SUBMISSION OF

THE MARITIME POWER POOL

TO

THE DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

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FEBRUARY 1971

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SUMMARY

1. Nova Scotia - New Brunswick Interconnection

The objective of the interconnection of the systems of the three major electric utilities in the Maritime Region may be summed up as being to co-ordinate operations so as to provide electric power and energy to consumers in the region at the lowest possible cost consistent with good utility operating practices. The achievement of this objective may be measured by the facts that since its inception the Maritime Power Pool, as the interconnected utilities have become known, has reduced the ratio of reserve capacity to peak load on the combined systems, has established a shared spinning reserve policy, has made definite reductions in energy costs due to the installation of larger generating units and has provided a means for interchange of economy energy valued at more than $13 million since initial interconnection all without sacrificing any reliability of supply.

2. Interrelation of Department of Regional Economic Expansion and Maritime Power Pool

The objectives of DREE have been stated as being the provision of incentives for the development of productive employment opportunities and the facilitation of economic expansion and social adjustment. To effectively provide for the industrial expansion implicit in these objectives, it is considered that the electric utilities serving the region should be able to supply, on short notice,

a load of 150 MW, over and above the load normally predicted, in the industrialized sections of the region particularly in the four designated areas of Saint John, Moncton, Halifax/Dartmouth and Canso Strait.

To meet this requirement would mean that the electric utilities would have to accelerate their programs for the construction of generating and transmission facilities. This would result in a substantial increase in their capital requirements, thereby placing an unacceptable burden on utility customers even if the investment funds could be obtained.

3. Concept of the H. V. Transmission Grid

The use of higher voltage transmission to provide the capability to continue taking full advantage of regional interconnection has been well recognized. This has been determined as a requirement for a 230 kV system superimposed over the existing 138 kV and 69 kV transmission. The higher voltage system is now being introduced as required according to presently established criteria and as economically practicable. Some lines in New Brunswick are already in operation at 230 kV while others in both Provinces are constructed for ultimate 230 kV use with initial operation at 138 kV.

Complete system flexibility is essential if industrial loads are to be met at widely separated points and if power sources throughout the region, and from the external interconnections, are to be fully utilized. This flexibility can be most economically provided by accelerating the introduction of the higher transmission voltage into the system and by creating an inter-provincial grid, operating at 230 kV connecting the major thermal generating station sites in the Dalhousie, New Brunswick south shore, Dartmouth and Point Tupper areas, the points at which interconnections are made with Hydro Quebec and New England at Eel River and Keswick and the load centres in the designated areas of Saint John, Moncton, Halifax and Canso Strait, as well as the industrialized areas of Northern New Brunswick and Sydney, Nova Scotia. This transmission grid would form a backbone to which new generating facilities could be connected and from which major loads could be served in any of the designated areas.

4. Generation Program

Under normal circumstances each utility would install sufficient generating capacity to meet its forecast peak load with a margin of reserve which, together with the reserves maintained by the other participants in the interconnection, would desirably approach the minimum required to provide acceptable reliability of supply in the Pool. This sharing of reserve capacity is most effective where there is no limitation on the interchange of electric power between the members of the Pool. The construction of a high voltage grid will, of course, tend to minimize the amount of reserve capacity required by each utility.

In order to be able to meet, on short notice, the requirements of the industrial loads which are anticipated in the DREE program, it is considered necessary that the Maritime Power Pool maintain a surplus generating capacity of 150 MW over the forecast peak load and normal reserve capacity.

5. Present Situation of Maritime Power Pool

In the past, the Federal Government, through various agencies, has provided both loans and grants to electric utilities of the Maritime Provinces, many of which have contributed to the development of the Maritime Power Pool. This assistance has now been withdrawn except for that offered through the Department of Regional Economic Expansion for projects contributing to the overall development of the region.

The Maritime Power Pool is at a critical point in its development in that the transmission capacity of the present inter-provincial interconnection limits the benefits that might be achieved by more complete co-ordination.

The recent completion by New Brunswick of a 500 MW sychronous interconnection with New England will achieve many short and long term benefits for the region including a market for Maritime surplus power in the next few years. The 320 MW direct current tie, now under construction by New Brunswick to interconnect with Hydro Quebec, will be a major power source to that Province in the 1970's and will also have long term benefits to the entire Maritime region.

The New England tie has however limited the transfers of economy energy that can be made to Nova Scotia due to transmission capacity which must be reserved for power which will flow through the New Brunswick system to Nova Scotia with loss of generation in that Province.

Furthermore, the lack of adequate internal transmission, and a high capacity inter-provincial interconnection, limits the ability of Nova Scotia to install larger generating sets and to take full advantage of power supplies and reserves which could be available from the New England and Quebec systems.

A decision should be made soon as to the steps which might be taken to strengthen the inter-provincial interconnection and supporting transmission thereby creating opportunities for closer co-ordination between the participating utilities. The extent of any such strengthening will be greatly influenced by the requirements of industrial expansion and the availability of capital.

6. Proposed Financial Assistance

In order to provide both surplus electric power to cover unusual industrial needs and the means to deliver this power to any of the growth centres in the Provinces of Nova Scotia and New Brunswick on relatively short notice, the electric utilities could be obliged to accelerate their planned transmission and generation construction programs which would result in substantially larger capital expenditures over the next 10 years than would otherwise be required.

It is estimated that a generating and transmission program including the superposition of a high voltage transmission grid on the system to meet forecasted load growth would require actual capital expenditures of $449 million during the period 1971-1980 as compared with $414 million for a normal program. To this $35 million difference there is the added cost of supplying 150 MW of surplus generating capacity based on a 1973 installation cost of $30 million.

The Nova Scotia Power Commission has already, as a result of DREE assisted Sydney area load, been required to insert in its planning program a major transmission expansion between Port Hastings and Sydney. This transmission exapnsion, which is consistent with the development program proposed in the brief, has been included in the tabulations related to both the normal and accelerated programs. This represents an actual capital expenditure of $10.9 million. This expenditure is, in fact, directly related to the concept of an expanded transmission program and is so designated in the tabulation which follows.

It is submitted that a grant covering the difference between the cost of accelerated program of system expansion and that of the normal program, taking into consideration the changes in the timing of the capital expenditures, would make additional electric power capacity available when and where required for industry without imposing an unacceptable financial burden on the electric utilities serving the region. The grant could be distributed in accordance with formulae recognizing the committments made by each utility in relation to both transmission and surplus capacity provision.

Since the time pattern of expenditures for the accelerated program differs from that of the normal program, it is suggested that the financial assistance should consist of a grant made up as follows:

	Actual Cost $ Millions	Present Worth $ Millions
Transmission expenditures to be committed for Sydney area which form part of the accelerated program	10.9	7.9
Excess of accelerated program over normal program additional to the above	34.5	21.1
150 MW of surplus capacity based on 1973 costs	30.0	25.7
Total Grant	75.4	54.7

The cost of the Canadian portion of the 345 kV interconnection with New England is being carried by the New Brunswick Electric Power Commission as is the cost of the high voltage D.C. facility, and associated transmission, interconnecting New Brunswick with Quebec with the exception of very limited Federal support to the D.C. facility. These two facilities will have a total cost in the order of $40 million. The Federal grant was limited to $4.0 million of which $1.5 million has been stipulated by the Federal Government as being in lieu of New Brunswick's portion of an A.P.P.D.A. settlement being made with Nova Scotia and New Brunswick with termination of the coal support program.

Predicated on acceptance by DREE of the principles embodied in the proposal outlined, no further request for assistance will be made for the HVDC and related facilities nor will assistance be sought for the 345 kV New Brunswick/New England interconnection. As with other facilities owned by the utilities, any required pool use can be covered within the context of the existing interconnection agreement.

THE MARITIME POWER POOL

SUBMISSION TO THE DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

A. BACKGROUND OF THE MARITIME POWER POOL

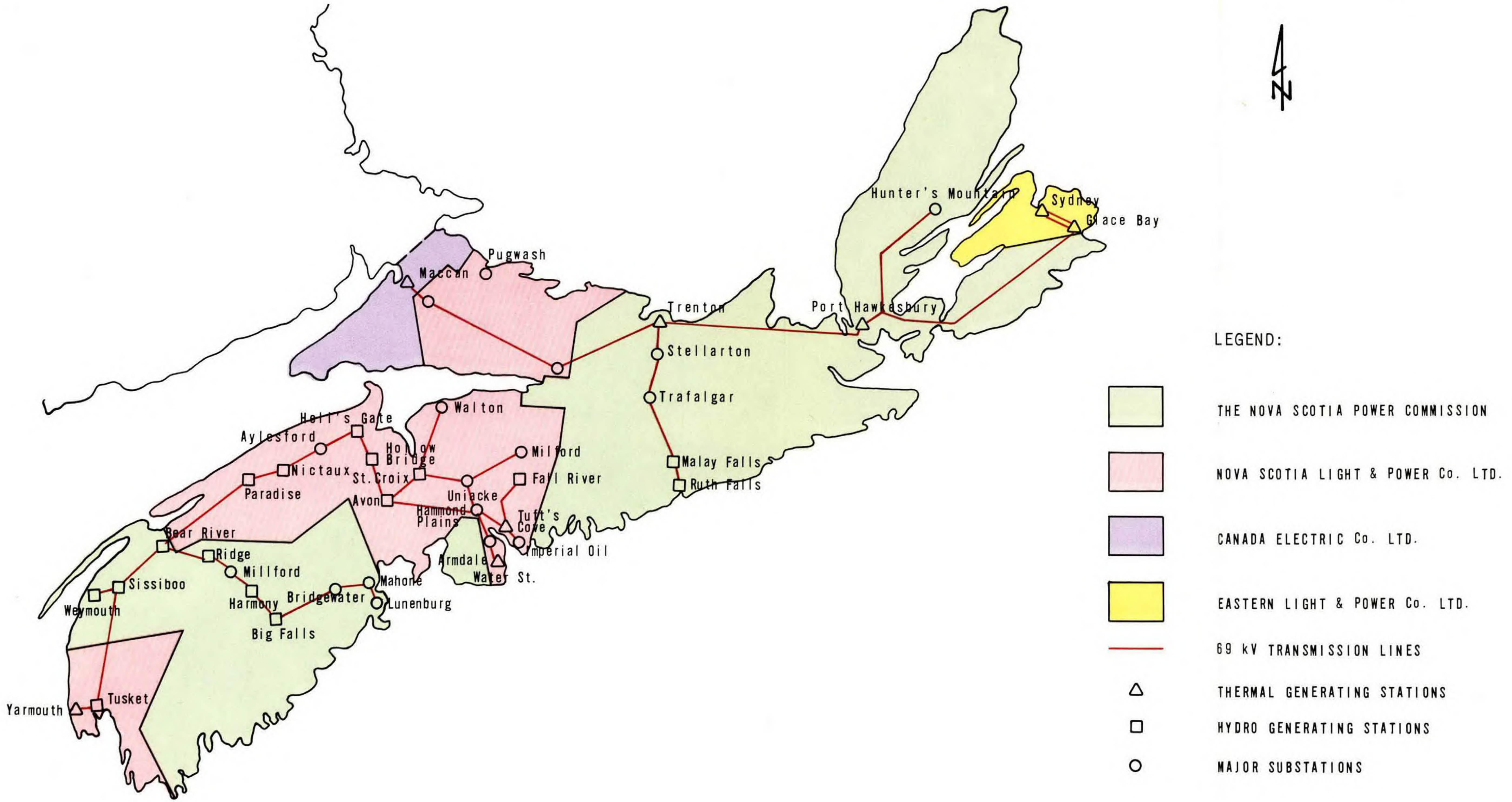
1. History of the Maritime Power Pool

(a) Individual Systems Prior to Interconnection

During the post-war years the electrical systems serving Nova Scotia and New Brunswick progressed from the fundamental state of local generating plants serving various local loads to varying degrees of integration within each province.

Figure 1 shows the service areas of the principal electric utilities serving Nova Scotia, together with the transmission systems of 69 kV and above as they existed prior to the Inter-provincial Interconnection in 1960. The main service area of Nova Scotia Light and Power Company, Limited separated the areas of the Eastern Network and the Western Network of The Nova Scotia Power Commission. The systems of the Seaboard Power Company and of the Eastern Light and Power Company, Limited (both purchased by The Nova Scotia Power Commission in 1966) in Cape Breton Island were connected by a relatively weak 69 kV tie to the Eastern Network of the Power Commission. The area served by the Canada Electric Company, Limited (purchased by the Power Commission in 1962) on the Isthmus of Chignecto near Amherst, lay between the systems of Nova Scotia Light and Power Company, Limited and The Nova Scotia Power Commission and that of The New Brunswick Electric Power Commission.

FIGURE 1



SERVICE AREAS AND TRANSMISSION SYSTEMS OF PRINCIPAL ELECTRIC UTILITIES IN NOVA SCOTIA IN 1959

In 1948, the Canada Electric Company, Limited thermal plant at Maccan was interconnected with the Eastern Network of the Nova Scotia Power Commission by a transmission line insulated for 138 kV, although operated initially at 69 kV.

In 1957, the Nova Scotia Light and Power Company Valley System at Paradise was interconnected with the Power Commission's Western Network at Bear River by the building of 28 miles of 69 kV transmission between Paradise, Annapolis County and Gulch, Digby County.

A map of the New Brunswick system prior to interconnection is shown in Figure 2. At that time The New Brunswick Electric Power Commission had expanded its service area by the purchase of other utilities and by contracts for the sale of wholesale power so that it directly or indirectly served all of the province.

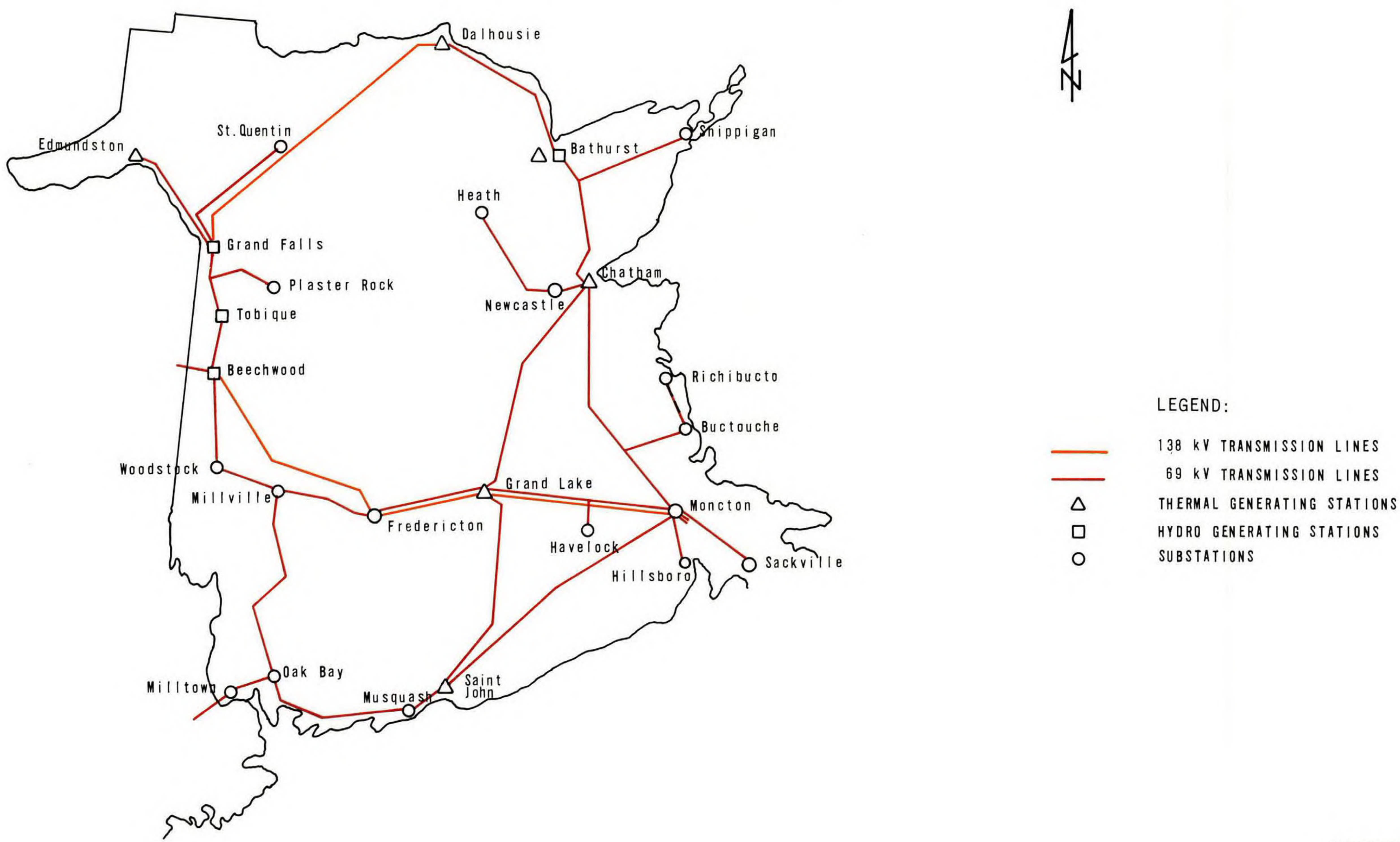
The New Brunswick Electric Power Commission had for some years operated ties with paper companies, who had generating capacity in the northern part of New Brunswick. Since 1957 a 69 kV tie had existed between the Power Commission's system and that of the Maine Public Service Company at Presque Isle, Maine.

(b) Initial Interconnection between Provinces of Nova Scotia and New Brunswick

An interconnection between Nova Scotia and New Brunswick was recommended by Prof. A.G. Christie in 1954[1]. In 1955 the Power Committee of the Atlantic Provinces Economic Council, comprising representatives of the

[1] Christie, Prof. A.G.; Report on Power Supply of New Brunswick and Nova Scotia; Dominion Coal Board; 1954.

FIGURE 2



TRANSMISSION SYSTEM
IN NEW BRUNSWICK
IN 1959

electric utilities of the four Atlantic Provinces, initiated an engineering study of the feasibility of interconnecting the transmission facilities of Nova Scotia and New Brunswick.

As a result of the studies started by the A.P.E.C. Power Committee, the Federal Government, through the Department of Northern Affairs and National Resources commissioned a study in 1957 by Montreal Engineering Company, Limited covering the power situation in the Maritimes. This report[2] indicated that substantial benefits would result not only from the interconnection of the transmission systems of Nova Scotia and New Brunswick but also from closer ties between the four generating electric utilities in Nova Scotia.

In 1957, representatives of the principal utilities of both provinces met and arranged a preliminary alternating current board study. Following the study, which reported that the interconnection of the systems was technically feasible, committees of the utilities were set up to explore the project more fully.

At this time the Federal Government offered[3] to assist in financing interconnecting transmission lines and coal burning thermal generating plants as well as assisting in industrial expansion by virtue of a subsidy payable to industrial customers resulting in lower power and energy rates.

[2]Montreal Engineering Company, Limited; Power Supply of New Brunswick and Nova Scotia; Department of Northern Affairs and National Resources; 1957.

[3]Atlantic Provinces Power Development Act; 6 Elizabeth II, Ch. 25, 1958.

The Engineering Committee of the utilities conducted a probability study[4] which estimated that the capital expenditure required for the interconnection would be justified by the savings in reserve capacity requirements of the participants in an interconnected system. At the same time, engineering studies resulted in the choice of a single circuit 138 kV tie line, with an emergency capacity of 75 MW peak. The line, to be constructed in three main sections between Moncton and Onslow, between Onslow and Halifax and between Onslow and Trenton, with Onslow established as the main interconnection point in Nova Scotia, comprised 102 miles of new construction, 53 miles of existing 138 kV line, and 37 miles of re-insulated line. The arrangement of the interconnection as constructed is illustrated in Figure 3.

The Executive Committee set up by the utilities drafted an Interconnection Agreement[5] which was patterned on successful interconnection agreements elsewhere, modified to suit the particular needs of the Region.

Construction of the interconnecting facilities was completed at a total cost of approximately $4,000,000 and the interconnection was placed in service in mid-August, 1960.

(c) Development of the Interconnection since Its Inception

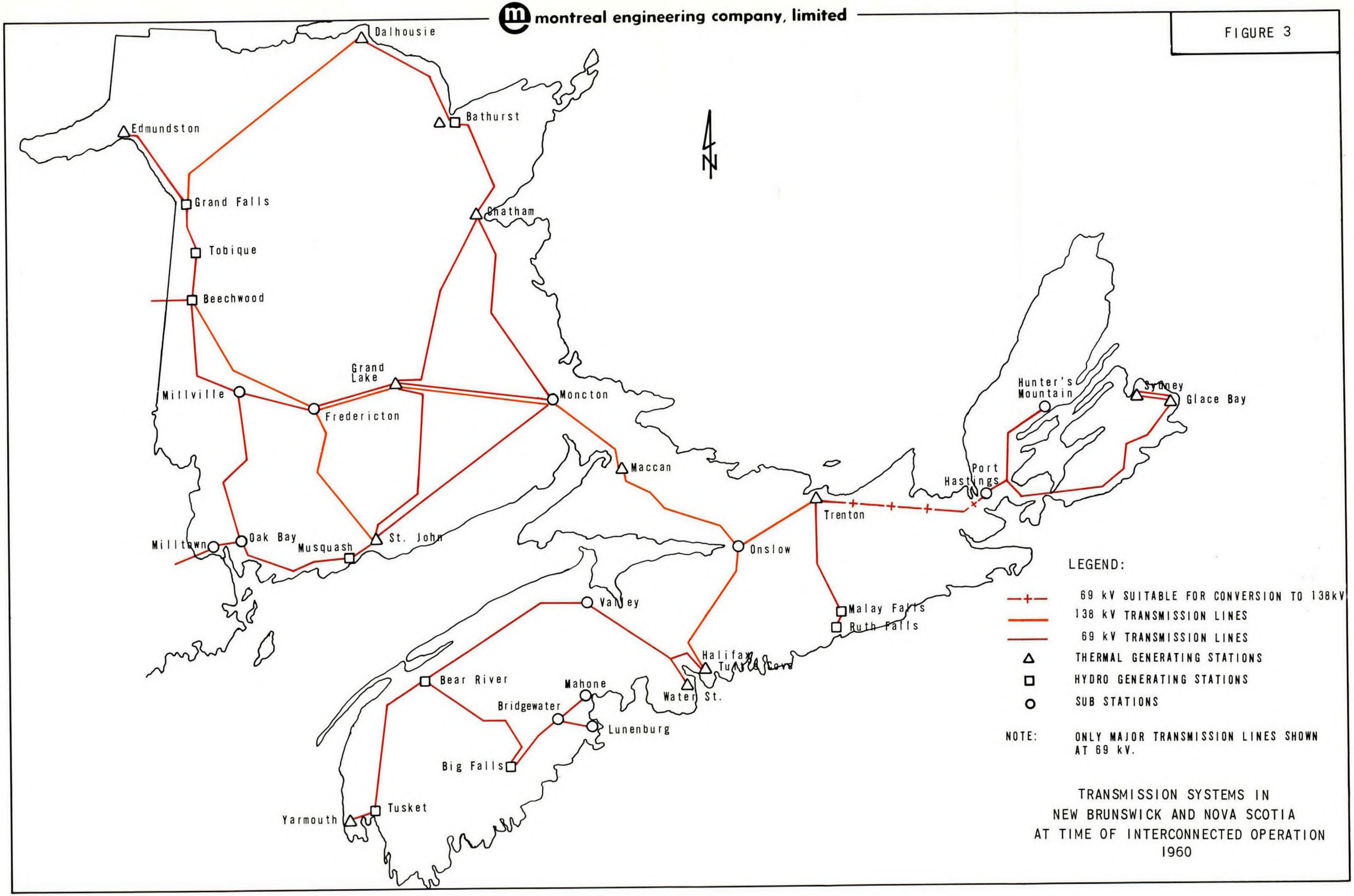
In the ten years since the interconnection was first made, the interconnection has been strengthened as the systems of the three utilities

[4]Marshall, H.E.; New Brunswick - Nova Scotia Interconnection - Report of Probability Study of Reserve Requirements; 4 Nov. 1957.

