Independent Electricity Market Operator **March 17, 2000**

18-Month Outlook:

An Assessment of the Adequacy and Capability of the Ontario Electricity System, March 2000 to August 2001

Independent Electricity Market Operator

Executive Summary

This report presents an assessment of the adequacy and capability of the Ontario Electricity System over an 18-month period beginning March, 2000; it has been prepared to fulfil section 18.1 of the IMO's transitional license from the Ontario Energy Board. The assessment is based on a forecast of electricity demand and available supply and current information on the configuration and capability of the transmission system. The assessment assumes that a target margin for generation reserve of 18%, as a minimum, is required.

The results of the assessment show the Ontario system to have adequate resources. The few periods showing forecast resources to be less than forecast demands are expected to be manageable with normal corrective options such as the rescheduling of maintenance activities.

With respect to the capability of the transmission system, the planned addition of phase shifters on the Ontario - Michigan interconnection in July will ameliorate loop flows around Lake Erie. This will alleviate potential voltage depressions on the south-central 500 kV grid (as experienced in July 1999), as well as provide relief on the Ontario - Michigan interconnection and on the Buchanan-Longwood Input and Queenston Flow West interfaces. Loop flows, which are unscheduled flows on the transmission system, arise due to the physical nature of electricity and have burdened the system in the past.

Table of Contents

Table of Tables and Figures

1.0 Introduction

A condition of the Transitional License for the Independent Electricity Market Operator (Section 18.1) requires the IMO to monitor the state of electricity demand and available supply in Ontario and to report its findings to the Minister of Energy, Science and Technology and to the Ontario Energy Board (OEB). This condition became effective on January 1, 2000, prior to which time the Ontario Power Generation Inc. (OPGI) was responsible for this work.

This report looks forward 18 months. Its purpose is to advise the Minister and the OEB of potentially adverse conditions that might be avoided through coordination of maintenance outage plans for generation and transmission equipment. A similar assessment will ultimately be produced on a regular basis after the opening of the electricity market in Ontario, as per Section 7, Chapter 5 of the Market Rules for the Ontario Electricity Market.

Section 2 of this report provides a forecast of electricity demand for Ontario. This is followed, in Section 3, with a summary of resource availability. Section 4 describes the method used to assess the adequacy of resources to meet forecast demand and presents the results of such an assessment over the 18-month time frame. In section 5, the transmission system in Ontario is described. This is followed, in section 6, with a description of the method used to assess the capability of the transmission system and presents the results of such an assessment over the 18-month time frame. Section 7, summarizes the results of the assessment of the adequacy and capability of the Ontario electricity system over an 18-month period, beginning March, 2000.

Readers are invited to provide comments on this report or to give suggestions as to the content of future reports. To do so, please call the IMO Help Centre at 416-506-2836 or send an email to: helpcentre@theIMO.com.

2.0 Forecast of Ontario Electricity Demand[1]

The forecast of Ontario electricity demand used in this assessment was provided by OPGI under an interim information sharing agreement. It is derived from a traditional central planning perspective and, therefore, is net of self generation.

2.1 Forecasting Methodology

The methodology used by OPGI to produce the forecast of electricity demand includes a combination of customer surveys, end-use models, econometric models, and judgement based on experience.

The end-use forecast represents an aggregation of end-use projections for different sectors of the economy. It is segregated into three major sectors that constitute about 98% of the total demand. These sectors together with actual energy consumption for 1998 and projections to 2001 are shown in Table 1, below.

[1] Information in this section is based on information that was provided by OPGI; it is consistent with the information included in their report on "Electricity Demand and Supply in Ontario", dated December 1999. The report is available on the IMO's web site at www.theIMO.com.

