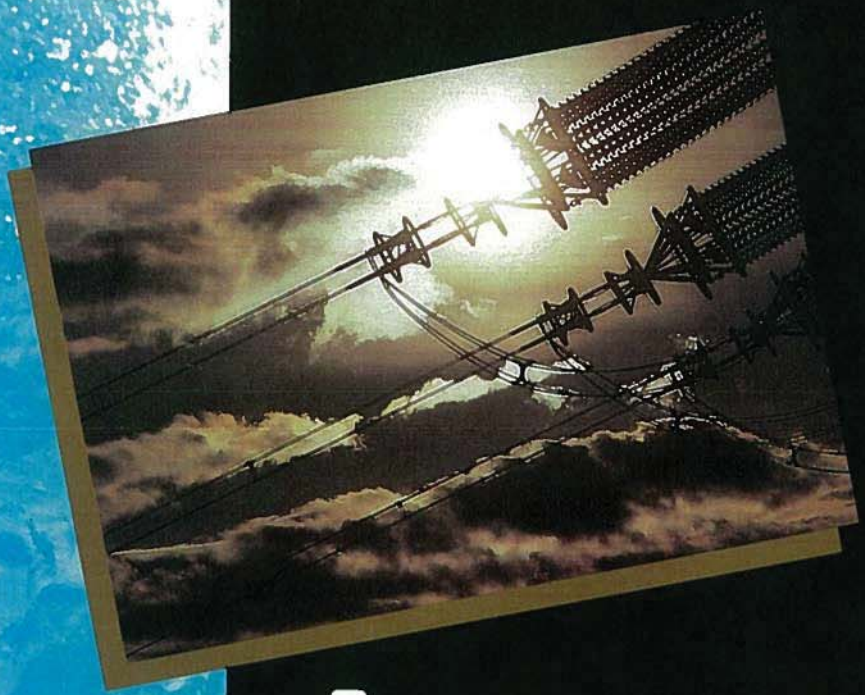
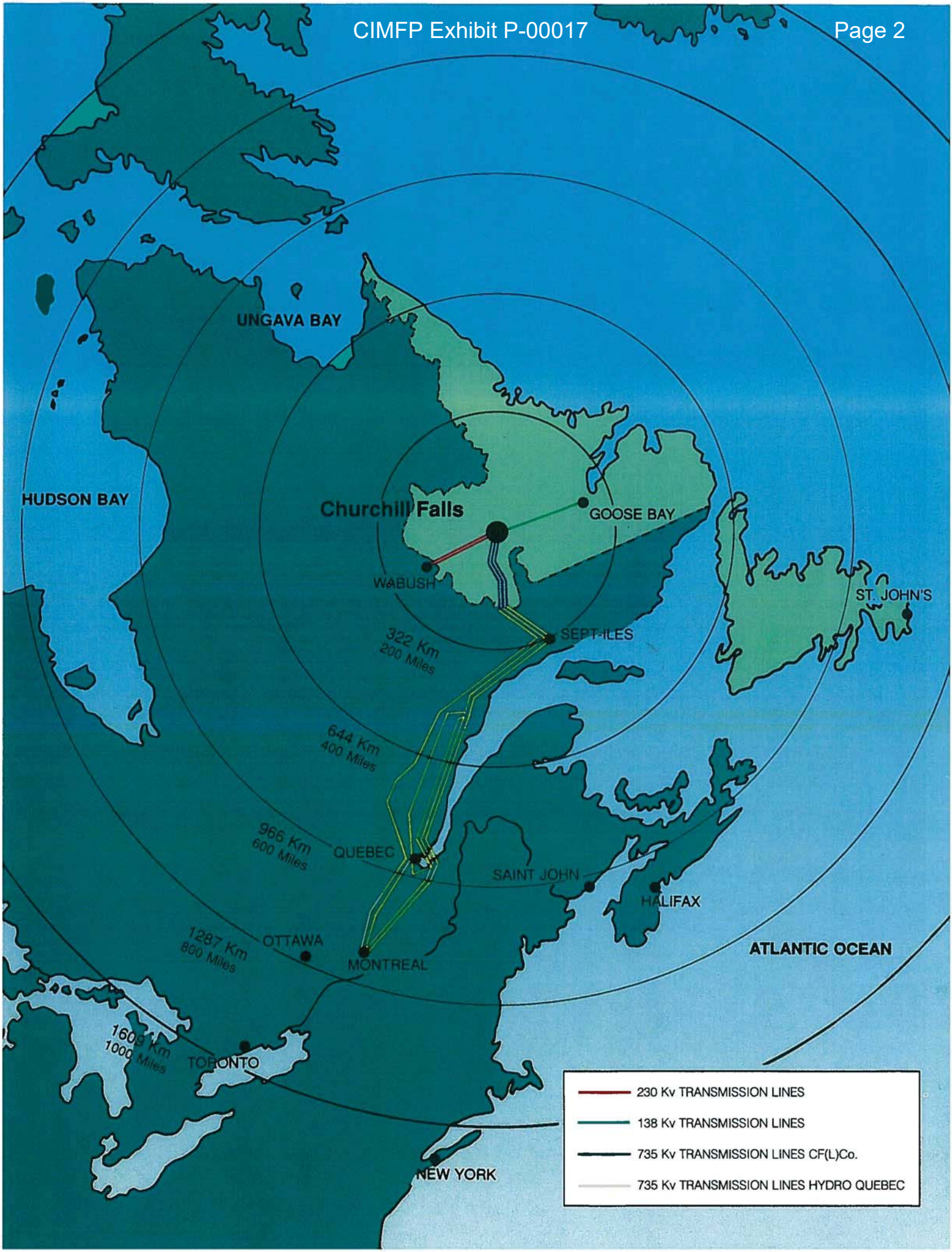
An Energy Giant

The Churchill Falls Power Development



HYDRO CF

CHURCHILL FALLS (LABRADOR) CORPORATION LIMITED


UNGAVA BAY
HUDSON BAY
Churchill Falls
GOOSE BAY
WABUSH
ST. JOHN'S
SEPT-ILES
322 Km
200 Miles
644 Km
400 Miles
966 Km
600 Miles
QUEBEC
SAINT JOHN
HALIFAX
1287 Km
800 Miles
OTTAWA
MONTREAL
ATLANTIC OCEAN
1609 Km
1000 Miles
TORONTO
NEW YORK
230 Kv TRANSMISSION LINES
138 Kv TRANSMISSION LINES
735 Kv TRANSMISSION LINES CF(L)Co.
735 Kv TRANSMISSION LINES HYDRO QUEBEC

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Design: Sheila Gillard Studio

One of The World's Great Natural Resources

Churchill Falls remained shrouded in mystery and native legend until 1839 when John McLean, on an expedition for the Hudson Bay Company, became the first recorded white man to visit the mighty falls.