[5]Interconnection Agreement: The Nova Scotia Power Commission, The New Brunswick Electric Power Commission, Nova Scotia Light and Power Company, Limited; 18 Nov. 1959.

montreal engineering company, limited

FIGURE 3



TRANSMISSION SYSTEMS IN
NEW BRUNSWICK AND NOVA SCOTIA
AT TIME OF INTERCONNECTED OPERATION
1960

have grown. Table 1 compares the accredited capacities, peak loads and reserve capacities for the three utilities in the provinces of Nova Scotia and New Brunswick, and in total as they existed at the end of the year after interconnection (1961) and at December, 1969. It will be seen that the total peak load on the interconnected systems increased to 1103.6 MW, while the accredited capacity of the systems increased to 1527.8 MW. This represented a reduction in total reserve capacity from 44.2% to 38.4%. While this proportion of reserve capacity does not approach the minimum of 10% set in the Interconnection Agreement, there were a number of circumstances which accounted for an unusually large amount of surplus capacity in the interconnected systems in 1969, including the installation of large units in New Brunswick in 1968 and 1969.

The reserve on the pool in 1970 amounted to 28.3% of the load and the expected reserve in 1971 is 14.8% of the forecast peak load.

TABLE 1

COMPARISON OF CURRENT CAPACITY, PEAK LOAD AND RESERVE WITH THOSE AT TIME OF INTERCONNECTION

Utility	1961 Accredited Capacity MW	1961 Peak Load MW[1]	1961 Reserve Capacity MW	1961 Reserve /Peak %	1969 Accredited Capacity MW	1969 Peak Load MW[2]	1969 Reserve Capacity MW	1969 Reserve /Peak %
NOVA SCOTIA								
The Nova Scotia Power Commission	117.7	88.0	29.7	33.8	395.0	286.0	109.0	38.1
Nova Scotia Light and Power Company, Limited	235.7	148.5	87.2	58.6	326.8	261.8	65.0	24.8
NEW BRUNSWICK								
The New Brunswick Electric Power Commission	249.5	181.8	67.7	37.2	806.0	555.8	250.2	45.0
TOTAL	602.9	418.3	184.6	44.2	1527.8	1103.6	424.2	38.4
Increase (Decrease) 1961 to 1969					153%	164%	130%	(13.1%)

[1] Instantaneous demand measurement

[2] Measurement of kilowatt-hours per hour

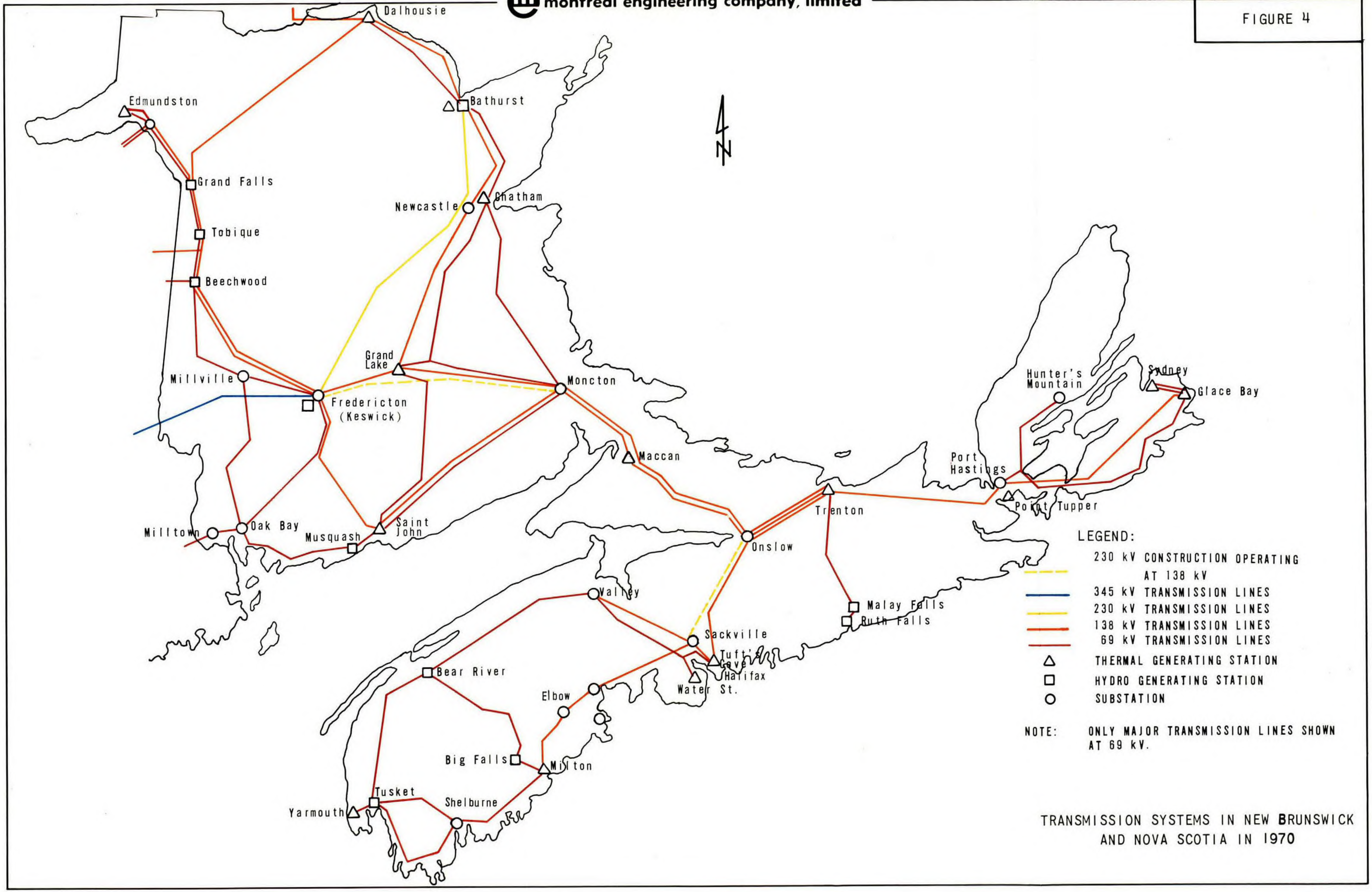
Source: Long Range Planning Committee, Maritime Power Pool

One feature of development to which the interconnection made a direct contribution was the introduction of larger generating units. At the time of interconnection the largest thermal unit on the systems of the two provinces was a 45 MW steam turbo-generator in the Water Street plant of Nova Scotia Light & Power Company in Halifax. In December 1970 The Nova Scotia Power Commission had in service a 150 MW thermal unit at Trenton, The New Brunswick Electric Power Commission had 100 MW units at Courtenay Bay and Dalhousie, and Nova Scotia Light & Power Company, Limited had a 100 MW unit at Tufts Cove.

Figure 4, which is a map of the interconnected systems as at December 1970, shows the development of the transmission system of each of the utilities since interconnection. In Nova Scotia, the Nova Scotia Power Commission increased the voltage on a 1957 line from Onslow to Trenton from 69 kV to 138 kV in 1960, and built two more 138 kV lines between these two points in 1969. A 138 kV line from Trenton to Point Tupper was built in 1959 and was operated at 69 kV until 1960, and a 138 kV line was built from Point Tupper to Glace Bay in 1966, thereby integrating the Cape Breton electrical system with that of the mainland. The tie between the Nova Scotia Light and Power Company, Limited and the Western Network of the Nova Scotia Power Commission was strengthened by the construction in 1962 of a 138 kV transmission line between Halifax and Milton. In 1970, the Halifax and Valley systems of Nova Scotia Light were also interconnected at 138 kV, and a 230 kV line (initially operated at 138 kV) was completed between Onslow and Sackville.

montreal engineering company, limited

FIGURE 4



TRANSMISSION SYSTEMS IN NEW BRUNSWICK AND NOVA SCOTIA IN 1970

In New Brunswick the 138 kV transmission system has been extended and strengthened to form a loop system interconnecting the province's major generating stations at Mactaquac, Beechwood, Grand Falls, Dalhousie, Grand Lake and Saint John and population centres at Fredericton, Saint John, Moncton, Edmundston, Campbellton, Bathurst and Newcastle-Chatham. The principal 138 kV lines connecting with the interconnection included a line from Fredericton through Grand Lake to Moncton, constructed in 1959, a line from Fredericton to Saint John, constructed in 1960 and a line from Saint John to Moncton in 1965. In addition, 230 kV lines (operated initially at 138 kV)were built between the Keswick terminal station (near Mactaquac) and Bathurst in 1967 and between Keswick and Moncton in 1970. Prior to the establishment of the 345 kV tie with Maine, two additional ties, one at 69kV and one at 138kV, had been made with the Maine Public Service Company in 1968 and a tie had been made in 1959 at 69 kV with the Eastern Maine Electric Cooperative near Milltown.

The development of the systems of the three utilities and the introduction of large generating units necessitated a strengthening of the interconnection between New Brunswick and Nova Scotia and in 1966 a second 138 kV tie line was completed between Onslow and Moncton.

In 1966 meetings were held between representatives of the Pool and Maritime Electric Company, Limited, which serves the greater part of Prince Edward Island, to discuss the inclusion of Maritime Electric Company, Limited in the Pool. These meetings resulted from an offer by the Atlantic Development Board to provide the cost of interconnecting cables in the causeway proposed at that time between Prince Edward Island and the mainland.

In 1967 when the cancellation of the causeway project was announced, members of the Pool participated with Maritime Electric Company, Limited and the National Energy Board in a study of alternatives for the future power supply of Prince Edward Island under the conditions existing at that time[6]. As a result of this study, Prince Edward Island is proceeding with an independent generation program to cover the period until 1975 but will again review the question of interconnection prior to this time. It was evident that, if this interconnection is shown to be technically practical and could be made at reasonable cost, it would extend to Prince Edward Island the benefits of sharing reserve capacity and the opportunity of installing larger and more efficient generating units, perhaps as large as 100 MW, after the initial interconnection is made.

Before the inter-provincial interconnection had been put into service, The New Brunswick Electric Power Commission had completed the construction of the Beechwood hydro-electric plant on the Saint John River. This plant was extended in 1962 to present development of 110 MW. With the purchase of the New Brunswick assets of the Gatineau Power Company, Limited, the Power Commission became owner of the second major generating plant on the main stem of the Saint John River at Grand Falls. In 1967 and 1968, The New Brunswick Electric Power Commission commissioned the first three units of the Mactaquac hydro-electric development on the Saint John River about 12 miles above Fredericton. As a result of these developments, The New Brunswick Electric Power Commission had acquired large resources of

[6] Engineering Branch, National Energy Board; An appraisal of Future Power Supply Alternatives for Prince Edward Island; February, 1968.

peak power and had, in addition, surplus to its own requirements, a quantity of secondary energy from this source during the months of high river flow. This surplus has been purchased by the other members of the Maritime Power Pool as economy energy, and has been utilized in carrying out thermal plant maintenance.

The availability of this surplus power and energy, coupled with the availability of surplus power in Quebec from the Churchill Falls Development, led to the consideration of interconnections between The New Brunswick Electric Power Commission and Hydro-Quebec and between The New Brunswick Electric Power Commission and the New England electric utilities.

(d) External Ties with Quebec and Maine

In 1968 The New Brunswick Electric Power Commission and Hydro-Quebec constructed a 138 kV A.C. tie between their systems at Eel River and Matapedia. This limited capacity tie permitted New Brunswick to purchase certain quantities of power from Hydro-Quebec, and provided for Hydro-Quebec a second source of power into the Gaspe area. With the prospect of the availability of substantial quantities of power from Churchill Falls in 1972, the strengthening of this tie was explored and in 1969 letters of intent were exchanged with Hydro-Quebec providing for substantial blocks of power to be delivered from 1972 to 1976 over a new high capacity 230 kV interconnection, including a 320 MW Direct Current back to back facility. The contract provides for the supply by Quebec to New Brunswick of the quantities of power indicated in Table 2 over the period 1972-76.

TABLE 2

PURCHASES OF POWER FROM HYDRO-QUEBEC

(90% Annual Load Factor)

Contract Period (12 months ending October 31st)	On Peak Contract Power MW	Off Peak Contract Power MW	Total MW
1972	65	-	65
1973	165	100	265
1974	215	100	315
1975	250	70	320
1976	320	-	320

Source: An Application to the National Energy Board by The New Brunswick Electric Power Commission for a Certificate in respect of an International Power Line and License to Export Power.

The Federal Government, through the Department of Regional Economic Expansion, has undertaken to supply assistance in the form of a grant towards the construction of the D.C. facility. This grant is said to be $4 million; however, of this, $1.5 million is designated as a settlement upon the termination of loans under the Atlantic Provinces Power Development Act.

In view of the availability of high load factor power from Quebec and of low load factor peaking power from the Saint John River hydro-electric system, The New Brunswick Electric Power Commission entered into negotiation with a group of New England power utilities with the object of establishing a tie, which could, amongst other things, provide a market for the sale of surplus Canadian power. In 1969, an agreement was signed with the Maine Electric Power Company, Inc. establishing an interconnection at 345 kV. Under this agreement, The New Brunswick Electric Power Commission constructed and owns a 345 kV terminal station at Keswick, N.B., and a 345 kV line from the terminal station to the New Brunswick border.

Contracts for the sale of power have been made between New Brunswick and the Maine utilities as shown in Table 3. Besides the Hydro-Quebec contract, these contracts are backed up by agreements between The New Brunswick Electric Power Commission and both The Nova Scotia Power Commission and Nova Scotia Light and Power Company, Limited, to provide portions of the power being sold in the United States up to the fall of 1972.

TABLE 3

SALES OF POWER TO MAINE ELECTRIC POWER COMPANY, INC.

Contract Period (12 months ending June 30th)	Contract Power: Load Factor 70% - 90% MW	Contract Power: Load Factor 10% weekly MW	Contract Power: Total MW
1971	67	133	200
1972	100	180	280
1973	100	160	260
1974	100	140	240
1975	80	120	200

Source: An Application to the National Energy Board by The New Brunswick Electric Power Commission for a Certificate in respect of an International Power Line and License to Export Power.

2. Objectives of the Maritime Power Pool

(a) As Defined in the Interconnection Agreement

The original objectives of the three participants in the interprovincial interconnection as defined in the Interconnection Agreement are as follows:

"<u>WHEREAS</u>, the parties hereto desire to interconnect their respective electric transmission systems for their mutual advantage and to achieve, as the result of co-ordinated interconnected operation, important benefits to their respective systems and thereby to the public served by each, to include such benefits as:

(a) the supply of the combined loads of the interconnected system, with adequate reserve capacity, by less aggregate installed generating capacity, with consequent net savings in investment and expenses;

(b) the ability to meet emergency conditions in any of the systems with less likelihood of impairment of service to the public;

(c) the greater utilization of more efficient and economical generating equipment;

(d) the reduction of the spinning reserve required by each system;

(e) the planning of new installations of generating equipment on a more economical basis as to timing, location and size of unit;

(f) the exchange of any surplus electric energy which may from time to time be available from any system beyond the needs of its own service area;

(g) any other benefits which may be possible because of the interconnected system."

(b) As Defined since Interconnections of the Systems

As the electrical systems of the participants have developed since the interconnection, additional benefits have been foreseen and new targets set. In particular the forthcoming interconnections with Hydro-Quebec and with the New England utilities by The New Brunswick Electric Power Commission resulted in a review by the Pool of its objectives in 1969.

These further objectives were at this time stated as follows:[7]

1) To recognize the responsibility of each utility to own, or otherwise provide for, the facilities, and to develop the arrangements, required to best supply the present and long term electric power requirements of its customers.

2) To support the principle of individual utility control and operation of its own electric power facilities.

3) To develop, in the form of a formal organization if necessary, an effective means of co-ordinating the operation of the utilities so that the lowest possible total generating cost will always be achieved consistent with good utility operating practices.

4) To develop a co-ordinated approach to the export of surplus power from the Maritime Power Pool such that maximum benefits will be achieved.

[7] M.P.P.; Statement of Objectives - M.P.P. Co-ordinated Operation; Draft II, 27 May, 1969.

5) To develop a cost and benefit sharing approach such that the real contribution of the facilities and resources of each utility in meeting the power needs of the Maritime utility customers, and the requirements of surplus exports, will be recognized in the distribution of benefits.

3. Administrative Basis of Maritime Power Pool

The Interconnection Agreement signed on 18 November 1959 by The Nova Scotia Power Commission, The New Brunswick Electric Power Commission and Nova Scotia Light and Power Company, Limited provides an administrative framework for the interconnection, or the Maritime Power Pool as it has become known. For the reader's reference, a brief summary of the highlights of this agreement is given as follows:

a) Construction and Ownership of Facilities

The Agreement provides for the following allocation of construction and ownership of 138 kV lines and associated facilities.

Halifax to Truro (Onslow): Nova Scotia Light and Power Company, Limited.

Trenton to Truro (Onslow): Nova Scotia Power Commission.

Truro (Onslow) to New Brunswick border: The Nova Scotia Power Commission.

New Brunswick border to Moncton: The New Brunswick Electric Power Commission.

Onslow Terminal Station: Co-ordinated joint ownership NSPC - NSL&P Co. Ltd.

(b) Administrative and Operating Committee

Provision has been made in the Agreement for an Administrative Committee and an Operating Committee. Each utility is equally represented in members on each committee. These committees have functioned continuously since the Agreement was signed.

(c) Capacity Adjustment and Charges

The Agreement calls for an objective of a minimum system reserve ratio of 10% with investments in generating capacity staggered between the participants as recommended by the Administrative and Operating Committees. It provides for deficiency payments by participants whose accredited capacity falls below the amount required, such payments being used to compensate the participant(s) making up the deficiency in capacity.

According to the Agreement, the systems are normally operated in parallel, with spinning reserve being allocated between the participants. Provision is made for co-ordination of operation and of maintenance and for sharing of reserves in emergency.

Four classes of energy interchange are anticipated in the Agreement and charges for such interchanges are defined:

Contract energy.

Economy energy.

Emergency energy.

Unintentional energy.

(d) The 1959 Interconnection Agreement has continued to provide the framework for the relationship between the participants in the interconnection with only one significant change. In 1968 the participants agreed on the addition of a Long Range Joint Planning Committee to the two committees charged with the administration and operation of the Pool respectively. (From 1964 to 1968 a sub-committee of the Operating Committee attended to joint planning functions.) The Committee was set up with the object of more fully co-ordinating the planning of the three utilities and, in particular, of providing for a continuing group which would have the responsibility of preparing and bringing up to date long-term forecasts of demand and recommended programs of expansion. Like the Administrative and Operating Committees, all three utilities are represented on the Long Range Joint Planning Committee.

4. Results Achieved by Maritime Power Pool

In reviewing over ten years of interconnected operation, the results of the setting up of the Maritime Power Pool will be examined under the following headings:

(a) Reduction in Generation Reserve

As mentioned in the 1957 Probability Study of Reserve Requirements, the feasibility of the interconnection was evident in the savings in reserve capacity requirements alone. In 1959 Mr. G.D. Mader[8] estimated that, on the basis of forecast loads and installed capacity for the year 1961, with a peak load on the interconnected system of 490 MW and a reliability level of one day in five years, the interconnected system would require 52 MW of reserve capacity. If, however, the utilities operated independently, they would require a total of 224 MW.

Although the reductions in reserve capacity in the years following interconnection have not been as large as those estimated prior to interconnection, they have been substantial. However, the installation of larger units than those contemplated before interconnection (with attendant

[8] Mader, G.D.; The Interconnected Power Systems of Nova Scotia and New Brunswick; The Engineering Journal, October, 1959.

benefits as will be dealt with below), together with progress towards the goal of better reliability, has resulted in greater reserve requirements.

Reference to Table 1 will show reserve capacity expressed as a percentage of peak load in 1961 (the year following interconnection) and in 1969.

(b) Reduction in Spinning Reserve

The usual criterion for the amount of spinning reserve required on an electrical system is related to the largest unit on the system. It is, therefore, self-evident that the ratio of spinning reserve to peak load will be substantially lower for the whole of an interconnected system than for each of the parts individually.

Actually the fact is that the individual utilities had no consistant spinning reserve policies before the interconnection. The establishment of the interconnection has been followed by the carrying of spinning reserve on a pool basis, which has resulted in the maintenance of improved reliability in the areas served by the three participants.

The pool policy[9] calls for the maintenance of an operating reserve, at least 60% of which must be spinning and the balance available within three minutes, equal to the largest single contingency, plus 10%. As provided for in the Interconnection Agreement, this reserve is allocated to the participants in the interconnection in proportion to their adjusted demand for the previous year.

[9] Nova Scotia - New Brunswick Interconnection; Daily Reserve Policy.

(c) Economy of Scale

As previously mentioned, the presence of the interconnection has made possible the introduction of comparatively large thermal generating units much earlier than would have been the case had the systems remained independent.

