitters	411	July/1974
Welders	182	July/1974
Electricians	99	Aug/1974
Oilers	4	Sept/1974
Painters	62	Sept/1974
Insulators	146	March/1975
Warehousemen	5	Aug/Nov/1975
Mechanics	4	Steady over much of project
Total All Trades	1,239	July/1974
Salaried Staff	196	Dec/1974
Total All Employees	1,406	July/1974

Source: Roy E. George, The Heavy Water Plant Being Constructed for Atomic Energy of Canada Limited at Glace Bay, Nova Scotia A Case Study, Department of Regional Economic Expansion, Halifax, 1975.

Skill Shortages

For most trades, the Cape Breton labour force had little or no problem meeting the project demands. The exceptions were the pipe trades and insulators. The increases in pipe work and the high demand for the pipe trades generated by the Come-By-Chance Oil refinery were the major causes of the shortage. Insulators were also in short supply. The ratio of journeymen to apprentices reached a critical level of one to two. Normally, the ratio should be four to one. The project experienced difficulty in attracting tradesmen from other parts of Canada. The shortfalls were overcome by importing both welders and insulators from the U.K. This measure was only taken when recruitment of other Canadian tradesmen had failed.

Labour Relations

The original Deuterium project experienced management-union relations which were termed disastrous. With the exception of an unfortunate incident involving the insulators imported from the U.K., the rehabilitation project experienced relatively harmonious labour relations.

The project was a union job site with labour relations governed by a project agreement negotiated between the prime contractor and the Cape Breton Trades Council. It was only the third multi-trade agreement negotiated in Cape Breton. Although the first agreement did allow for a six month extension, it was necessary to renegotiate a second agreement in July of 1975. The agreement contained a no strike/no lock-out provison. This agreement covered not only the heavy water plant, but all industrial projects on Cape Breton valued at over $8 million. The Cape Breton Development Corporation and the Nova Scotia Power Corporation were added as signatories to this agreement.

The project lost a relatively small amount of time to labour relations problems. In contrast with other major industrial projects at that time, it is interesting to note that not a single day was lost due to jurisdictional disputes. This was surprising given the nature of the project where much of the design was done as the project went along. The contractor held an initial "mark-up" meeting lasting two to three days. All parts of the work was assigned to the various unions. Two additional meetings were held in the course of the project as jurisdictional questions came up. The results of this procedure contrast with the initial project where no "mark-up" was carried out.

Community and Social Impacts

When the project was at its peak, 80 percent of the tradespeople were from Cape Breton and 10 percent from the rest of Nova Scotia. This factor helped alleviate any negative impact a project of this type can have on a community. Most of the men lived at home and commuted to the work site on a daily basis. A temporary camp for 250 men was constructed at the work site, about three to four km from the town. According to labour sources, this camp was never more than 50 percent utilized.

OPERATIONS PHASE

Until its closure in 1985 due to weak marekts, the operation of the Heavy Water Plant employed approximately 330 persons. Many of the positions were relatively high paying technical jobs and made an important contribution to the economic well-being of the area. Closure will deliver a serious blow to an already weak local economy as there are few opportunities in the local area open to the employees of the plant.

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CGE HEAVY WATER PLANT

BACKGROUND

During the 1960's the federal government through its crown corporation Atomic Energy of Canada Ltd. (AECL) encouraged the private sector to construct plants capable of supplying heavy water to the nuclear industry in anticipation of increased demand. As a result of this, the Canadian General Electric Company undertook construction of a heavy water plant at Point Tupper, Nova Scotia. This plant experienced severe financial and technical problems during construction, and AECL subsequently purchased it from General Electric.

CONSTRUCTION PHASE

The CGE Heavy Water Plant was the first of three major projects to be implemented in the Strait of Canso area within a three-year period. Construction on the Gulf refinery began in 1968, followed closely by a major renovation at an adjacent pulp and paper mill. Construction activity at the three sites was concurrent during 1970. The Heavy Water Plant construction experienced both cost and schedule overruns. There is conflicting information about the magnitude of these overruns.

Schedule

Construction began in mid-1966 and was completed in the fall of 1970. Company officials maintain they had expected the plant to be completed by late 1969, whereas the contractor maintained the date was late 1970. Secondary sources tend to side with the owner, implying a one-year schedule overrun. It has been estimated that labour difficulties were responsible for delays of six to eight months. Engineering and design problems accounted for the other four to six months.

Capital Costs

Original cost estimates for this project range from $40-$65 million. The estimates of final cost range from $68-$90 million. Secondary sources place the initial cost estimate in the $50-$55 million range and the final cost in the $85-$90 million range. The uncertainty relating to these costs can probably be attributed to revisions in the design as the project progressed. In addition to the reasons cited above for time overruns, the project is reported to have suffered from large scale waste and confusion due to poor construction management.

Employment

Construction of the CGE plant generated approximately 2,500 person-years of employment. Original estimates for the project were closer to 1,400 person-years. Peak employment of 1,200 persons was reached in the fall of 1968 and maintained until the spring of 1969.

Skill Requirements

Detailed information on a trade-by-trade basis for this project is not available. However, the profile on the reconstruction of the Glace Bay Heavy Water Plant contains a table of the peak employment by trade. It is reasonable to assume that the trade mix on the CGE plant would have been quite to the Glace Bay project. In terms of skill level and numbers, by far the most important trade group was the pipefitters; other important trade groups were the boilermakers, welders, electricians and insulators. As with the other heavy water project, the civil trades (carpenters, labourers, etc.), would have peaked in the early phase of the project with the mechanical trades being utilized in the more advanced stages.

Skill Shortages

Though Cape Breton had a large construction labour force, it was relatively inexperienced with projects requiring stringent fitting and welding standards. The supply of workers with the requisite skill levels was initally low and had an adverse effect on productivity. These problems did not last long, as workers' skills improved rapidly with on-the-job experience. The heavy water plant was the first major project to start construction and in this respect had an advantage over others in the area in that it didn't initially have to compete for skilled labour. This may explain in part why it was generally felt that the rejection rate on pipe welds was significantly lower than on the Gulf refinery.

Labour Relations

This project was governed by a project agreement negotiated between the prime contractor and the individual trade unions. The negotiation of this agreement was relatively smooth. The administration of the agreement was a different story. The project experienced numerous work stoppages, though total time lost was not significant. A substantial number of these stoppages were caused by jurisdictional disputes, a reflection of the inexperience of both management and labour with this type of project.

Community and Social Impacts

There was a considerable overlap among three major projects and related infrastructure development in the Strait of Canso area. This makes it difficult to isolate the impact of any one project. The construction activity in general resulted in a substantial influx of workers to the area. This caused a substantial demand for accommodation in the area, though between 40 and 60 percent of the workers were housed in construction camps. The project caused housing and rental costs to rise sharply, retail prices to rise and placed severe constraints on municipal services and infrastructure.

OPERATIONS PHASE

The plant at Point Tupper has suffered the same fate as the one at Glace Bay: it ceased operations in 1985 due to weak markets for heavy water. The plant operated for fifteen years, employing about 350 people. Like Glace Bay, the Strait of Canso area faces a bleak future with the loss of the personal income and other revenues generated by plant operations.

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BAY D'ESPOIR HYDRO-ELECTRIC GENERATING STATION

BACKGROUND

The Bay d'Espoir Hydro-Electric Station is located on the south coast of Newfoundland, to the west of the Burin Peninsula. The station utilizes the watersheds of four major rivers and has an installed capacity of about 580 MW.

The hydro-electric potential of the Bay d'Espoir area was first recognized in the early 1920's. The decision to proceed with its development was not made until the early 1960's. At that time, electrical demand forecasts predicted that the addition of about 225 MW to the provincial grid would satisfy demand into the late 1970's. The province's successful drive to attract industrial users subsequently forced the Newfoundland Power Commission to revise its load growth estimates such that an additional 450 MW was required. The initial Bay d'Espoir project was therefore expanded to accommodate a two stage development. This plan was further revised in the late 1960's to a three stage development which in total would add about 750 MW to the provincial grid. Stage III was subsequently revised downward from the original 300 MW to 130 MW. When work was completed in 1975, a total of 580 MW and been added to the system.

This profile covers Stages I and II only.