A.P. Low, on an 1894 expedition for the Geological Survey of Canada, reported the availability of "several millions of horsepower", identifying the potential of Churchill Falls as a source of useable energy.

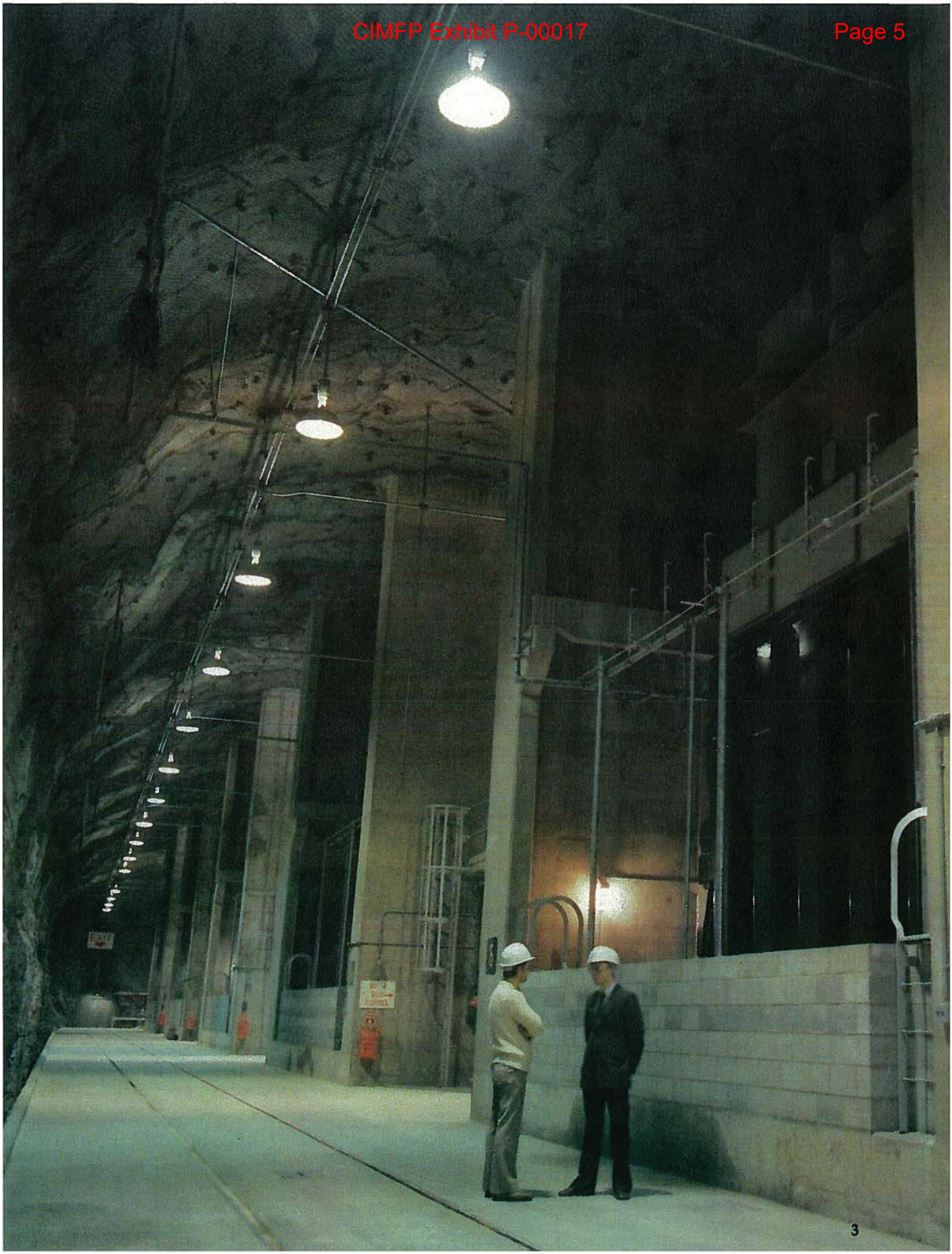
In the 1960s work commenced on the development of the hydro potential of the central Labrador plateau, one of the world's great natural resources.

This brochure describes the main features of the Churchill Falls hydro development, the infrastructure required to support it in the remoteness of the central Labrador wilderness, and the principal aspects of its operation. The heart of the project is the 5,428,500 KW underground power station, one of the largest in the world.

But Churchill Falls is more than a hydro development, it is a community of approximately 850 people who have made their home in this wilderness area.

The challenge of developing this project was not so much about developing complex technology as it was about scale and planning. The construction team met this challenge and completed the project on schedule and within budget, in spite of the harsh climate and remote location.

The development of the Churchill Falls power project was a great engineering achievement and it continues to be one of Canada's great success stories.



A Brief History

The Churchill River had been recognized since 1894 as a potentially huge source of hydro-electric power. The inhospitable terrain, severe climatic conditions, and geographic remoteness, were further complicated by long distance transmission requirements and lack of markets for such a large block of power.

The first geological survey of the area was conducted in 1894 but economic development of Labrador did not take place until the discovery of large iron ore deposits in western Labrador and northeastern Quebec. The construction of the Quebec North Shore and Labrador Railway was completed in 1954. By 1962 further field surveys, power studies and basic planning, proved the feasibility of development of Churchill Falls as a power source.

The significant advantages of Churchill Falls as a potential hydro-electric power site would enable the disadvantages of the area to be overcome. Precipitation and run-off patterns were forecasted to be dependable and extensive storage of water on the elevated plateau was readily achievable. The river's natural drop of over 300 meters (1000 feet) in less than 32 km (20 miles) was perhaps its most significant feature, with respect to hydro power development.

A great many people shared a vision that Churchill Falls would not only provide a world class source of hydro-electricity, but the opportunity to bring other economic development activity to Newfoundland and Labrador.