Economies of scale are typically applicable to the case of thermal electric generating units. Improvements in the efficiency of heat utilization have been achieved in recent years, largely through advances which increased the capital cost of the units. Consequently, for a given advance in steam or other conditions, there is a minimum size of unit below which it is not economical to proceed. Moreover, the comparatively costly service facilities required by thermal generating units in the form of fuel supply and storage, cooling water and housing are proportionately less costly when distributed over the capacity of a larger unit. In the Maritime Provinces, where fuel costs are often comparatively high, there is more to be gained by investment in more costly units of higher efficiency than in regions where fuel costs might be lower.

Table 4 following compares the thermal input in BTU's to the electrical output in kilowatt-hours between the largest unit in service in each of the participants' systems with the unit which might have been installed had the systems not been interconnected.

TABLE 4

COMPARISON OF EFFICIENCY OF LARGE UNITS
INSTALLED WITH THAT OF SMALLER UNITS WITHOUT INTERCONNECTION

	LARGE THERMAL UNIT	UNIT WITHOUT INTERCONNECTION
The Nova Scotia Power Commission		
Unit:	Trenton No. 5	Hypothetical[1]
Capacity, MW:	150	75
Full load heat rate BTU/kWh (net):	9,422	10,300
Increase in efficiency: per cent	9.3	
Nova Scotia Light and Power Company, Limited		
Unit:	Tufts Cove No. 1	Water Street No.7
Capacity, MW:	100	45
Full load heat rate BTU/kWh (net):	10,200	11,570
Increase in efficiency: per cent	13.4	
The New Brunswick Electric Power Commission		
Unit:	Courtenay Bay No.3	Courtenay Bay No.1
Capacity, MW:	100	50
Full load heat rate BTU/kWh (net):	9,270	11,985
Increase in efficiency: per cent	29.3	

Source: Long Range Planning Committee, Maritime Power Pool

[1]Montreal Engineering Company, Limited estimate.

Although the variation in the fuel costs between the participants does not make the introduction of fuel costs into the comparison meaningful, for a typical fuel cost of 40¢/MBTU's the efficiency of the Trenton 150 MW unit represents a fuel cost saving of 0.35 mills/kWh over its hypothetical smaller alternative, lacking interconnection.

(d) Improvement in Reliability

Other factors remaining constant, an improvement in reliability would normally be expected in interconnecting several electrical systems into one. This effect is illustrated in Figure 3 of Mr. Mader's paper of October 1959 which shows that, based on probability studies, for a given system capacity the reliability of the combined system always remains higher than that of the systems operated separately. This, however, assumes similar system characteristics, such as unit size. Aside from other factors, the interconnection of electrical systems provides multiple feeds to parts of the systems which would not otherwise be so served.

In actual fact, however, it is difficult to compare the reliability of electrical systems over time because of other circumstances which change. The reduction in reserve capacity, made possible by the interconnection, has already been mentioned, as has the trend to larger unit sizes upon which reliability is also dependent.

There are no statistics available to determine what change in reliability has occurred since the interconnection of Nova Scotia and New Brunswick. Subjective evidence varies from opinions that interruptions are much less frequent at the present time than they were ten years ago to opinions that the combination into larger systems has tended to increase the extent of outages. Moreover, subjective estimates are inclined to be distorted by changes in the environment of which the higher standards of reliability expected by today's electrical customers are one. The least that can be said is that there has been no reduction in reliability in the electrical systems of Nova Scotia and New Brunswick despite the introduction of larger generating units and the reduction of system reserves as a result of interconnection.

(e) Interchange of Economy Energy

Although savings resulting from the exchange of energy were not considered in establishing the feasibility of the interconnection, and the Interconnection Agreement provides no more than the framework under which such exchanges can take place, contracts have been made between the participants for substantial sales of capacity and associated energy, and economy energy has been interchanged on a day-to-day basis since the interconnection was set up.

Economy energy is exchanged between participants on a "split increment" basis, that is the price is set so as to allow the seller and the buyer each to enjoy one-half of the saving resulting from the sale.

The total amount of economy energy interchanged in the eleven years the interconnection has been in use has exceeded 2.5 billion kWh at a total value of over $13 million.[10] [11] [12]

(f) Interchange of Surplus Capacity

There have been four major sales of capacity together with associated energy between the participants from the time of establishment of the interconnection to the present. These sales assisted the seller in supporting surplus capacity which was installed for economy of scale, and

[10] Letter from Nova Scotia Power Commission to Montreal Engineering Company, Limited, 14 January, 1971.

[11] Letter from Nova Scotia Light and Power Company, Limited to Montreal Engineering Company, Limited, 15 January, 1971.

[12] Letter from The New Brunswick Electric Power Commission to Montreal Engineering Company, Limited, 18 January, 1971.

enabled the purchaser to correspondingly defer the installation of a large unit for one to two years.

In the year 1965-66, Nova Scotia Light and Power Company, Limited, in consequence of the installation of its Tufts Cove No. 1 unit, sold 25 MW of capacity together with associated energy to The New Brunswick Electric Power Commission. In the year 1968-69 The New Brunswick Electric Power Commission sold 20 MW of surplus power and energy to The Nova Scotia Power Commission.

In a contract made in 1969, Nova Scotia Light and Power Company purchased 25 MW of The Nova Scotia Power Commission's Trenton #5 unit for delivery between November 1, 1970, and October 31, 1972. In the period January 1971 to October 1972, The Nova Scotia Power Commission and Nova Scotia Light and Power Company, Limited will sell to The New Brunswick Electric Power Commission power and energy on a monthly basis up to as much as 110 MW.

(g) Consultation and Planning

Until the formation of the Long Range Joint Planning Committee in 1968, contacts between the participants for planning purposes were informal. However, meetings of the Administrative Committee and the Operating Committee and the day-to-day contacts between members of the staff of the three utilities resulted in exchanges of information on planning and informal agreements on action.

Among joint studies which have been initiated since 1965 are the following:

- 20-Year long range planning study of generation and transmission.
- Joint technical study.

- Energy utilization study, 1965.
- Study of second 138 kV line to strengthen interconnection, 1965.
- A.C. network analyzer study of Quebec tie.
- Annual operational study.
- Joint planning of Nova Scotia Power Commission and Nova Scotia Light and Power Company, Limited system development.
- Study re. deferment of Tufts Cove No. 2 unit as a result of Trenton No. 5 unit.
- Joint study with U.S. Department of the Interior, International Joint Committee, and Department of Energy, Mines, and Resources on Lincoln-Dickie project (Storage on Upper Saint John River in Maine).
- Joint study with Maritime Electric Company, Limited and National Energy Board, of future power alternatives for Prince Edward Island, including interconnection with Mainland, 1967.

5. Past Financial Assistance to Maritime Power Pool Members

(a) Atlantic Provinces Power Development Act

Under this Act the federal government has since 1958 provided assistance to the electric utilities of the Atlantic Provinces in the form of low interest loans for the construction of coal burning thermal plants and associated transmission lines and other facilities.

In this period loans have been made for facilities as indicated in Table 6 and totalling $117 million.

TABLE 6

LOANS TO NOVA SCOTIA AND NEW BRUNSWICK
UNDER ATLANTIC PROVINCES POWER DEVELOPMENT ACT

PROJECT	AMOUNT
Nova Scotia	
Generating plants	$ 37,379,008
Transmission lines	15,884,873
New Brunswick	
Dalhousie Generating Plant	19,468,608
Transmission lines and terminal stations	38,766,393
Projects without completed agreements	5,651,957
Total	$117,150,839

In addition, the Act provided that the federal government make payments to utilities, for the benefit of industrial customers. The payments were originally based on an amount of 7.43¢/MBTU's equivalent obtained from coal which was changed on November 30th, 1964 to 1.05 mills/kWh and and were earned by the utility to the extent that coal fuel was used for generation. The Act empowered the federal government to sign 5-year agreements with the provincial governments concerned to cover these industrial incentives. One such 5-year agreement[13] had been extended for two years and a second agreement[14] had been completed when the arrangement was terminated in 1969. In all, some $23 million of industrial incentives were paid in the two provinces during this 12 year period.

13 Memorandum of Agreement between the Government of Canada and the Government of the Province of New Brunswick, 14 February, 1958.

14 Memorandum of Agreement between the Government of Canada and the Government of the Province of New Brunswick, 11 May, 1965.

(b) Atlantic Development Board

Out of the funds made available to it by the federal government, the Atlantic Development Board made two large outright grants to pool utilities for power facilities in Nova Scotia and New Brunswick.

In 1964 a grant of $20 million to The New Brunswick Electric Power Commission towards the construction of the Mactaquac hydro-electric development was approved. In the following year, a grant of $12 million was approved to The Nova Scotia Power Commission for the installation of No. 5 unit at the Trenton plant (150 MW). In addition, a grant of $112,800 was made to The Nova Scotia Power Commission for the construction of a 69 kV transmission line between Amherst and Maccan.

At the time that the Prince Edward Island causeway was under consideration the Board also approved in October, 1965 the provision of $4.3 million towards the cost of interconnecting cables to be incorporated in the causeway.

(c) Discontinuance of Financing under Atlantic Provinces Power Development Act

With the formation of the Department of Regional Economic Expansion in 1969, the activities of the Atlantic Development Board ceased and grants for power facilities on grounds of economic development are now administered by the new department.

In May 1970 the governments of Nova Scotia and New Brunswick were advised by the Minister of Regional Economic Expansion that financial assistance under the Atlantic Provinces Power Development Act was being terminated.

With the ending of the existence of both of the sources through which federal assistance to the power industry in the Maritimes has been channelled, the utilities of the Maritimes now look to the Department of Regional Economic Expansion to provide funds for power facilities where these facilities would not normally be provided, but are required to fulfil objectives set up for the Department of Regional Economic Expansion.

6. Present Situation of Maritime Power Pool

(a) Requirement for Closer Co-operation to Achieve Further Economies

At the present time the Maritime Power Pool finds itself at a critical point where major commitments must be made if closer co-ordination between the participating utilities is to be achieved. Economies could be gained by further reductions in the total reserve capacity carried in the Pool, by increased exchanges of economy energy and by the installation of units of a larger size than those installed in the Maritimes to date. Constraints are currently imposed upon the participants limiting the advantages that could be taken of such economies. The exchanges of reserve capacity which would permit further reduction of the reserve capacity of the Pool is limited by the capacity of the transmission interconnection and transmission lines within the utility systems. The same circumstances prevent the dependence by Nova Scotia utilities on the inter-provincial tie to the full extent of their reserve requirements unless economy energy interchanges are limited. This limitation of capacity becomes particularly significant with the tie between New Brunswick and the New England States in operation.

The capacity limitations of the present inter-provincial tie prevents dependence by the Nova Scotia utilities upon it for the full reserve capacity required to support the installation of larger units.

The potential economies suggest the need for closer co-operation in the planning of unit installations and interconnecting transmission facilities, in the purchase and sale of surplus capacity to support new generating units and in approaches to other agencies charged with the advancement of the economic development of the Maritime Provinces.

(b) Effects of External Ties Between New Brunswick, Quebec and Maine

The facilities comprising the 230 kV D.C. tie between New Brunswick and Quebec and the 345 kV tie between New Brunswick and Maine have been described briefly in paragraph 1(d). The effects of these ties on the Maritime Power Pool may be classified under the headings of (1) opportunities for the purchase and sale of power and energy, and (2) benefits and other effects of being tied to these very large systems.

The interconnection with the American utilities provides access for all three members of the Pool to a large market for the sale of power and energy. For instance, under agreements with The New Brunswick Electric Power Commission, The Nova Scotia Power Commission and Nova Scotia Light and Power Company, Limited are jointly selling up to 110 MW of capacity and associated energy which forms part of the export sale by The New Brunswick Electric Power Commission to the Maine utilities. The interconnection with Quebec could potentially provide the Nova Scotia utilities as well as The New Brunswick Electric Power Commission with access to a source of low cost power in Quebec.

These two major interconnections provide a large amount of capacity back-up for the Pool. However, until the Pool transmission system is strengthened, this spare capacity is not fully usable by the Nova Scotia utilities. The interconnection with the New England systems has, moreover, one apparently unfavourable effect on the Nova Scotia members of the Pool since the New England system acts, comparatively speaking, as an infinite bus. The outage of any of the Nova Scotia units is replaced by power from this bus instantly the outage occurs after which generation adjustments are made by the Nova Scotia system. In consequence, in order to prevent system instability, it has been judged necessary at the present time to reserve capacity in the New Brunswick-Nova Scotia tie as spinning reserve for the largest individual unit loading in the Nova Scotia system. This has, in addition, limited the use of the tie for the import of economy energy to Nova Scotia.

(c) Summary

As a result of New Brunswick's external ties the Maritime Power Pool finds itself at present with opportunities for greater savings, both from the larger market for the sale and purchase of power and for greater reliability of service. The synchronous tie with the Maine utilities has also brought a problem. It is realized that, if the Pool is to capitalize on these opportunities and to deal with this problem, a more integrated approach to planning and operation and steps to strengthen its internal transmission systems including the inter-provincial interconnection are necessary.

B. INTER-RELATION OF DEPARTMENT OF REGIONAL ECONOMIC EXPANSION AND MARITIME POWER POOL

1. Objectives of the DREE Program

The objectives of the Department of Regional Economic Expansion and its regional development program are given in the preamble to the Act[15] as the provision of incentives for the development of productive employment opportunities and the facilitation of economic expansion and social adjustment. There are also regulations under the Act[16] and legislation in process in the House of Commons.[17]

In a letter to the Premiers of Nova Scotia and New Brunswick[18] the Minister states further:

> " In the future, this Department will be willing to consider appropriate assistance to individual power projects in New Brunswick and the other Atlantic Provinces on their own merits.
>
> Such assistance will not be provided for normal growth, in which the situation of the Atlantic Provinces is not now greatly different from that of the rest of the country. The assistance should be for projects of major significance to the power systems of the Region, including the Maritime Power Pool, taking into account the importance of power system economies through size of generating units, and the contributions of the projects to the overall development of the Region. "

[15] An Act to provide incentives for the development of productive employment opportunities in regions of Canada determined to require special measures to facilitate economic expansion and social adjustment; 17-18 Elizabeth II, Chapter 56; 1969.

[16] Regional Development Incentives Regulations; P.C. 1969-1 71.

[17] Proposal for Strengthening Regional Development Incentives; Department of Regional Economic Expansion News Release 6 December 1970.

[18] Letter from the Minister of Regional Economic Expansion to the Premier of New Brunswick, 5 May, 1970.

2. Effect of DREE Program on Maritime Power Pool Planning

(a) Provision for Increased Load Growth

In pursuing its objectives as laid down in the enabling legislation, the Department of Regional Economic Expansion is carrying out activities which are aimed to result in an increased level of business activity in the Maritime Provinces. The successful carrying out of the DREE programs should result in an accelerated rate of growth of electrical load. In addition, in order to attract industry to the Maritime Provinces, it is necessary for DREE to assure itself that the requirements of industry for adequate and reliable electric power will be met. It has been suggested that the attraction of the kind and magnitude of industry anticipated requires the maintenance of surplus capacity on the Maritime utility systems such as will enable the utilities to meet a demand of 150 MW at any of the specified growth centres in the provinces of New Brunswick and Nova Scotia, namely Saint John, Moncton, Halifax-Dartmouth, and the Strait of Canso area as well as other industrialized areas such as Northern New Brunswick and Sydney, Nova Scotia. Normally a utility system can expect sufficient time to plan generating units in the lead time that is necessary to establish an industry. For any industrial requirements which have a shorter lead time, it is usual to assume that the system's spare capacity reserve can be utilized to meet such requirements. Under the DREE program there is a requirement to maintain a reserve of surplus capacity over and above the normal spare capacity reserve which represents a major addition to the existing annual costs of the utilities.

(b) System Flexibility

The requirement to have a surplus of generating capacity available to meet the needs of industrial loads on short notice is coupled with the problem of delivering this industrial reserve to all or to any one of named growth centres or to other locations in the two provinces. This problem could be met by the installation of the required amount of surplus capacity at each of the growth centres or by providing the necessary transmission capacity to supply the load at any of the growth centres. The latter is what is here described as "system flexibility". Such a provision has the additional advantage that the system will still be in a position to serve industries (whose location, of course, cannot be dictated) which may locate at places other than the named growth centres, and that power sources can be utilized irrespective of input point. It is this lack of flexibility which most clearly points out the difference between the Maritime systems and those of the more heavily populated areas of the country.

The building-in of this kind of flexibility in a system dispersed geographically as is that of Nova Scotia and New Brunswick is costly, as will be shown by order-of-magnitude estimates presented in this brief. However, provided the difficulties of obtaining and supporting the initial cost can be relieved, this will be more economic in the long term than duplicate generating facilities at or near each load centre to provide for the possible demand for power for industry there.

The characteristic of system flexibility would assist in solving some of the other problems facing the Maritime Power Pool at this time. The transmission network with the ability to make power transfers of the size required by DREE industrial plans would also facilitate the transfer of spare capacity, spinning reserve and economy energy. This is presently restricted by the capacity of the inter-provincial interconnection and associated transmission lines within the individual systems and by the relative strength of the continental grid with which the Maritime system is now interconnected.

(c) Co-ordinated planning

Obviously the requirement for a central reserve of power capability for industrial purposes together with the capacity to deliver this reserve to widely separated points in the two provinces makes effective co-ordination in the planning of generation and transmission facilities highly desirable.

In addition, the increased business activity intended to arise from the DREE program should increase the growth rate of electrical demand well above normal, further increasing the need for co-ordinated planning.

As has been mentioned previously, the Nova Scotia utilities have a particular problem in grasping opportunities for the installation of larger thermal generating units and the exchange of surplus power in the larger markets outside of the Maritimes. Opportunities such as these are only within their reach if a co-ordinated Maritime transmission expansion takes place. New Brunswick would also benefit to the extent that opportunities for joint development of Maritime generation might arise.

3. Effect of DREE Program on Capital Requirements of Utilities

(a) Capital Requirements of Planning for Normal Load Growth

The size of the total demand for electric power in New Brunswick and Nova Scotia and the continuation of the increase in the demand at a steady exponential rate results in requirements for increments of generation and transmission capacity of a magnitude which will fully occupy the financing resources of the utilities of the two provinces.

Appendices 1 and 2 of this brief provide estimates of the capital expenditures for generating plants and transmission facilities required to be made by the utilities of Nova Scotia and New Brunswick respectively, in the ten years 1971 to 1980 under anticipated conditions of load growth. It will be seen that it is estimated that a total of $414 million will be required to be invested by the three utilities.

(b) Capital Requirements of Planning for Increased Load Growth

Appendix 3 gives estimates of the capital costs of generating plants and transmission facilities, including the 230 kV transmission grid system, which would be needed to provide the system flexibility made even more desirable by the DREE industrial power requirements during the ten-year period 1971 to 1980. This estimate amounts to $449 million and, at a fixed charge rate of 9.23%, represents an additional $3.2 million in annual costs over those which would normally have to be borne by the three utilities.

In appendix 4 is an estimate of the cost of a 150 MW increment of generating capacity in Nova Scotia and New Brunswick, which totals $30 million. At a fixed charge rate of 9.23%, this represents $2.8 million in annual costs over and above those necessary to meet normal load growth.

Thus, it can be seen that the extra system capacity and flexibility required of the Maritime Power Pool by DREE industrial power demands corresponds to the following amounts of capital additional to that which the Pool would ordinarily be expected to raise through its own resources:

Capital required for increased load growth	$449 million
Capital required for normal load growth	$414 million
Additional capital required	$ 35 million
Capital required for 150 MW increment of generating capacity	$ 30 million
Total additional capital required	$ 65 million

This additional capital represents a total of $6.0 million in annual costs over those which would normally be supported on the existing electric rate structures.

C. CONCEPT OF H. V. TRANSMISSION GRID

1. System Concepts

(a) Integration of Transmission Facilities:

In the development of the transmission systems of the three utilities, each has been responsible for providing a system with the flexibility and capacity to supply the loads forecast in its own service area and to meet reserve commitments to the Pool.

Plans have been made for the expansion of the transmission systems to meet anticipated loads over the next ten years. These are based on continued use of the interconnection for sharing of generation reserves, with the interconnection being strengthened for this purpose when required and for other purposes when justified economically. These plans are based on providing systems with the same degree of flexibility, reliability and economy as has been provided in the past, on the basis of load forecasts using proven techniques, but not taking into consideration the effect which the DREE program may have on industrial load growth in the region.

A re-examination of the ten-year system development plan with the added criterion that the systems must be capable of supplying the additional industrial load related to the DREE programs indicates that the establishment of an inter-utility high voltage transmission grid is the most economical way of providing the required system flexibility. This H.V. grid would form a system connecting the major generating plant sites and external ties and would provide the means whereby large loads in any of the designated areas could be supplied through the construction of relatively short transmission lines.

