Report Title: Site C Environmental Impact Statement
Issuer: BC Hydro and Power Authority, System Engineering Division
Date: July 1980

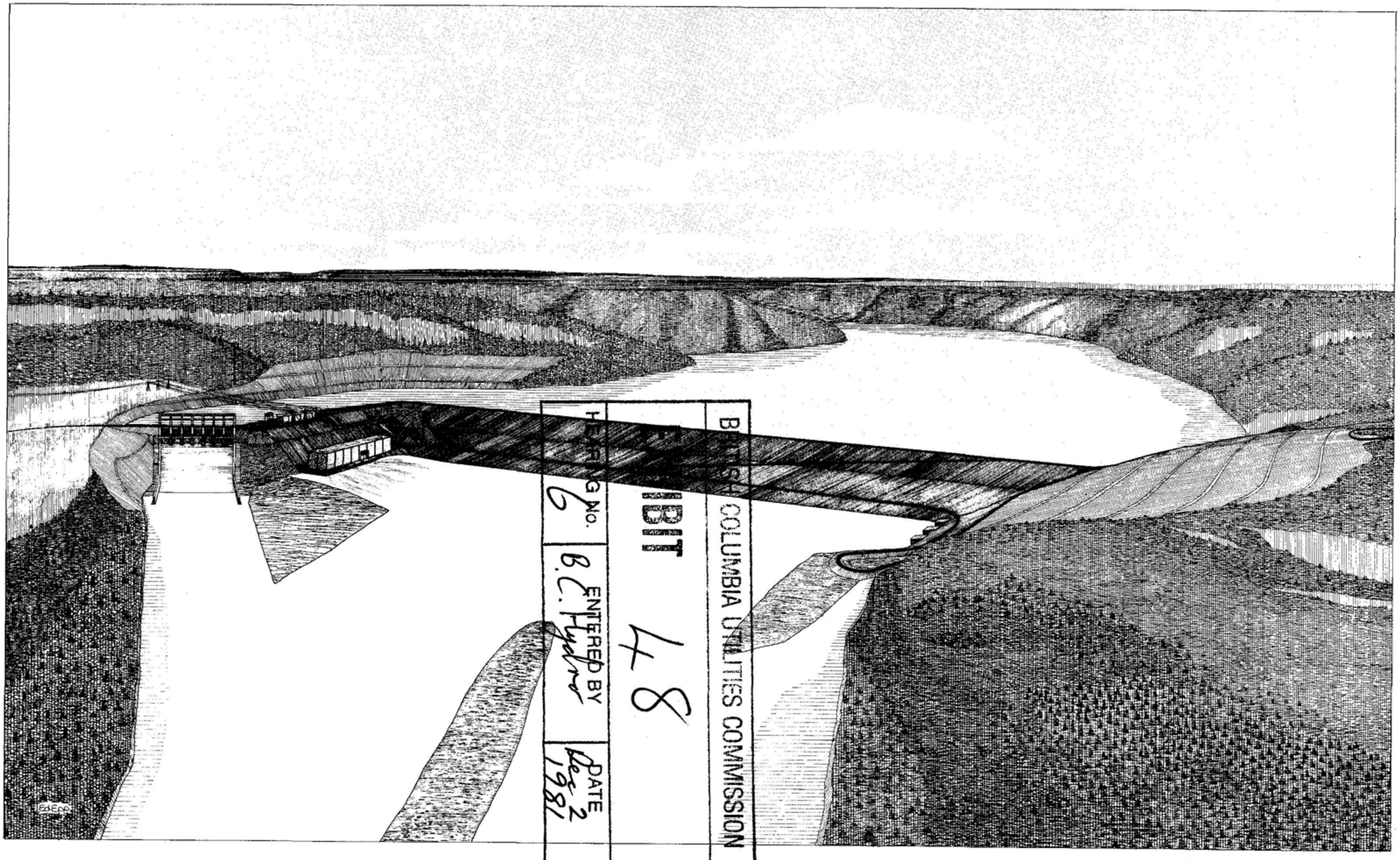
NOTE TO READER:

THE FOLLOWING REPORT IS MORE THAN TWO DECADES OLD. INFORMATION CONTAINED IN THIS REPORT MAY BE OUT OF DATE AND BC HYDRO MAKES NO STATEMENT ABOUT ITS ACCURACY OR COMPLETENESS. USE OF THIS REPORT AND/OR ITS CONTENTS IS AT THE USER'S OWN RISK.

During Stage 2 of the Site C Project, studies are underway to update many of the historical studies and information known about the project.

The potential Site C project, as originally conceived, will be updated to reflect current information and to incorporate new ideas brought forward by communities, First Nations, regulatory agencies and stakeholders. Today's approach to Site C will consider environmental concerns, impacts to land, and opportunities for community benefits, and will update design, financial and technical work.

Note: A location map, which also shows the area to be flooded, is contained in the pocket at the end of this report.



peace river site c project

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

PEACE SITE C PROJECT

ENVIRONMENTAL IMPACT STATEMENT

SYSTEM ENGINEERING DIVISION

Report No. SE 7910

July 1980

PEACE SITE C PROJECT

ENVIRONMENTAL IMPACT STATEMENT

CONTENTS

(A detailed Contents for each Section is given at the beginning of each Section as it appears in the text).

PREFACE

The purpose of this Environmental Impact Statement is to provide documentation in support of applications for licences to construct the Site C project on the Peace River.

Located 18 km upstream of Taylor, and approximately 6.5 km southwest of Fort St. John, the project would comprise a 60 m high earthfill dam across the river, with a spillway and powerhouse on the right bank. The powerplant would contain six units having a total combined capacity of 900 MW.

The project would raise the present level of the Peace River at the damsite by 50 m, creating a reservoir 80 km in length and with an average width approximately twice that of the existing river. The reservoir would stretch upstream to the Peace Canyon Development just west of Hudson Hope, and as it would not be used for major regulation of flow the water level variations would be small.