In response to the province's desire to see its largely untapped water and mineral resources developed, a group of banking and industrial firms established the British Newfoundland Corporation Limited (Brinco) in 1953.

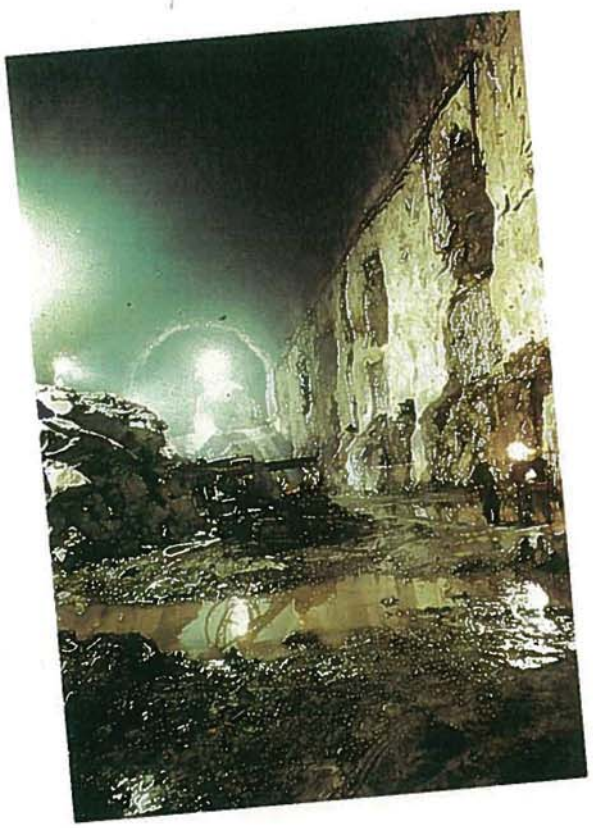
Brinco was granted exclusive mineral and water rights for a 20 year period over more than 129,450 square kilometres (50,000 square miles) in both Newfoundland and Labrador, including the right to develop the river systems in both areas. Under the terms of its agreement with the province, Brinco undertook to carry out extensive exploration within Newfoundland. To carry out its commitment at Churchill Falls, the Churchill Falls (Labrador) Corporation Limited was established in 1961 and granted a 99 year lease authorizing development of the upper Churchill River watershed.

The Twin Falls hydro plant on the Unknown River, a tributary of the Churchill River, was constructed in the early 1960 s. This facility, with a capacity of 225 mw, supplied the power requirements for the iron mining industries in western Labrador.

Twin Falls power was essential to the development at Churchill Falls. It helped open up the area and supplied the power required during the construction phase of the project. In the planning however, it became apparent that greater efficiency in the production of electricity could be achieved by diverting the flow of water from the Ossokmanuan Reservoir into the Smallwood Reservoir. Utilizing this water at the Churchill Falls plant enabled approximately three times as much electricity to be produced from the same volume of water. In July, 1974 the Twin Falls plant was closed and the water diverted into the Smallwood Reservoir.

The development of 735 kv transmission lines permitted power to be moved over long distances. Negotiations for the sale of the power started in 1963 and continued until 1966 when a letter of intent with Hydro-Quebec provided the market and removed a significant barrier to development of the project. A further three years of negotiations were required to finalize the power contract and financial agreements concluding in 1969.

Many years of planning, five years of non-stop field work by approximately 6,300 workers and 946 million dollars of construction costs culminated at 5:17 pm on December 6, 1971 when the first two generating units began delivering power to Hydro-Quebec, five months and three weeks ahead of schedule.



Project Management

A significant feature of the Churchill Falls development was the retention of project management functions by the owner, Churchill Falls (Labrador) Corporation Ltd. (CF(L)Co), a separate and autonomous company set up by Brinco to deal with all aspects of engineering, construction, public and government realtions.

The Acres Canadian Bechtel (ACB) consortium acted as agents for CF(L)Co, charged with responsibility for engineering and construction management. The construction organization in the field had ultimate responsibility for contract administration, inspection and construction coordination.

All work on the project was carried out by contractors. More than 180 construction and services contracts were awarded, ranging widely in value, but with a maximum of $75 million for a single contract.

Owner supplied transportation and catering services removed an item of uncertainty from bids. The controls established by ACB/CF(L)Co ensured that materials were shipped according to priority and delays were not experienced. During construction, a total of 663,000 tonnes (730,000 tons) of material, equipment and fuel were moved to the site.

Schedule and financial control was exercised by monitoring progress continuously, enabling early warning of significant variations and allowing time for remedial action where required.

CF(L)Co took over operation of permanent facilities as they were completed, including the townsite and airport. A uniformly high standard of accommodations and mess facilities were provided by CF(L)Co for a work force which peaked at 6,300 workers.

The Hydro Group of Companies

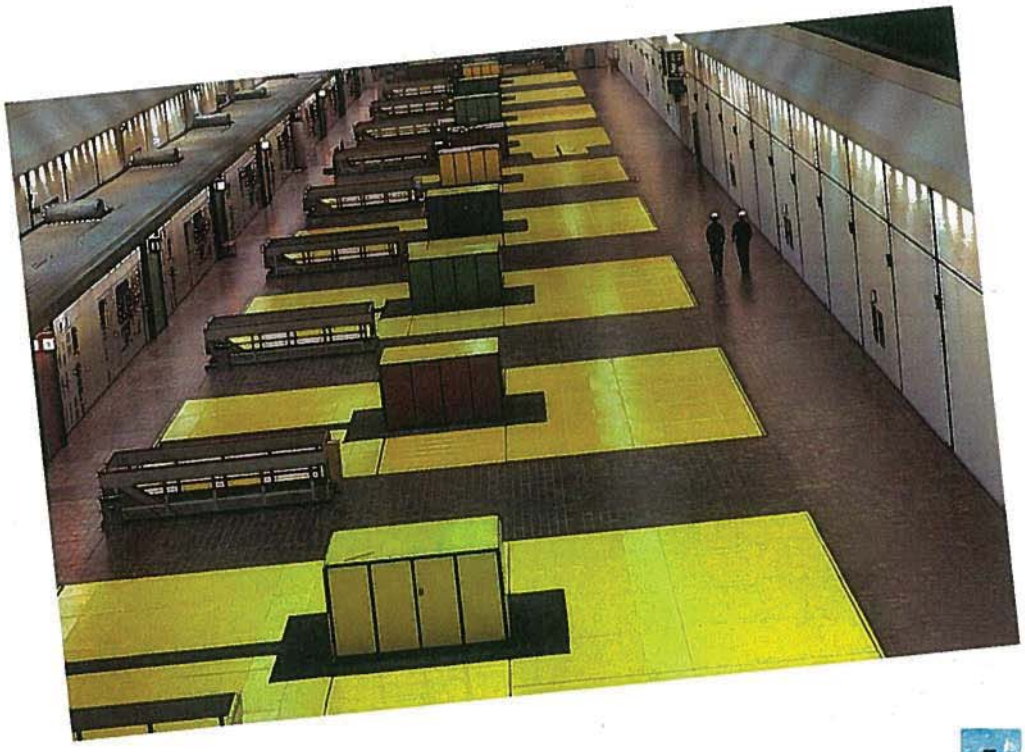
Churchill Falls(Labrador) Corporation Limited became a subsidiary of the Newfoundland and Labrador Hydro-Electric Corporation, when the government of Newfoundland and Labrador purchased 65.8% of the issued share capital of CF(L)Co from Brinco in 1974. The remaining share capital is held by Hydro Quebec.