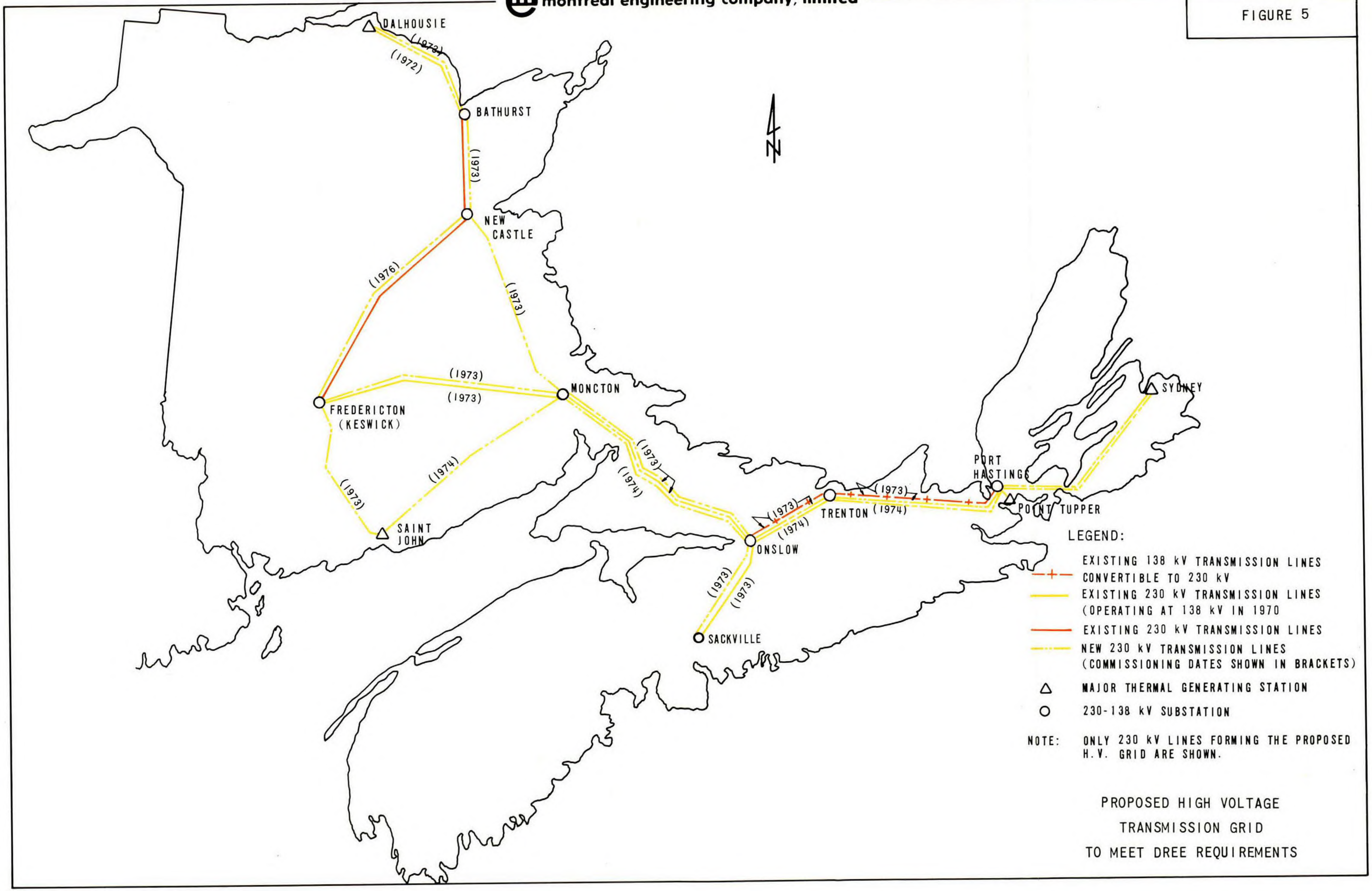
It is likely that such an H.V. transmission grid will evolve ultimately and that it will be interconnected with the systems of adjacent utilities in Prince Edward Island, Quebec and Maine. It is certain, however, that it will not be economically feasible to construct such a system in its entirety within the next ten years, without substantial support on the basis of the need for added flexibility to supply the increase in industrial load on relatively short notice from the most economic source.

An example of such an increase in industrial load is the program of expansion of the SYSCO plant in Sydney, recently announced by the Premier of Nova Scotia and supported by the Department of Regional Economic Expansion. This increase in load, estimated at over 100 MW, has already necessitated the planning of two 230 kV transmission lines from Port Hastings to Sydney.

(b) Extent of System:

The proposed H.V. transmission grid would form a backbone from which loads could be supplied in either New Brunswick or Nova Scotia and is shown in Figure 5. It would interconnect those areas with generating station sites in both New Brunswick and Nova Scotia which have been designated for expansion, namely Dalhousie, New Brunswick South Shore, Halifax and the Canso area and the tie points with Quebec and Maine. In so doing, supply to major industrial loads in the Saint John, Moncton, North-East New Brunswick, Halifax/ Dartmouth, Strait of Canso and Sydney areas would be assured and loads in any other areas could be supplied by the construction of transmission lines from one or other of the designated areas or interconnecting transmission. The montreal engineering company, limited

FIGURE 5



PROPOSED HIGH VOLTAGE TRANSMISSION GRID TO MEET DREE REQUIREMENTS transmission system would be so arranged as to create a system of maximum capacity and flexibility. The transmission lines forming the grid would be kept free of minor loads, these being supplied by the existing 69 kV and 138 kV systems. The facilities forming the grid would include transmission lines, terminal facilities for these lines including circuit breakers, protection and control equipment, structures, busses, and transformers installed to tie the H.V. system to the 138 kV system. Whenever feasible, future generating capacity would be connected directly to the H.V. grid rather than to lower voltage systems.

(c) Voltage Levels and Capacities:

The introduction of a transmission voltage higher than the 138 kV presently employed has been considered for some time. The distances between major generation sites, both existing and future, and the major load areas are such that transmission lines linking these areas would not be more than about 200 miles in length. Studies have shown that the use of lines operating at 230 kV, with a capacity in the order of 150-200 MW, will economically satisfy the requirements of the region for at least 20 years after which time the use of a higher voltage may be justified. For this reason, the planning of all three of the interconnected utilities calls for the establishing of a 230 kV transmission system and many of the recently constructed 138 kV transmission lines have been built for ultimate conversion to operation at 230 kV. These lines, together with the additional lines required, would form the H.V. transmission grid system.

(d) External Ties:

The connection of the H.V. transmission grid to the points at which the New Brunswick system is tied to the H.V.D.C. facility adjacent to Quebec and to the 345 kV circuit to Maine will permit these interconnections to be used in the manner most beneficial to the Maritime region as a whole at any given time. Amongst other things, it will permit the import or export of power and energy in order to achieve maximum economy of operation and, through sharing of the reserves of the large systems in Quebec and Maine, it will permit earlier installation of large generating units in the Maritime region.

2. Benefit to the Region

The benefits to the Maritime region from the forward development of a high capacity inter-utility/inter-provincial transmission grid are many. As already noted these include ready availability of power to meet unanticipated load flexibility of supply, economy of scale in thermal unit size and reliability of system supply.

(a) Availability of Power and Flexibility of Power Supply:

The transmission grid will ensure that surplus generating capacity, that is, any capacity in excess of required reserves, will be available for the supply of unanticipated loads, irrespective of the location of generating capacity or loads in either New Brunswick or Nova Scotia. It will also permit import into any part of the Maritime region of any surplus power and energy available from Quebec or Maine, which could be useful particularly for the short term supply of loads until new generating facilities can be installed.

(b) Economy of Scale:

The high voltage, high capacity transmission system will permit consideration to be given to installation of larger individual generating units, with their associated economies, sooner than would otherwise be possible by eliminating the present transmission penalty associated with the provision of reserve capacity for such larger units. It will also allow generating plants to be installed at the most economic sites.

The flexibility provided by the transmission grid in the sizing and siting of new generating plants will also permit them to be operated in the most economical manner with respect to pool requirements.

(c) System Reliability:

The existence of the transmission grid should obviously provide a higher degree of reliability of supply. In addition, although not specifically provided for, the carrying of additional capacity on the system, both generation and transmission, will result in an inherent improvement in the reliability of supply to all loads in the region in that this additional capacity will take care of multiple contingencies for which provision would not normally be made.

3. Benefit to MPP Members:

An important benefit of the transmission grid to the utilities participating in the interconnection agreement will be in the opportunities it will continue to create to fully co-ordinate the planning and operations of the three systems.

The existence of the transmission grid will promote closer co-ordination of planning than has been hitherto possible, since it will only be through the full co-ordination of plans that each participant will be able to take best advantage of the benefits available from the transmission grid.

The transmission grid will also permit closer co-ordination of system operations between the three utilities, which to date has suffered due to a limited transmission capability. The capacity provided by the grid will allow the systems to be operated closer to the ideal of a fully pooled system with generation costs and transmission losses minimized.

It is notable at this point that the development of pool facilities and progress toward more fully integrated operation has now reached a particularly significant stage. The internal systems of the three participants have grown markedly since interconnection, and two major external interconnections now exist. Experience has now been gained in operation of the interconnected systems and the benefits which the Pool provides are unquestionably recognized. The external ties and the larger generating units which have been commissioned during the past six years have been selected and agreed upon on the assumption that the Pool would ultimately enter a phase of major transmission expansion. The time of this phase has arrived.

4. Alternatives to Achieve Similar Results

An alternative to the construction of a regional H.V. transmission grid which would provide the same ability to supply unanticipated loads would be for each utility or each provincial system to maintain sufficient surplus capacity on its own system to supply the loads which might materialize in its service area, and to limit the use of the interconnection to its present basic function of reserve sharing. It is apparent that this alternative would require the maintenance of three times the surplus capacity required to anticipate the supply of industrial loads than would be required in an integrated system.

Notwithstanding this, the limitation on the effective capacity of the interprovincial interconnection imposed by the stability problem inherent in the New England tie, can only be lifted by the construction of additional transmission lines.

D. PROPOSED 230 kV TRANSMISSION GRID

1. Description of System

It has been assumed that, as a minimum, the transmission grid must be capable of load flows such that it is possible to supply a load of the order of 150 MW over and above the predicted load in any year in any one of the Saint John, Moncton, North-East New Brunswick, Halifax/Dartmouth, Canso Strait or Sydney, Nova Scotia areas, or in areas within a reasonable distance from these. It is further assumed that the supply for the load may be in any one of the Dalhousie, Keswick, New Brunswick South Shore, Dartmouth or Point Tupper areas. To provide this flexibility, the transmission grid system as shown on Figure 5 is proposed. This system would consist of the 230 kV transmission lines shown in Table 7.

TABLE 7

230 kV TRANSMISSION LINES FORMING THE H.V. GRID

	No. of Lines	Total Line Length (miles)
Dalhousie - Bathurst	2	110
Bathurst - Newcastle	2	90
Newcastle - Fredericton (Keswick)	2	180
Newcastle - Moncton (Memramcook)	1	85
Fredericton - Moncton	2	180
Fredericton - Saint John	1	70
Saint John - Moncton	1	90
Moncton - Onslow	3	300
Onslow - Halifax	2	110
Onslow - Port Hastings	3	300
Port Hastings - Sydney	2	160
Total line mileage		1675

2. Estimated Costs

Details of capital expenditures, year by year, of a 10-year generating plant and transmission facilities program, including a 230 kV transmission grid as described in paragraph 1, are given in Appendix 3. It is not possible to consider the cost of the 230 kV system in isolation from that of the lower voltage transmission system, since the introduction of the H.V. system itself changes the program of installations for the L.V. system. Similarly the cost of the transmission system cannot be considered in isolation from that of the generating system, since the latter is affected by changes in the transmission systems.

A summary of the estimates of the total capital cost over the 10-year period of both generating and transmission facilities, including the cost of converting existing facilities to 230 kV operation follows. These estimates include escalation.

	Estimated Cost $ millions
Generating plants	$342.1
Transmission lines	69.7
Terminal facilities	26.0
Transformers	11.1
Total	448.9

3. Allocation of Costs and Benefits

(a) Concept of Jointly Supported Facilities

The present Interconnection Agreement provides a framework within which subsidiary agreements may be arrived at, such as an agreement to cover the dedication of certain transmission lines to pool service.

It is desirable that an agreement covering transmission pooling should provide for the ownership and operation of the lines by the parties best able to construct and maintain them. On the other hand, a formula must be provided such that the costs of construction and maintenance are allocated among the Pool participants in proportion to the benefits received by them.

Most pool agreements involving transmission have the objectives named above. The first is normally provided for by agreeing that each company will own and operate the transmission lines and terminal stations in its service area.

The second objective, that of allocating costs, has been achieved in various ways. The international Pacific Northwest Power Pool, in making use of the transmission system of the Bonneville Power Administration as pool facilities, has a schedule of charges [19] per kilowatt year which are paid by member utilities making use of the system.

[19] Bonneville Power Administration; Charges per kilowatt year for Wheeling Power from Non-Federal Projects over BPA Facilities; based on June 1961 System.

The Carolina-Virginia Pool (CARVA) in the United States of America [20] allocates expenses of pool transmission, including annual fixed capital charges and actual operating and maintenance expenses, to member companies in the proportion of their peak demands. It is understood that a similar allocation of the annual cost of pool supported transmission facilities is proposed for the New England Power Pool.

On the basis of the experience of other power pools, of which the foregoing is only a sample, it is foreseen that the concept of pool supported transmission facilities, wholly or partly dedicated for the benefit of the participating utilities as a whole, would provide a basis for the construction, ownership and allocation of annual costs of a high voltage transmission grid in the Maritime Power Pool. This concept can be included in the framework of the existing Interconnection Agreement and would permit the equitable distribution of the benefits of a Federal grant made to the Maritime Power Pool, which would make the construction of the high voltage grid possible. This formula could readily be applied to the facilities necessary to enable Prince Edward Island to share the benefits of interconnection with New Brunswick and Nova Scotia.

[20] Skaale, A.J.; Carolina-Virginia Companies Form Power Pool; Electrical World, 17 August 1964.

(b) Construction, Ownership and Allocation of Annual Costs

As in the case of many other transmission pools, the best arrangement in the Maritime Power Pool would seem to be for each utility to construct, own and operate the pool transmission lines, terminal stations and transformers located in its service area. The annual costs of the pool transmission facilities would be borne in the first instance by the owner, subject to the receipt of such costs as would be allocated to the other participating utilities according to the formula adopted.

4. Proposed Financial Assistance

(a) Rationale

It has been suggested in Section B of this brief that the needs of the Department of Regional Economic Expansion program will have the effect of increasing the capital requirements of the utilities of the Maritime Power Pool. The purposes of these increased capital requirements may be given as follows:

i. Provision for system flexibility

ii. Provision for accelerated load growth

It has been shown that the necessary degree of system flexibility to deliver the required amount of industrial load reserve to the growth centers of the two provinces can be achieved by the superposition of a high voltage transmission grid upon the existing systems.

It has been shown in sub-section B.3 of this brief that this provision imposes on the utilities of the Pool in the period 1971-1980 total capital requirements estimated at $449 million as compared with $414 million required for a normal program of expansion of generating and transmission facilities. Consequently additional capital expenditures estimated at $35 million will be required over a period of ten years.

It is submitted that a grant recognizing the difference between both the amount and the time pattern of capital expenditures on the grid program as compared with the normal program of expansion would make possible the construction of a high voltage grid, which would provide the system flexibility required by the DREE industrial program.

The H.V.D.C. station being constructed to interconnect New Brunswick and Quebec has been the subject of a previous request for assistance from the Federal Government. This facility, along with 230 kV terminations and the two 230 kV circuits to the Quebec border, is being constructed by the N.B. Commission at a cost to it of some $35.0 million.

The Federal Government approved a grant of $4.0 million to the N.B. Commission of which $1.5 million was later stipulated by the Federal Government as being in lieu of New Brunswick's portion of an A.P.P.D.A. settlement being made with Nova Scotia and New Brunswick with termination of the coal support program.

No proposals are being made here for further support to the D.C. and related facilities nor for support of the 345 kV transformation, termination or transmission constructed by the N.B. Commission at a cost of some $5.0 million, forming the Canadian section of the New Brunswick/ New England interconnection.

Where uses are required of these facilities by utilities other than N.B. Power, such uses will be covered by separate agreements between the N.B. Commission and the other utilities which can be made within the context of the existing New Brunswick/Nova Scotia Interconnection Agreement.

(b) Estimated Amount

Year-by-year estimates of capital expenditures by the utilities of Nova Scotia and New Brunswick in the years 1971 to 1980 are given in Appendices 1 and 2 respectively, for a program of installations of generating and transmission facilities required to meet normal load growth under present Pool operating conditions. Similar estimates are given in Appendix 3 for a program of installations including a high voltage transmission grid. It will be noticed that both programs include generating plants, in order to show the effect of deferments of generating plants possible with the grid program. It should also be noted that the grid program does not include surplus generating capacity for special industrial purposes beyond normal planning.

Since the time pattern of expenditures for the grid program differs from that of the normal program, it is submitted that a Department of Regional Economic Expansion grant should be made of the order of magnitude of the difference in the present value (at an interest rate of 8%) between the normal ten year program of installations and the ten year program of installations including the high voltage transmission grid.

Details of the total capital expenditures for two programs of installations are given in Table 8.

There has been a recent development which prevents the difference in present value between the program of installations in Appendix 3 and those in Appendices 1 and 2 from completely reflecting the projected cost of the high voltage grid. The announcement of the expansion of the SYSCO plant in Sydney has been followed by the planning of two 230 kV transmission lines from Port Hastings to Sydney which would not otherwise have been required in the next ten years. The estimated cost of these lines and associated equipment is accordingly included in the normal program as well as in the grid program and is therefore not reflected in the difference in these present values. The two lines and associated facilities will involve capital expenditures in 1973 of $3.2 million, in 1976 of $6.3 million and in 1977 of $1.4 million, of which the present value is $7.9 million. These amounts are, therefore, identified as a separate item in the tabulation on the following page.

Present Value at 1971 - $ Million

	$ Transmission	$ Generation	$ Total
Grid Program	86.2	230.9	317.1
Normal Program	56.8	239.2	296.0
Difference	$29.4	$ (8.3)	$21.1
The transmission program to be committed to meet the SYSCO Load	7.9	Nil	7.9
Total	$37.3	$ (8.3)	$29.0

It will be seen that the order of magnitude of the requested grant for the H.V. Transmission Grid is $29 million. This allows for generating capacity deferrals amounting to a present value of $8.3 million.

(c) Allocation of Grant by Maritime Power Pool to Members

If the requested grant is made to the Maritime Power Pool, it could be allocated by the Pool to its members on the basis of the present value of additional expenditures to be made by the members in carrying out the planned grid program as compared with the normal program. Each member therefore would receive a share of the grant in proportion to the difference between value of the expenditures it would have to make to maintain the grid program and the present value of the expenditures it would have made in its normal program.

TABLE 8

TOTAL CAPITAL EXPENDITURES AND PRESENT VALUES FOR NORMAL PROGRAM AND GRID PROGRAM (1971-80)

	Capital Expenditures $		Present Value at 1971 of Capital Expenditures $	
Normal Program of Installations				
Nova Scotia (Appendix #1)				
Generation	166,560,000		117,698,600	
Transmission	24,092,000		18,870,100	
HV Breakers	7,089,000		5,474,400	
HV Transformers	3,893,000		2,956,100	
	201,634,000	201,634,000	144,999,200	144,999,200
New Brunswick (Appendix #2)				
Generation	173,760,000		121,550,700	
Transmission	21,617,600		16,153,000	
HV Breakers	13,758,000		10,428,000	
HV Transformers	3,680,000		2,859,600	
	212,815,600	212,815,600	150,991,300	150,991,300
		414,449,600		295,990,500
Combined Program of Installations Including HV Transmission Grid (Appendix #3)				
Generation	342,130,000		230,936,400	
Transmission	69,692,000		56,611,500	
HV Breakers	26,011,000		20,788,400	
HV Transformers	11,125,000		8,774,100	
	448,958,000	448,958,000	317,110,400	317,110,400
Difference		34,508,400		21,119,900

E. GENERATION PROGRAM

1. Normal Expansion Program

The program of installations of generating capacity in Nova Scotia and New Brunswick under normal load growth and present pool operating conditions is shown in Table 9. This schedule for installation of generating capacity results in an apparent excess of capacity over the normal requirement to supply the combined loads on the system with a reserve of 15%. However, because of the limited capability of the transmission facilities interconnecting the three utilities, complete integration of the generating facilities is not possible. Therefore, the combined generating capacities in New Brunswick and Nova Scotia are above the theoretical value. A program for the installation of generating capacity assuming that sufficient transmission capacity exists among the three utilities to permit complete integration of their generating capacities is shown in Table 10. This is not necessarily the optimum schedule but it illustrates the order of magnitude of generating capacity required with the establishment of the 230 kV transmission grid.

2. Requirement of Surplus Capacity for Industrial Loads Arising on Short Notice

Assuming that provision must be made to supply a load in the order of 150 MW over and above the normally predicted load, and assuming that this must be supplied on relatively short notice, each utility would have to have available additional reserve generating capacity of this amount on its own system because the interconnection facilities as they exist do not have sufficient capacity to permit the transfer of this amount of power between utilities as well as providing for reserve sharing. However, by establishing the 230 kV transmission grid as proposed, the additional reserve generating capacity required could be carried at any one of four locations or could be obtained elsewhere using external interconnections, thus eliminating duplication of these facilities and minimizing the cost of providing the additional capacity.

While the establishment of a 230 kV transmission grid would permit the total reserve capacity on the system to be minimized, it would still be necessary to provide about 150 MW of generating capacity in addition to that required to supply the normally predicted peak load and to carry this additional reserve at all times. The cost of this additional reserve capacity is estimated in Appendix 4 at approximately $26 million, based on 1971 costs.

The announcement of the expansion of the SYSCO plant in Sydney is an example of the demands for electric power that may be made on the Pool by DREE assisted industry. The total additional electrical demand resulting from the expansion is estimated at about 130 MW, of which about 30 MW may be supplied by in-plant resources.

3. Proposed Financial Assistance

(a) Rationale

The requirement that an additional 150 MW of reserve generating capacity be available on the combined systems will impose an additional financial burden on the utilities serving the Maritime region. Since this additional capital cost is effectively part of the cost of the Department of Regional Economic Expansion program of providing incentives for industrial expansion in the region, it is submitted that a grant should be made of an amount equivalent to the capital cost of an additional 150 MW of generating capacity.

(b) Estimated Amount

The earliest that this additional generating capacity could be made available would be late in 1973. The cost of the capacity at that time would be about $30 million which would have a present value in 1971 of $25.7 million. It is requested that a grant of this order of magnitude be made by the Department of Regional Economic Expansion to the Maritime Power Pool.

(c) Allocation by Maritime Power Pool to Members

If the requested grant is made by the Department of Regional Economic Expansion to the Maritime Power Pool, it could be allocated to the members of the Pool according to a formula that would recognize the committments made by each member to the required generating capacity surplus over the ten year period. The earliest that this additional generating capacity could be made available, if obtained from new generation in the Maritimes, would be late in 1973.