This document is divided into three parts. PART ONE - INTRODUCTION AND PROJECT JUSTIFICATION, provides information on the need for further sources of electric energy, and the reasons why the Peace Site C Project is being recommended for development at this time. Also included is a benefit-cost analysis comparing Peace Site C with other projects which are currently under consideration, and a detailed description of the project.

The second part of this document, PART TWO - ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT, was based on a report prepared by Thurber Consultants Ltd., the co-ordinating consultant for the environmental studies. It contains an overall summary of the environmental and socio-economic impacts, and is intended to fulfill the requirements of the general reader requiring information on the effects of the project.

The full documentation being submitted in support of the licence applications includes the consultants' detailed report on the environmental and socio-economic studies which are the basis for this summary report.

For those requiring the detailed information contained in these reports, copies are located at the various libraries listed below.

PART THREE - MITIGATION AND COMPENSATION contains chapters on B.C. Hydro's approach to the issues and problems of mitigation and compensation, including a preliminary response to each of the consultants' proposals on these matters, and an assessment of these proposals. It is expected that considerable progress will be made toward developing appropriate mitigation and compensation proposals between the date of licence application and the time of the hearing.

REPORTS LOCATED IN THE FOLLOWING LIBRARIES

College Libraries

B.C. Institute of Technology
Government Documents Section
3700 Willingdon Avenue
Burnaby, B.C. V5G 3H2

Cariboo College
Box 860
Kamloops, B.C. V2C 5N3

Malaspina College
Learning Resources Centre
900 - 5th Street
Nanaimo, B.C. V9R 5S5

Douglas College
Box 2503
New Westminster, B.C. V3L 5B2

College of New Caledonia
2001 Central Street
Prince George, B.C. V2N 1P8

Selkirk College
Box 1200
Castlegar, B.C.

Okanagan College
1000 KLO Road
Kelowna, B.C. V1Y 4X8

David Thompson University Centre
Nelson, B.C.

Capilano College
2055 Purcell Way
North Vancouver, B.C. V7J 3H5

University of B.C.
Government Documents Section
Vancouver, B.C.

Vancouver Community College
100 West 49th Avenue
Vancouver, B.C. V5Y 2Z6

University of Victoria
Government Documents Section
Victoria, B.C.

University of Washington
Reference Division
Government Documents Center
Seattle, Washington
98195

Camosun College
1950 Lansdowne Road
Victoria, B.C. V8P 5J2

Northern Lights College
Dawson Creek, B.C.

Canadiana Acquisitions Division
and Legal Deposit Office
National Library of Canada
Ottawa, Ontario
K1A 0N4

Municipal Libraries

Vancouver Library
750 Burrard Street
Vancouver, B.C. V6Z 1X5

Prince George Library
V2L 2B7

Regional Libraries

Fraser Valley Regional Library
2469 Montrose Avenue
Abbotsford, B.C. V2S 3T2

Vancouver Island Regional Library
10 Strickland Street
Nanaimo, B.C. V9R 5J7

Okanagan Regional Library
480 Queensway
Kelowna, B.C. V1Y 6S7

Cariboo-Thompson-Nicola Library
System
906 Laval Crescent
Kamloops, B.C.

Local Libraries

Fort St. John

Dawson Creek

Hudson Hope

Local Hydro Offices

Fort St. John

Dawson Creek

PEACE SITE C PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Part One

Introduction

and

Project Justification

SECTION 1.0 - DESCRIPTION OF STUDIES

CONTENTS

TABLES

SECTION 1.0 - DESCRIPTION OF STUDIES

1.1 BACKGROUND STUDIES

The development of the hydroelectric power potential of the lower Peace River between Peace Canyon Development and the Alberta border, has been the subject of continuing study at B.C. Hydro for a number of years. Engineering feasibility studies undertaken in 1971 and 1972 indicated that it would be practical to develop most of the head within this reach of the Peace River either by a single high dam at Site E near the Alberta border, or by two low dams, one at Site E and one at Site C, just upstream of Taylor. Studies carried out from 1974 to 1976* concluded that:

1. Power development using two low dams at Site C and Site E would have less environmental impact than a single high dam at Site E.

2. The Site C development would be considerably more economic than a low dam at Site E.

From 1976 on, work has concentrated on studying in detail the potential for developing the Site C project from both engineering and environmental standpoints. Because of higher costs relative to other potential projects Site E has received no further consideration since 1976, and is not included in any of B.C. Hydro's present plans for future development.

The detailed environmental studies were conducted by a team of consultants under the overall direction of Thurber Consultants Ltd.

---

* Thurber Consultants Ltd., 1976. Sites C and E Hydroelectric Development Proposals. Lower Peace River Environmental Study Vol. I, IA, II, III and Map Atlas. B. C. Hydro and Power Authority, Vancouver.

1.1 BACKGROUND STUDIES - (Cont'd)

Table 1-1 lists the main participants in the study and their respective areas of expertise. The main objectives of the studies were to:

1. Develop an inventory of resources for the study area.

2. Provide an assessment of impacts of the development on environmental and socio-economic resources.

3. Provide information for B.C. Hydro to develop mitigation and compensation proposals in consultation with agencies at the provincial and local government levels.

4. Evaluate resource losses in monetary terms for inclusion in a benefit-cost analysis and to serve as a basis for mitigation and compensation discussions.

The work was organized into the following 12 disciplines, and the results of the studies are summarized in Part Two of this Environmental Impact Statement:

Land Resources	
Physical Environment	Section 5
General Land Use	Section 6
Agriculture	Section 7
Recreation	Section 8
Forestry	Section 9
Wildlife	Section 10
Water Resources	
Water Quality and Use	Section 11
Fisheries	Section 12
Socio-Economics	
Heritage Sites	Section 13

1.1 BACKGROUND STUDIES - (Cont'd)

Sociology	Section 14
Regional Economics and Resource Values	Section 15

The detailed reports prepared by the individual consultants are listed in Table 1-2, and for those requiring the more detailed information contained in these reports, they are located at the libraries listed at the end of the Preface.