The Hydro Group today includes: Newfoundland and Labrador Hydro-Electric Corporation, Churchill Falls (Labrador) Corporation Limited, Twin Falls Power Corporation Limited, Lower Churchill Development Corporation Limited, and Gull Island Power Company Limited.

The Mission of the Hydro Group of Companies is to provide electrical power and energy, on behalf of the people of the province, at the lowest cost consistent with reliable service, due consideration for the environment and the safety of our employees and the customers which we serve.

The Hydro Group of Companies is committed to the maintenance of a corporate organization and managerial structure which operates effectively and efficiently and earns recognition for corporate leadership, productivity, financial responsibility and integrity.

Each of our employees contributes to achieving our mission. We seek to attract, retain and promote high quality employees in order to ensure maximum productivity and efficiency, by rewarding performance through competitive compensation and benefit programs, comprehensive management training and nondiscriminatory opportunities for career development.



THE CHURCHILL FALLS PROJECT

1. RATED CAPACITY		
Original	5,225,000	kw
Uprated (1985)	5,428,500	kw
2. GENERATING UNITS		
Number of Turbines	11	
Type	Francis	
Rated Capacity (Original)	648,000	HP
(Uprated)	680,000	HP
Rated Net Head	312.4 m	(1,025 ft)
Synchronous Speed	200	r.p.m.
Scroll Case Inlet Diameter	4.48 m	(14.7 ft)
Runner Inlet Diameter	5.82 m	(19.1 ft)
Runner Weight	77.13 t	170,000 lb
Long Term Plant Mean Flow	1387.52 m^3/s	(49,000 ft^3/sec)
Generators		
Rated Voltage	15	kv
Rated Capacity	526,315	kva (7 units)
	500,000	kva (3 units)
	530,000	kva (1 unit)
Rated Power Factor	0.95	
Rotor Diameter	9.11 m	(29.9 ft)
Rotor Weight	576 t	(1,270,000 lb)
Stator Core Depth	2.99 m	(9.8 ft)
3. PENSTOCKS		
Number	11	
Length	426.72 m	(1,400 ft)
Diameter - Concrete Lined Section	6.10 m	(20 ft)
Diameter - Steel Lined Section	4.48 m	(14.7 ft)
4. MACHINE HALL		
Length	296.27 m	(972 ft)
Width	24.70 m	(81 ft)
Height	46.94 m	(154 ft)
Overhead Travelling	2 X 400	t

5. SURGE CHAMBER		
Length	232.56 m	(763 ft)
Bottom Width	12.19 m	(40 ft)
Top Width	19.5 m	(64 ft)
Height	45.11 m	(148 ft)
6. VENT SHAFT		
Diameter	6.10 m	(20 ft)
Depth	252.68 m	(829 ft)
7. TAILRACE TUNNELS (Unlined)		
Number	2	
Width	13.71 m	(45 ft)
Height	18.29 m	(60 ft)
Length	1691.64 m	(5,500 ft)
8. TRANSFORMER GALLERY		
Transformers	11	(5,500 mva)
Voltage	14.75/240	kv
Length	260.91 m	(856 ft)
Width	15.24 m	(50 ft)
Height	11.89 m	(39 ft)
9. CABLE SHAFTS		
Cables (oil filled)	10.07	km
Voltage	240	kv
Number	6	
Diameter	2.13 m	(7 ft)
Depth	263.65 m	(865 ft)
10. SWITCHYARD		
715/236 kv Transformers	18	(6,000 mva)
230/138 kv Transformers	2	(84 mva)
735 kv - 55 mva Reactors	9	(495 mva)
735 kv Circuit Breakers	12	
230 kv Circuit Breakers	16	
11. TRANSMISSION		
735 kv Lines	3	608 km (378 mi)
230 kv Lines	2	463 km (288 mi)
138 kv Lines	1	267 km (166 mi)
66 kv Lines		200 km (124 mi)

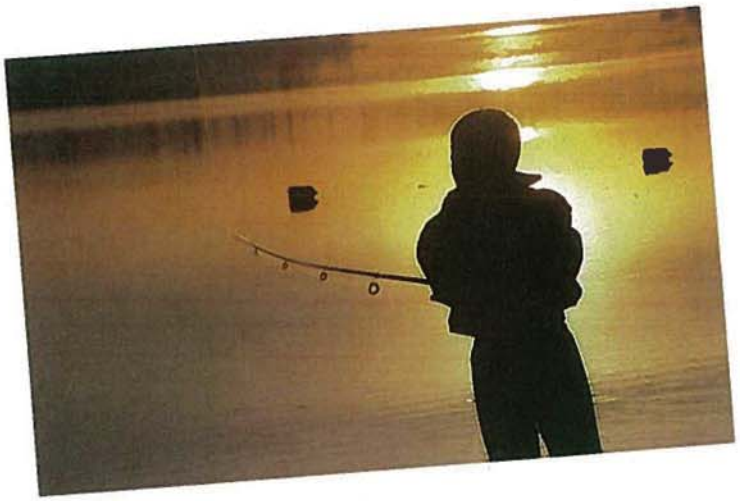
The Community

Beginning in 1967 and continuing throughout the construction years, the community of Churchill Falls consisted of rows of trailers and metal buildings designed to meet the needs of approximately 3000 construction workers. As the families of construction workers arrived, additional amenities such as schools and recreational facilities were required. By 1969 permanent houses were nearing completion and a permanent community was in the making.