TABLE 9

PLANNED GENERATING CAPACITY AND PURCHASED POWER

(See Appendices 1 & 2)

Year	Location	Capacity Gross (MW)	Incr. Net (MW)	Total Capacity (MW)	Peak Load +15% Reserve (MW)
1970		-	-	1915	
1971	Tusket G.T. N.S.	25	25		
	Import - N.B.	120	120		
	Moncton G.T. N.B.	25	25	2085	2088
1972	Tuft's Cove #2 - N.S.	100	92		
	Import - N.B.	45	45		
	Mactaquac #4 - N.B.	100	100	2322	2246
1973	Tupper #2 - N.S.	150	140		
	Import - N.B.	50	50	2512	2354
1974	Import - N.B.	35	20 (1)	2532	2435
1975	Halifax G.T. - N.S.	25	25		
	Sydney G.T. - N.S.	25	25		
	Import - N.B.	70	70	2652	2524
1976	Tuft's Cove #3 - N.S.	150	140		
	SYSCO - N.S.	30	20 (2)		
	Dalhousie - N.B.	350	20 (2)	2832	2737
1977	Tupper #3 - N.S. (4)	150	140		
	Mactaquac #5 - N.B. (4)	100	100		
	Import - N.B.	60	60	3132	2893
1978	South Shore - N.B.	300	220 (3)	3352	3050
1979	Tuft's Cove #4 - N.S.	150	140	3492	3238
1980		-	-	3492	3427

(1) Saint John Dock Street Plant retired - 15 MW

(2) Import of power from Quebec terminated - 320 MW

(3) Import of power terminated - 60 MW

(4) May be advanced to 1974 for other reasons

TABLE 10

GENERATING CAPACITY INSTALLATION ASSUMING COMBINED SYSTEMS APPENDIX 3

Year	Location	Capacity Increase Gross (MW)	Capacity Increase Net (MW)	Total Capacity (MW)	Peak Load +15% Reserve (MW)
1970				1915	
1971	Moncton G.T. N.B.	25	25		
	Tusket G.T. - N.S.	25	25		
	Import - N.B.	120	120	2085	2088
1972	Tuft's Cove #2 - N.S.	100	92		
	Import - N.B.	45	45		
	Mactaquac #4 - N.B.	100	100	2322	2246
1973	Import - N.B.	50	50	2372	2354
1974	Tupper #2 - N.S.	150	140 (1)		
	Sydney G.T. N.S.	25	25 (2)		
	Import - N.B.	35	20	2557	2435
1975	Import - N.B.	70	70	2627	2524
1976	SYSCO - N.S.	30	20 (3)		
	Mactaquac #5 - N.B. (5)	100	100 (4)		
	Dalhousie - N.B.	350	20	2767	2737
1977	Tuft's Cove #3 - N.S.	150	140	2907	2893
1978	Tupper #3 - N.S.	150	140	3047	3050
1979	South Shore - N.B.	300	280	3327	3238
1980	Tuft's Cove #4 - N.S.	150	140	3467	3427

Notes:

(1) Unit required to firm up supply and to support voltage in Sydney area
(2) Saint John Dock St. Plant retired - 15 MW
(3) Installed by SYSCO to meet their requirements
(4) Import of power from Quebec terminated - 320 MW
(5) Maybe advanced to 1974 for other reasons

F. RESULTS OF D.R.E.E. FINANCIAL ASSISTANCE TO M.P.P.

1. Comparison with DREE Objectives

The basic objective of the Department of Regional Economic Expansion is to assist in the economic development of designated areas by creating an environment which will encourage industrial expansion and thus develop productive employment opportunities, facilitate economic expansion and social adjustment within these regions.

One of the most important requirements for industrial expansion and for improvement of social conditions is an abundant and readily available supply of dependable, low cost electric power and energy. The power supply system is, therefore, one of the essential infrastructures in any region in which economic expansion is to be encouraged.

Through financial assistance for the creation of a high voltage, inter-provincial transmission grid and the maintenance of extra reserve generating capacity in the Maritime region, the Department can ensure that this facility, which is essential for the industrial, and thus the economic, development of the region, is available. There is no logical argument to suggest that the utilities should burden their existing customers with the cost of maintaining additional transmission and generating capacity to meet industrial expansion which cannot be normally anticipated or clearly defined as to extent and timing. The assistance, therefore, would be a direct contribution to the achievement of the Department's objectives, namely, the overall economic development of the Maritime region. Furthermore, it would be a direct incentive for the expansion of one of the major industries in the region, the electric utility industry.

2. Comparison with M.P.P. Objectives

The basic objective of the Maritime Power Pool is to provide reliable power and energy to the consumers in the Maritime region at the lowest possible cost. The creation of the high voltage transmission grid would assist in achieving this objective since it would permit all of the objectives recognized in the original Interconnection Agreement, namely, reduction in overall reserve generating capacity, greater reliability of supply, more economical use of generating capacity, reduction of overall spinning reserve, co-ordination of installation of additional generating capacity and interchange of surplus energy, to be enjoyed to a greater degree than has been possible heretofore. In this way a greater flexibility of power supply could be maintained at a lower cost than could otherwise be achieved.

The objectives defined subsequent to the interconnection of the systems recognize the need for closer co-ordination of operation, and a more equitable allocation of costs with respect to benefits, all without infringing on the autonomy of the participants in the Pool. The high voltage transmission grid would provide sufficient transmission capacity to permit complete co-ordination of operations while the administration of pool supported facilities in the manner proposed would result in equitable sharing of costs without the need for the participants to relinquish their autonomy with respect to the management of their respective utilities.

The financial assistance for the creation of a more flexible power system in the region, therefore, would assist not only the Department of

Regional Economic Expansion but also the Maritime Power Pool in the achievement of its objectives.

G. PROPOSED ADMINISTRATION OF FACILITIES BY MARITIME POWER POOL

1. Administration

The Interconnection Agreement between the Nova Scotia Power Commission, The New Brunswick Electric Power Commission and Nova Scotia Light and Power Company, Limited provides terms of reference under which the Maritime Power Pool can continue to function with the responsibilities added by the generating and transmission facilities envisaged in this brief.

Under the Agreement, the responsibility for setting the policies of the Pool is carried by the Administrative Committee, consisting of the General Managers of the three utilities. The receipt of grants to the Pool from the Department of Regional Economic Expansion and their allocation to member utilities would be the responsibility of the Administrative Committee. It is to be noted, however, that, in this Agreement as in the majority of Interconnection and Pool Agreements, the authority for committing capital expenditures rests with the respective managements of the member utilities. This autonomy is cardinal to the character of the Interconnection. However, with the receipt of portions of the grants requested in each brief, each utility will be assuming obligations to construct transmission facilities and to maintain surplus capacity reserves. This may require the signing of subsidiary agreements by the utilities. These obligations of the utilities may be altered by future conditions; consequently there may be a need for discretionary action subject to the agreement of the Administrative Committee.

2. Operation

The Interconnection Agreement also makes provision for an Operating Committee which has direct responsibilities in the operation of the interconnection, including purchases and sales of energy, co-ordination of maintenance and provision of operating reserves.

If a grant is extended, making possible the construction of pool supported transmission facilities, the duties of the Operating Committee will be appreciably augmented. The high voltage grid will make possible the closer co-ordination of the operation of generating plants for greater economy. This more extensive use of the pool transmission facilities by participating utilities will require more sophisticated scheduling of such use in order that transmission capacity may be utilized to the greatest advantage.

3. Planning

As has been referred to earlier in this brief, the development of the Quebec and Maine interconnections has already highlighted the need for greater co-ordination in planning. The construction of a high voltage transmission grid would provide the catalyst for implementing a higher degree of planning co-ordination than has been achieved so far.

The existence of a high voltage grid would, in itself, require additional planning activity on the pool level in maximizing the use of the additional transmission capacity and developing programs of expansion. It will be necessary to make formal provision for continuous planning to ensure that the programs proposed keep pace with future changes in conditions.

It is foreseen that the activities of the Long Range Planning Committee of the Pool will be intensified. It may be necessary for engineers to be assigned more specifically to Pool planning functions.

APPENDIX 1

APPENDIX 1

TEN YEAR GENERATION AND TRANSMISSION DEVELOPMENT

PROVINCE OF NOVA SCOTIA

1971-1980 INCLUSIVE

August 1970
Revised January 1971
Revised February 1971

1. Firm Load Requirements (Tables attached)

The individual system loads for Nova Scotia Light and Power Company, Limited and The Nova Scotia Power Commission were combined to obtain the total provincial firm load. This was then subdivided into two broad categories - basic and industrial. The basic loads were projected using historic growth rates, the industrial loads were projected from information available at this time. The industrial load breakdown was shown in previous load forecast tables. The possible acceleration of industrial load due to future Regional Economic Expansion promotion was not considered, therefore, the loads used here represent a conservative estimate of the firm demand within the Province of Nova Scotia for the next decade.

2. Generation/Retirements/ Reserves

(a) Since the Nova Scotia systems already have a unit of 150 MW size and have two good sites which can be further developed using large base load thermal units, it was decided to do the first generation and transmission expansion plan using 150 MW units at Tufts Cove and Point Tupper supplemented by quick start gas turbines of 25 MW size where these were useful in deferring large units and/or transmission.

Undeveloped potential hydro sites have not been considered on the basis that at present high interest rates these are not competitive with gas turbines.

No sophisticated (waste heat recovery) schemes involving gas turbines in conjunction with new or existing thermal plants have been considered in the base case development.

(b) Retirement of older thermal units has not been provided for. If this were done the development pattern would have to be altered to provide for the lost capacity.

(c) The present interconnection agreement specifies that each participant must provide reserves equal to 15% of its firm peak load.

The effect of the New England interconnection plus the development of a generation expansion with a number of 150 MW units would result in a decreased reserve requirement. For this study the reserve criterion used is as follows:
The total reserve in the Province of Nova Scotia shall equal the smaller of either 15% of peak load or the net capability of the largest unit, but in no case shall this be less than 10% of the provincial firm peak.

3. Effects of New England Tie Line

The presence of a strong tie to New England necessitates increased transmission capability between Nova Scotia and New Brunswick. There is a detailed technical study underway now to determine the extent of the transmission improvements needed to enable Nova Scotia to retain synchronism with New England and New Brunswick on the loss of a large unit in Nova Scotia.

However, it is anticipated that a 230 kV circuit from Keswick to Onslow will be required no later than 1974. This circuit will, of course, require a 230/138 kV terminal at Onslow. Costs of the sections of these facilities which will be located in Nova Scotia have been included in the cost estimates shown in this report.

4. Area Generation and Load

The system in the province as it existed at the end of 1970 is shown geographically on the attached map. A simplified one line diagram of this system is also attached.

As a guide to developing a backbone transmission system, area load and generation for the December peak loads from 1971 to 1980 inclusive were considered.

Generally speaking the assumptions with regard to generation scheduling at the time of December peak load are independent of utility service areas, i.e. integrated operation is assumed.

5. 1980 System

A simplified one line diagram of the 1980 system is attached. This diagram shows the basic transmission elements, 138 and 230 kV, required for the generation expansion which was developed for this case. The system is shown geographically on the attached map.

6. Load Duration Curve

A daily load duration curve is included in this report to show the utilization of the generation sources on a December day in 1980. The resultant unit loading shows a reasonably good utilization of base load thermal, hydro and peaking generation.

7. Timing of Generation and Transmission Facilities and Preliminary Cost Estimates (Tables attached)

Separate tables have been prepared for generation, transmission lines, high voltage transformers and high voltage circuit breakers. These estimates include the facilities required to interconnect Nova Scotia and

New Brunswick. The estimates are based on recent costs with an allowance for escalation. The number of circuit breakers included provides for one breaker per circuit element which is considered to be a basic minimum. Detailed design may show the need for more breakers. The costs then are basic estimates and as such are not detailed design estimate costs.

The subtransmission and distribution requirement which will generally be common to all generation and transmission plans are not included.

8. Other Possible Alternatives

This base case was developed as a yardstick against which other schemes may be compared. Some other developments which may have to be studied are:

a) Development of new sites at Sydney and/or South Shore.

b) Larger thermal units.

c) Participation in large pool units located in New Brunswick.

d) Undeveloped hydro.

e) Gas turbine and waste heat boiler thermal complex.

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TABLE 1

NOVA SCOTIA LIGHT AND POWER COMPANY, LIMITED

FIRM LOAD VS. INSTALLED GENERATION

Year	LOAD		GENERATION					
			Hydro		Thermal*		Total	Required
	MW	GWhr	MW	GWhr	MW	GWhr	MW	MW
1970	292	1,535	56	200	273	1,335	329	336
1971	315	1,656	56	200	273	1,456	329	362
1972	339	1,787	56	200	365	1,587	421	390
1973	366	1,924	56	200	365	1,724	421	421
1974	395	2,076	56	200	365	1,876	421	454
1975	426	2,339	56	200	390	2,139	446	490
1976	459	2,419	56	200	530	2,219	586	528
1977	495	2,602	56	200	530	2,402	586	569
1978	534	2,807	56	200	530	2,607	586	614
1979	576	3,027	56	200	670	2,827	726	662
1980	621	3,273	56	200	670	3,073	726	714

* Generation installation pattern as follows:

1972 - 100 MW - T.C. #2
1975 - 25 MW G.T. - Halifax
1976 - 150 MW - T.C. #3
1979 - 150 MW - T.C. #4

TABLE 2

NOVA SCOTIA POWER COMMISSION

FIRM LOAD VS. INSTALLED GENERATION

Year	LOAD						GENERATION					
	Basic		Industrial		Total Firm		Hydro		Thermal*		Total	Required
	MW	GWhr	MW	GWhr	MW	GWhr	MW	GWhr	MW	GWhr	MW	MW
1970	222	1,130	148	822	370	1,952	104	460	407	1,492	511	425
1971	237	1,205	186	1,141	423	2,346	104	460	432	1,886	536	486
1972	254	1,292	246	1,412	500	2,704	104	460	432	2,244	536	575
1973	272	1,383	256	1,783	528	3,166	104	460	572	2,706	676	606
1974	291	1,480	261	1,778	552	3,258	104	460	572	2,798	676	635
1975	311	1,582	278	1,908	589	3,490	104	460	597	3,030	701	677
1976	333	1,695	346	2,054	679	3,749	104	460	617	3,289	721	780
1977	356	1,810	356	2,489	712	4,299	104	460	757	3,839	861	818
1978	381	1,940	366	2,559	747	4,499	104	460	757	4,039	861	860
1979	407	2,070	376	2,629	783	4,699	104	460	757	4,239	861	900
1980	436	2,220	386	2,699	822	4,919	104	460	757	4,459	861	945

* Generation installation pattern as follows:

1971	-	25 MW G.T.	-	Tusket
1973	-	150 MW	-	Tupper #2
1975	-	25 MW G.T.	-	Sydney
1976	-	20 MW	-	Sysco
1977	-	150 MW	-	Tupper #3

TABLE 3

PROVINCE OF NOVA SCOTIA

FIRM LOAD VS. INSTALLED GENERATION

Year	LOAD						GENERATION					
	Basic		Industrial		Firm		Hydro		Thermal*		Total	Required
	MW	GWhr	MW	GWhr	MW	GWhr	MW	GWhr	MW	GWhr	MW	MW
1970	514	2,665	148	822	662	3,487	160	660	680	2,827	840	761
1971	552	2,861	186	1,141	738	4,002	160	660	705	3,342	865	848
1972	593	3,079	246	1,412	839	4,491	160	660	797	3,831	957	965
1973	638	3,307	256	1,783	894	5,090	160	660	937	4,430	1,097	1,027
1974	686	3,556	261	1,778	947	5,334	160	660	937	4,674	1,097	1,089
1975	737	3,921	278	1,908	1,015	5,829	160	660	987	5,169	1,147	1,155
1976	792	4,114	346	2,054	1,138	6,168	160	660	1,147	5,508	1,307	1,278
1977	851	4,412	356	2,489	1,207	6,901	160	660	1,287	6,241	1,447	1,347
1978	915	4,747	366	2,559	1,271	7,306	160	660	1,287	6,646	1,447	1,411
1979	983	5,097	376	2,629	1,359	7,726	160	660	1,427	7,066	1,587	1,499
1980	1,057	5,493	386	2,699	1,443	8,192	160	660	1,427	7,532	1,587	1,583

* Generation installation pattern as follows:

1971 - Tusket - 25 MW G.T.
1972 - TC #2 - 100 MW
1973 - Tup. #2 - 150 MW
1974 - 0
1975 - Hlfx. - 25 MW G.T.
Syd. - 25 MW G.T.

1976 - T.C. #3 - 150 MW + Sysco 20 MW
1977 - Tup. #3 - 150 MW
1978 - 0
1979 - T.C. #4 - 150 MW
1980 - 0

NOTE: Required reserve equal to the lesser of A) 15% of firm load or B) net capacity of largest machine but in no case less than 10% of firm load.

TABLE 4

GENERATING FACILITIES[1]

Year	Location	Size (MW)	Estimated[2] Cost ($)	Present[3] Value at 1971 $
1971	Tusket (Gas Turbine)	25	$ 3,000,000	$ 3,000,000
1972	Tufts Cove #2	100	18,000,000	16,666,200
1973	Tupper #2	150	30,000,000	25,719,000
1974	-	-	-	-
1975	Sydney (Gas Turbine)	25	3,580,000	2,631,300
	Halifax (Gas Turbine)	25	3,580,000	2,631,300
1976	Tufts Cove #3	150	32,800,000	22,323,700
	Sysco	30	6,000,000	4,083,600
1977	Tupper #3	150	33,800,000	21,300,800
1978	-	-	-	-
1979	Tufts Cove #4	150	35,800,000	19,342,700
	Total Capital Cost:		$166,560,000	$117,698,600

Notes:

(1) This table includes all facilities up to the high voltage terminals of the generator transformer circuit breaker.

(2) Estimates are based on 1971 costs escalated at 6% p.a. to 1973 and at 3% p.a. thereafter.

(3) Present values are based on an interest rate of 8%.

TABLE 5

TRANSMISSION LINE FACILITIES[1]

Year	Location	Voltage (kV)	Length (miles)	Estimated[5] Cost $	Present[6] Value at 1971 $
1971	Trenton-Port Hastings	230[2]	64	$ 1,825,000	$ 1,825,000
	Port Hastings-Tupper	138	7	175,000	175,000
1972	Port Hastings-Sydney	138	102	2,700,000	2,500,200
1973	Onslow-Port Hastings	230[3]	100	842,000	721,600
	Sackville-Milton	230[2]	85	3,350,000	2,871,000
	Port Hastings-Sydney	230[2]	80	3,150,000	2,699,600
1974	Onslow-Sackville	230[3]	55	-	
	Onslow-Moncton[4]	230	64	2,590,000	2,056,500
	Tufts Cove-Sackville	138	10	290,000	230,300
1975	Nil	-	-	-	-
1976	Valley-Milton	230[2]	70	3,000,000	2,043,000
	Port Hastings-Sydney	230	80	3,440,600	2,342,600
	Port Hastings-Sydney	230[3]	80	-	-
1977	Tupper-Port Hastings	230	7	310,000	195,300
1978	Nil	-	-	-	-
1979	Nil	-	-	-	-
1980	Sackville-Valley	230[2]	50	2,420,000	1,210,000
		Total Capital Cost		$24,092,000	$18,870,100

Notes:
(1) This table includes the transmission lines and their right-of-way only.
(2) This line will be operated at 138 kV initially.
(3) The existing line will be uprated to 230 kV operation.
(4) This includes only that part of the line located in Nova Scotia.
(5) Estimates include all costs such as right-of-way, clearing, design, material, construction, supervision and interest during construction. Estimates are based on 1969 costs with an allowance for escalation of 7% p.a. to 1971, 6% p.a. from 1971 to 1973, and 3% p.a. thereafter.
(6) Present values are based on an interest rate of 8%.

TABLE 6

HIGH VOLTAGE BREAKERS[1]

Year	Location	Voltage kV	Quantity	Estimated[4] Cost $	Present[5] Value At 1971 $
1971	Trenton	138	1	$ 130,000	$ 130,000
	Port Hastings	138	3	390,000	390,000
	Tupper	138	1	130,000	130,000
1972	Port Hastings	138	1	138,000	127,800
	Sydney	138	6	827,000	765,800
1973	Sackville	138	1 (2)	146,000	125,100
	Milton	138	3	151,000	129,400
	Onslow	230	2	528,000	452,500
	Port Hastings	138	2	292,000	250,200
	Sydney	138	1	146,000	125,100
1974	Onslow	230	2 (3)	545,000	432,700
	Tufts Cove	138	1	52,000	41,300
	Sackville	138	1	151,000	119,900
1975	-	-	-	-	-
1976	Valley	138	1	159,500	108,600
	Milton	138	1	159,500	108,600
	Port Hastings	230	4	1,156,000	787,200
	Sydney	230	3	870,000	592,500
1977	Port Hastings	230	1	298,000	187,700
	Sydney	230	1	298,000	187,700
	Sydney	138	1	164,000	103,300
1980	Sackville	138	1	179,000	89,500
	Valley	138	1	179,000	89,500
		Total Capital Cost:		$7,089,000	$5,474,400

Notes:

(1) This table includes the circuit breaker and all associated equipment such as structures, isolating switches, buswork, protective relaying, instrument transformers, etc., and their installation cost.

(2) Circuit breakers on the Onslow-Trenton 230 kV line will be relocated.

(3) A circuit breaker from Onslow will be relocated.

(4) Estimates are based on 1971 costs escalated at 6% p.a. to 1973 and at 3% p.a. thereafter.

(5) Present values are based on an interest rate of 8%.