The studies have shown that there would be a number of potential impacts. However, they also indicated that with careful planning it should be possible to compensate for most of these impacts and thereby provide a socially acceptable project.

1.2 GOVERNMENT REVIEW

All the environmental and socio-economic reports have received extensive review by the provincial government agencies under the co-ordination of the Environment and Land Use Committee Secretariat. The comments received by B.C. Hydro as a result of this review were discussed with the consultants and the agencies concerned. In many cases revisions were made to the reports to clarify points and to incorporate points raised by the various agencies. In a few cases where disagreement existed as a result of differences of professional opinion, the author's statements remain unchanged.

This review identified two gaps in the work which have now been addressed. While the recreation study had examined the impacts of the project on recreational use by residents of British Columbia, it had not examined the impacts on tourism. This has now been done. Similarly, the agriculture study examined a number of different scenarios of development of potential agricultural land for vegetable production. The Department of Agriculture and the Agricultural Land

TABLE 1-1

MAIN PARTICIPANTS IN SITE C ENVIRONMENTAL AND SOCIO-ECONOMIC STUDY

Affiliation	Individual Team Members	Area of Expertise
Thurber Consultants Ltd. Victoria, B.C.	G.C. Morgan, P.Eng. H.M. Etter, Ph.D., P.Ag. D. Smith, P.Eng. S. Tullar, Ph.D.	Study Management Co-ordination & Land Use Physical Environment Climate
Canadian Bio Resources Consultants Ltd. Surrey, B.C.	J.R. Husdon, P.Ag. G.F. Kennedy, P.Eng., P.Ag.	Agriculture Water Quality
Edwin, Reid & Associates Vancouver, B.C.	D. Williams, Ph.D. D. MacDonald, M.Sc.	Recreation Visual Qualities
Reid, Collins & Associates Vancouver, B.C.	M. Vennesland, R.P.F. D. Norris, R.P.F.	Forestry
D.A. Blood & Associates Lantzville, B.C.	D.A. Blood, M.Sc.	Wildlife
Renewable Resources Consulting Services Edmonton, Alta.	G. Ash, M.Sc.	Fisheries
Provincial Archaeologist's Office Victoria, B.C.	J. McMurdo	Heritage Sites
Canadian Resourcecon Ltd. Vancouver, B.C.	G.A. Constable, M.Sc. G. Staple, B.A.	Economics
Suzanne Veit & Associates Galiano, B.C.	S. Veit, M.S.W.	Sociology

TABLE 1-2

SITE C ENVIRONMENTAL AND SOCIO-ECONOMIC REPORTS

Blood, Donald A. 1979. Peace River Site C Hydroelectric Development, Environmental and Socio-economic Assessment: Wildlife Sub-Report.

Canadian Bio Resources Consultants Ltd. 1979. Peace River Site C Hydroelectric Development, Agriculture Assessment.

Canadian Bio Resources Consultants Ltd. 1979. Peace River Site C Hydroelectric Development, Environmental and Socio-economic Assessment: Water Quality and Use.

Canadian Resourcecon Ltd. 1979. Peace River Site C Hydroelectric Development, Environmental and Socio-economic Assessment: Resource Evaluation Study.

Canadian Resourcecon Ltd., Suzanne Veit and Associates Inc., Urban Programme Planners, and Sigma Engineering Ltd. 1979. Peace River Site C Hydroelectric Development, Environmental and Socio-economic Assessment: Socio-economic Impact Study.

Canadian Resourcecon Ltd., 1980. Peace River Site C Hydroelectric Development: Vegetable Industry Study.

Canadian Resourcecon Ltd., 1980. Peace River Site C Hydroelectric Development, Environmental and Socio-economic Assessment: Tourism Impact Study.

Edwin, Reid & Associates. 1979. Peace River Site C Hydroelectric Development, Recreation Impact Assessment.

Reid, Collins and Associates Ltd. 1979. Peace River Site C Hydroelectric Development, Environmental and Socio-economic Assessment: Forest Resource Assessment.

Renewable Resources Consulting Services Ltd. 1979. Peace River Site C Hydroelectric Development, Fish and Aquatic Environment.

Spurling, Brian E. 1978. The Site C Heritage Resource Inventory and Assessment.

Thurber Consultants Ltd. 1979. Peace River Site C Hydroelectric Development, General Land Use Studies.

Thurber Consultants Ltd. 1979. Peace River Site C Hydroelectric Development, Physical Environment Impact Assessment.

1.2 GOVERNMENT REVIEW - (Cont'd)

Commission requested more detailed information on the potential for a vegetable industry based on the Peace River valley agriculture, and the question of whether or not the Peace Site C project would affect the viability of such a vegetable industry. This study also has now been completed.

The socio-economic impact study has been updated to take account of the major expansion in Fort St. John since the first study was completed. The results will serve as the basis for detailed negotiations with the local and provincial agencies.

1.3 MITIGATION AND COMPENSATION

The various consultants were asked to identify opportunities for mitigation and compensation for project impacts and have done so in their reports. B.C. Hydro is currently discussing these suggestions with the provincial government agencies and with local government bodies in order to firm up proposals for mitigation and compensation in the event that the project is to proceed. It is expected that considerable progress will be made by the time hearings begin on the licence applications. In the meantime, B.C. Hydro's approach to mitigation and compensation, together with preliminary proposals, is outlined in Part Three of this report.

1.4 LICENCE REQUIREMENTS AND PROCEDURES

Following B.C. Hydro's announcement in October 1979 of its plans to apply for the statutory and regulatory approvals that would be necessary for the hydroelectric power project to be built at Site C on the Peace River, the government advised that the licensing process was under review and various changes would be implemented.