CONSTRUCTION PHASE

The original plan for Bay d'Espoir was revised several times such that the overall project was divided into three stages. Government's decision to proceed with the project was predicated on receiving federal assistance with the construction of a necessary transmission system and road link with the area. The powerhouse, transformers and auxiliaries were situated at St. Albans. Seven major dams and five canals were required to control the runoff from the various watersheds.

Schedule

Major civil construction of Stage I of the project began in July, 1965 with the planned installation of three generators and associated infrastructure. Stage I was essentially completed in 1967. The first generating unit at Bay d'Espoir was commissioned in May, the second in June, and the third and final unit of Stage I in October of 1967. The work on installing an additional 225 MW began in 1966 while Stage I was in progress. The civil works were completed in December, 1969, and the sixth and final unit became operational in March, 1970. The total project consisting of stages I and II has taken 57 months to complete.

Capital Cost

The estimated cost of Stages I and II including the cost of the transmission system and highway was $142 million. The project was completed at a cost of $181 million. Stage I costs rose from the estimated $78 million to $87 million, while Stage II costs rose from $64 to $94 million.

Employment

Bay d'Espoir (Stages I and II) generated about 6,000 person-years of employment. Accurate employment statistics by year are not available; on average the project employed about 1,400 workers per year. Peak employment occurred late in 1966 when 2,000 workers were on site with Stages I and II in progress. These employment statistics do not account for the indirect employment benefits attributable to the construction of the transmission line linking Bay d'Espoir with the priovincial grid or the highway from Bay d'Espoir to Bishop Falls.

Skill Requirements

The labour skills required to complete the project were similar to those found on other hydro-electric developments, notably Churchill Falls. Records indicate that over 90 percent of the persons employed were residents of the province. Table 1 outlines the construction trades used on the project. Provincial vocational training schools were called upon to provide training in many of the skills required at Bay d'Espoir and made a valuable contribution to supply of skilled tradesmen, thus reducing in-migration of workers from outside the province.

Skill Shortages

The Bay d'Espoir development coincided with the development of Churchill Falls and the construction of a phosphorus plant at Long Harbour, also on the province's south coast. The combined demand caused shortages in both the skilled and unskilled labour markets. Engineering skills were in short supply and the project manager was forced to recruit personnel outside the province. Wage competition with Churchill Falls resulted in some movement of skilled workers from Bay d'Espoir to that project. While this created some problems, the Bay d'Espoir construction schedule was not materially affected.

TABLE 1

Construction Trade Skills Employed at Bay d'Espoir

Trades
Carpenters
Crane Operators
Electricians
Machinists
Mehcanics
Plumbers and Pipefitters
Oil Burner Mechanics
Heavy Equipment Operators
Refrigeration Mechanics
Boilermakers
Shovel & Dragline Operators

Source: Evening Telegram, March 22, 1966.

Community and Social Impact

Before the development began, the Bay d'Espoir-St. Albans area had per capita incomes well below the provincial average. Similarly, the community infrastructure lacked facilities such as schools, hospitals, and recreational facilities. Transportation and communication links in the general area were also poor. Initially planners projected that the Bay d'Espoir area would reach a population of 10,000 people in the first three years. Plans to develop the area's port facilities and the availability of low cost electricity were seen as factors which might contribute to future industrialization of the general area. A major development plan was prepared and with federal assistance an airport was built at St. Albans, transportation links with Bishop Falls were completed, water and sewage systems were installed, and education and medical facilities were upgraded. Some industrial development did accompany the project, attracted by the offer of highly favourable electricity prices. But to the disappointment of residents in the local area, these developments occurred elsewhere in the province.

OPERATIONS PHASE

The Bay d'Espoir facility has a permanent workforce of 55 people. The project contributed to the development of a unified production and transmission system within Newfoundland thus making it easier to control and manage electricity output.

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GULF CANADA OIL REFINERY

BACKGROUND

The construction of the Canso Causeway created a sheltered, deep and ice-free harbour. The Gulf Oil Company did not have an east coast refinery that had access to harbour facilities capable of handling large world class oil tankers. Market conditions and the availability of appropriate harbour facilities led Gulf to construct an 80,000 barrel/day refinery at the Strait of Canso. The refinery was intended to receive oil shipments for the middle east and produce a product mix consisting of lighter products, i.e., gasoline, furnace fuel, diesel oil, etc. During construction, a cost cutting measure was taken to simplify the refinery's process. The plant's "cracking capacity" was downgraded. The result was a product mix yielding approximately 50 percent heavy fuel oil. Generally, poor market conditions and a glut of heavy fuel oil on the east coast market caused Gulf to suspend refining operations in 1980. The refinery remains closed.

CONSTRUCTION PHASE

The refinery was constructed over the period mid-1968 to April, 1971. During the same time period, two other major construction projects were underway in the Strait of Canso area: the CGE Heavy Water Plant and a major expansion of the Nova Scotia Forest Industries pulp and paper mill.

Schedule

The project was scheduled to have been completed early in 1970. It was completed in April 1971, more than a year behind schedule. The major causes of the schedule overrun were numerous work stoppages, low labour productivity and inefficient construction management.

Capital Costs

The initial cost estimate for the refinery was $68 million. The final cost was $104 million, about 50 percent higher. During the course of construction, the plant design was modified in an attempt to save time and cost. This would make the cost overrun even more serious than the actual numbers indicate. Secondary sources estimate $9 million of the overrun was caused by labour problems, while the remaining $27 million was accounted for by an underestimation of the cost of machinery, equipment and services. The company's view at the time was that much of the increased cost could have been avoided had labour productivity been up to the Canadian construction industry standard. They cited the example of a similar refinery built at the same time in Alberta for a total cost of just over $60 million. Other analysts attribute the cost plus contract under which the project was executed of not providing any incentive for contractors to be cost conscious.

Employment

Construction of the refinery generated approximately 2,900 person-years of employment. The initial estimate was in the order of 1,900 person-years. Peak employment occurred in the spring of 1969 when 1,800 persons were on the job site. There is little evidence of detailed manpower planning having taken place in the preliminary stages of the project.

Skill Requirements

Detailed data on a trade by trade basis is not available. The nature of the work suggests that significant numbers of the highly skilled trades already in demand in the area were required to build the refinery. Pipe fitters and welders, electricians, instrument fitters, millwrights and insulators tended to be the most important trades. The civil trades (carpenters, labourers, concrete workers, etc.) were utilized in the early stages but as work progressed, demand for these skills dropped off.

Skill Shortages

As noted, construction of the Gulf refinery occurred at the same time as construction of two other major projects in the area. The combination of these projects led to a peak construction workforce in excess of 3,000 persons. The general lack of experience of the Cape Breton labour force with major projects of this type caused significant skill shortages in many trades. Serious skill shortages were most prevalent in the following trades: pipefitters, pipewelders, electricians, insulators, instrument workers and millwrights. To overcome these shortages, some workers were imported. It is reported that 100-150 pipefitters from Quebec worked on the project. The local trade unions resisted the importation of skilled workers from other areas. It has been reported that many unqualified persons were admitted to the union as journeymen. In many trades, no attempts were made to overcome shortages and this in turn contributed to the project's schedule problems. The importation of workers that did take place caused a great deal of resentment in the Cape Breton labour force. As long as there was relatively high unemployment in Cape Breton, there was great pressure to hire local persons regardless of qualifications.

Labour Relations

As with other construction projects in Cape Breton at this time, a project agreement governed the building of the refinery. Fortunately the agreement contained provisons for extension if the project was not completed within the expected time frame. The agreement was negotiated by the prime contractor and business agents and international representatives for the individual unions.

The project experienced a significant number of illegal work stoppages. Among the main causes of these stoppages were jurisdictional disputes, pay and work conditions and complaints regarding management. Approximately half of these disputes involved all trades. The underlying causes of these walkouts are difficult to pinpoint. Lack of leadership, inexperienced unions and poor project planning are generally thought to have been responsible for most of the stoppages.

Community and Social Impacts

It is not possible to consider the impact of the refinery project on the Strait area in isolation from the other two major projects that occurred there concurrently. The nature of these community and social impacts is discussed in the profile of the CGE Heavy Water Plant.

OPERATIONS PHASE

During operations, the refinery employed approximately 140 people. This permanent workforce placed a different type of demand on the town for services than did the construction phase. Most of the people did not come from the immediate area but rather from other parts of Canada. The types of jobs at the refinery were relatively technical, highly skilled and well paid. When the refinery ceased operations in 1980, a substantial proportion of the workforce accepted offers from Gulf to move to jobs in other areas. The loss of these jobs represented a significant blow to the community.