Table 1: Ontario Energy Demand by Sector

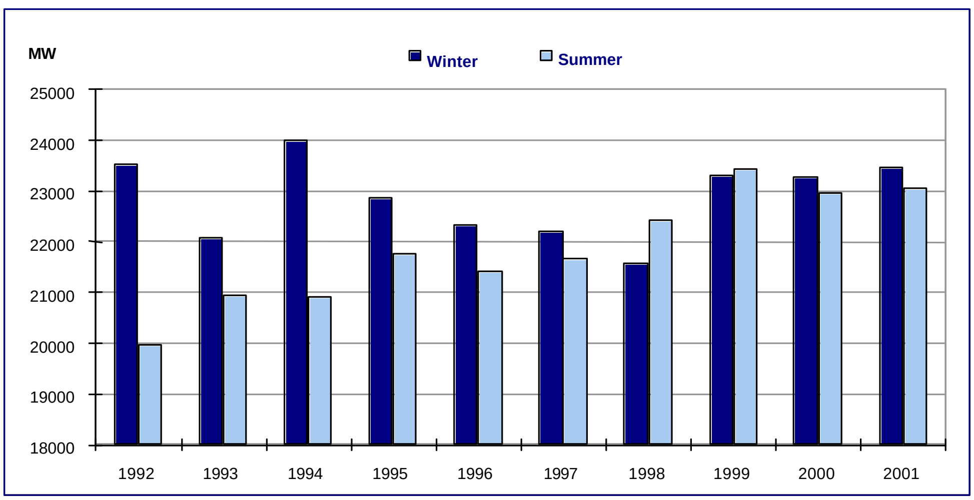
Actual energy is shown for 1998; forecasts are provided for 1999 and beyond.

Sector	1998 (%)	1998 (TWh)	1999 (TWh)	2000 (TWh)	2001 (TWh)
Commercial	38.3	53.5	54.4	55.1	55.3
Industrial	33.6	46.8	47.9	48.9	49.7
Residential	26.1	36.5	36.6	36.7	36.9
Agriculture/Transportation	2.0	2.8	2.8	2.9	2.7
Total	**100.0**	**139.5**	**141.7**	**143.6**	**144.7**

2.2 Forecast of Demand and Energy during Peak Periods[2]

Peak demand for Ontario (as measured in MWs) is derived from the energy forecast using historical energy-to-peak load ratios. Traditionally, Ontario's peak demand[3] occurs during the months of December to February. Exceptions to this were in 1998 and 1999 when the annual peak occurred in July, a shift that was attributable to a warmer than normal winter and an unusually hot summer as a result of El Niño and La Niña. Under normal weather conditions, this summer peaking phenomenon is not expected to continue; this is shown in Figure 1, below.

Figure 1: Ontario Peak Demand:
Actual and Seasonally-Adjusted, Forecast Values



The all-time record for peak demand in Ontario, as measured over a 20-minute period, was 24,007 MW in January 1994. Peak demands in the summer and winter of 1999 were 23,435 MW and 23,308 MW, respectively.

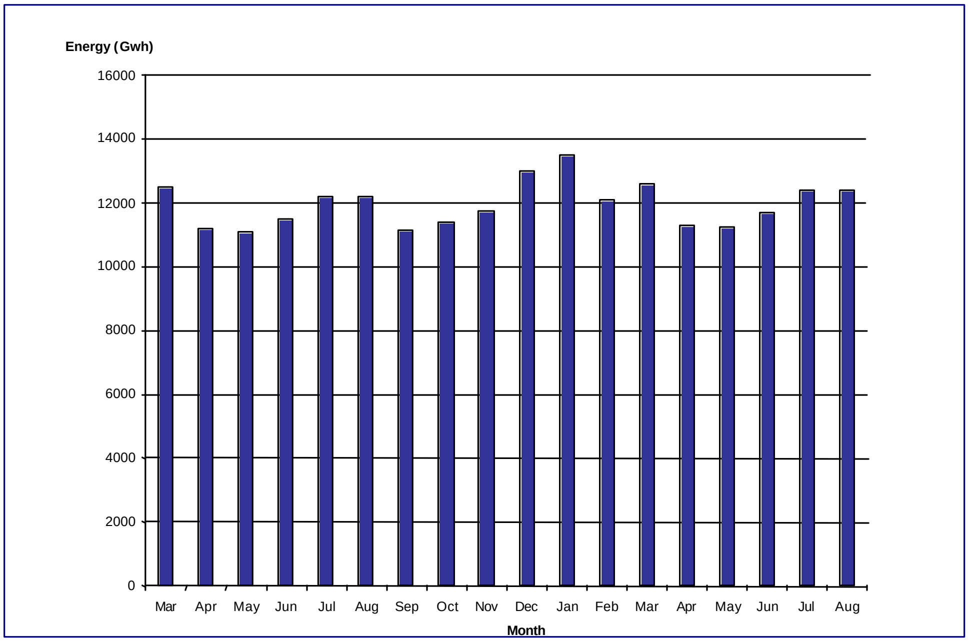
[2] No forecast of Contract Sales is included in this assessment. This is consistent with the approach taken by OPG, which is currently responsible for arranging such contracts until the market opens.