TABLE 7

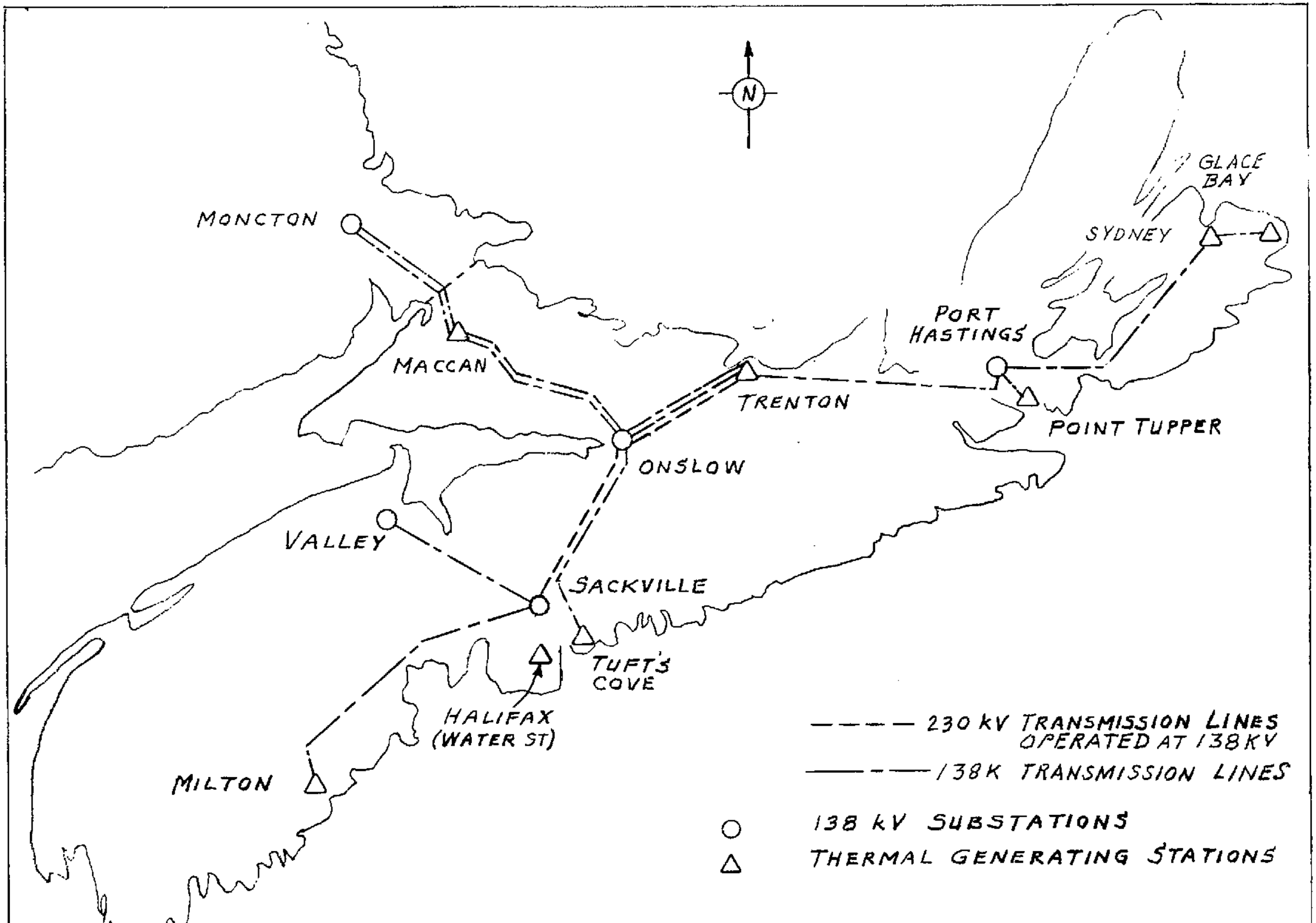
HIGH VOLTAGE TRANSFORMERS[1]

Year	Location	Capacity MVA	Voltage kV	Estimated Cost $[2]	Present Value At 1971 $[3]
1973	Port Hastings	90/120/150	230/138	$ 742,000	$ 635,900
	Onslow	90/120/150	230/138	742,000	635,900
1974	Sackville	90/120/150	230/138	764,000	606,600
1976	Sydney	90/120/150	230/138	810,000	551,600
1977	Sydney	90/120/150	230/138	835,000	526,100
		Total Capital Cost:		$3,893,000	$2,956,100

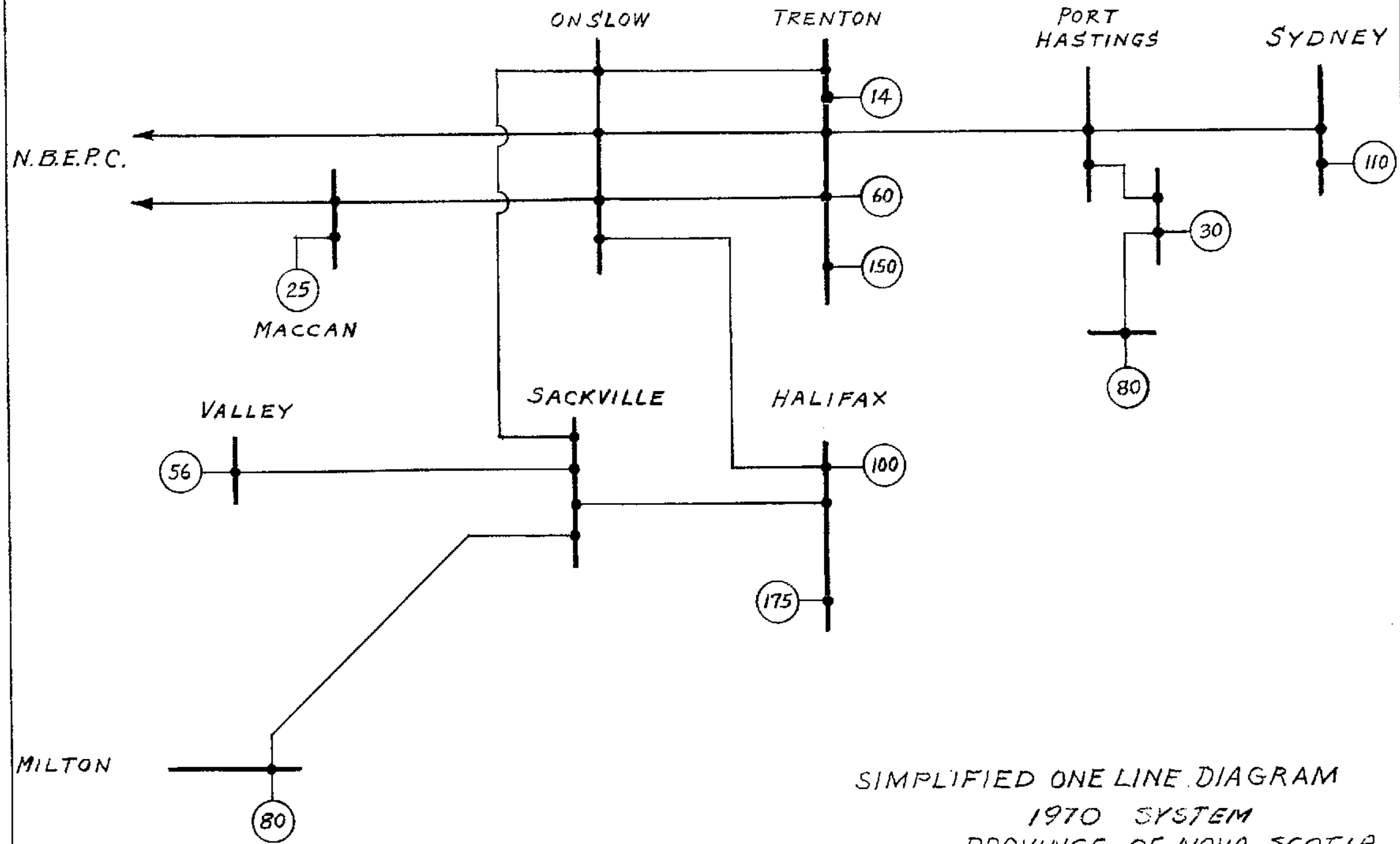
Notes: (1) This table includes the transformer and its installation costs only. Circuit breakers, structures, etc., are allowed for under circuit breaker requirements.

(2) Estimates are based on 1971 costs escalated at 6% p.a. to 1973 and at 3% p.a. thereafter.

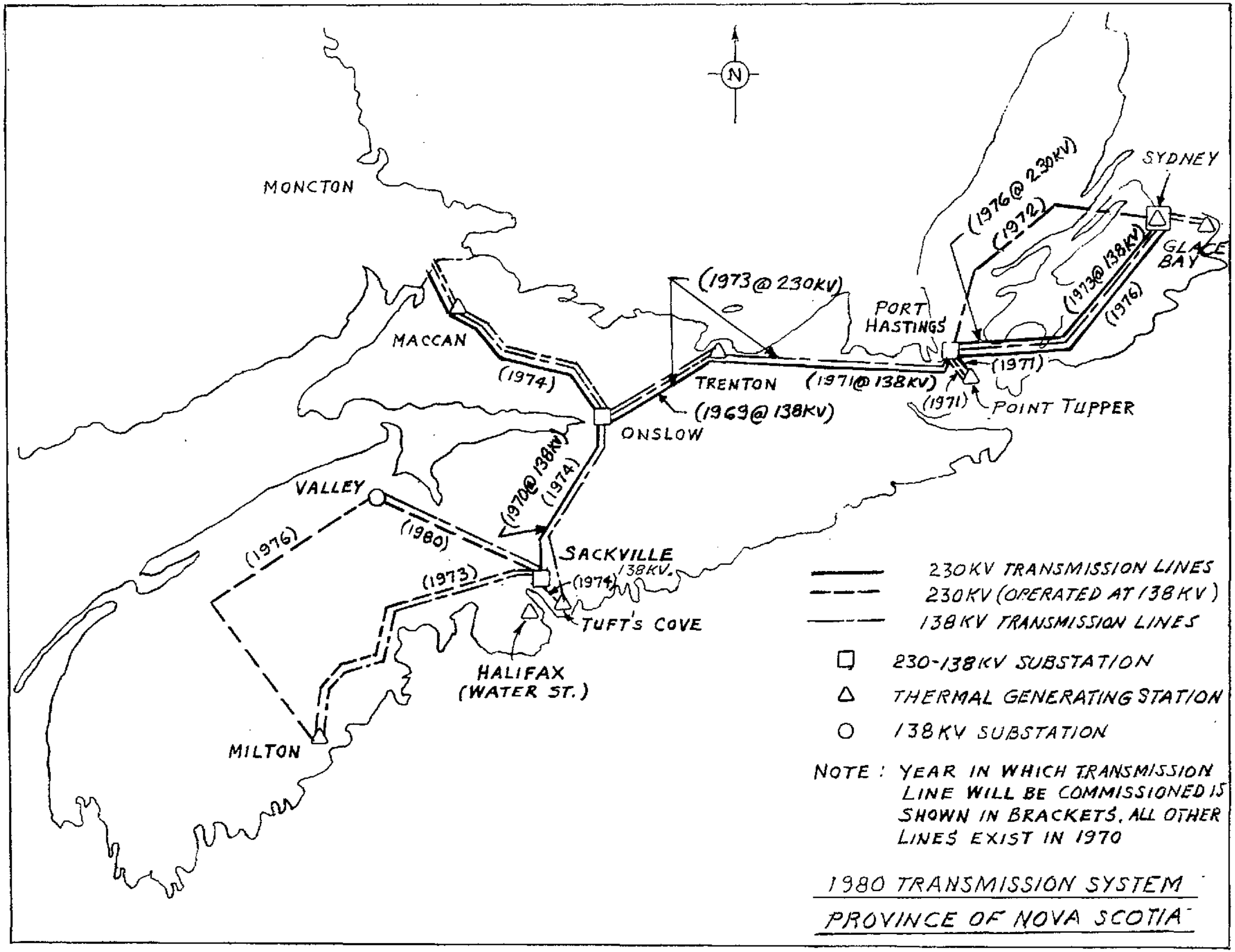
(3) Present values are based on an interest rate of 8%.

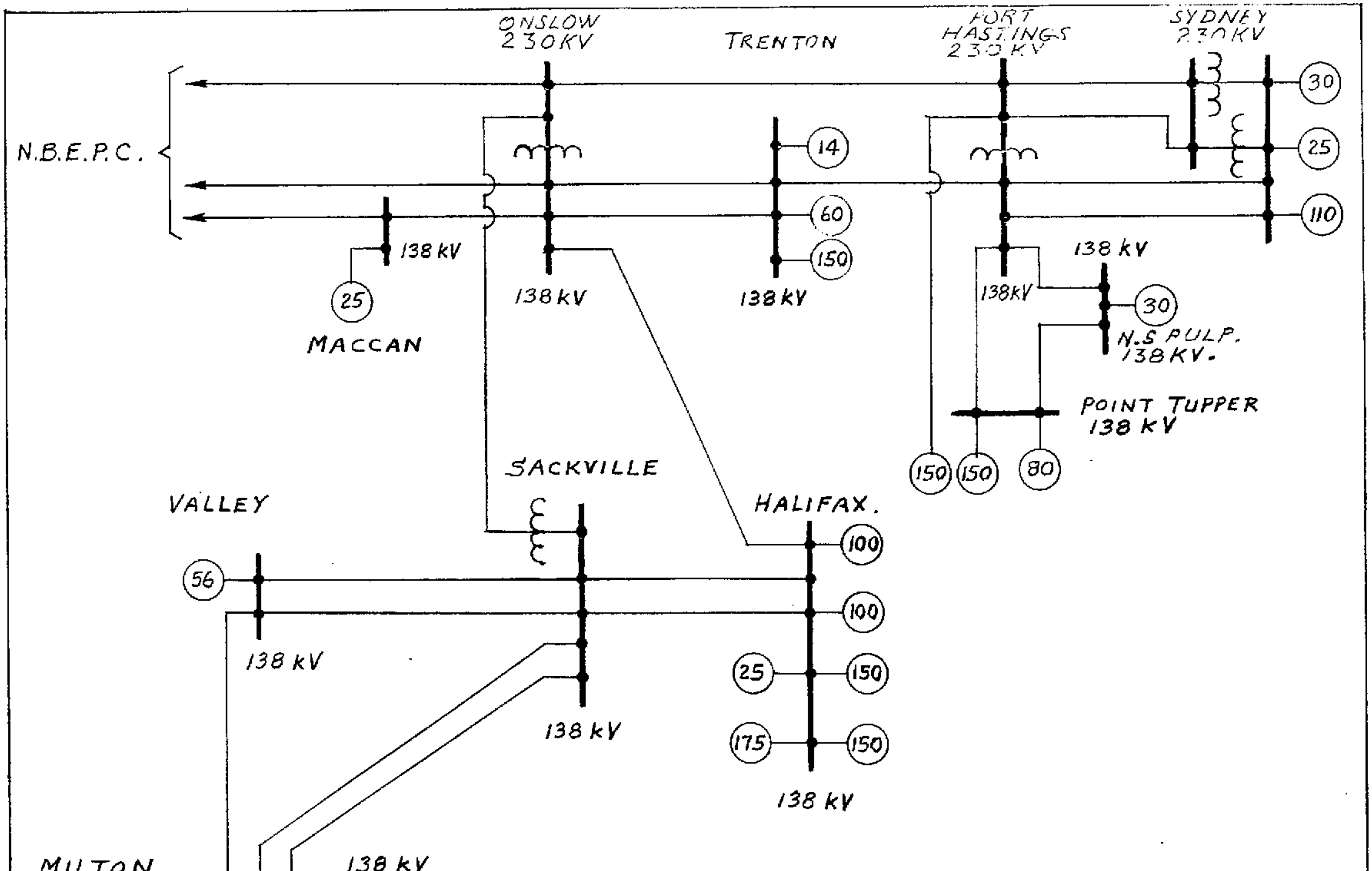


1970 TRANSMISSION SYSTEM.
PROVINCE OF NOVA SCOTIA.



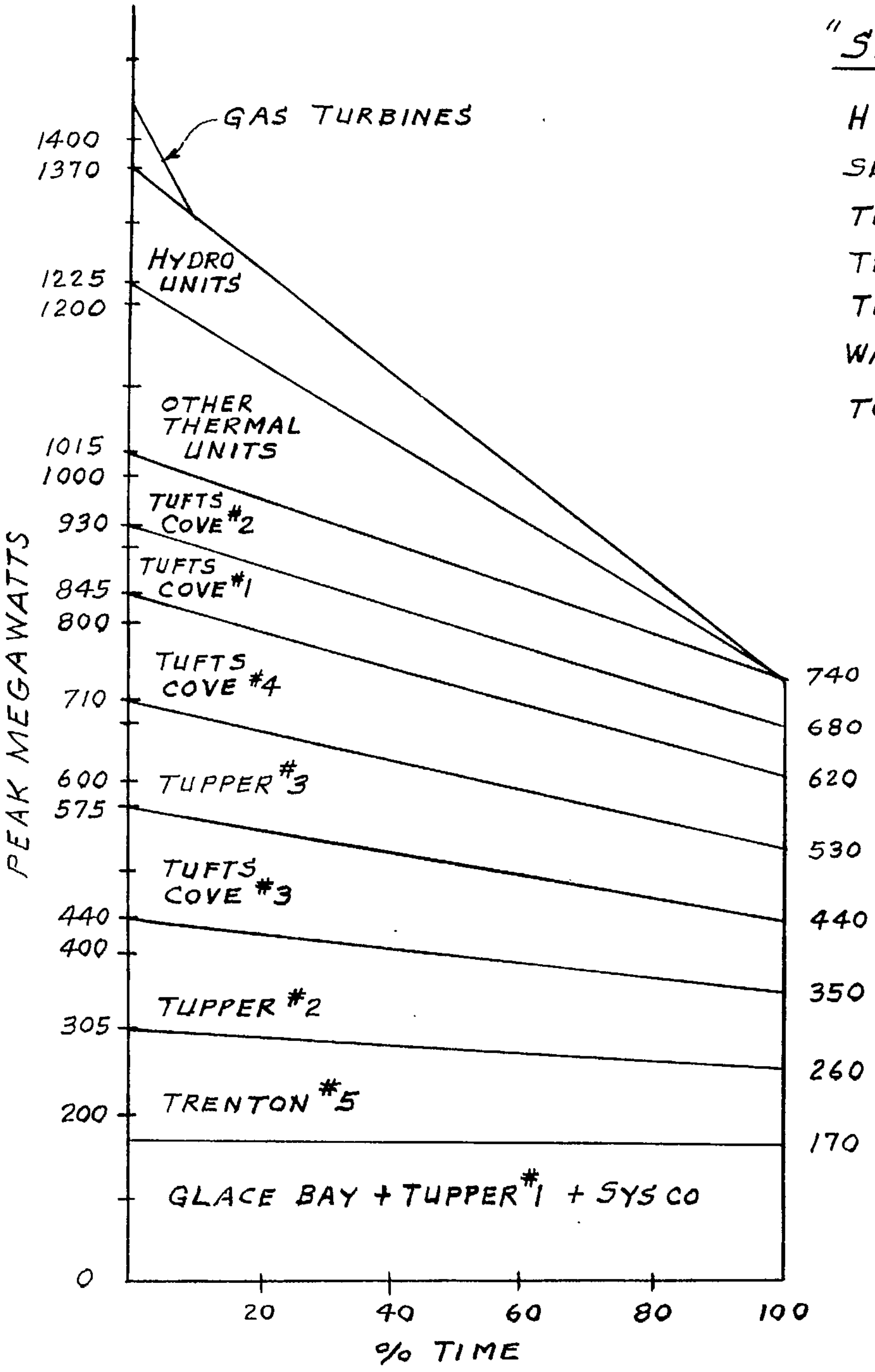
SIMPLIFIED ONE LINE DIAGRAM
1970 SYSTEM
PROVINCE OF NOVA SCOTIA.


MONCTON
MACCAN
(1974)
ONSLOW
TRENTON
(1973@230KV)
(1969@138KV)
(1971@138KV)
PORT HASTINGS
(1971)
POINT TUPPER
(1976@230KV)
(1972)
SYDNEY
GLACE BAY
(1973@138KV)
(1976)
VALLEY
(1976)
(1980)
(1970@138KV)
(1974)
SACKVILLE
138KV.
(1973)
(1974)
TUFT'S COVE
HALIFAX (WATER ST.)
MILTON
N
230KV TRANSMISSION LINES
230KV (OPERATED AT 138KV)
138KV TRANSMISSION LINES
230-138KV SUBSTATION
THERMAL GENERATING STATION
138KV SUBSTATION
NOTE: YEAR IN WHICH TRANSMISSION LINE WILL BE COMMISSIONED IS SHOWN IN BRACKETS. ALL OTHER LINES EXIST IN 1970
1980 TRANSMISSION SYSTEM
PROVINCE OF NOVA SCOTIA



SIMPLIFIED ONE LINE DIAGRAM
1980 SYSTEM
PROVINCE OF NOVA SCOTIA.

DECEMBER DAY - 1980



"SPINNING RESERVE"

HYDRO	15	MW
SEA'BD	20	
TUPPER	10	
TRENTON	15	
TUFT'S COVE	30	
WATER ST	15	
TOTAL	105	MW

APPENDIX 2

APPENDIX 2

TEN YEAR GENERATION AND TRANSMISSION EXPANSION

N. B. E. P. C.

1971 - 1980 Inclusive

September 1970
Revised January 1971
Revised February 1971

1. Load Forecast

The load forecast used in the "base case" is broken down into four categories; namely, basic, industry, non-firm and export. The annual load growth used in forecasting the in-province "basic" is some 8% for the ten year period. The "industry" is based on signed contracts to 1972 with an average annual growth of 4.5% the remaining eight years. The in-province "basic" and "industry" forecasts are considered as the normal expected load growth.

The export forecast is based on signed contracts with M.E.P.C.O. to June 30, 1975 and continued supply of Maine Public Service and Eastern Maine Co-Op to 1980. It was also assumed that N.B.E.P.C. would continue to export 150 megawatts of low load factor capacity over one or more of the external interconnections.

2. Generation

In view of the large capacity of our interconnection in 1976 it was considered that the base case generation expansion should utilize thermal units in the 300 to 400 MW size range, these units to be scheduled with further development of our Mactaquac Hydro site. The first large thermal unit was assumed to be located at the existing Dalhousie station. It was further assumed an outside utility would purchase some 60 MW of the 340 MW net thermal unit scheduled for 1976.

The only retirement considered in this base case is the Dock Street Plant in Saint John. It is considered that due to urban renewal in the area the plant will be disbanded by 1975.

The purchase shown from Hydro-Quebec in Table 3 only shows the amount contracted during Hydro-Quebec's peak load period. The off-peak portion amounting to 100 MW in 1972 and 1973 and 70 MW in 1974 is not included.

The purchases shown in 1977 are assumed to be available over one of the interconnections.

3. Reserve Criteria

(a) Capacity

(i) December hourly peak plus 15% or largest single unit, whichever the greater against 2 - hour net capability of resources.

(ii) May hourly peak plus 15% or largest single unit, whichever is the greater against 2-hour net capability of resources with Hydro derated for high flows.

(b) Energy

February monthly energy requirements plus 1/2 largest unit at 100% load factor; as compared with 95% low monthly hydro including storage plus thermal. (After 350 MW unit in system used 1/3 largest unit in reserve).

It has been determined that if the February energy requirement is satisfied the remaining months are also acceptable.

4. Transmission Facilities

The development of our transmission is based on a load versus generation study of each major load area. Line capabilities of 1.5 surge impedance loading have been considered as an allowable load level.

The transmission expansion plan shows 230 kV in the Moncton area by 1974. The installation of synchronous condensers in the Moncton area for 1971 has assured that this is the earliest date of the 230 kV requirement.

The concept of single pole reclosing is also being explored to permit deferral of some of our 230 kV facilities.

5. Remarks

The attached case is considered our base case; however, a major Generation Expansion Study is currently underway to determine the economics of this case along with others. The expansion study will assess our capacity and energy capabilities separately for a given loss of load probability. It is our intention to assess this base case in the study to determine the adequacy of our reserve criteria.