Considerable effort went into making the community of Churchill Falls one of the most advanced and comfortable of its kind. The community revolves around a unique town centre complex, the Donald Gordon Centre. The centre houses a school, hotel, theatre, library, bank, beauty salon, post office, recreational and commercial facilities, all under one roof.

Residents enjoy modern living accommodations and recreational facilities. An indoor swimming pool, arena, bowling alley, gymnasium, ski-hill, cross-country ski trails, playground, ball diamond and community centre provide facilities for many hours of active living.

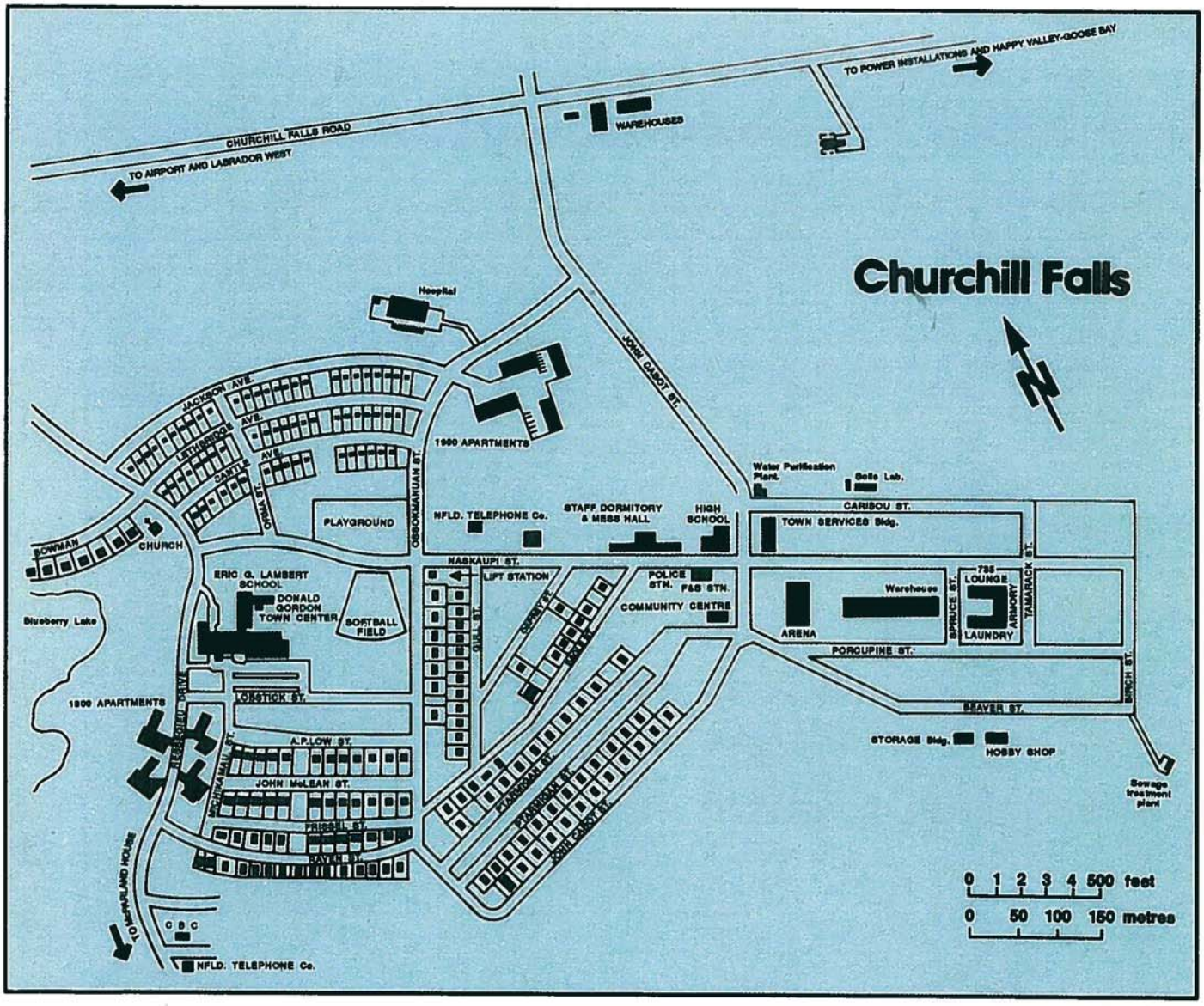
Other facilities include an interdenominational church, a privately run school system, hospital, fire department, and a police detachment.



The community is linked through the Newfoundland Telephone Company to the continental telephone system. The Canadian Broadcasting Corporation provides television and radio programming in both English and French. Additional programming is provided by private sources and a community owned cable system.

Churchill Falls is serviced by regularly scheduled commercial airlines. The airstrip is 8 km (5 miles) from the community and is 1676 m (5500 feet) in length, capable of handling jet aircraft service.

The total population of Churchill Falls is approximately 850 people, some 240 families, providing the work force to operate one of Canada's largest hydro electric plants.



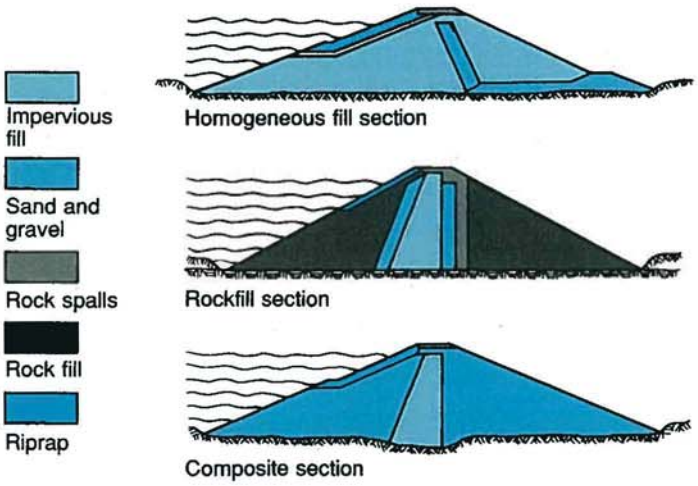
Care for the Environment

From the early phases of construction, the Churchill Falls (Labrador) Corporation Limited carried out its work with an awareness of its responsibility to minimize environmental disturbance and has endeavored to keep pace with changing environmental legislation and standards.