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LINGAN GENERATING STATION

BACKGROUND

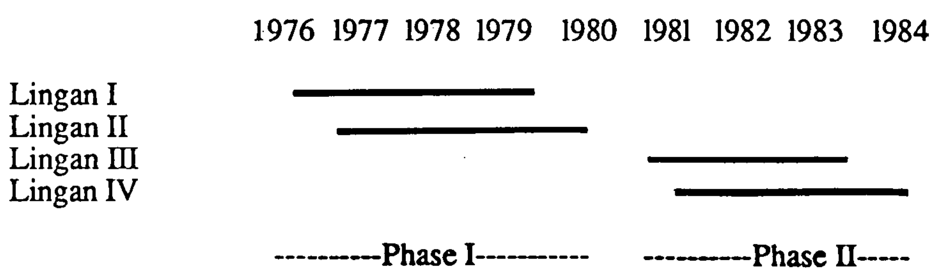
The relative price advantage of oil to coal during the 1960's led the Nova Scotia Power Corporation (NSPC) to develop its generating capacity using oil as its primary source. When oil prices dramatically increased in the 1970's, the utility was dependent on oil for 60-70 percent of its generating capacity. In view of this, NSPC embarked on a plan to reduce its dependence on petroleum and increase its coal generating capacity. As part of the plan, four 150 MW generating stations have been constructed at Lingan in Cape Breton.

CONSTRUCTION PHASE

The total project entailed the construction of four separate generating units. All units have been built on the same site and are part of the same complex. The project was split into two phases. Lingan I and II were built together with a six month lag in the start-up and finishing times. Units III and IV started six months after Unit II was finished. Although the two units were built simultaneously, they were treated as separate and distinct construction projects. In terms of estimated costs and construction time, the project is considered to have been a success.

Schedule

The schedule for the Lingan units is set out below:



The combined total estimated construction time for the projects was 167 months. The project was actually completed in 153 months. The first two units each took approximately 3.5 years to construct while the second two units were each completed in three years. As shown in the project schedule, the first unit was completed exactly on time. The following three units took one to four months less to complete than originally planned.

The Power Corporation attributes the project's success to several factors: good labour relations, on-time deliveries of plant components and equipment and the repetitious nature of the construction process.

During the eight years over which this project took place there were no work stoppages. A very few days were reported as lost during the renegotiation of collective agreements. It appears that a responsible attitude towards labour matters existed between management and the labour organizations. The fact that there were no other major competing projects that could have provided alternative employment for the labour force at this time may also have been a contributing factor.

Capital Costs

The original estimated cost of completing the four units was $492 million. The completed cost was $396 million close to $100 million under budget. Through the project was completed at less than its budgeted cost, the extent of the savings is more nominal than real. In preparing the original estimate, NSPC officals used an across the board inflation factor of 15 percent for Units III and IV. In fact, over the period of construction the price index for this sector of the economy was in the 6-9 percent range on an annual basis. This accounted for a significant part of the "cost savings" related to the original budget.

Employment

The construction of the four units created a total of 2,700 person-years of employment. The peak in the first phase was between 600-700 persons occurring in late 1978-early 1979. The peak in the second phase was reached early in 1983 when 550 tradespeople were on site. Detailed information on the Phase II construction manpower loading reveals that the project implementation attempted to phase the work on each unit so that the labour demand remained relatively constant over a period of time. The Cape Breton labour was able to meet the demands of this project and there were no reports of off island trade labour working on the project.

Skill Requirements/Skill Shortages

The trades required at the peak of the second phase are set out in Table 1 for each unit. The most important trades were ironworkers, pipefitters/welders/plumbers and electricians. The Cape Breton labour force had no difficulty meeting the labour demands both in terms of skill level and number of tradespeople. It should be noted that during the construction of the entire Lingan project there were no other significant construction projects which might have competed for labour.

TABLE 1

Peak Labour Requirements During Phase 2
Construction of Lingan Generating Station

Trade	Peak Employment No.	Month
Carpenters	55	May/1981
Millwrights	25	May/1983
Electricians	115	Feb/1983
Labourers	38	Oct/1981
Insulators	25	May/1983
Ironworkers, Welders, Rodsmen	110	Aug/1982
Operators, Inst. Man Survey Asst.	35	Nov/1981
Painters, Glazers	35	Oct/1983
Pipefitters, Welders, Plumbers	105	Feb/1983
Sheetmetal Workers, Roofers	35	May/1983
Supervisory	95	Feb/1982
Boilermakers	75	Dec/1982
Service Staff	30	Feb/1983
Teamsters	7	Jan/1981
Elevator Operators	2	several mos.
Phase 2 Peak	550	Feb/1983

Source: Nova Scotia Power Corporation, personal communications

Labour Relations

This project fell under the definition of an industrial project and therefore the collective agreement was between the unions of the Cape Breton Trades Council and NSPC. From a labour relations standpoint, this project was considered by the Power Corporation to have been a tremendous success. The smooth relation contributed to the completion of the project ahead of schedule and under budget. There were no illegal work stoppages and only a few days were lost when the agreement was being renegotiated. The Power Corporation contributed much of its labour relations success to careful management of the collective agreements.

Community and Social Impacts

The project was constructed in the heart of industrial Cape Breton. The potential problems associated with large construction projects did not arise because the majority of the construction workers were residents of the immediate area. (Lingan is situated between Glace Bay and Sydney). There was no requirement for temporary housing such as a work camp.

OPERATIONS PHASE

The operation of the plants requires approximately 125 NSPC personnel. Given the small number of jobs created in relation to the economy of the area, no difficulty was experienced in recruiting personnel. The employment created by this project was most welcome in an area that has been experiencing extremely high unemployment rates for a number of years.

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COME-BY-CHANCE REFINERY

BACKGROUND

The 100,000 barrel per day Come-By-Chance oil refinery was developed jointly by the Province of Newfoundland and an American financier, John Shaheen. The refinery is situated at Come-By-Chance, a deepwater, ice-free harbour on the isthmus connecting the Avalon Peninsula to the main part of the island of Newfoundland, approximately 150 km from St. John's.

In the early 1960's, as part of its economic development program, the government of Newfoundland tried to establish several large industrial projects in the province. Come-By-Chance was identified as an area for development because of its strategic location and natural harbour. Various schemes including a pulp and paper mill and an anhydrous amonia plant were examined. Although initial steps were taken to prepare an industrial site, these projects did not come to fruition. Rather, industrialization plans were revised to accommodate the development of a three-phased complex valued at $500 million. The first phase was to consist of a $120 million oil refinery, to be followed by a petro-chemical plant and finally a pulp and paper mill and a petro-chemical plant. Only the refinery was built.

With a Newfoundland government guarantee for a $30 million bond and federal assistance of $20 million for wharves and docking facilities, plus a $125 million loan from a syndicate of British banks headed by Klienwort Benson and guaranteed by the Export Credit Guarantee Department of the British government, the project began. The Newfoundland Refining Company (NRC) was set up to manage and operate the refinery. NRC arranged for the purchase of light Kuwait and Iranian crude which was to be transported to Come-By-Chance and refined into jet fuel, motor gasoline and propane. NRC negotiated sales contracts with five major U.S. airlines to purchase over 70 percent of the refinery's output, the balance to be sold in Europe and Canada.

Financing was arranged in 1971 and construction began in that year. By mid-1972, the project was frought with construction delays and additional funding was required. In late 1973, the refinery began operations. By the end of 1975 it was losing $10 million per month and in early 1976 it was placed into receivership owing over $600 million.

CONSTRUCTION PHASE

The original plan for Come-By-Chance called for the setting up of three crown corporations to build the refinery. Under a separate agreement the province delegated to NRC the responsibility for supervising construction, managing the refinery and selling the refined products. Due to financing arrangements, PROCON Limited of Great Britain was selected as the project's major contractor to build the refinery at a cost of $155 million in August of 1970.

Schedule

Site preparation and preliminary planning for Come-By-Chance was delayed until federal assistance was received for the refinery's wharf and docking facilities. Actual construction began one year late, in 1971. The construction schedule was disrupted midway through the project due to design changes. Consequently, working capital deficiencies resulted in slowdowns. An injection of an additional $25 million allowed the project to proceed and finish in late 1973, behind schedule.