1.4 LICENCE REQUIREMENTS AND PROCEDURES - (Cont'd)

The government's Energy Policy Statement of February 1980 outlined a two phase process of government review, the first phase examining the broad justification for the project and the second phase examining the specific environmental concerns, mitigation measures and other detailed factors. As of mid-July 1980 the details of the new process have not been finalized, but it is fully anticipated by B.C. Hydro that public hearings will be required for Site C covering both project justification and environmental and socio-economic impacts.

SECTION 2.0 - NEED FOR THE PROJECT

CONTENTS

TABLES

CONTENTS - (Cont'd)

TABLES - (Cont'd)

FIGURES

SECTION 2.0 - NEED FOR THE PROJECT

2.1 INTRODUCTION

B.C. Hydro's forecast of electrical energy demand provides the basis for scheduling the addition of new resources as B.C. Hydro must plan its generation additions to be capable of meeting the demand for energy as it develops. The September 1979 forecast indicates a probable average annual growth rate for the total power system of 5.9 percent for the period 1979/80 to 1989/90. This includes meeting projected future deficiencies in the West Kootenay Power and Light system beginning in 1980/81. Projects already committed to construction will meet forecast needs up to 1985/86. An additional source of energy will be necessary to meet energy requirements after 1986.

The Peace Site C hydro project is proposed by B.C. Hydro to meet load growth deficits beginning in 1987. This project would benefit from the streamflow regulation of the Peace River already provided by the existing Bennett Dam and Williston Lake, and is the most economic source of new power available to meet the need. Development of the Peace Site C project in 1987 will result in substantial cost savings compared to alternative power developments.

The earliest feasible in-service date of the Peace Site C project is estimated to be October 1987. This development schedule allows 5 3/4 years for project construction and approximately 1 1/2 years to complete project licensing. To meet this schedule will require final project approval by late 1981.

2.2 ENERGY AND ELECTRICAL POWER SUPPLY

(a) Energy Use in British Columbia

Electricity, natural gas, petroleum fuels, wood and coal all contribute towards the supply of energy in British Columbia. The share of total primary energy consumption of these energy sources in British Columbia in 1978 has been estimated as shown below:*

Oil products	43.6%
Natural Gas	18.0%
Coal	0.9%
Wood wastes	21.2%
Electricity	16.3%

British Columbia must import about 77 percent of its oil requirements, but it is self-sufficient in its other energy consumption.

The share of electricity as a preferred energy source has been growing steadily over the past decades, due to the convenience and versatility of electricity. Consequently, the rate of growth of demand for electricity has been more rapid than the growth of demand for most other energy sources.

The B.C. Hydro Task Force Report of 1975** showed that the demand for total energy in British Columbia during the period 1953 to 1973 grew at an average rate of 5.6 percent annually, which was almost the same as the provincial economic growth rate of 5.9 percent annually. However, the total provincial demand for

---

* See the "British Columbia Energy Supply and Requirements Forecast, 1979-1996, Summary Report", Fig. 2, prepared by the B.C. Ministry of Energy, Mines, and Petroleum Resources, February 1980.

** See Section 3, "The Demand for Energy", of the report Alternatives, 1975 to 1990, Report of the Task Force on Future Generation and Transmission Requirements, B.C. Hydro, May 1975.

electricity over the same period grew at 8.1 percent annually, and the demand on the B.C. Hydro system grew at 11 percent annually. Studies of historic United States energy demands also showed that total energy demand grew at approximately the same rate as total economic growth, but total electricity demand grew at approximately 1.7 times this rate.

Future growth rates for total energy demand relative to economic growth may decline due to increased energy costs and increased conservation efforts. However, the demand for electricity is still expected to grow more rapidly than total energy demand, due to its convenience and versatility, and due to the increasing reliance that will become necessary in the future on electricity, coal and renewable energy resources as oil and natural gas supplies are reduced.

(b) Electrical Power Supply in British Columbia

In 1978, electricity supplied approximately 16.3 percent of the province's total energy requirements. About 90 percent of this electricity was generated by hydro power and the remainder was generated by burning natural gas, oil and hog fuel.

Electric energy is generated in the province by B.C. Hydro, by a number of industries including Alcan and Cominco for their own use, by the city of Nelson, and by the West Kootenay Power and Light Company, a private utility owned by Cominco. The generation installed by Alcan, Cominco, the West Kootenay Power and Light Company and the city of Nelson is all hydroelectric. The generation installed by industries other than Alcan and Cominco is predominantly thermal-electric. Most of this other generation is installed in the pulp and paper industry in conjunction with process heat facilities and is fuelled by waste wood, oil and natural gas.

2.2 ENERGY AND ELECTRICAL POWER SUPPLY - (Cont'd)

In 1978, total electricity generation for domestic consumption in British Columbia was 40 010 GW.h. Of this total, B.C. Hydro generated 28 530 GW.h, or about 71 percent, and the remaining 29 percent was generated by private industry and other utilities.

B.C. Hydro currently provides electric power service to 92 percent of the population in British Columbia. Almost all of the future load growth in British Columbia will be served by B.C. Hydro. The only prospects for a future increase in private power generation are the possible expansion of Alcan's Kemano hydro project, and some limited development of additional self-generation facilities by the forest industry.

B.C. Hydro now has three major power projects under construction (the Seven Mile, Peace Canyon and Revelstoke hydro projects), and when these are completed by 1984, the total energy capability of the B.C. Hydro power system will be as itemized in Table 2-1. In 1984, 88 percent of B.C. Hydro's generating capacity will be hydroelectric, and almost all of the energy generation will be hydroelectric. The firm energy that B.C. Hydro's power system can generate during a critical drought period will be 44 700 GW.h/a by 1984, and average hydro generation at that time will be about 46 060 GW.h/a, as shown on Table 2-1.