The Churchill Falls project was one of the first large scale users of PCB equipment to undertake a program to remove this equipment from service. This was done in advance of a national recommendation by the Canadian Council of Ministers of the Environment that such action be taken.

Various studies have been undertaken to investigate biological issues, such as: changes in local fish populations caused by reservoir structures and the effects of flooding on the shoreline and vegetation. These studies were carried out in conjunction with federal and provincial government agencies.

Care for the environment is an operational responsibility which is taken very seriously by CF(L)Co and finding a healthy balance between the needs of the operation and the constraints of the environment is one of its objectives.



Cross sections of the three basic dyke designs, all of which contain riprap protection against wave action. Homogeneous dykes are the most common and are mainly built of compacted glacial till. Rockfill dykes are used when broken rock is available from nearby excavations. Composite dykes contain mainly sand and gravel fill.

RESERVOIRS

Smallwood

Maximum Water Level	473 m	(1,551 ft)
Minimum Water Level	464 m	(1,522.5 ft)
Reservoir Area	5698 km^2	(2,200 mi^2)
Active Storage	2.84 X 10^9 m^3	(1022 X 10^9 ft^3)

Ossokmanuan

Maximum Normal Water Level	479 m	(1,572 ft)
Active Storage	2.84 X 10^9 m^3	(100.1 X 10^9 ft^3)

East and West Forebay

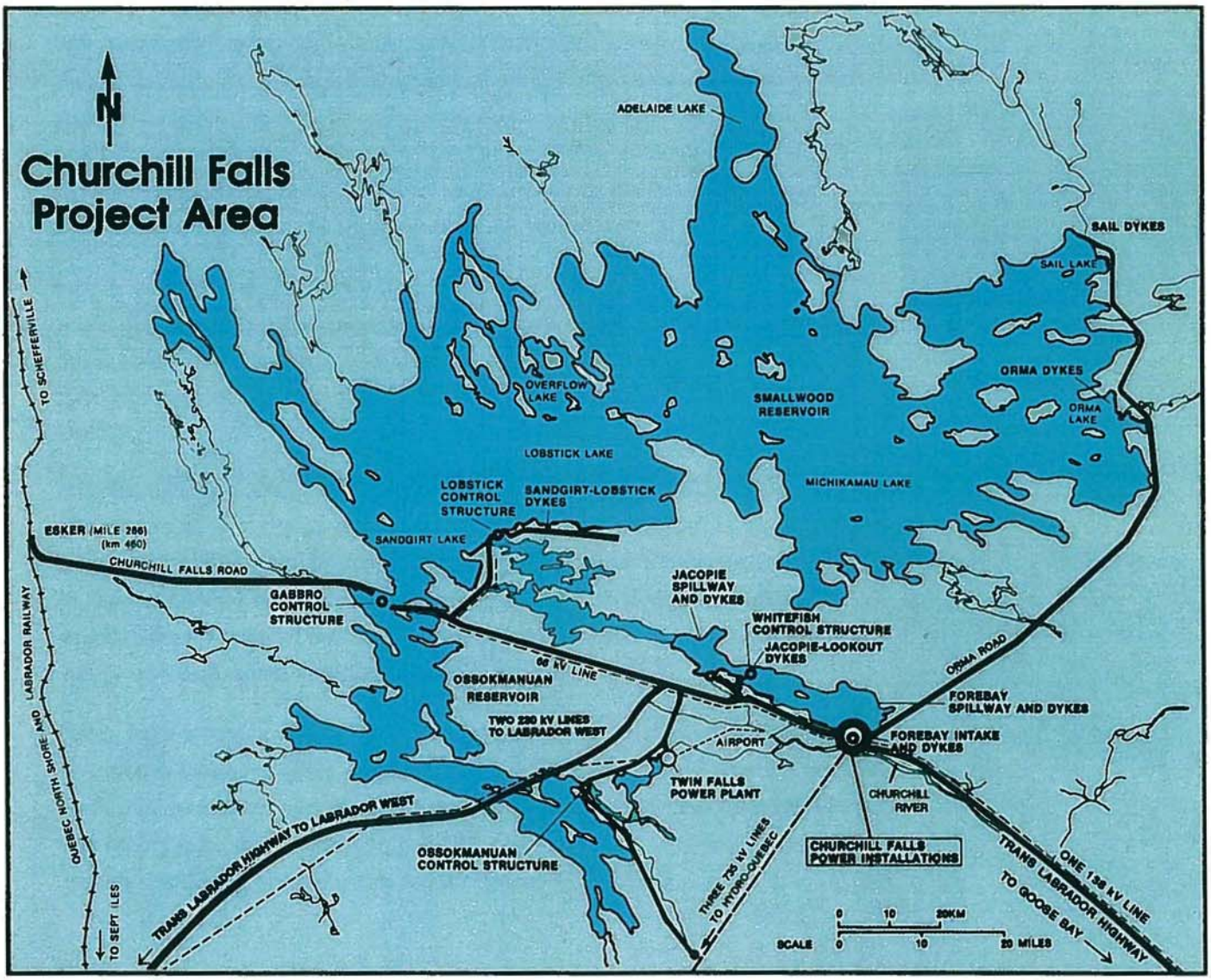
Active Storage	0.864 10^9 m^3	(30.5 X 10^9 ft^3)

DYKES

Total Number	88	
Total Volume of Material	20,000,000 m^3	(26,000,000 cyd)
Average Height	9 m	(30 ft)
Maximum Height (Forebay area)	36 m	(117 ft)
Largest in Volume (Forebay area)	1,950,000 m^3	(2,551,000 cyd)
Longest (Sail Lake area)	6041 m	(19,813 ft)
Total Crest Length	64.4 km	(40 mi)

CLIMATE

Average Annual Precipitation	765 mm	(30.1 in)
Temperature Range	-48° C to 30° C	(-55° F to 87° F)
Temperature Average Annual	-4° C	(25° F)



Operations

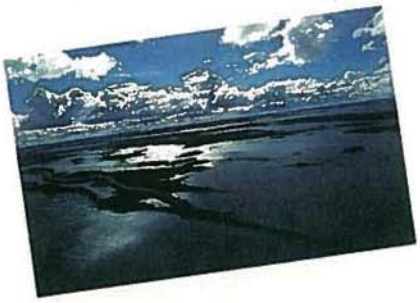
Churchill Falls is a modern power installation utilizing mechanical, electrical and communications systems and civil structures designed and maintained according to modern techniques and standards. The 265 staff members are trained appropriately to operate and maintain the reservoir dykes and spillways, the power plant and switchyard, the transmission lines, the network of roads, and townsite housing and service facilities.