Capital Cost

The initial projected cost of the refinery was $120 million. Design modifications resulted in delays and the final cost rose to $198 million. The refinery was, however, never completely finished so that it could produce the products, such as jet fuel, that it had initially been designed to do.

Employment

Come-By-Chance generated about 4,000 person-years of employment. Peak employment occurred in 1973 when 2,400 workers were on the site. In 1972, the project employed 1,700 workers, while in 1974, the number employed declined to 800 persons of which about 500 were full time operating personnel.

Skill Requirements

The range of construction trades required to complete the project was typical of that required for major industrial developments. Detailed records of labour requirements by trade are not available, but among the key trades in terms of skills and numbers would have been ironworkers (particularly riggers and scaffolders), boilermakers, pipefitters, plate and pipe welders and insulators. A skilled labour surplus existed because major projects, notably Churchill Falls, were near completion.

Skill Shortages

Construction of the phosphorus plant at nearby Long Harbour and the hydro-electric development at Churchill Falls were nearing completion as construction at Come-

By-Chance was beginning. This meant a substantial pool of skilled labour was available in the province. Estimates of Newfoundland labour content in the project exceed 85 percent, though most workers lived beyond easy commuting distance of the project. Specialized chemical engineering and supervisory personnel were recruited outside the province by the prime contractor. A limited number of construction labourers (fitters, welders and insulators) were recruited from the Maritimes and Quebec.

Community and Social Impact

The overall impact of the development at Come-By-Chance is considered to be small when compared to the impact that similar sized projects have had on other areas. This is due primarily to the rapid growth that had occured in the area surrounding the refinery site for the preceeding ten years. The Newfoundland government had designated a number of communities in the area as growth resettlement centres in the early 1960's. The population within fifty kilometres of the site had increased by 9 percent between 1960 and 1965, but between 1965 and 1970 the area recorded a population increase of 24 per cent. Most of this increase was confined to larger communities such as Arnold's Cove within five kilometres of the refinery site.

With the advent of these growth centres, the fishery had been displaced as a major employer. By the time the refinery's construction began, the fishing industry accounted for less than 10 percent of employment. The towns were fairly well developed with a high percentage of the population living in single detached units. Only in Clarenville were there to be found apartment buildings, while in no other community did rental accommodation exceed 10 per cent of the housing base. There was very little upward pressure on housing prices or on land prices. In many cases Crown land was available at little or no charge, and the homeowner supplied much of his own labour. Housing construction peaked in 1967 and gradually declined until 1971, and thereafter gradually rose between 1971 and 1976.

The construction phase had a limited impact on the housing market, but it greatly increased the capacity of local residents to buy durable goods. The limited impact on housing was due in part to the high proportion of home ownership by those working at the refinery. It was also due to the use of bunk-houses to accommodate non-resident workers. At peak, the bunk-houses accommodated about 1,400 workers.

Community and social impacts were minimal during production because most of those employed were carried over from the construction phase. While the area benefitted from the upgrading of skills by local residents, it also suffered as occupational adjustments occurred. The higher wages paid at the refinery attracted persons already employed. For example, the local hospital lost its entire technical staff to the refinery. Perhaps the most unpleasant aspect of the refinery's operation was the complete lack of integration into the local community of the 50 or so foreign management personnel. This group kept to itself and enjoyed privileges not available to resident workers. This led to jealousy and some animosity.

OPERATIONS PHASE

The refinery was hampered by a number of major problems. Technical problems caused by design and construction flaws in the hydrogen plant inhibited production of higher priced products. The 1973 Arab-Isreali war resulted in a major increase of crude oil prices, thus the cost of financing purchases escalated significantly. To counter this fundamental market change, the U.S. government imposed import restrictions on non-U.S. refiners. Prices for U.S. refiners were artifically set below the world price. Products produced from crude purchased at the world price and refined outside the U.S. were no longer competitive.

Long-term contracts to supply U.S.-based airlines were thus cancelled because of force mejure, resulting in refinery losses of $58 million in 1974 and an estimated $133 million in 1975. The refinery was forced to close in 1976. It was mothballed and subsequently sold to Petro-Canada.

When the refinery ceased operations, between 400 and 500 full-time jobs were lost. It is estimated that 260 of approximately 450 non-supervisory personnel remained in the area after the closure. The balance of those resident in the area left to seek alternate employment. Real estate values declined significantly as did the demand for consumer durables. This seems to have been a temporary phenomenon, since within two years housing prices were within 10 percent of their pre-bankruptcy levels. By 1980, the housing market had more or less fully recovered.

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POINT LEPREAU NUCLEAR GENERATING STATION

BACKGROUND

The Point Lepreau Nuclear Generating Station (hereafter referred to as "Lepreau") is a 630 megawatt plant owned and operated by the New Brunswick Electric Power Commission (NBEPC). It takes its name from its location, Point Lepreau, situated on the Bay of Fundy about 40 km west of Saint John.

Lepreau was built in response to growing concerns in the province about the latter's high and increasing dependence on imported petroleum as a source of electricity. Construction began in 1974 and the plant was commissioned and producing at full power by early 1983. At a capital cost approaching $1.5 billion, Lepreau was the largest investment ever undertaken in New Brunswick.

Construction of Lepreau was beset with numerous problems which led to serious cost and schedule overruns. Poor project planning and scheduling were a fundamental source of problems. Detailed drawings were often non-existent, inaccurate, inadequate or incomplete. Government's over-anxiousness to commence construction may account for this source of difficulties. In keeping with the inadequate state of planning, many of the construction contracts were of a cost plus and cost reimbursable type, and undoubtedly this contributed to the cost overruns. Finally, construction was not well managed from a labour relations perspective. There were many illegal work stoppages and jurisdictional disputes.

CONSTRUCTION PHASE

The original plan for Lepreau entailed overlapping construction of two 630 megawatt plants during the 1975-1982 period. For a variety of reasons, only the first unit was constructed. The second unit is at the proposal stage. Facilities common to both units were included as part of the first phase.

Schedule

Under the proposed schedule, construction on Lepreau was to begin in 1974 and be completed early in 1980. The project commenced more or less on schedule but was not fully operational until 1983, a full three years beyond the original estimate for the first unit. Indeed, construction of the first unit took almost two years longer than the original schedule for overlapping construction of two units.

Capital Costs

The initial capital cost of both plants was estimated at $854 million, with the first unit including common facilities estimated to cost $466 million, and the second unit $388 million. By the time Lepreau had become fully operational, the cost had risen from $466 million to just under $1.5 billion, more than three times the original estimate and just less than double the original estimate for both units.

Employment

Lepreau construction generated about 14,300 person-years of employment. This was made up of:

Activity	Person-Years
On-Site Work	11,000
Engineering/Design	2,300
Commissioning	1,000
Total	14,300

As with costs, actual labour requirements greatly exceeded initial estimates. The projected labour requirements were approximately 5,000 person-years for on-site work, just less than half the actual demand.

Peak employment occurred in March, 1979, when 2,400 workers were on site. This was exactly double the projected peak which was to have occurred late in 1977 or early 1978.

Skill Requirements

The range of skills required are typical of those found on major construction projects. Peak requirements by trade are shown in Table 1. For comparative purposes, actual and predicted requirements are given. For the major trades, requirements were underestimated by more than 100 percent. The degree of underestimation for pipefitters, one of the more critical trades, was in the order of 500 percent. The original estimate called for a peak of 200 pipefitters, and 960 were on site in September, 1979. The timing of peak requirements was off by between 1.5 to 2 years.

TABLE 1

Peak Manpower Requirements
A Comparison of Predicted and Actual
(Through September, 1979)

	Actual Peak		Predicted Peak		Differences		
	Number	Date	Number	Date	Number	%	Date
All Trades	2,275	June/79*	925	Jan/78	1,350	(146)	1 1/2
Labourers	385	June/79	155	1977	230	(148)	1 1/2
Electricians	365	Nov/79	175	78-July/79	190	(109)	1/6
Operators	140	June/79	40	1977	100	(250)	1
Sheet Metal	35	Oct/79*	22	Jan/78	13	(59)	1 1/2
Insulators	-	**	45	Jan/79	-		1
Boilermakers	85	June/79	50	78/79	35	(70)	1
Millwrights	95	Sept/79	70	June/78	25	(36)	1 1/4
Ironworkers	135	Sept/79	90	Jan/78	45	(50)	1 3/4
Carpenters	230	Sept/79	125	1977	105	(84)	1 3/4
Pipefitters	960	Sept/79	200	1977	760	(380)	1 3/4

Notes: * Indicates the peak may not have been reached as of September, 1979. The graph is still showing an upward trend in employment.