[3] All references to peak demand are based on a 20-minute interval.

The assessment described in this report is based on the median forecast of peak demand for each week of the forecast period. This forecast, for the next 18 months, can be found in Appendix A, Table A.1, in the column labeled 'Total Ontario Demand'.

Energy utilization varies from month to month as indicated in Figure 2, below. Amounts are in GWh.

Figure 2: Monthly Energy Forecast for Ontario - March 2000 to August 2001



3.0 Resources

3.1 Existing Generating Capacity

Generating capacity in this assessment includes generating stations currently owned by OPGI and stations under contract to the Ontario Electricity Financial Corporation.

Generation from Ontario Power Generation Inc.

The OPGI generation is shown in Appendix B. It includes nuclear, coal, oil and gas-fuelled generation, as well as hydroelectric and wind-powered stations. Capacity that is either laid up (5,136 MW of nuclear generation) or mothballed (1,200 MW of fossil generation) has been excluded. Unit sizes range from 881 MW at Darlington NGS to less than 1 MW for some wind and hydroelectric installations.

Generation from Contract Generators

Contract Generators are generators that have contracts with the Ontario Electricity Financial Corporation to deliver defined amounts of capacity and energy. This generation includes hydroelectric generation as well as waste-fuelled and natural gas-fuelled thermal generation. The installations range in size from 165 MW to less than 1 MW; total in-service capacity is 1,690 MW. The Contract Generators are grouped in Appendix C, by fuel type.

Contracts on behalf of the Contract Generators are being managed, and their outputs forecast, by the Ontario Hydro Services Corporation. Generator output varies from month to month, depending upon the terms and conditions in individual agreements. For the purposes of this report, it is assumed that all Contract Generators will remain committed under existing contracts when the market opens; they therefore continue to be reported as a group.

3.2 Dispatchable Demand

Currently, some industrial customers in Ontario pay reduced rates for permitting the interruption of a portion of their load for economic or emergency reasons when insufficient generation resources are available. The total amount of this resource varies from about 900 MW to 1,200 MW; however, in the past, it has been assumed that 600 MW could be interrupted at any one time. Once the market opens, the availability of dispatchable resources could change significantly as more participants take advantage of the opportunity to offer such resources to the market. At this time there is no indication of how much the market will benefit from this resource and, for this report, 600 MW continues to be used through the period of this assessment.

3.3 Contract Purchases

OPGI has an existing contract for the purchase of 200 MW of firm capacity and energy from Manitoba Hydro; the contract expires beyond the timeframe of this assessment. Although OPGI may arrange for other such purchases prior to the opening of the market, none other than the current contract is included in this assessment.

3.4 Summary of In-Service Resources

Resources that are currently in service total 28,224 MW; this Figure includes OPGI generation, generation from Contract Generators, dispatchable demands, and purchases through existing contracts. A summary of these resources for the year 2000 is shown below; more detail is found in Appendix A, Table A.1, under the column labeled ‘In-Service Resources’.

Table 2: Summary of In-Service Resources – Year 2000

Resource	Percent (%)	In-Service Capacity (MW)
OPGI	91.2	25,734
Contract Generators	6.0	1,690
Dispatchable Demand	2.1	600
Contract Purchases	0.7	200
Total	**100.0**	**28,224**

3.5 Committed Resources

OPGI has planned to undertake a number of upgrades at various hydroelectric stations over the next several years to improve the output of their units. Within the time frame of this assessment, an additional 30 MW of capacity is to be brought into service (in 2001); this is shown in

Appendix A, Table A.1 in the column labeled 'Committed Resources'. No additional resources are contracted to come into service in the time frame addressed by this assessment.