(c) B.C. Hydro's Role in Meeting Provincial Power Needs

Electric power loads on the B.C. Hydro system have more than doubled in the last 10 years. The demand for electricity is increasing continuously with the growth of the economy, and the power demands on most electric utilities in North America have doubled almost every 10 years at historic rates of growth. This growth has led to a significant risk of future power shortages in

TABLE 2-1

B.C. HYDRO INTEGRATED POWER SYSTEM CAPABILITY - 1984

Projects	Generating Capability MW	Average Energy GW.h/a	Firm Energy GW.h/a
Hydro			
Existing			
G.M. Shrum (Peace)	2 680	13 130	12 590
Mica	1 600	7 620	6 820
Kootenay Canal	529	2 970	2 200
Other Hydro	1 614	8 000	7 320
Peace Canyon (4 Units)(1980)	700	3 340	3 360
Seven Mile (3 units)(1980)	529	3 120	2 580
SUBTOTAL	7 652	38 180	34 870
Under Construction			
Revelstoke (4 units)(1983)	1 800	7 880	7 080
SUBTOTAL	9 452	46 060	41 950
Thermal			
Burrard	900	variable	2 750[1]
Gas Turbines	331		0
SUBTOTAL	1 231		2 750
Total System	10 683		44 700

[1] Availability of natural gas for Burrard is not assured and may not be available during peak winter periods.

the next decade for many electric utilities in North America due both to the rapid growth of power demands, and also to the increasing difficulty of licensing and building new powerplants.

Many people are concerned about the scale and rate of future economic growth, and its accompanying consumption of limited natural resources and effects on the environment. Opposition to the expansion of electric energy supply as an inevitable consequence of economic growth is just one aspect of that concern. It is obvious that unconstrained exponential growth of the economy and its power demands cannot continue forever at historic rates; but the questions of more immediate concern are: "will growth continue in the near future?", and "at what rate?"

The question of whether or not growth should continue and whether or not this is to society's best long-term benefit involves many fundamental value judgements that are clearly beyond B.C. Hydro's mandate. Any policy to deliberately limit growth cannot be established by B.C. Hydro unilaterally; Hydro has only the authority and responsibility to serve the public by supplying future power demands at the minimum cost consistent with the reliability, safety and public acceptability of new sources of power supply. B.C. Hydro can and does promote electricity conservation, but such conservation is entirely voluntary. In view of these responsibilities, B.C. Hydro cannot base its planning for future power supply on value judgements about what economic growth should be. It has to plan on the basis of realistic expectations about the actual development that will occur. Current expectations are that the growth of future power demands will be significantly lower than historic growth rates, but perhaps not so low as some of the critics of economic growth would like to see.

2.2 ENERGY AND ELECTRICAL POWER SUPPLY - (Cont'd)

This reduction in forecast future growth rates reflects both the recent slowdown in economic growth, and the expectation of a sustained period of considerably slower economic growth for British Columbia in the next decade than experienced over the past 25 years. Rising energy costs and increasing conservation efforts will also contribute to a slower rate of growth of future power demands, and although British Columbia's favourable climate and living conditions are expected to continue to attract newcomers to this province, the rate of future population growth is also expected to be lower than in recent decades.

2.3 FORECASTING THE REQUIREMENTS FOR ELECTRIC ENERGY

(a) Load Forecast Procedure

B.C. Hydro's forecast of future energy requirements has been derived in accordance with conventional utility forecasting techniques. It is based on an extrapolation of past trends of demand, modified as considered appropriate by known or expected developments in patterns of energy use.

B.C. Hydro prepares estimates of electric energy sales, losses, gross energy requirements and peak demands annually for a 10-year budget period and a further 10-year planning period. Energy forecasts are made first and peak demand estimates are then established by applying appropriate load factors* to forecast energy demands.

B.C. Hydro currently provides electricity to about 1 009 000 customers in 73 power districts in British Columbia.

---

* "Load factor" is the ratio of average power demand in kilowatts supplied during a designated period to the maximum demand occurring in that period.

Fifty-two of these customers are large industrial bulk loads served at transmission voltage and account for 36 percent of total electric energy sales. Forecast procedures start by isolating these large customers, with each to be analyzed on an individual basis. Remaining sales are forecast in detail for each district by load categories, i.e. residential, general under 35 kW, general 35 kW and over, street lighting and company use. Categories are then added to obtain a total sales forecast for each district. For major plant operation and planning purposes, applicable district sales forecasts are summed, bulk sales and losses are added, and gross energy and peak demand requirements are ascertained for power districts and generating systems. The peak demand estimates are based on normal weather, and these normal winter peak demands may be exceeded by as much as 6 percent should colder weather occur in about 1 year out of 10. For the 10 to 20-year planning period, a general extension of total load projections is made consistent with population estimates and related economic indicators.

The category sales estimates other than bulk industrial loads are based on detailed forecasts of numbers of customers, energy use per customer, commercial and industrial activity. These data are generated by power district managers and B.C. Hydro head office analysts with reliance on district information for short-term projections. Each district manager provides: a 2-year projection of kW.h sales by customer class, a 5-year projection of customers, and a written summary of short-term commercial and industrial activity. Bulk industrial sales forecasts are prepared in consultation with each of the customers involved to incorporate their latest outlooks. Bulk industrial allowances for unspecified growth are made by assessing the probabilities of various proposed new industrial developments.

Only the 10-year probable forecast is prepared by the Power District in the detail described above. The further extension of the probable forecast from 10 to 20 years, and also low and high forecasts for the 10 and 20-year periods are prepared by sales categories at the total B.C. Hydro level only. For these projections, residential customers and sales are related to forecasts of total population served, general commercial sales are related to forecasts of provincial economic growth, and bulk industrial sales incorporate growth allowances based on varying degrees of probability for new industrial developments as mentioned previously.

Projections become progressively more uncertain as they are extended into the future. They are not targets, but rather a considered expectation of what may reasonably occur under given sets of conditions. They provide a rational basis for specific short-range planning and general planning for the longer term. In order that forecasts may reasonably reflect changing conditions, they are reviewed and updated annually.