** No workers were yet on site.

In the column on differences, the bracketed term represents the percentage over the original estimate which occurred at the peak employment date. The time differential is an estimate since peak employment for some trades was projected to remain constant for up to 12 months.

Source: Mega Projects: The Collective Bargaining Dimension, 1981.

Skill Shortages

At the time construction was getting under way at Lepreau, two other "mega projects" in the same area were nearing completion: a major expansion of the Irving Refinery at Saint John and the construction of a thermal electric generating station at Coleson Cove. These provided Lepreau with a ready workforce and helped alleviate major problems with trade shortages.

Planners expected approximately 75 percent of the workforce would be recruited from within the province. In fact, provincial content approached 80 percent. This was a significant achievement given the degree by which trade requirements were initially underestimated. The workers recruited from outside the province were in the highly skilled trades: plate and pipe welders, pipefitters and electricians.

It is worth noting that shortages and the resulting in-migration would have been higher had not a large number of workers left jobs with industrial employers for work at Lepreau. One of the largest industrial employers in the area, Saint John Shipbuilding and Dry Dock, reported turnover rates exceeding 100 percent in certain steelworking trades during the 1978-79 period. Hourly rates at the construction site were some 25-30 percent higher than could be earned at the shipyard.

Labour Relations

Lepreau was a union job site. The New Brunswick government used special legislation to "carve-out" projects in the Lorneville area from the normal pattern of collective bargaining. This involved establishing the Lorneville Projects bargaining Authority (LBA) to negotiate contracts for all projects in the area. Negotiations were conducted on a trade by trade basis. Contracts were negotiated for two-year periods with the right to strike existing while renegotiation was taking place.

The project experienced numerous labour relations problems. The major cause of illegal work stoppages was jurisdictional disputes. These disputes stemmed from the generally poor management and planning that characterized this project. For example, pre-project meetings to allocate work to specific trade unions (so called "mark-up" meetings) were not conducted in sufficient detail to handle the predictable jurisdictional uncertainties associated with a project of this type.

Community and Social Impacts

The project generated few negative impacts on the surrounding community. The fact that 80 percent of the labour force originated from within the province alleviated potential problems. Many of the workers were from the immediate area around Saint John and were easily able to commute to the project. It is estimated that perhaps a total of thirty families moved into the Point Lepreau region during construction. A construction camp housed workers who were too far from home to commute on a daily basis. The size of the camp ranged from 160 persons to as many as 500-600 during peak construction activity.

The Environmental Impact Statement prepared for Lepreau II states that government services such as police, fire protection, hospitals and social services were not strained. Increased school enrollment merely held in check the declining enrollment trend.

Local authorities felt that population changes associated with the project were sufficiently dispersed so that no single location suffered.

OPERATIONS PHASE

The operation of Lepreau I has created approximately 300 full time jobs, the majority of which have been filled from within the New Brunswick labour force. This has limited the impact on the region of the plant operation. As with the construction aspect of the project, local authorities feel that the operations phase has not resulted in any problems relating to community infrastructure or social programs.

REFERENCES

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Washburn & Gillis Associates Ltd., Lepreau 2 - Environmental Impact Statement, Prepared for Maritime Nuclear, Fredericton, 1984.

Weiler, Paul C., et. al, Mega Projects: The Collective Bargaining Dimension, Canadian Construction Association, Ottawa, 1981.

CHURCHILL FALLS HYDRO-ELECTRIC GENERATING STATION

BACKGROUND

The Churchill Falls Hydro-Electric Generating Station (hereafter referred to as Churchill Falls) has an installed capacity of 5,225 megawatts (MW) and is capable of producing 34.5 billion kilowatt hours (kWh) of energy annually. The plant is located on the Churchill River in Labrador, some 750 miles north of Montreal. At the time of its completion in 1974, Churchill Falls was the largest hydro-electric installation in the world.

The Labrador Plateau is covered with muskeg and interconnected lakes, many draining into the Churchill River which flows into a deep gorge at the edge of the plateau. The possibility of developing the hydro-electric potential of this area was first considered in 1953 and in 1958 the Churchill Falls (Labrador) Corporation Limited (CFLCo) was formed. CFLCo's shareholders were the British Newfoundland Company (BRINCO), Hydro Quebec and the Province of Newfoundland. By 1963, site preparation and basic planning had been completed. With the development of high voltage transmission technology and the negotiation of a 65 year sales contract for the installation's output, construction proceeded.

Construction began in 1967 and the first of eleven generators was on stream by late 1971, with full power achieved by the fall of 1974. At a capital cost of $932 million, Churchill Falls was the largest single investment made in Newfoundland. The project was completed ahead of schedule and under budget, a significant accomplishment given the project's complexity and the logistical problems associated with remote site developments of this type.

CONSTRUCTION PHASE

The plan for the Churchill Falls development called for the construction and installation of eleven turbine-generators each with a capacity of 475 MW. By building diversions, water which normally cascaded over Churchill Falls was retained on the plateau and channeled to a point near the river below the falls. A natural saucer, the plateau was plugged with 64 km of dykes with water funnelled down 11 penstocks to an underground installation housing the turbine-generators.

Schedule

Under the proposed schedule the project was to begin in 1967 and the forecast completion date was late 1976. The project started on schedule and was fully operational in late 1974, a full two years ahead of schedule.

Capital Costs

The capital cost of the facility (excluding transmission lines) was estimated at $946 million. The transmission lines to Montreal were estimated to cost $360 million. The facility was actually completed at a cost of $932 million, some $14 million under budget. A breakdown of capital costs by plant component is provided in Table 1.

TABLE 1

Churchill Falls Estimated Capital Cost

	($ Millions)
Storage and Forebay	115
Plant	168
Switchboard's Transmission	100
Permanent Facilities	25
Temporary Facilities	83
Management & Engineering	31
Escalation	102
Contingency	41
Direct Construction Cost	665
Interest During Construction	189
Administration	92
Total Projected Cost	946

Source: Churchill Falls (Labrador) Corporation Limited, Churchill Falls Power Project: Project Management Concepts.

Employment

Churchill Falls generated an estimated 26,000 person-years of construction employment in the field. Off-site construction of the turbine-generators provided an additional 3,500 person-years of employment. Table 2 shows that peak employment on the project occurred in 1970 when 6,224 workers were engaged.

TABLE 2

Churchill Falls, Peak Employment by Year

Year	Persons
1967	680
1968	2,949
1969	4,607
1970	6,224
1971	3,777
1972	1,823
1973	1,290
1974	709

Source: The Newfoundland Statistics Agency, Total Persons Hired, Peak Work Force, and Average Work Force by Place Hired, 1967-1974.

Skill Requirements

The range of skills required to complete the project are typical of those found on major construction projects - manual labour (69 percent) and non-manual labour (31 percent). The general categories of skills required for Churchill Falls are outlined in Table 3.

TABLE 3

Trades Employed on the Churchill Falls Project

Brush Cutters
Carpenters
Cement Finishers
Clerks
Cooks
Drillers
Electricians & Apprentices
Heavy Equipment Operators
Iron Workers
Lineworkers
Mechanics
Plumbers & Pipefitters
Surveyors
Boilermakers
Truck Drivers
General Labourers

Source: The Newfoundland Statistics Agency, Total Persons Hired, Peak Work Force, and Average Work Force by Place Hired, 1967-1974.

Skill Shortages

Throughout the life of the project, planners expected that the majority of the manual labour trades would be drawn from the Newfoundland labour market. In fact, over 73 percent of the manual trades were drawn from the province and the balance were recruited from Quebec. The largest net in-migration of labour occurred in the non-manual labour component. Less than 38 percent of workers in this category were hired locally. The project manager, Acres Bechtel Canada, were forced to recruit its engineering and construction supervisors in Quebec and elsewhere. The fact that another major hydro-electric development was proceeding on the Island of Newfoundland (at Bay d'Espoir) may have been a contributing factor to shortages in the professional labour market.