Prepared by: C.T. Flynn, P. Eng.
Facility Engineer
Planning Division.
N.B. Power.

TABLE 1

SUMMARY OF DECEMBER LOAD V.S. CAPACITY IN MEGAWATTS BASE CASE

		YEAR										
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
RESOURCES:												
Hydro		545	545	645	645	645	645	645	745	745	745	745
Thermal + G.T.		530	555	555	555	540	540	880	880	1,160	1,160	1,160
Purchases:	N.S.		25									
	H.Q.		120	165	215	250	320					
	Misc.								60			
I. TOTAL		1,075	1,245	1,365	1,415	1,435	1,505	1,525	1,685	1,905	1,905	1,905
LOAD:												
In-Prov.:	Basic	372	413	451	491	530	570	612	658	708	760	817
	Industry	192	284	300	317	333	349	365	380	396	413	429
	Non-firm	56	56	56	56	56	56	56	56	56	56	56
Export		236	325	307	289	251	205	209	215	221	228	235
Total		856	1,078	1,114	1,153	1,170	1,180	1,242	1,309	1,381	1,457	1,537
Plus 15% of Firm or Largest Unit		120	153	159	165	167	169	280	280	280	280	280
II. TOTAL REQUIRED		976	1,231	1,273	1,318	1,337	1,349	1,522	1,589	1,661	1,737	1,817
I. MINUS II.		99	14	92	97	98	156	3	96	244	168	88

NOTE: 15% Reserve not on non-firm in-province.

TABLE 2

SUMMARY OF FEBRUARY ENERGY ANALYSIS (GWH)

		YEAR										
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
RESOURCES:												
Hydro (95%) and Storage		69	78	78	78	78	78	78	78	78	78	78
Thermal + G.T.		347	372	385	372	363	363	376	591	591	780	807
Purchase:	N.S.		28	14								
	H.Q.			72	160	190	193	200				
	Other									34		
I. TOTAL		416	478	549	610	631	634	654	669	703	858	885
LOAD:												
In-Prov.:	Basic	161	172	190	207	227	243	262	281	303	325	350
	Industry	100	119	179	189	199	209	227	229	239	249	268
	Non-firm	28	30	30	30	30	30	30	30	30	30	30
Export		15	64	91	96	97	86	44	54	60	66	72
Sub-Total		304	385	490	522	553	568	563	594	632	670	720
Reserve *		50	50	50	50	50	50	50	67	67	67	67
II. TOTAL		354	435	540	572	603	618	613	661	699	737	787
I. MINUS II.		62	43	9	38	28	16	41	8	4	121	98

* NOTE: Energy reserve of one-half largest pool unit at 100% load factor up to 1976 inclusive; allowing for 100 MW reserve after first large unit with remaining reserve assumed available on Interconnections.

TABLE 3

GENERATION FACILITIES

Year	Location	Capacity	Estimated Cost $	Present Value at 1971 $
1971	Moncton - G.T.	25 MW	2,750,000	2,750,000
	Purchase- H.Q. and N.S.	145 MW	-	-
1972	Purchase- H.Q.	165 MW	-	-
	D.C. Facilities - Eel River	-	31,000,000	28,706,000
	Mactaquac # 4	100 MW	5,100,000	4,722,600
1973	Purchase- H.Q.	215 MW	-	-
1974	Purchase- H.Q.	250 MW	-	-
1975	Purchase- H.Q.	320 MW	-	-
1976	Dalhousie	350 MW	65,000,000	44,265,000
1977	Purchase	60 MW	-	-
	Mactaquac # 5 (1)	100 MW	6,080,000	3,830,400
1978	South Shore Unit	300 MW	63,830,000	37,276,700
1979	Nil	-	-	-
1980	Nil	-	-	-
		Total Capital Cost	$173,760,000	$121,550,700

NOTE: Estimates include an allowance for escalation of 6% p.a. to 1973 and 3% p.a. thereafter

Present values are based on an interest rate of 8%.

(1) May be installed by 1974 for other reasons.

TABLE 4

MAJOR TRANSMISSION LINE FACILITIES [2]

YEAR	LOCATION		VOLTAGE (kV)	MILES	ESTIMATED COST (3)	PRESENT VALUE AT 1971 (5)
1971	Quebec	Eel River	230	20	700,000	700,000
1972	Quebec	Eel River	230	20	636,000	
	Eel River	Bathurst	230	55	2,010,000	
	Total				2,646,000	2,455,000
1973	Eel River	Bathurst	230 [1]	55	2,130,000	1,825,000
1974	Salisbury	Memramcook	230	28	1,158,000	
	Memramcook	N.S. Border	230	32	1,325,000	
	Total				2,483,000	1,973,000
1975	Keswick	Acamac	230 [4]	70	2,820,000	
	Courtenay Bay	Acamac	138	10	59,600	
	Total				2,879,600	2,115,000
1976	Bathurst	Keswick	230	130	5,900,000	
	Dal.Plant	Eel River	230	5	307,000	
	Total				6,207,000	4,225,000
1977	Newcastle	Memramcook	230 [1]	85	3,800,000	
	Mactaquac	Keswick	230	7	316,000	
	Total				4,116,000	2,594,000
1978	Keswick	Acamac	230 [4]	70	-	-
	Plant Site	Acamac	230	10	456,000	266,000
1979	Nil	-	-	-	-	-
1980	Nil	-	-	-	-	-
	TOTAL CAPITAL COST:				$21,617,600	$16,153,000

Notes: (1) Use of single pole reclosing on 230 kV lines could delay these from three to five years.

(2) Only transmission lines forming part of network are included. Radial lines to serve load remote from busses shown are not included.

(3) Estimates are based on 1969 costs escalated at 7% p.a. to 1971, 6% p.a. from 1971 to 1973 and 3% p.a. thereafter.

(4) This line will be constructed for 230 kV in 1975 but will be operated at 138 kV until 1979.

(5) Present value is based on an interest rate of 8%.

TABLE 5

HIGH VOLTAGE BREAKERS

Year	Location	kV	Quantity	Cost (Installed)[1]	Present Value at 1971[2]
1971	Eel River	230	10	2,350,000	
	Eel River	138	2	260,000	
	Total			2,610,000	2,610,000
1972	Bathurst	230	3	750,000	
	Keswick	230	1	250,000	
	Newcastle	138	2	275,000	
	Total			1,275,000	1,181,000
1973	Eel River	230	1	264,000	
	Bathurst	230	1	264,000	
	Total			528,000	452,000
1974	Keswick	230	2	545,000	
	Memramcook	230	3	818,000	
	Memramcook	138	4	602,000	
	Total			1,965,000	1,560,000
1975	Keswick	138	1	155,000	114,000
1976	Bathurst	230	1	288,000	
	Keswick	230	1	288,000	
	Eel River	230	2	576,000	
	Dalhousie Plant	230	3	864,000	
	Total			2,016,000	1,371,000
1977	Newcastle	230	3	893,000	
	Memramcook	230	1	297,000	
	Mactaquac	230	2	594,000	
	Keswick	230	1	297,000	
	Total			2,081,000	1,312,000
1978	Keswick	230	2	612,000	
	Acamac	230	3	920,000	
	New Plant	230	3	920,000	
	Acamac	138	4	676,000	
	Total			3,128,000	1,828,000
	Total Capital Cost:			13,758,000	10,428,000

Notes: (1) Estimates include escalation at 6% p.a. to 1973 and 3% p.a. thereafter. Structures, protective relaying, etc. are included in the estimated cost.

(2) Present values are based on an interest rate of 8%.

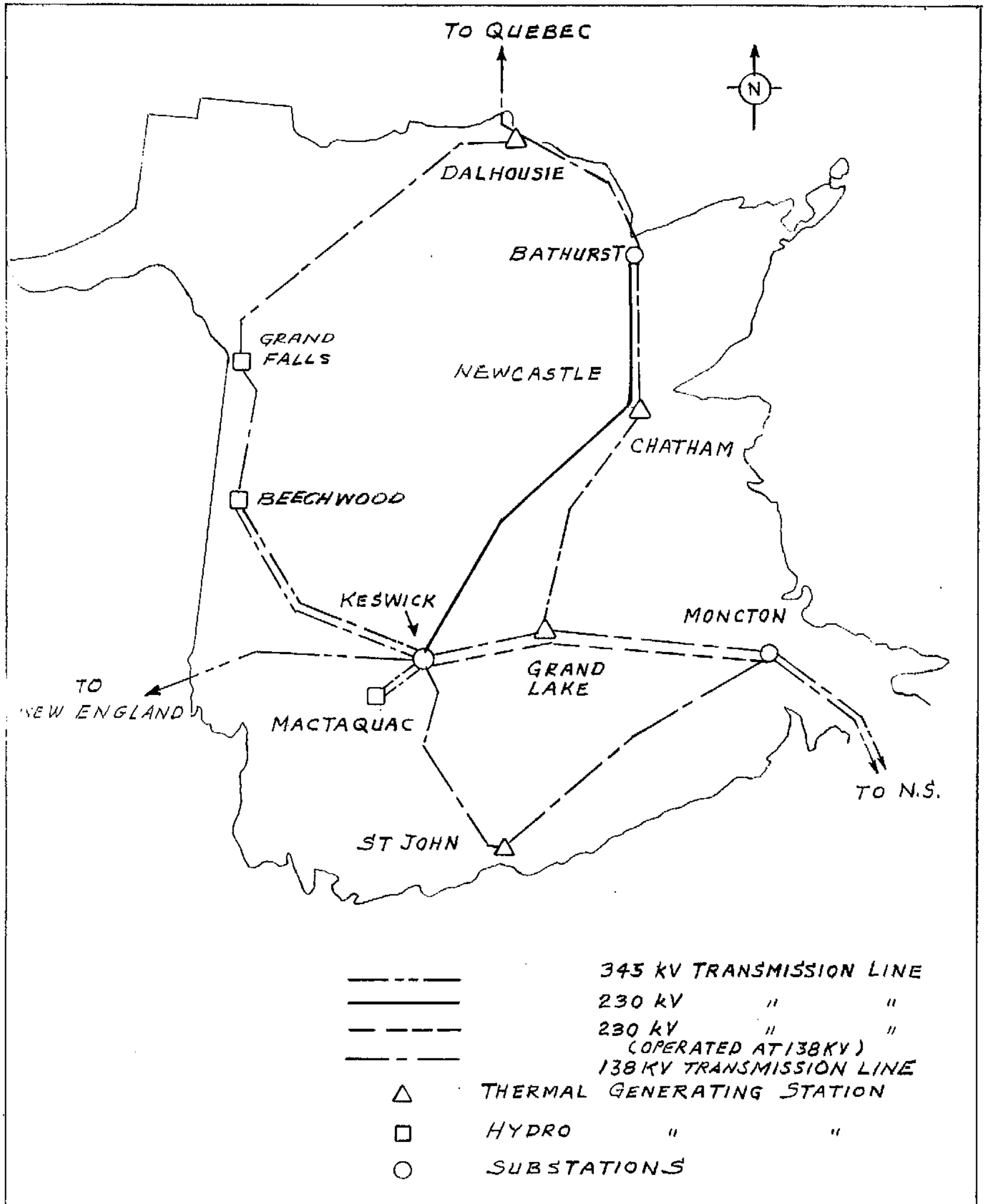
TABLE 6

HIGH VOLTAGE TRANSFORMERS

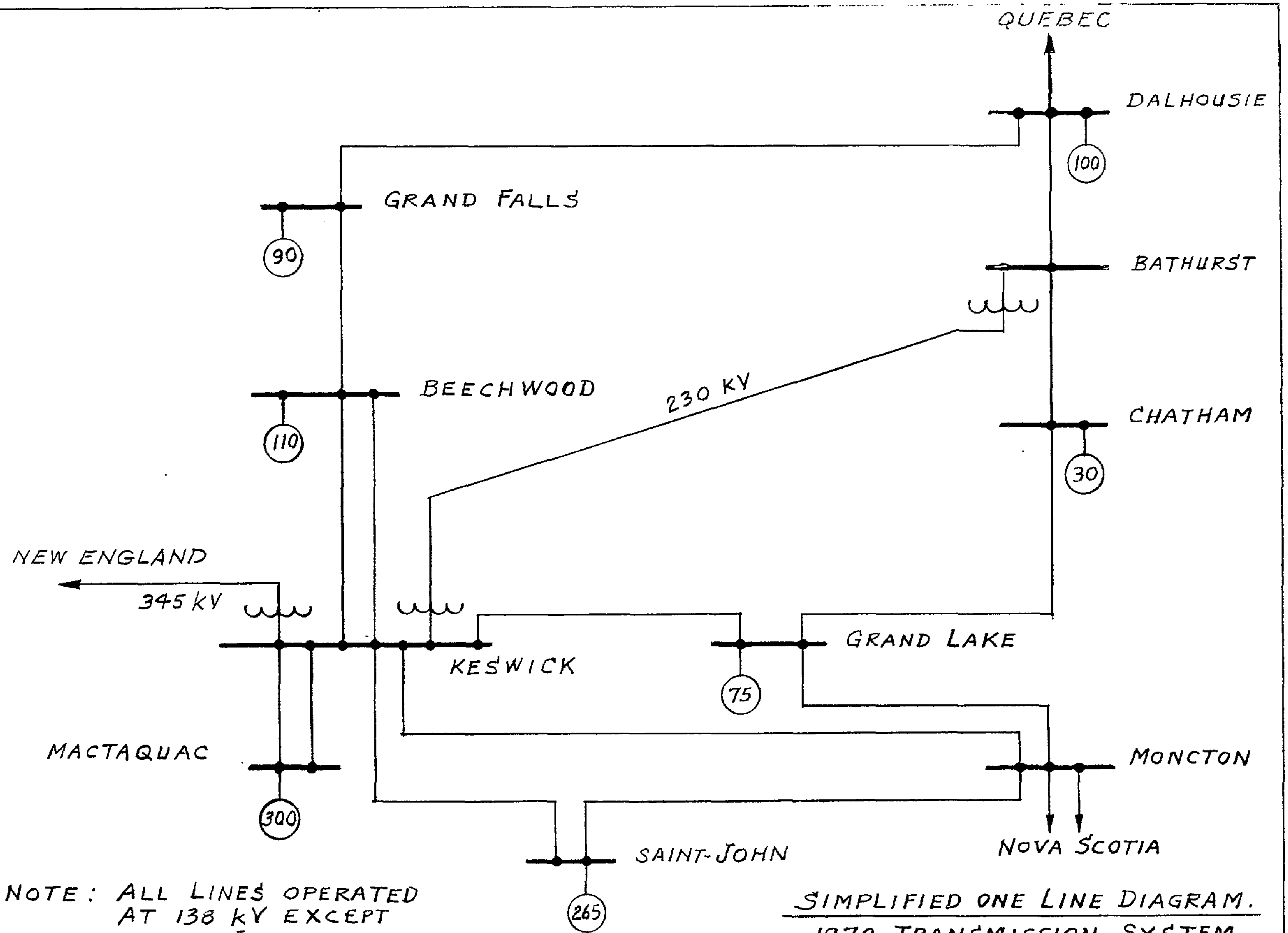
Year	Location	Capacity	Voltage	Estimated Cost	Present Value at 1971
1971	Eel River	75/100/125	230/161/138	600,000	600,000
	Eel River	75/100/125	230/138	500,000	500,000
1974	Memramcook	120/160/200	230/138	694,000	551,000
1976	Bathurst	200/266/333	230/138	1,105,000	752,500
1978	Acamac	120/160/200	230/138	781,000	456,100
			Total Capital Cost:	$3,680,000	$2,859,600

Note: Estimate cost includes transformer and all associated equipment, i.e. structure, buswork, foundations, etc., together with their installation.

Present values are based on an interest rate of 8%.

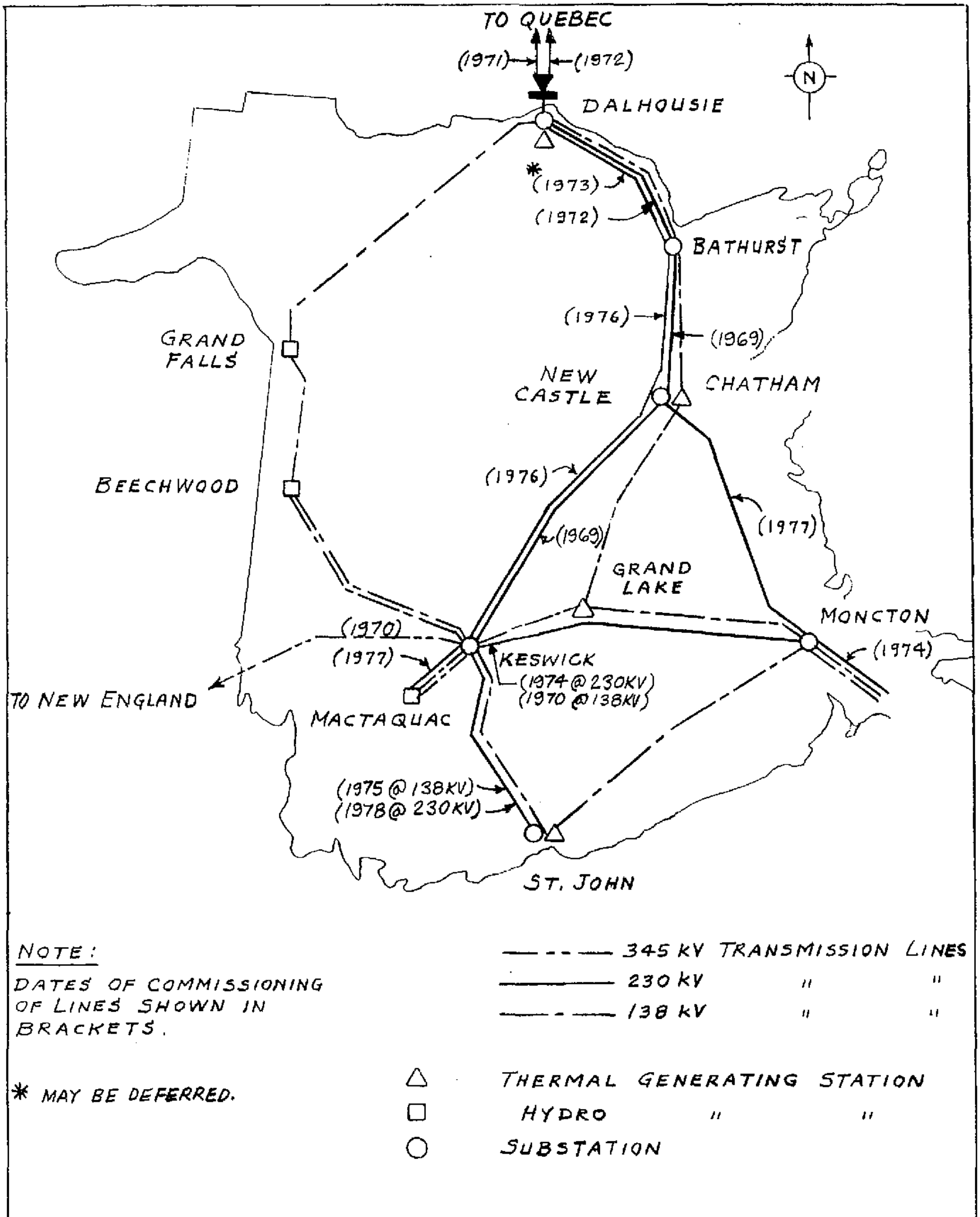


1970 TRANSMISSION SYSTEM

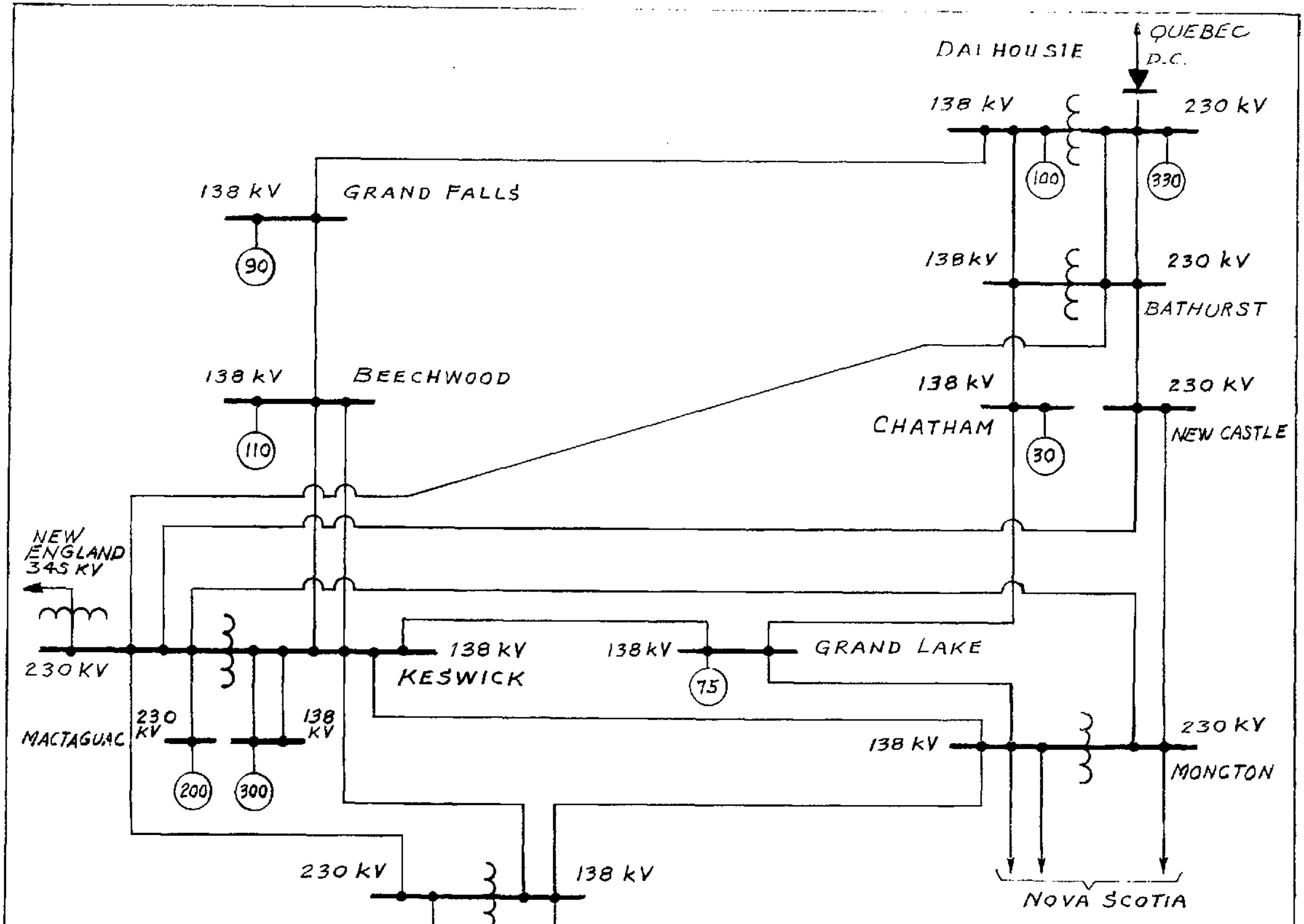


NOTE: ALL LINES OPERATED AT 138 KV EXCEPT WHERE INDICATED

SIMPLIFIED ONE LINE DIAGRAM.
1970 TRANSMISSION SYSTEM.