The variety of work requirements demands that staff are equally versatile in their duties and knowledge. A communications technician, for example, will work on troposcatter and point to point microwave systems, UHF and VHF systems, satellite ground stations and numerous other smaller systems.

While outside contractors and specialists are used, the security of the operation and the well-being of the community demands that adequate staff are available to trouble shoot and repair every aspect of the operation.

The operating staff is comprised of engineers, supervisors, technicians and technologists, electricians, mechanics, welders, linespersons, station operators, heavy equipment operators, helicopter pilots, carpenters, fire and security officers, painters, utility workers and janitors. Providing services also requires accountants, clerical staff, warehouse workers, retail clerks, personnel and industrial relations staff, teachers, and medical staff.

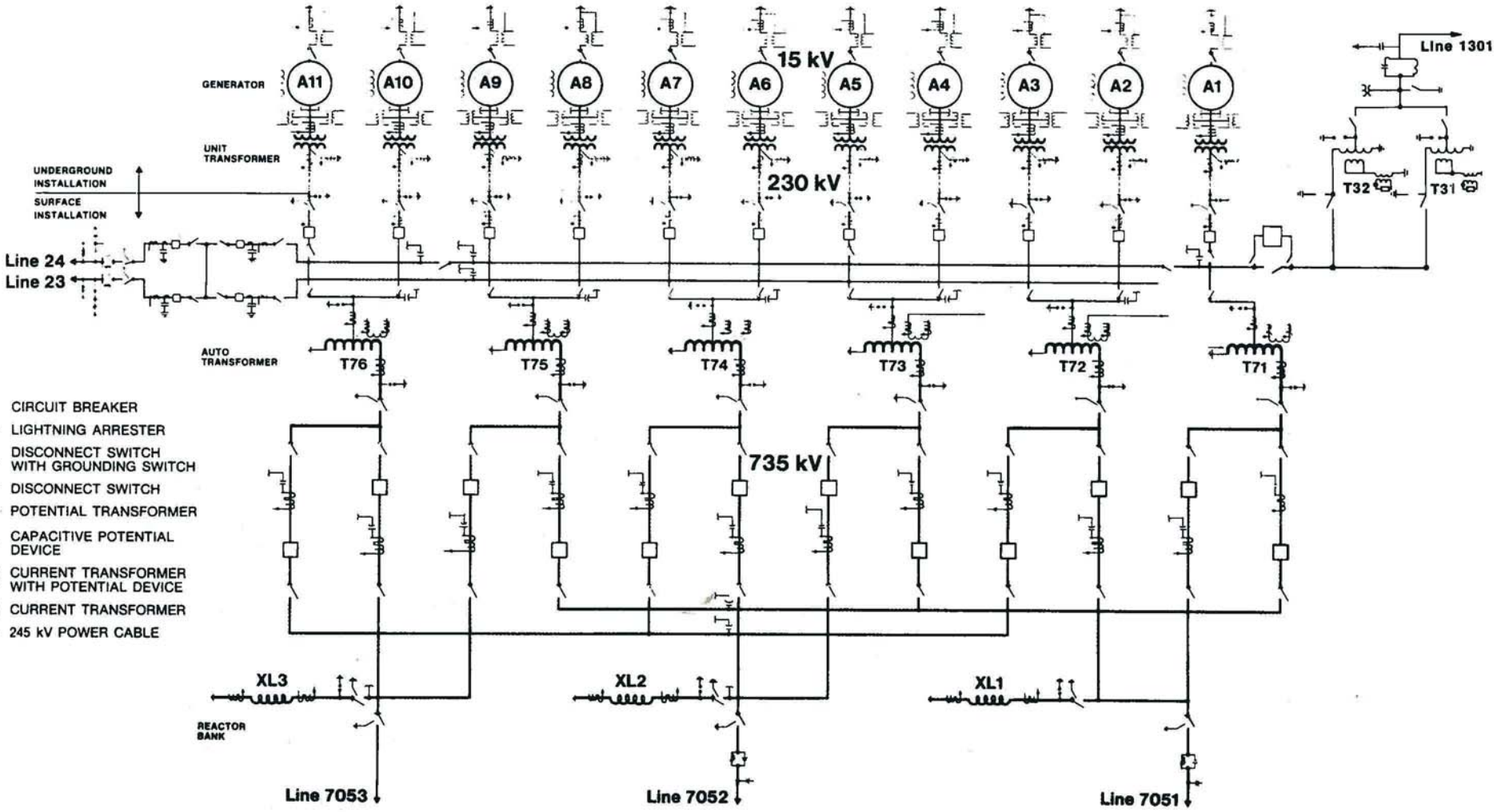
The majority of staff are hired within the province and there is close cooperation between CF(L)Co and the post-secondary school system. An active apprenticeship and training program enables staff to achieve the skill levels required to maintain and operate the sophisticated plant equipment and other facilities.