As described in OPGI's report on "Electricity Demand and Supply in Ontario", dated December 1999, four units at Pickering A (totalling 2,060 MWs) are to be returned to service beginning in mid 2001. This potential resource has been excluded from this assessment pending clarification with respect to timing.

3.6 Reductions to In-Service Capacity

Total in-service capacity, as noted above in Table 2, will not be fully available due to various planned and uncontrollable reductions in service, as shown in Appendix A, Table A.1 in the column labeled 'Total Reductions to Generation'.

The in-service capacity of OPGI's hydroelectric generation, from Appendix B, is about 7,280 MW. This number reflects the maximum output from all such stations and, in this report, is reduced to reflect a forecast of monthly variations in water availability.

Capacities shown for all other types of OPGI generation are generally available to the system. The exception to this includes those capacities that are not available due to planned and unplanned outages. The capacity of thermal units, as an example, is primarily reduced as a result of planned maintenance, generally scheduled to take place during periods of low demand. Seasonal factors, problems related to equipment, and regulatory requirements, whether due to licensing (primarily for nuclear facilities) or environmental restrictions, may also reduce the capacity available to the system at any point in time.

The Ontario Hydro Services Corporation has provided capacity reductions associated with Contract Generators. Factors that affect the levels of in-service capacity are similar to those affecting OPGI facilities. In addition, the operational requirements of individual facilities may also influence the scheduling of outages and, hence, reductions to in-service capacity.

3.7 Available Resources

Resources that are available to the system include all in-service and committed resources, less reductions to in-service capacity. The total is shown in Appendix A, Table A.1, in the column labeled 'Available Resources'.

4.0 Resource Assessment

4.1 Methodology to Assess Resource Adequacy

To assess the adequacy of available resources to meet forecast demand, in-service and committed resources, less planned maintenance, other reductions, and an allowance for uncertainties[4] is

[4] Included are uncertainties associated with the operation of generating units, i.e. the fact that they can malfunction and be forced out of service for repair, and uncertainty associated with the forecast of electricity demand. Traditionally, a "reserve margin" of 18% has been used; this margin continues to be used in this assessment which therefore assumes that, in the future, customers will be willing to pay for the same level of reliability as was provided in the past.

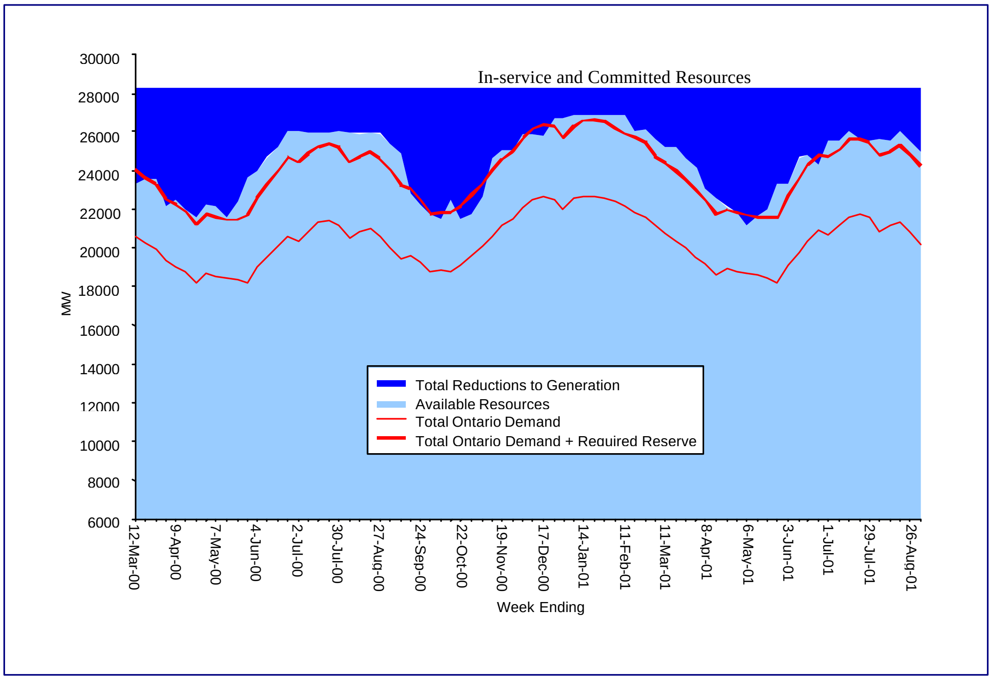
compared with forecast demand. The difference is expressed as either an excess or shortfall in resources.