Labour Relations

Churchill Falls was a union site. A single project agreement between the prime contractor and 11 major unions was signed in 1967. Master labour agreements governed labour relations at the site for eight years. A significant feature of that agreement was a no-strike clause prohibiting any collective action by the unions that worked on the project. Persons working at Churchill Falls were provided with accommodations on site and transportation to the site. The project agreement also provided for higher wages and fringe benefits than the general construction industry collective agreements in existence at the time. Before these agreements came up for renegotiation, there was some movement of workers from other projects (e.g., Bay d'Espoir) to the Churchill Falls project, a typical problem where project agreements are negotiated. The careful management of the project's labour relations contributed to its early completion.

Community and Social Impact

Prior to the development, the area surrounding Churchill Falls was essentially uninhabited. Consequently, temporary and permanent facilities were required to accommodate both the transient and permanent work force. Ten camps were developed at various locations. The main camp housed approximately 3,500 single men and 115 single women in complexes consisting of three interconnected 10 ft by 50 ft trailers. The nine "out-camps" had capacity anywhere from 500 to 800 men. There was also a 200 unit family-trailer court between the main camp and the out-camps. Permanent facilities were also developed at Churchill Falls. A new townsite, which accommodated over 1,000 people, was completed. A permanent infrastructure including housing, a school, a hospital, recreation facilities, a hotel and shops were completed. In addition, permanent communications and transportation facilities were developed. Over the life of the project, $100 million was spent on this infrastructure.

OPERATIONS PHASE

The output of Churchill Falls is purchased by Hydro Quebec and transmitted through its grid system to consumers in southern Canada and the Northeast United States. Revenues generated by Churchill Falls are estimated at $800 million per annum, of which $15 million is the net return to the Province of Newfoundland. A permanent staff of 330 persons is required to operate and maintain the installation.

REFERENCES

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Newfoundland Statistics Agency, Major Industrial Projects: Hydro, Churchill Falls [Upper], February 26, 1981.

Newfoundland Statistics Agency, Project Work Force Peaks, Churchill Falls, (Labrador) Corporation Limited, Feburary 28, 1981.

Newfoundland Statistics Agency, Total Persons Hired, Peak Work Force, and Average Work Force by Place Hired, 1967-1974, Churchill Falls (Labrador) Corporation Limited, June 17, 1980.

THE VENTURE NATURAL GAS DEVELOPMENT

BACKGROUND

Exploration for oil and gas on the Scotian Shelf began with seismic surveying in the late 1950's. The first well was drilled in 1967. Since then, about 100 exploratory wells have been drilled. A number of significant gas discoveries have been made with the largest of these, the Venture field, discovered in 1979 by Mobil and partners. Several additional wells have been drilled in the Venture area since 1979 to establish the volume of recoverable gas reserves and the characteristics of the reservoir. This work has been accompanied by a wide range of engineering studies to determine the best method for developing the field and transporting the gas to market.

THE PROJECT

Mobil and partners have evaluated various production, processing and transportation alternatives for the Venture project. The current plan takes into consideration the technical, environmental and economic aspects of these alternatives and consists of the following elements:

1) Production and treatment of raw gas and condensate from four offshore platform complexes. Two complexes would consist of two steel platforms connected by bridges. The other two complexes would consist of single steel platforms. The platforms would be fabricated onshore, transported to the field in sections and installed and hooked-up using specialized marine equipment. Once installed, development wells would be drilled to produce the gas reserves. A total of 21 wells are planned at the four sites. The wells would be drilled using two jack-up tender vessels. These vessels would provide rig utilities and services and would operate in conjunction with drilling rig derricks situated on the platforms.

2) Transmission of these raw fluids via a subsea pipeline to landfall facilities located at Country Harbour, Nova Scotia. The pipeline would be about 260 km in length. Pipeline installation would require the services of specialized pipelaying barges and support vessels. Trenching equipment to bury the pipeline where necessary would also be required.

3) Processing of these raw fluids into sales gas and natural gas liquid (NGL) products at a gas plant located at County Harbour, Nova Scotia. The gas plant and associated facilities would be field constructed with minimal offsite fabrication of components. (In a competing proposal, Sable Gas Systems Ltd. has proposed construction of a gas plant at

Country Harbour with NGL fractionation facilities and a marine terminal at the Strait of Canso.)

4) Storage facilities for NGL products and marine loading facilities for transport to market. The product handling facilities at the marine terminal would consist of refrigerated storage tanks, vapour recovery units and product storage pumping systems. The marine terminal is designed to accommodate tankers with capacities up to 25,000 DWT. The marine terminal would be field constructed. Caissons would be constructed onshore, skidded into the water, floated to their locations, submerged and ballasted with solid material. Product storage tanks too large to be fabricated off-site would be erected by contractors specializing in on-site construction.

5) Transmission of sales gas to market in the U.S. via a pipeline through Nova Scotia and New Brunswick. The pipeline would be about 545 km in length. It would be constructed using conventional overland pipeline methods. A right of way about 30m wide would be cleared, a trench would be dug, line pipe would be welded in sections next to the trench and lowered into it when completed. The trench would then be backfilled. Two work crews are planned, one in Nova Scotia moving from the Nova Scotia-New Brunswick border to the gas plant; the other in New Brunswick moving from the Nova Scotia-New Brunswick border to the United States border. (Sable Gas Systems Ltd. has also proposed construction of the pipeline following essentially the same route.)

It should be emphasized that exploration and reservoir evaluation activity is on-going and modifications may be required as more precise information is obtained. Project engineering is also a continuing activity, and refinements in design may require modifications to be made to the facilities.

CONSTRUCTION PHASE

Detailed engineering could begin in mid-1987, assuming all Canadian regulatory approvals have been received. Fabrication and construction of facilities could begin in late 1988, once United States regulatory approvals had been received. If fabrication and construction begin in late 1988, gas production could commence in mid-1991, with additional offshore facilities coming on-stream in 1992. The length of the construction schedule from the start of fabrication to first gas production is expected to be about 38 months. This excludes engineering which would add about 15 months to the schedule. It must be emphasized that these dates are highly tentative, dependent as they are on regulatory filing dates and the length of the approval process.

Capital Costs

Capital costs for the Venture project are estimated to be about $2.9 billion ($1984). This estimate includes all facilities and activities identified above. It must be emphasized this estimate is a preliminary one and could change substantially once detailed engineering is completed.

Employment

The Venture project is expected to create about 9,000 person-years of employment during construction. A breakdown of labour requirements by project component is shown in Table 1. As in the case of the cost estimate, these figures are preliminary and subject to change upon completion of detailed engineering.

It is important to recognize that the employment opportunities will be created in a variety of locations. Some of these locations are site-specific, e.g., construction of onshore facilities and drilling development wells, and some are non-site-specific, e.g., fabrication of offshore platforms and design engineering. In advance of awarding contracts for non-site-specific activities, it is not possible to identify where the employment they generate will be located.

Skill Requirements

Venture is typical of offshore projects elsewhere in that the design, fabrication, construction and installation of facilities will draw on a broad range of skills. The requirements will vary over time and will be distributed according to the locations of the various project activities. At peak, demand will be greatest at the onshore facilities construction site. A preliminary indication of peak requirements by occupation and onshore project activities is provided in Table 2.

Skill Shortages

The Venture project includes a number of construction and fabrication activities that will be familiar to the Canadian and regional work force, and some activities that will be unfamiliar. Skill shortages are not anticipated at the regional level for construction of onshore facilities. Most jobs in onshore pipeline construction are expected to be filled at the regional level; a significant proportion of those requiring special skills such as welding and operating side-boom cranes are expected to be filled by experienced personnel from central and western Canada. No shortages are expected in fabrication though some upgrading of skills may be required. The one aspect of the project where

TABLE 1

Venture Gas Project
Total Employment During Development

	Total Employment (person-years)
Engineering and Project Services	2,485
Onshore Construction	
Gas Plant[1]	875
Marine Terminal	540
Slugcatcher	185
Offshore Pipeline[2]	205
Sales Gas Pipeline	1,020
Sub-Total	2,825
Fabrication	1,700
Offshore Activity	
Development Drilling	1,710
Offshore Pipeline[3]	155
Hook-up and Installation	125
Sub-Total	1,835
Total	9,000

Note: 1. Gas Plant includes camp construction and operation for onshore construction projects located at Country Harbour.

2. Includes coating yard construction, pipe coating, outward loading and demobilization, onshore portion of offshore pipeline.