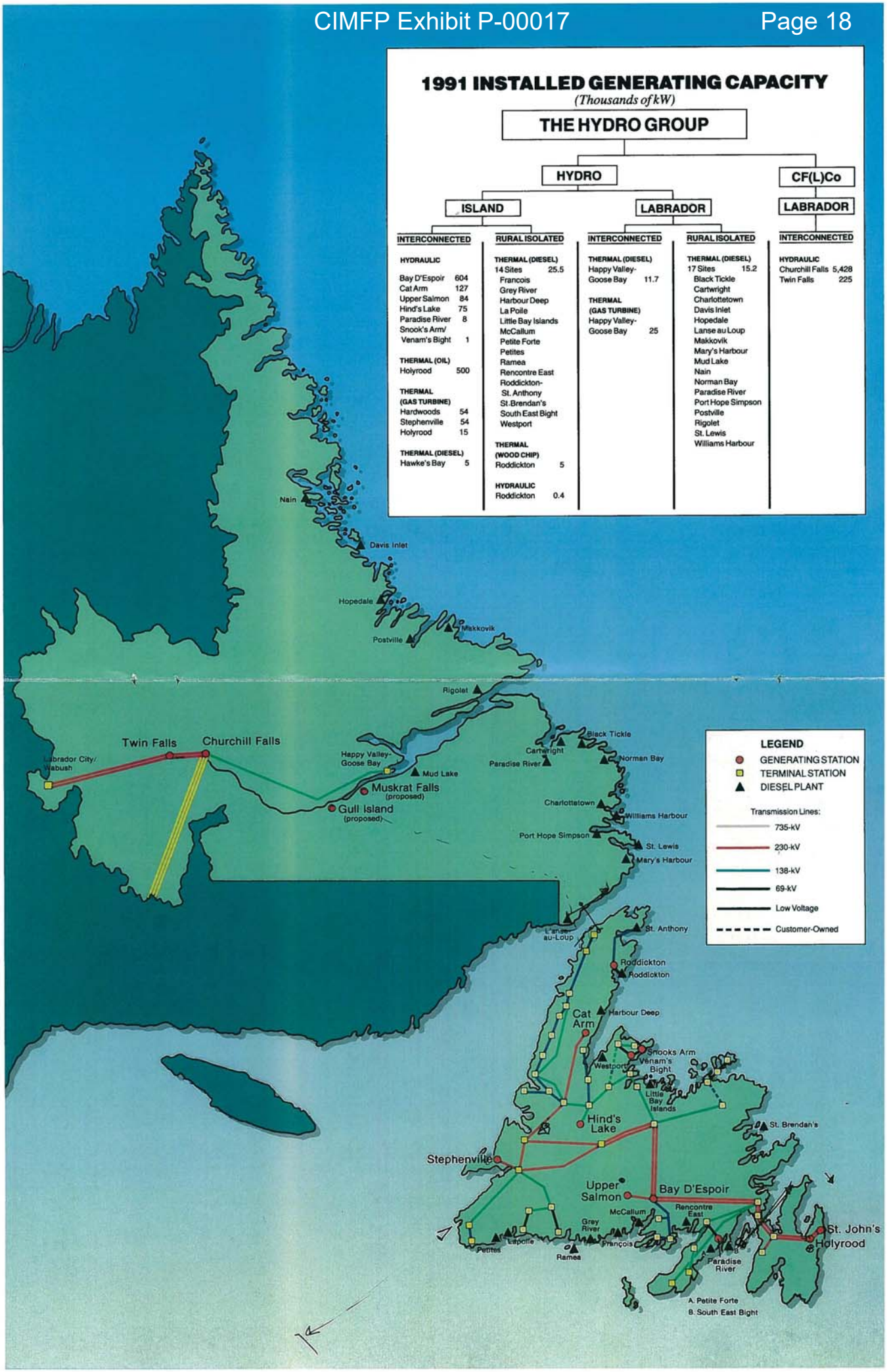


Loss control is part of the philosophy that guides CF(L)Co and contributes significantly to the stability and well being of the company and its employees. The prevention and control of occupational injury and illness, property damage, security breaches and pollution are integrated into every facet of management and operations. Specific committees and training programs have been established for every major area of concern.

During the period 1975 to 1991 (inclusive) CF(L)Co produced a total of 595 billion kilowatt hours of electricity representing an average annual production of 35 billion kilowatt hours. This represents the energy equivalent of 58 million barrels of bunker (sea) oil annually (or 158 thousand barrels of oil per day) at a conventional steam electric generating station.

Single line diagram




1991 INSTALLED GENERATING CAPACITY
(Thousands of kW)
THE HYDRO GROUP
HYDRO
ISLAND
INTERCONNECTED
HYDRAULIC
Bay D'Espoir 604
Cat Arm 127
Upper Salmon 84
Hind's Lake 75
Paradise River 8
Snook's Arm/ Venam's Bight 1
THERMAL (OIL)
Holyrood 500
THERMAL (GAS TURBINE)
Hardwoods 54
Stephenville 54
Holyrood 15
THERMAL (DIESEL)
Hawke's Bay 5
RURAL ISOLATED
THERMAL (DIESEL)
14 Sites 25.5
Francois
Grey River
Harbour Deep
La Poile
Little Bay Islands
McCallum
Petite Forte
Petites
Ramea
Rencontre East
Roddickton-St. Anthony
St.Brendan's
South East Bight
Westport
THERMAL (WOOD CHIP)
Roddickton 5
HYDRAULIC
Roddickton 0.4
LABRADOR
INTERCONNECTED
THERMAL (DIESEL)
Happy Valley-Goose Bay 11.7
THERMAL (GAS TURBINE)
Happy Valley-Goose Bay 25
RURAL ISOLATED
THERMAL (DIESEL)
17 Sites 15.2
Black Tickle
Cartwright
Charlottetown
Davis Inlet
Hopedale
Lanse au Loup
Makkovik
Mary's Harbour
Mud Lake
Nain
Norman Bay
Paradise River
Port Hope Simpson
Postville
Rigolet
St. Lewis
Williams Harbour
CF(L)Co
LABRADOR
INTERCONNECTED
HYDRAULIC
Churchill Falls 5,428
Twin Falls 225
LEGEND
GENERATING STATION
TERMINAL STATION
DIESEL PLANT
Transmission Lines:
735-kV
230-kV
138-kV
69-kV
Low Voltage
Customer-Owned
Nain
Davis Inlet
Hopedale
Makkovik
Postville
Rigolet
Twin Falls
Churchill Falls
Labrador City/ Wabush
Happy Valley-Goose Bay
Mud Lake
Muskrat Falls (proposed)
Gull Island (proposed)
Black Tickle
Cartwright
Parsdise River
Norman Bay
Charlottetown
Williams Harbour
Port Hope Simpson
St. Lewis
Mary's Harbour
St. Anthony
L'anse-au-Loup
Roddickton
Roddickton
Cat Arm
Harbour Deep
Snooks Arm
Venam's Bight
Westport
Little Bay Islands
Hind's Lake
St. Brendan's
Stephenville
Upper Salmon
Bay D'Espoir
McCallum
Rencontre East
Grey River
La Poile
François
Petites
Ramea
St. John's
Holyrood
Paradise River
A. Petite Forte
B. South East Bight