4.2 Assessment of Resource Adequacy

The forecast excess or shortfall of resources for each week of the 18-month outlook is shown in Appendix A, Table A.1 in the column labeled 'Excess / Shorfall [-]'. It can be noted from the Table that the week during which the maximum shortfall is forecast to occur is not necessarily the week with the peak demand; it primarily reflects units being out of service for planned maintenance.

As noted in Table A.1 as well as in Figure 3, a number of weeks show shortfalls[5]. This is particularly evident in March and October 2000, but also in several other months. This suggests an opportunity for participants to reschedule maintenance or to arrange for purchases from interconnected systems, either or both of which could be used to eliminate these shortfalls. Prior to the opening of the market, OPGI is responsible for arranging purchases; once the market opens, it is expected that the market will provide whatever resources are required to balance capacity with demand.

Figure 3: 18-Month Outlook of Resource Adequacy



5.0 The Ontario Electricity System

The Ontario Electricity System is shown in Appendix D, in Figure D.1; it includes transmission facilities that convey electrical energy throughout Ontario from generating stations to load

---

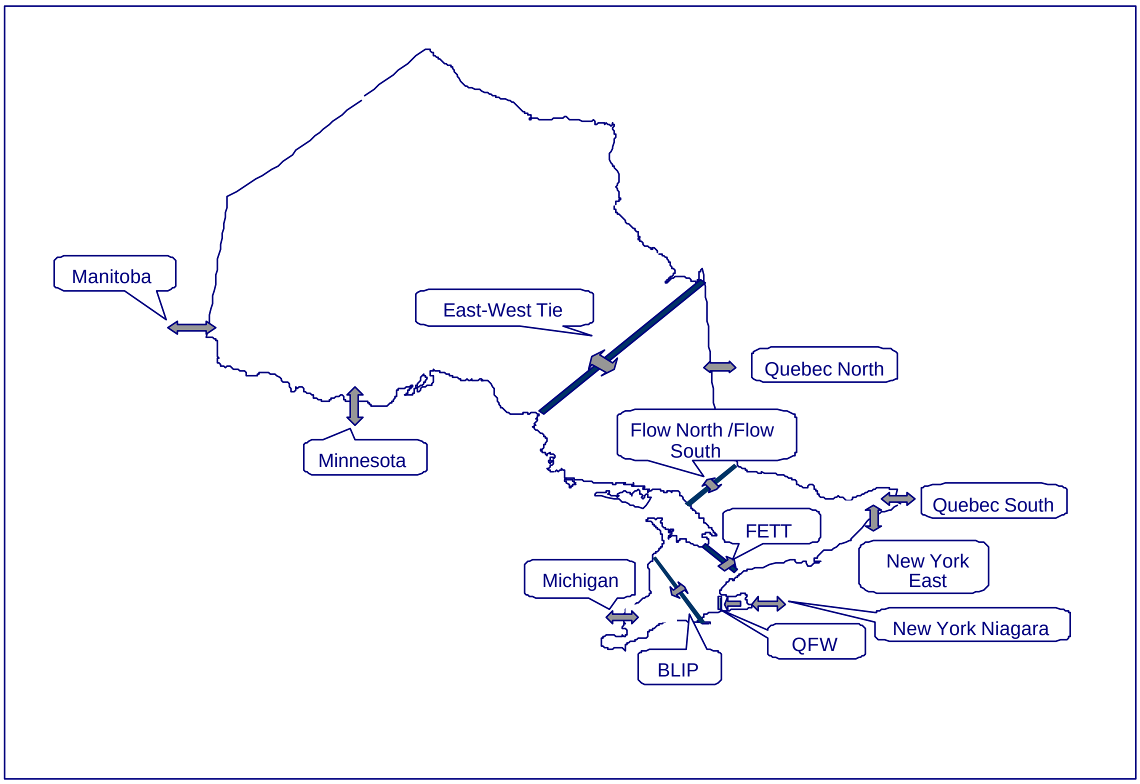
5 In Figure 3, the shortfalls are shown as a dark colour below the thicker line.

centres. Generally the transmission system is robust; from time to time, however, there are bottlenecks in the system that result in the need for increased output from more costly generation than would otherwise be the case. Although the bottlenecks might occur with all system elements in service, they are more likely to occur when generation or transmission facilities are out of service for maintenance or other reasons. To minimize the additional cost associated with these limitations, coordination of maintenance activities is required.