(b) B.C. Hydro Load Forecast, 1979 to 2000

B.C. Hydro's most recent forecast of future loads on the B.C. Hydro system is shown in Tables 2-2 and 2-3. This forecast shows the expected electric loads on the total B.C. Hydro system, including all transmission and distribution losses, and including all future deficits expected by the West Kootenay Power and Light Company after 1979/80. The expected average annual rate of load growth for energy is 5.9 percent from 1979 to 1990, and about 5.6 percent from 1979 to 2000, as shown in Table 2-2.

The expected future average annual growth rate of 5.9 percent for electrical energy is significantly less than the actual rate of historic load growth in the B.C. Hydro system,

TABLE 2-2

B.C. HYDRO 20-YEAR PROBABLE LOAD FORECAST
(Including W.K.P. & L. Co. Ltd. and Cominco Deficiencies)
(Includes all Losses Except Thermal Station Service at Major Thermal Plants)

FISCAL YEAR	TOTAL B.C. HYDRO		INTEGRATED SYSTEM	
	Peak (MW)	Energy (GW.h)	Peak (MW)	Energy (GW.h)
1978/79 (Actual)	5,122	29,304	5,091	29,163
1979/80	5,390	30,320	5,350	30,165
1980/81	5,790	32,080	5,750	31,905
1981/82	6,270	34,820	6,230	34,630
1982/83	6,790	38,030	6,740	37,830
1983/84	7,370	41,350	7,320	41,135
1984/85	7,740	43,290	7,690	43,060
1985/86	8,150	45,310	8,090	45,065
1986/87	8,590	47,520	8,530	47,260
1987/88	9,040	49,770	8,970	49,490
1988/89	9,520	52,190	9,450	51,890
1989/90	10,050	54,810	9,970	54,490
11 Yr. Av. Growth 1978/79 to 1989/90		5.9%		5.8%
1990/91	10,600	58,100	10,520	57,700
1991/92	11,200	61,300	11,120	60,900
1992/93	11,800	64,700	11,720	64,300
1993/94	12,500	68,100	12,420	67,700
1994/95	13,200	71,700	13,120	71,300
1995/96	13,900	75,400	13,810	75,000
1996/97	14,600	79,400	14,510	79,000
1997/98	15,300	83,500	15,210	83,100
1998/99	16,100	87,800	16,010	87,400
1999/2000	16,900	92,400	16,810	92,000
21 Yr. Av. Growth 1978/79 to 1999/2000		5.6%		5.6%

Prepared September 1979

TABLE 2-3

B.C. HYDRO AND POWER AUTHORITY
HISTORIC AND PROBABLE FORECAST OF ELECTRIC POWER REQUIREMENTS BY SALES CATEGORIES

Fiscal Year	Residential		Other		West Kootenay Power & Light Co. Ltd. Load Deficiency		Total Sales less Bulk		Bulk Sales		Total Billed Sales		Losses and Accruals		Total Gross Requirements[1] (including W.K.P. & L. Co. Ltd. Load Deficiencies) Energy		Peak	
	GW.h	Annual % Growth	GW.h	Annual % Growth	GW.h	Annual % Growth	GW.h	Annual % Growth	GW.h	Annual % Growth	GW.h	Annual % Growth	GW.h	% of Total Sales	GW.h	Annual % Growth	MW[3]	Annual % Growth
1968/69	3 488	13.8	4 311	9.7			7 799	11.5	4 545	11.0	12 344	11.3	1 259	10.2	13 603	11.2	2 557	9.1
1969/70	3 664	5.0	4 718	9.4			8 382	7.5	5 062	11.4	13 444	8.9	1 407	10.5	14 851	9.2	2 716	6.2
1970/71	4 044	10.4	5 041	6.8			9 085	8.4	5 278	4.3	14 363	6.8	1 666	11.6	16 029	7.9	2 972	9.4
1971/72	4 465	10.4	5 863	16.3			10 328	13.7	5 860	11.0	16 188	12.7	1 684	10.4	17 872	11.5	3 130	5.3
1972/73	4 739	6.1	6 112	4.2			10 851	5.1	7 066	20.6	17 917	10.7	2 366	13.2	20 283	13.5	3 653	16.7
1973/74	5 176	9.2	6 848	12.0			12 024	10.8	7 776	10.0	19 800	10.5	2 493	12.6	22 293	9.9	3 739	2.4
1974/75	5 685	9.8	7 180	4.8			12 865	7.0	7 714	-0.8	20 579	3.9	2 775	13.5	23 354	4.8	3 957	5.8
1975/76	6 258	10.1	7 594	5.8			13 852	7.7	6 808[2]	-11.7	20 660	0.4	2 765	13.4	23 425	0.3	4 232	6.9
1976/77	6 625	5.9	8 133	7.1			14 758	6.5	8 166	19.9	22 924	11.0	3 034	13.2	25 958	10.8	4 421	4.5
1977/78	7 051	6.4	8 634	6.2			15 685	6.3	8 479	3.8	24 164	5.4	3 328	13.8	27 492	5.9	4 800	8.6
1978/79	7 492	6.3	9 095	5.3			16.587	5.8	9 133	7.7	25 720	6.4	3 584	13.9	29 304	6.6	5 122	6.7
10 Yr Average % 1968/69-1978/79	7.9		7.8				7.8		7.2		7.6				8.0		7.2	
Forecast																		
1979/80	7 869	5.0	9 575	5.3			17 444	5.2	9 285	1.7	26 729	3.9	3 591	13.4	30 320	3.5	5 390	5.2
1980/81	8 278	5.2	10 187	6.4	61	-	18 526	6.2	9 770	5.2	28 296	5.9	3 784	13.4	32 080	5.8	5 790	7.4
1981/82	8 706	5.2	10 710	5.1	245	-	19 661	6.1	11 090	13.5	30 751	8.7	4 069	13.2	34 820	8.5	6 270	8.3
1982/83	9 181	5.5	11 413	6.6	771	-	21 365	8.7	12 270	10.6	33 635	9.4	4 395	13.1	38 030	9.2	6 790	8.3
1983/84	9 701	5.7	12 143	6.4	1 113	-	22 957	7.5	13 665	11.4	36 622	8.9	4 728	12.9	41 350	8.7	7 370	8.5
1984/85	10 270	5.9	12 899	6.2	1 296	16.4	24 465	6.6	13 855	1.4	38 320	4.6	4 970	13.0	43 290	4.7	7 740	5.0
1985/86	10 863	5.8	13 773	6.8	1 489	14.9	26 125	6.8	13 980	0.9	40 105	4.7	5 205	13.0	45 310	4.7	8 150	5.3
1986/87	11 492	5.8	14 713	6.8	1 673	12.4	27 878	6.7	14 165	1.3	42 043	4.8	5 477	13.0	47 520	4.9	8 590	5.4
1987/88	12 176	6.0	15 749	7.0	1 875	12.1	29 800	6.9	14 235	0.5	44 035	4.7	5 735	13.0	49 770	4.7	9 040	5.2
1988/89	12 909	6.0	16 850	7.0	2 076	10.7	31 835	6.8	14 340	0.7	46 175	4.9	6 015	13.0	52 190	4.9	9 520	5.3
1989/90	13 684	6.0	18 053	7.1	2 278	9.7	34 015	6.8	14 445	0.7	48 460	4.9	6 350	13.1	54 810	5.0	10 050	5.6
11 Yr Average % 1978/79-1989/90	5.6		6.4				6.7		4.3		5.9				5.9		6.3	