3. Includes requirements for lay and trench barges.

Source: Mobil Oil Canada, Ltd., personal communications.

TABLE 2

Venture Gas Project
Peak Labour Requirements by Occupation
and Project Component (persons)

	Fabrication of Offshore Platforms[1] (peak in 1989)	Construction of Onshore Facilities[2] (peak in 1990)	Installation of Onshore Pipeline[3] (peak in 1990)
Catering	-	60	100
Welder	350	312	135
Grinding	65	42	30
Marine Fabricator	180	35	-
Painting	50	45	-
Const. Equip Op.	-	90	185
Labourer	140	232	250
Electrician	80	97	7
Carpenter	45	60	6
Concrete Worker	-	70	-
Insulator	40	65	-
Pipefitter	100	100	5
Ironworker	50	90	-
Truck Drivers	-	25	115
Material Handling	9	52	50
Other	341	431	322
Total	1,450	1,770	1,205

Notes: 1. Locations not yet identified.

2. Assumed to be Country Harbour, Nova Scotia.

3. Across Nova Scotia and New Brunswick.

Source: Mobil Oil Canada, Ltd., personal communications.

significant skill shortages are anticipated is offshore pipeline installation. Few Canadians have had exposure to this type of work and direct experience is required for most positions on a lay barge.

Community and Social Impact

Three aspects of the project have the potential to generate community and social impacts: project management, construction of onshore facilities and installation of the sales gas pipeline.

Project management is expected to be located in Halifax. The size of the management group could vary between one and two hundred persons over a three to four year period. Most of the personnel would be recruited from outside Nova Scotia. With a considerable surplus of office space, accommodating the management group in Halifax would not be a problem. Some strains on the housing market would be likely, particularly for rental accommodation. Halifax has one of the lowest vacancy rates in Canada. No significant impact on community and social services in the area is anticipated.

Construction of onshore facilities is planned for the Country Harbour area. This is a relatively isolated part of Nova Scotia. There are a few villages in the immediate area, but the nearest significant commercial centre is Antigonish, some 80 km by road to the north. Rental accommodations, recreational facilities and community and social services in the area are limited. To minimize impacts on surrounding communities, a self-contained construction camp capable of housing about 1,200-1,400 workers at peak is expected to be required.

Installation of the sales gas pipeline takes place in Nova Scotia and New Brunswick. It involves simultaneous construction activity of two work forces, each with peak requirements of about 450 persons.

Though private accommodation is available along much of the pipeline route, construction camps are likely to be required during peak activity during the summer months. Since construction is a mobile activity involving camp facilities, the impacts on communities along the pipeline route are expected to be minimal.

PRODUCTION PHASE

Employment during production is estimated at 365 persons. The distribution of employment by function is as follows:

Offshore Operations	260
Onshore Facilities	55
Mobil Office (Halifax)	15
Sales Gas Pipeline	35
Total	365

The impacts during production would be associated with the onshore facilities at Country Harbour. Employment there is expected to be about 70 persons, including 15 pipeline personnel. Between 40 and 50 of the positions are expected to be filled by persons within commuting distance of the facilities. The more senior positions would be filled by experienced personnel from outside the area. Those moving into the area could reside in a number of locations including nearby Sherbrooke or Antigonish.

The impacts during production are expected to be generally beneficial to the area, with the operations providing an important source of employment and income.

REFERENCES

Mobil Oil Canada, Ltd., Application to the National Energy Board for an Export License, July, 1985.

THE HIBERNIA OIL DEVELOPMENT

BACKGROUND

Exploration for hydrocarbons in the waters off Newfoundland began in the late 1950's. The first well was drilled on the Grand Banks in 1966. Since then, just over 100 exploration wells have been drilled there and on the Labrador Shelf. Of the many oil and gas discoveries made, the most significant has been the Hibernia oil field. Since the discovery by Mobil Oil and partners in 1979, nine delineation wells have been drilled to establish the volume for recoverable oil reserves and the characteristics of the reservoir. Drilling has been accompanied by a wide range of engineering and bio-physical studies to determine the best method for developing the field and transporting the oil to market.

THE PROJECT

Mobil and partners have evaluated various production and transportation alternatives for the Hibernia development. The preferred method was selected on the basis of technical, environmental and economic considerations and consists of the following elements:

1) Production and treatment of crude oil from a single fixed production platform. The platform would consist of a concrete gravity base structure (GBS) supporting a deck and topside facilities. The platform is planned to have a production capacity of 24,000 cubic metres of oil per day.

   The GBS would be built initially in a dry dock and completed in deepwater inshore. Construction would take place at a "greenfield" site in Newfoundland, possibly near Come-By-Chance. The topside facilities would be of modular construction, with modules built in fabrication yards in Canada and elsewhere. The modules would be barged to Newfoundland, assembled on a prefabricated deck and hooked-up. From the assembly area (possibly at Argentia), the completed topside deck would be barged to Come-By-Chance and mated with the GBS. The completed platform would then be towed to the field, installed and ballasted.

   Once installed, approximately 50 development wells would be drilled from two rigs located on the platform. An additional 30-40 wells are planned for remote locations around the platforms. These would be drilled by semi-submersible rigs.

2) Flowlines and manifolds to take crude oil from the remote wells to the platform. Flowlines would be fabricated onshore, possibly at Argentia, towed to the field and installed. Manifolds would be fabricated at yards in Canada or elsewhere.

3) Transfer of crude oil from storage facilities in the GBS via pipeline to two articulated loading platforms (ALP) for transport to onshore refineries by shuttle tanker. The ALP's would be fabricated in yards in Canada or elsewhere. The shuttle tankers as currently designed are too large to be built in Canadian shipyards.

Figure 1 illustrates the fixed production system concept and shows the terminology used to describe the facilities. It should be emphasized that project engineering is a continuing activity, and refinements in design may require modifications to be made to the facilities.

CONSTRUCTION PHASE

Detailed engineering is planned to begin in early 1986, assuming Canadian regulatory approvals have been received. Fabrication and construction of facilities are expected to take just over five years, commencing in 1987 with the start-up of production planned for early 1992. The length of the construction schedule is expected to be about 75 months. This excludes engineering which would add about 12 months to the schedule. These dates and the estimated duration of activities are tentative.

Capital Costs

Capital costs for the Hibernia project are estimated to be about $4.3 billion ($1984). This estimate includes all facilities and activities outlined above. This estimate is a preliminary one and could change significantly once detailed engineering is completed.

Employment

The Hibernia project is expected to generate about 21,500 person-years of employment during construction. A breakdown of labour requirements by component is shown in Table 1. As in the case of the cost estimate, these figures are preliminary and subject to change upon completion of detailed engineering.

The employment opportunities will be created in a variety of locations. Some of these locations are site-specific, e.g., construction of the GBS, assembly of topsides and development drilling, and some are non-site-specific, e.g., design engineering, fabrication of topside modules and construction of vessels. In advance of awarding contracts for activities in the latter category, it is not possible to identify where the employment they generate will be located.