1980 TRANSMISSION SYSTEM.



SIMPLIFIED ONE LINE DIAGRAM
1980 TRANSMISSION SYSTEM.

APPENDIX 3

APPENDIX 3

COMBINED GENERATION AND GRID TRANSMISSION DEVELOPMENT

FOR

THE PROVINCES OF NEW BRUNSWICK AND NOVA SCOTIA

1971 - 1980 INCLUSIVE

January 1971
Revised February 1971

1. Load Forecast

The forecast of demand and energy load on the combined New Brunswick and Nova Scotia systems is the sum of the forecasts prepared by each province individually. Peak demands are assumed to occur coincidently in December and no allowance for accelerated industrial load growth is included. The forecast peak load compared with installed capacity is shown in Table 1.

2. Generation

(a) Unit Sizes and Locations

The peak load on the combined systems is such that use of 150 MW thermal generating units in the early stages and units of the 300 MW size in the later stages of development, much as proposed by the individual utilities, fills the requirement for additional capacity most satisfactorily, with peaking capacity being obtained from additional hydro units at Mactaquac. Gas turbines are also proposed to defer major transmission expenditures or to defer installation of larger thermal units.

The proposed locations for generating capacity additions are at existing plant sites or major load centres.

(b) Reserves

A reserve capacity of the larger of 15% of the combined system peak load or the net capacity of the largest generator installed is considered to be the minimum required to maintain the reliability of supply presently achieved. With this capacity reserve, the energy reserve criteria of the N.B.E.P.C. would be satisfied.

(c) Installation Schedule

Assuming that sufficient transmission capacity is available to permit complete integration of the generation requirements of the system, the installation of additional generation could be scheduled to maintain a minimum of excess capacity on the combined systems without detrimental effects on reliability. A proposed schedule of installations is shown in Table 2.

This schedule takes into consideration present commitments with regard to the import of power into New Brunswick from Quebec but does not include any import after the termination of the present agreement.

(d) Estimated Costs

The estimated capital cost of the program of generation installation is shown in Table 2. The estimates are based on current costs escalated at 6% per annum to 1973 and 3% per annum thereafter.

3. Transmission

(a) Philosophy of Development

The basic assumptions applied to the development of a high voltage grid for the Maritime region are that the transmission system must provide the flexibility to permit the supply of a load in the order of 150 MW over and above that presently predicted, particularly in any one of the Saint John, Moncton, Halifax, Canso Strait or Sydney areas. Furthermore, it must be capable of doing this with the supply source being at any one of the existing thermal generating sites at Dalhousie, South Shore, Dartmouth, or Point Tupper. A third criterion is that the system must be such that there is no instability on the loss of the largest generating unit on the system or any other unit on the system. This means that the system must be able to withstand the loss of the largest unit in Nova Scotia, recognizing that on the first power swings the flow will be from the New England tie at Keswick to the load regardless of where the spinning reserve is carried.

(b) Line Voltages and Capacities

The expansion of the system is based on the continued use of 230 kV for the period under study, this having been shown in previous studies to be the most economical voltage. Line capacities in the order of 150 MW to 200 MW are assumed.

(c) Installation Schedule

The schedule for the required transmission system additions is shown in Table 3. This schedule is based on having the high voltage transmission grid completed in the shortest time consistent with the ability to carry out the construction without incurring additional costs due to excessive work loads and also with the ability to construct the generating facilities to provide the necessary surplus capacity.

(d) Costs

Estimated capital costs are shown in Table 3. These estimates are based on present day costs for 138 kV and 230 kV transmission lines escalated at 6% per annum to 1973 and at 3% per annum thereafter.

4. Line Terminations and Transformers

While detailed study of terminal station design may indicate the need for more sophisticated switching schemes, for the purposes of this study a minimum of one circuit breaker per line termination is assumed.

It is assumed that 230-138 kV transformers will be installed at key points on the system and that both high and low voltage circuit breakers will be installed with each transformer.

The total requirement for circuit breakers is shown in Table 4 and for transformers in Table 5 together with estimated costs. The circuit breaker estimates include the circuit breaker together with all associated equipment, such as structures, foundations, protective relays, buswork, switches, etc., and their installation costs. The estimated costs of transformers include all associated equipment and installation costs. All estimates are based on present day costs with an allowance for escalation of 6% per annum to 1973 and 3% per annum thereafter.

5. General

The system development outlined in this report is based on general studies of transmission and generation requirements. Detailed studies might indicate possible cost reductions, through optimization of the installation programs. Investigation of the minimum permissible reserve capacity on the combined systems, the economics of installing 300 MW units instead of 150 MW units in the later years of the program, the minimum number of 230 kV transmission lines required to maintain stability on the system under fault conditions, etc., might indicate areas in which savings could be achieved. However, it is unlikely that these would indicate more than relatively minor changes in the proposed schedules.

TABLE 1

PEAK LOAD VS INSTALLED CAPACITY

Year	Peak Load (MW)	Reserve (15% of peak) (MW)	Minimum Required Capacity (MW)	Installed Capacity (MW)
1971	1816	272	2088	2085
1972	1953	293	2246	2322
1973	2047	307	2354	2372
1974	2117	318	2435	2557
1975	2195	329	2524	2627
1976	2380	357	2737	2767
1977	2516	377	2893	2907
1978	2652	398	3050	3047
1979	2816	422	3238	3327
1980	2980	447	3427	3467

Note: Total installed capacity is net and is based on Schedule of installation as shown in Table 2.

TABLE 2

GENERATING FACILITIES

Year	Location	Capacity (MW)	Estimated Cost ($)	Present Value At 1971 ($)
1971	Moncton G.T. N.B.	25	$ 2,750,000	
	Tusket G.T. N.S.	25	3,000,000	
	Import N.B.	120	-	
	Total	170	$ 5,750,000	$ 5,750,000
1972	Tufts Cove #2 N.S.	100	18,000,000	
	Import N.B.	165	-	
	Mactaquac #4 N.B.	100	5,100,000	
	H.V.D.C. N.B.	-	31,000,000	
	Total	365	$ 54,100,000	$ 50,096,600
1973	Import N.B.	215	-	
1974	Tupper #2 N.S.	150	30,900,000	
	Sydney G.T. N.S.	25	3,480,000	
	Import N.B.	250	-	
	Total	425	$ 34,380,000	$ 27,297,700
1975	Import N.B.	320	-	-
1976	SYSCO N.S.	30	6,000,000	
	Mactaquac #5 N.B.	100	5,900,000	
	Dalhousie N.B.	350	65,000,000	
	Total	480	$ 76,900,000	$ 52,368,900
1977	Tufts Cove #3 N.S.	150	33,600,000	21,168,000
1978	Tupper #3 N.S.	150	34,800,000	20,323,200
1979	South Shore N.B.	300	65,800,000	35,532,000
1980	Tufts Cove #4 N.S.	150	36,800,000	18,400,000
	Total Capital Cost		$342,130,000	$230,936,400

Note: Present values are based on an interest rate of 8%.

TABLE 3

TRANSMISSION LINES

Year	Location	Voltage (kV)	Length (miles)	Estimated Cost ($)	Present Value At 1971($) (3)
1971	Quebec - Eel River	230 (1)	20	$ 700,000	
	Trenton - Port Hastings	230	64	1,825,000	
	Port Hastings - Tupper	138	7	175,000	
	Total			$ 2,700,000	$2,700,000
1972	Quebec - Eel River	230	20	636,000	
	Eel River - Bathurst	230	55	2,010,000	
	Port Hastings - Sydney	138	102	2,700,000	
	Total			$ 5,346,000	$4,950,400
1973	Eel River - Bathurst	230	55	2,130,000	
	Bathurst - Newcastle	230	45	1,770,000	
	Newcastle - Moncton	230 (2)	85	2,645,000	
	Keswick - Moncton	230	90	1,123,000	
	Keswick - Acamac	230	70	2,660,000	
	Acamac - Courtney Bay	138	10	56,000	
	Moncton - Onslow (2 ccts)	230	200	7,870,000	
	Keswick - Moncton	230 (2)	90	3,545,000	
	Onslow - Port Hastings	230	100	842,000	
	Onslow - Port Hastings	230	100	3,940,000	
	Port Hastings - Sydney	230 (2)	80	3,150,000	
	Onslow - Sackville	230	55	-	
	Onslow - Sackville	230 (1)	55	2,160,000	
	Sackville - Milton	230	85	3,350,000	
	Total			$35,141,000	$30,115,800
1974	Saint John - Moncton	230	90	3,650,000	
	Moncton - Onslow	230	100	4,050,000	
	Onslow - Port Hastings	230	100	4,050,000	
	Tufts Cove - Sackville	138	10	290,000	
	Total			$12,040,000	$ 9,597,600
1975	Nil			-	-

...2/

Year	Location	Voltage (kV)	Length (miles)	Estimated Cost ($)	Present Value At 1971($)
1976	Newcastle - Keswick	230	90	$ 4,100,000	
	Dalhousie - Eel River	230 (1)	5	307,000	
	Valley - Milton	230 (2)	70	3,000,000	
	Port Hastings - Sydney	230	80	-	
	Port Hastings - Sydney	230	80	3,440,000	
	Mactaquac - Keswick	230	7	307,000	
	Total			$11,154,000	$7,595,900
1977	Nil	-	-	-	-
1978	Tupper - Port Hastings	230	7	322,000	188,000
1979	Plant - Acamac	230	10	470,000	253,800
1980	Sackville - Valley	230 (1)	50	2,420,000	1,210,000
		Total Capital Cost:		$69,692,000	$56,611,500

Notes: (1) Lines built for 230 kV but operated at 138 kV.

(2) Existing line uprated to 230 kV operation.

(3) Present values are based on an interest rate of 8%.

TABLE 4

CIRCUIT BREAKER REQUIREMENTS

Year	Location	Circuit Breakers	Estimated Cost ($) (1)	Present Value At 1971($) (4)
1971	Eel River	10-230 kV	$ 2,350,000	
	Eel River	2-138 kV	260,000	
	Trenton	1-138 kV	130,000	
	Port Hastings	3-138 kV	390,000	
	Tupper	1-138 kV	130,000	
	Total		$ 3,260,000	$ 3,260,000
1972	Bathurst	3-230 kV	750,000	
	Keswick	1-230 kV	250,000	
	Newcastle	2-138 kV	275,000	
	Port Hastings	1-138 kV	138,000	
	Sydney	6-138 kV	827,000	
	Total		$ 2,240,000	$ 2,074,200
1973	Eel River	1-230 kV	264,000	
	Bathurst	2-230 kV	528,000	
	Newcastle	4-230 kV	1,056,000	
	Moncton	5-230 kV	1,320,000	
		4-138 kV	584,000	
	Keswick	4-230 kV	1,056,000	
	Acamac	2-230 kV	528,000	
		1-138 kV	146,000	
	Courtney Bay	1-138 kV	146,000	
	Onslow	6-230 kV	1,585,000	
	Port Hastings	2-138 kV	292,000	
	Sydney	1-138 kV	146,000	
	Sackville	4-230 kV	1,064,000	
		2-138 kV	292,000	
	Milton	1-230 kV (2)	264,000	
		3-138 kV	151,000	
	Total		$ 9,422,000	$ 8,074,700
1974	Saint John	1-230 kV	272,500	
	Moncton	2-230 kV	545,000	
	Onslow	2-230 kV	545,000	
	Port Hastings	2-230 kV	545,000	
		1-138 kV	151,000	
	Tufts Cove	1-138 kV	52,000 (3)	
	Sackville	1-138 kV	151,000	
	Moncton	1-230 kV	272,500	
		1-138 kV	151,000	
	Total		$ 2,685,000	$ 2,131,900
1975	Nil	-	-	-

TABLE 4 (Cont'd)

Year	Location	Circuit Breakers	Estimated Cost ($) (1)	Present Value At 1971 ($) (4)
1976	Newcastle	1-230 kV	$ 288,000	
	Keswick	2-230 kV	576,000	
	Dalhousie	1-230 kV	288,000	
	Eel River	2-230 kV	576,000	
	Valley	1-138 kV	159,500	
	Milton	1-138 kV	159,500	
	Port Hastings	4-230 kV	1,156,000	
	Sydney	3-230 kV	870,000	
	Mactaquac	2-230 kV	576,000	
	Total		$ 4,649,000	$ 3,166,000
1977	Sydney	1-230 kV	$ 296,000	
		1-138 kV	164,000	
	Total		$ 460,000	$ 289,800
1978	Tupper	1-230 kV	$ 305,000	
	Port Hastings	1-230 kV	305,000	
	Total		$ 610,000	$ 356,200
1979	Acamac	2-230 kV	$ 682,000	
		4-138 kV	697,000	
	New Plant (Saint John)	3-230 kV	948,000	
	Total		$ 2,327,000	$ 1,256,600
1980	Sackville	1-138 kV	179,000	
	Valley	1-138 kV	179,000	
	Total		$ 358,000	$ 179,000
	Total Capital Cost		$26,011,000	$20,788,400

Note:

(1) Estimates include escalation at 6% p.a. to 1973 and 3% p.a. thereafter.

(2) Circuit breakers on the Onslow-Trenton 230 kV line will be relocated.

(3) A circuit breaker from Onslow will be relocated.

(4) Present values are based on an interest rate of 8%.

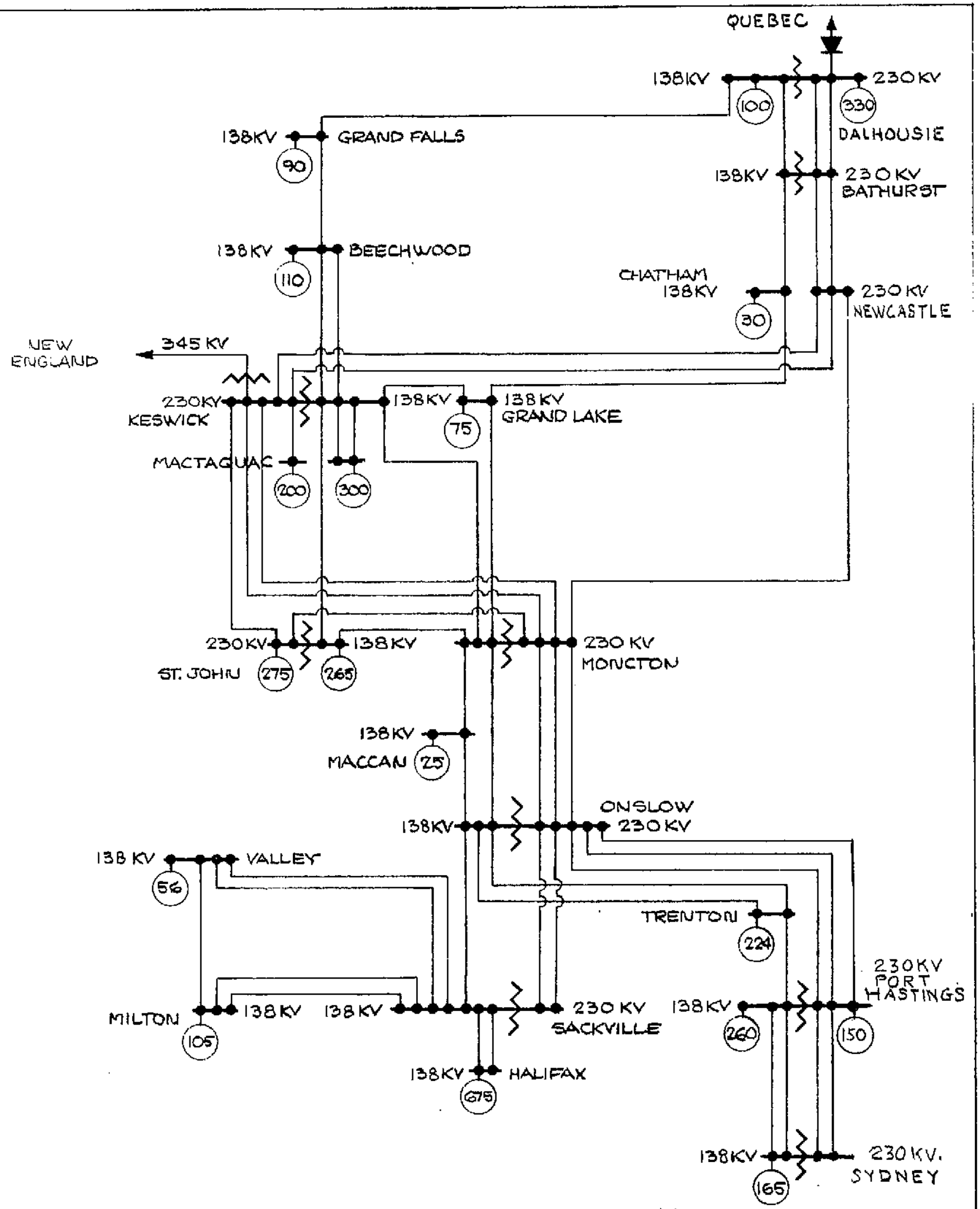
TABLE 5

TRANSFORMER REQUIREMENTS

Year	Location	Transformers 230-138 kV	Estimated Cost ($)	Present Value At 1971 ($)
1971	Eel River	2- 75/100/125	$ 1,100,000	$ 1,100,000
1972	-	-	-	-
1973	Moncton	1-120/160/200	$ 675,000	
	Acamac	1-120/160/200	675,000	
	Onslow	1- 90/120/150	742,000	
	Port Hastings	1- 90/120/150	742,000	
	Sackville	2- 90/120/150	1,484,000	
	Total		$ 4,318,000	$ 3,700,500
1974	Saint John	1-120/160/200	$ 694,000	
	Port Hastings	1- 90/120/150	764,000	
	Moncton	1-120/160/200	694,000	
	Total		$ 2,152,000	$ 1,708,700
1975	-	-	-	-
1976	Sydney	1- 90/120/150	$ 810,000	
	Bathurst	1-200/266/333	1,105,000	
	Total		$ 1,915,000	$ 1,304,100
1977	Sydney	1- 90/120/150	$ 835,000	$ 526,100
1978	-	-	-	-
1979	Acamac	1-120/160/200	$ 805,000	$ 434,700
1980	-	-	-	-
	Total Capital Cost		$11,125,000	$ 8,774,100

Note:

Present values are based on an interest rate of 8%.



SIMPLIFIED SINGLE LINE DIAGRAM

1980 COMBINED NEW BRUNSWICK AND NOVA SCOTIA SYSTEMS

APPENDIX 4

APPENDIX 4

ESTIMATED COST OF

GENERATING CAPACITY INCREMENT

Revised February 1971

1. Basis of Estimate

The estimate of cost for a 150 MW increment of generating capacity in the Maritime region is based on the installation of an oil fired unit at an existing plant site. A high efficiency unit is assumed because of the high plant factor anticipated and the relatively high cost of fuel in the Maritime area.

The basis for the estimate is the currently estimated cost of the 150 MW Tupper #2 unit, which reflects current equipment costs and construction costs in the Maritimes, adjusted to 1971.

2. Estimated Cost

The estimated 1971 cost for a 150 MW unit as described is $26,000,000 made up as follows:

Civil Works	$ 4,000,000.
Mechanical Works	$14,000,000.
Electrical Works	$ 1,500,000.
General Expenses	$ 6,500,000.
TOTAL	$26,000,000.

3. Escalated Cost

The 1973 cost of this 150 MW unit, escalated from the above estimate is approximately, $30,000,000.

APPENDIX 5

APPENDIX 5

DERIVATION OF INTEREST RATE

AND

FIXED CHARGE USED

Revised February 1971

1. Interest Rate

Over the past few years the cost of debt to provincial governments has changed considerably. The average yield on 10 Provincials as published by McLeod, Young, Weir reached a peak of 9.32% in January, 1970 and has since decreased to 7.66% in January, 1971 (the most recent figure available at the time of writing). The resulting average cost of debt, using 7.66% plus 0.15% as the levelized cost of financing, is 7.81%. This has been rounded to 8% for the purpose of this brief.

2. Fixed Charge Rate

The fixed charge rate used in the calculation included in this brief is made up as follows:

	%
Interest	8.00
Insurance	0.30
Interim replacement	0.35
Depreciation (S.F. at 8% - 35 yrs.)	0.58
Fixed charges	9.23

It will be noted that an average service life of 35 years is assumed, taking into consideration the proportions of steam generating plant and transmission properties in the calculations.

General References

1. Tweeddale, R.E.; Factors Related to Interconnection of Regional Power Systems; paper presented to Dominion-Provincial Committee on Coal Research; St. Andrews, N.B., 1 September 1958.

2. Main, Chas. T., Inc.; Electric Power in Nova Scotia; Boston, Mass., U.S.A.; 11 January 1963.

3. Murphy, L.B.: Electrical Aspects of the Nova Scotia-New Brunswick Interprovincial Interconnection; paper presented to Canadian Electrical Association; Halifax, N.S.; 24 January 1961.

4. The Nova Scotia Power Commission - Nova Scotia Light and Power Company, Limited, Interconnection Agreement; 19 January 1962.

5. Nova Scotia Power Commission, Staff of: Province of Nova Scotia, Voluntary Economic Planning, Power Sector; 9 April 1963.

6. The New Brunswick Electric Power Commission; Annual Reports, 1964-1970.

7. Nova Scotia Light and Power Company, Limited; Annual Reports, 1960-1969.

8. Nova Scotia Power Commission; Annual Reports, 1965, 1966, 1968, 1969.

9. Atlantic Development Board; Annual Reports, 1965-66, 1966-67, 1967-68.

10. Growth Areas a Business Opportunity; Canadian Business, January 1971.

Acknowledgement

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