1 Excludes thermal station service at Burrard, Port Mann, Georgia, Keogh and Prince Rupert.

2 Bulk sales in 1975/76 abnormally depressed by approximately 1400 GW.h as a direct result of 3 months pulp and paper strike.

3 Forecast peak loads are based on normal weather conditions.

September 1979

which averaged 8.0 percent annually from 1968 to 1978, as shown in Table 2-3. B.C. Hydro's electric forecast also includes annual incremental requirements expected on the West Kootenay system, as estimated by West Kootenay Power and Light.

The forecast rate of growth of peak power demands is slightly higher than for average energy demands, as shown in Table 2-3. However, future peak loads will have no effect in determining the scheduling of new generation projects in the forecast period, because new generation projects will be required to provide firm energy generation rather than for their peaking capacity. The actual peaking capacity provided is determined by the plant capacity required to optimize energy production from the available water.

The electric forecast of future residential power demands takes into account an increasing trend towards use of electricity for space heating. However, it also recognizes several factors which are expected to temper future growth in residential use: increased conservation efforts, increased efficiency in new appliances, some supplemental solar heating, and expected legislation concerning insulation in new dwellings.

The forecast future growth rate of bulk industrial loads is only about half of the historic growth rate for this sector, as shown in Table 2-3, and the forecast future growth rate in the commercial sector is also less than the historic commercial growth rate.

The electric forecast of 5.9 percent is in effect Hydro's "best guess" as to how future loads will develop, taking into account anticipated economic conditions and development and such factors as relative costs of various forms of energy and growing public awareness of energy conservation. B.C. Hydro also prepares a low and a high forecast of growth in electric loads as the minimum and the maximum reasonable estimates of future load growth. B.C. Hydro's low forecast shows an average annual growth rate of at least 4.9 percent from 1979 to 1990, and the high forecast shows an average annual growth rate of at most 7.6 percent from 1979 to 1990.

(c) The Consequences of Over or Underplanning

Other government agencies, such as the B.C. Energy Commission and the Ministry of Energy, Mines and Petroleum Resources, have also prepared forecasts of future economic growth, future energy demands, and future electricity demands in British Columbia. In some cases, these forecasts have differed significantly from B.C. Hydro's forecast of future electricity demand. In view of these differences, it is worth considering the problem of uncertainty in load forecasting, and the consequences of over or underplanning to meet future power demands.

No single load forecast can be a perfect estimate of exactly what will happen in the future. B.C. Hydro's probable load forecast represents what it considers the most probable development of future loads, but the uncertainty of the load forecast is recognized by bracketing it with a high and a low load forecast.

When there is doubt as to the future level of energy consumption, as exists at present with the difference between the Ministry of Energy, Mines and Petroleum Resources' forecast and that of B.C. Hydro, it is considered more prudent to plan to meet the higher forecast than the lower one. If projects are begun too soon, it is usually possible to delay completion to coincide with a subsequently reduced load forecast. Some additional costs might be incurred if schedules have to be delayed once started, but the costs would be much less than the alternative if the load requirements are suddenly found to be underestimated. It is also very likely that all the electricity generation from any new projects that are completed before they are absolutely required in British Columbia could be exported to the United States on a short-term basis at a price that would more than cover their costs, thus effectively reducing future rates for B.C. customers.

If, on the other hand, future load growth is higher than anticipated, there is no assurance that construction and manufacturing schedules could be accelerated sufficiently to meet such increased loads. Even if they could, such an accelerated construction program would certainly result in a large increase in costs. If the project cannot be completed by the time it is required, then at best the utility is faced with heavier reliance on thermal generation and the consumption of expensive fossil fuels. At worst, if no replacement power is available, the utility and its customers face a shortage of electricity with all its serious consequences on industry and jobs.

After carefully reviewing alternative forecasts, and considering the consequences of being in short rather than adequate supply, B.C. Hydro has concluded that its own forecast, shown in Tables 2-2 and 2-3, should continue to be used for planning future power supplies. This forecast provides an adequate assurance of being able to meet uncertain future power demands in a reliable and economic manner, and does not impose undue economic penalties. To plan for any forecast that is significantly less than this would involve an unacceptable and unjustified risk of future power shortages.

2.3 FORECASTING THE REQUIREMENTS FOR ELECTRIC ENERGY - (Cont'd)

B.C. Hydro revises and updates its load forecast annually in light of the most recent experience of the actual load on the system, and if future load forecasts are reduced before major project commitments are made, then those future projects can be rescheduled if necessary.