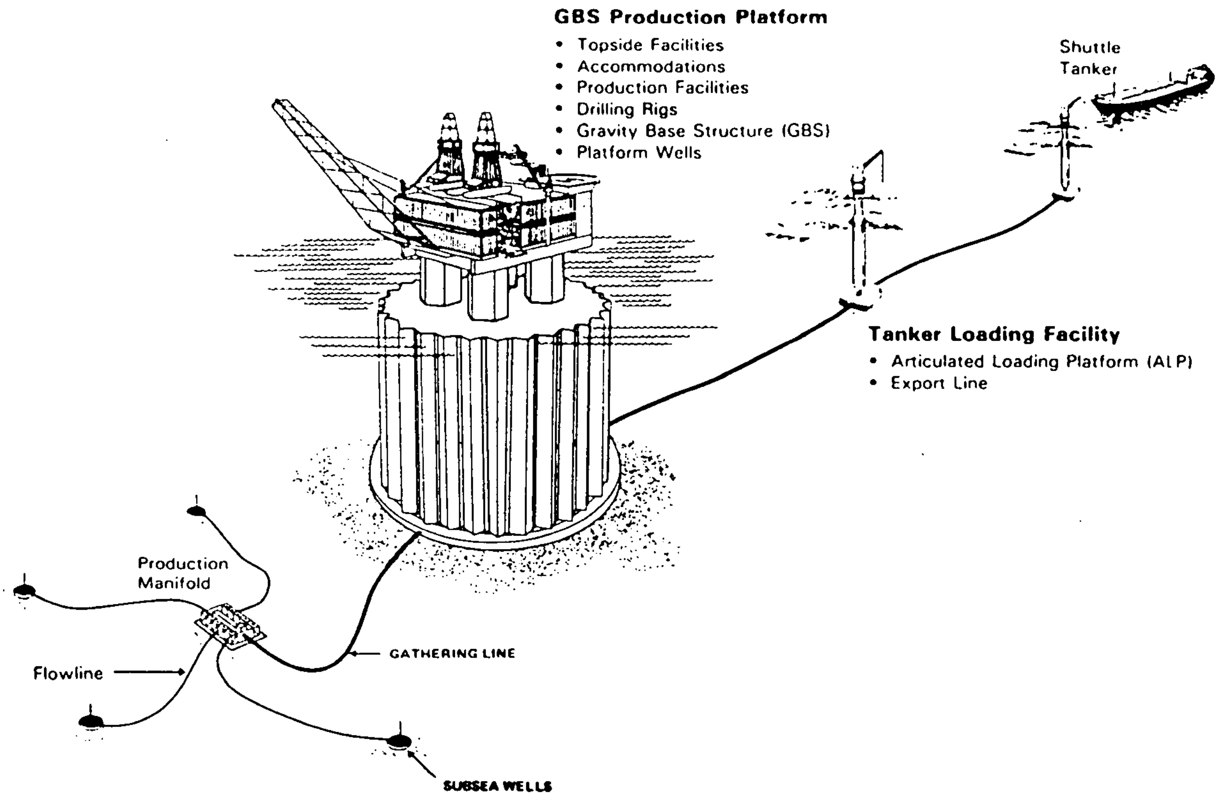

Figure 1. Hibernia Fixed Production System Components (source: Mobil Oil Canada, Ltd., Hibernia Development Project, Environmental Impact Statement, Update, August, 1985)

Skill Requirements

The design, fabrication, construction and installation of facilities will draw on a wide range of skills in a number of disciplines. The requirements will vary over time and will be distributed according to the locations of the various project activities. At peak, demand will be greatest at the GBS construction site. A preliminary indication of peak requirements by occupation for the main onshore project activities is provided in Table 2.

TABLE 1

Hibernia Project
Total Direct Employment

	Employment (person-years)
Engineering and Project Services	4,150
Fixed Production Platform*	
GBS	3,500
Topsides	7,100
Articulated Loading Platform (two)	600
Subsea Structures and Equipment	225
Tankers (three)	3,000
Ice Vessel (one)	450
Flowlines and Tie-Ins	625
Development Drilling	1,650
Commissioning and Start-Up	150
Total	21,500

Note: * GBS and Topsides include site development and camp construction and operation at Come-By-Chance and Argentia

Source: Mobil Oil Canada, Ltd., Hibernia Development Project, Environmental Impact Statement, Update, August, 1985.

TABLE 2

Hibernia Project
Peak Labour Requirements by Occupation
and Project Component (persons)

	Fabrication of Topside Modules (Peak in 1988)	Assembly of Topside Facilities (Peak in 1989)	Construction of Gravity Base Structure (Peak in 1990)
Catering	-	25	75
Welder	380	100	200
Boilermaker	180	55	50
Grinding	80	30	20
Supervisor	100	20	25
Const. Equip. Operator	60	15	65
Labourer	200	85	190
Electrician	240	105	30
Carpenter	50	15	120
Concrete Worker	-	-	210
Insulator	80	20	25
Pipefitter	330	90	110
Ironworker	80	15	500
Truck Driver	60	15	65
Material Handling	60	35	75
Testing	60	30	35
Other	760	195	415
Total	2,720	850	2,210

Source: Mobil Oil Canada, Ltd., Hibernia Development Project, Environmental Impact Statement, Volume IV, Socio-Economic Assessment, Appendix B.

Skill Shortages

The Hibernia project consists of construction and fabrication activities unfamiliar to most members of the Newfoundland labour force. The nature of the work combined with the rapid build-up of labour requirements is expected to result in shortages in certain occupations. The occupations for which potential shortfalls exist fall into two categories. First, there are those requiring direct experience in offshore development; included here are occupations associated mainly with project management and offshore and onshore construction such as:

- Senior and Intermediate Level Managers
- Construction Managers and Control Personnel
- Drafting Personnel
- Engineering Technicians
- Divers
- Specialized Construction Personnel (e.g., Crane Operators) on Offshore Vessels and Barges
- Instrument Fitters
- Crane Operators (onshore)
- Quality Control Personnel (Inspection and Testing)

The prospect for meeting demand in these occupations from within Newfoundland is limited given the length of the training period and the need for direct offshore experience. A large proportion of the personnel recruited are therefore likely to originate outside Canada and elsewhere in Canada.

Second, potential shortfalls may occur in occupations requiring skills or skill levels related specifically to GBS construction and topsides assembly and hook-up. The occupations include:

- Sheet Metal Workers
- Plate and Pipe Welders
- Boilermakers
- Marine/Construction Electricians
- Pipefitters
- Ironworkers (reinforcing steel fixers and scaffolders)
- Insulators

A substantial training effort is required to minimize potential shortfalls in these skilled trades. It is unlikely they can be avoided altogether, since training must be supplemented with considerable on-the-job experience to meet required skill levels in certain key trades (for example, pipefitter, welders and pressure welders, electricians).

Labour market imbalances can be anticipated in relation to GBS construction and the assembly and hook-up of topside facilities. One of the main characteristics of these projects is the rapid build-up of the work force. The process of adjusting supply to meet demand may include such short-run phenomena as labour shortages in other sectors of the economy with the possible disruption of the operations of firms competing for the same skills.

Community and Social Impacts

Two aspects of the project have the potential to generate community and social impacts: project management and the onshore construction of offshore facilities. Certain aspects of project management are expected to be located in St. John's, with the balance elsewhere in Canada. The size of the management group located in St. John's is expected to vary between one and three hundred persons over a four to five year period. Most of the personnel would be recruited from outside Newfoundland. The influx of persons would be small in relation to the city's population. With extensive infrastructure in place or under construction and adequate services, community and social impacts are expected to be minimal. Some strains are expected on the housing market given the limited supply of available accommodation.

A major concern facing community and social planners is the uncertainty over the numbers of persons who may move into St. John's seeking work. The level of speculative in-migration is impossible to predict with confidence and the impacts arising from it may overwhelm the impacts arising from changes due to direct employment.

The main area of onshore activity is expected to be Come-By-Chance, where at peak some 2,200 persons would be employed in construction of the GBS. Construction activity is expected to last from four to five years. There are a number of small communities in the area, but the nearest significant population centre is St. John's, some 150 km by road to the east. As an area with a history of industrial development, Come-By-Chance is reasonably well served with infrastructure, serviced land and community and social services. This factor, coupled with the short duration of the construction activity and the proposed use of a self-contained construction camp, means the impacts would be short-term and localized.

Argentia has been proposed as the site for assembling the topside modules on a completed deck frame. An average of about 850 workers would be required over the one to two year construction period. As the site of a former U.S. naval base and an existing ferry terminal, Argentia is reasonably well served with physical infrastructure and services. Some improvements in the road transportation and water systems would be required. The short duration of construction activity and the proposed use of a self-contained construction camp or floating hotel would keep community and social impacts to a minimum.

PRODUCTION PHASE

Employment during production is estimated at 1,090 persons. The distribution of employment by function is as follows:

Offshore Operations	760
Tanker operators	180
Engineering and Administration	150
Total	1,090

Although this is a relatively large operational workforce, the onshore impacts will be minimal because about 85 percent of the personnel will actually be working on offshore facilities and vessels. Only one-half of these personnel will be working at any one time with the remainder on shore leave. Given the circumstances of employment, most operations personnel recruited from Newfoundland are expected to maintain existing residences as is the practice with rig workers. Those recruited from outside the province are expected to take up residence in the St. John's, area. This could involve from 150 to 200 people plus families. This figure is small in relation to the population of the area.

The impacts during production are expected to be generally beneficial to the province, with the operations providing an important source of employment and income.

REFERENCES

Mobil Oil Canada, Ltd. Hibernia Development Project, Environmental Impact Statement, May, 1985.