2.4 CRITERIA FOR PLANNING TO MEET FORECASTED LOADS

(a) Introduction

Having estimated the future demand for electricity from the B.C. Hydro system, it is necessary to establish both the optimum sequence of installation of new generating plants and the in-service schedule for each project. First of all an inventory of potential projects is compiled, together with preliminary estimates of their costs, with cost estimates also of the associated transmission additions required to meet the increasing load on the system.

By considering these projects in relation to the technical and economic criteria developed for planning, and taking into consideration the environmental and socio-economic implications of development known at this stage of the planning process, an optimum sequence of new power developments is established. This generation program, extending some 15 years into the future, provides the basis for recommending the next project or projects for development in the B.C. Hydro power system.

(b) Environmental and Socio-economic Considerations

The environmental effects of energy resource development have social and economic implications for the public at large, and are therefore of concern to government. The formal interest of the government in these matters is embodied in various acts of the provincial and federal governments, the provisions of which must be adhered to by B.C. Hydro before facilities can be constructed.

However, the planning of new generation facilities, including related studies and investigations, must be initiated several years in advance of applications under relevant statutes to allow construction of specific projects. Not all potential projects in the inventory can be studied in depth at one time, nor would this be desirable. The planning process is progressive with the projects which are apparently more economic and less disturbing to the environment receiving earliest study attention. Projects which have been included in the early years of the generation program will have received extensive study, whereas those in later years may only have been studied in a preliminary sense.

The length of time required for environmental and engineering planning studies and licensing of new projects often constitutes an important constraint on the estimated earliest feasible in-service dates of those projects, and consequently on whether or not those projects are really feasible alternatives for early development.

(c) Technical Planning Criteria

Given a forecast of demand for electricity, the scheduling of generation projects is determined primarily by the planning requirements of supplying the forecast peak load and energy demands in a reliable and economic manner.

(i) Energy Requirements

Additions of generating plant are scheduled so that the firm energy capability of the system will be equal to or greater than the forecast probable electric energy demand including transmission and distribution losses.

The firm energy capability of the hydroelectric generation on the system is established by the average energy available during the worst 5-year drought in the historic streamflow record, referred to as the critical period.

This schedule of plant additions is then checked to determine if there are economic advantages in advancing new projects under average water conditions to reduce the expected use of oil and gas fuels at thermal plants.

(ii) Peak Load Requirements

In addition to supplying the average energy demand, the B.C. Hydro power system must be able to meet the peak power loads each winter, and it must also have a minimum margin of reserve generating capacity (usually 12 to 15 percent of peak load) over and above the forecast peak to allow for scheduled and unscheduled outages of equipment. The exact amount of capacity reserve required is based on a statistical analysis of the probability of outages on each unit in the system.

The rivers of British Columbia have flows that are highly variable throughout the year with low flows generally occurring during the cold winter period followed by high runoff in the spring and early summer periods when the snowpack melts. Reservoir storage is used to regulate these flows and attempt to "shape" them to the pattern of load demand. Because this storage is limited it is sometimes necessary to pass flows in excess of the powerplant capacity and the excess flow has to be spilled. The more the capacity of the powerplant, then the smaller is the amount of water spilled.

The optimum capacity of each plant is determined by balancing the cost of added powerplant equipment against gains in energy due to the reduced spill and this has resulted in more capacity in the system as a whole than is necessary to meet the peak load requirement in the December - January period. Hence the peak load criterion is not the governing factor at present which determines additions to the generation system. The installed generating capacity at new hydro projects is determined on the basis of their ability to generate an optimum amount of energy, rather than on the need for additional peaking capacity. The future possible addition of thermal-electric power to the system may change this situation, with the result that over time the peak reserve requirements may develop some significance.

(d) Economic Planning Criteria

In scheduling new plant additions, the capital costs and annual costs (including fuel) of alternative projects and sequences of power system development are evaluated using a discounted cash flow analysis to establish the most economic sequence and timing of new generation projects. Computer runs are made to simulate the system operation for projected loads with the sequence under consideration. This is to confirm the capability of the proposed system to meet energy and capacity requirements, and also to determine the quantity of natural gas which will have to be burned at Burrard Thermal Plant, near Vancouver, to make up the difference between the energy demand and the supply from hydroelectric sources.

The Burrard Thermal Plant is more expensive to operate than the projects currently under construction or planned for the immediate future. Consequently, Burrard is used in the integrated system only when necessary. Gas turbine plants, which mainly operate on natural gas or distillate oils, are much too costly to use for regular operation. Gas turbines are used in the B.C. Hydro system mainly for emergencies such as transmission line outages or during major outages of other generation sources.

(a) Required In-service Date for Next Project

The need for a new project is illustrated graphically in Fig. 2-1, which shows the committed system capability compared to forecast loads. The three forecasts are shown, high, probable and low, together with the committed system capability under long-term average water conditions (blue), and critical water conditions corresponding to the period from November 1940 to May 1946 (red). The high cost thermal energy which may be available from the Burrard Thermal Plant is shown with cross-hatching at the top of the blue and red bars, indicating that it is only generated when absolutely essential due to the very high operating cost of the plant. Moreover, the availability of natural gas to operate the plant cannot be assured.

From Fig. 2-1 it is seen that additional generation is required by the fall of 1986 (fiscal year 1986/87) to meet the probable load forecast. The Peace Site C project would therefore be preferred for an October 1986 in-service date in order to supply adequate firm energy to meet the probable load forecast. However, due to delays in the commencement of project licensing for Peace Site C, it appears that October 1987 would be the earliest feasible in-service date for this project. With a 1987 in-service date for Peace Site C, B.C. Hydro would run a risk of significant firm energy deficits in 1986/87 and 1987/88. This risk could be reduced if either: 1) future load demands are less than the current probable forecast; or 2) average or above average water conditions occur in 1986 to 1988; or 3) firm energy imports and purchases are feasible in 1986 to 1988.

FIGURE 2-1

COMMITTED SYSTEM CAPABILITY COMPARED TO FORECAST LOADS