5.1 Configuration of the Transmission System

With the present configuration of the power system it is logical to divide the province into six zones. The transmission facilities between these zones are referred to as interfaces, while those to neighbouring systems are referred to as interconnections. Interfaces and interconnections in the Ontario system are shown in Figure 4 and are defined in Appendix E.

Figure 4: Major Interfaces and Interconnections



5.2 Capability of the Transmission System in Ontario

Flows of electricity on interfaces and interconnections are constrained by limits related to their thermal, voltage, or stability characteristics. These limits also depend on the simultaneous flows across other interfaces or interconnections and the mix of generating resources in service. Although limits are specified for all interfaces and interconnections, these interfaces and interconnections may only be constraining during limited situations and periods as described in the following sections.

The limits within which the different interfaces and interconnections are to be operated are shown in the following Tables. While this assessment assumes all elements to be in service, it is intended that future releases of this report will include the impact of planned outages.[6]

Table 3a Interface Capability

Interface	Limit (MW)	Limit (MW)
East-west tie	325 East	350 West
Flow North/South	1,900 North	1,400 South
Flow East Toward Toronto (FETT)	5,700 East	non-limiting West
Queenston Flow West (QFW) – Winter*	non-limiting East	2,030 West
Queenston Flow West (QFW) – Summer*	non-limiting East	1,830 West
Buchanan-Longwood Input (BLIP)	1,500 East	3,500 West

Table 3b Interconnection Capability

Interconnection	Limit (MW) Flows Out of Ontario	Limit (MW) Flows Into Ontario
Manitoba	240	240
Minnesota	150	100
Quebec North	120	65
Quebec South	800	1,200
New York East	400	400
New York Niagara – Winter*	2,100	1,790
New York Niagara – Summer*	2,070	1,480
Michigan – Winter*	2,180	1,490
Michigan – Summer*	1,970	1,390
With new phase shifters, after July 4, 2000:		
Michigan – Winter*	2,300**	1,600**
Michigan – Summer*	2,300**	1,600**

* Seasonal Limits are based on the thermal ratings and 75% of pre-load.[7]

** Preliminary estimate.

Manitoba and Minnesota Interconnections (Northwest Zone)

The limit on the interconnection with Manitoba for flows into and out of Ontario is currently 240 MW. With OPGI's 200 MW purchase from Manitoba, as noted in Section 3.3, some Ontario

6 The planned outage of certain elements within the transmission system can significantly weaken parts of the system thereby affecting its capability.

7 Summer Limits apply from May 1 to October 31 and are based on 0-4 km/hr wind speed and 30° C ambient temperature (except on ties with Michigan, which are based on 35° C). Winter Limits apply from November 1 to April 30 and are based on 0-4 km/hr wind speed and 10° C ambient temperature.

capacity west of Atikokan is forecast to be locked in. The limit on the interconnection with Minnesota for flows into and out of Ontario is currently 100 and 150 MW respectively. Both the Manitoba and Minnesota interconnections are constrained by stability and thermal limitations.

East-West Tie (Northeast, Northwest Zones)

The limits on the East-West tie are 325 MW to the east and 350 MW to the west. The limit to the west will be reduced shortly to improve reliability in the Northwest zone. This reduction will also reduce limits in the Northeast zone. During freshet, the East-West tie toward the east will be limiting and will therefore lock in generation capacity in the Northwest zone. The East-West tie interface is constrained by stability limitations.

Flow North, Flow South Interface (Northeast, East-Central Zones)

The Flow South limit is 1,400 MW and the Flow North limit is 1,900 MW. In day-time periods during freshet, the Flow South interface is limiting to make maximum use of lower-cost generating resources. At night, outside of freshet conditions, the Flow North interface is normally limiting. The Flow North and Flow South interfaces are constrained by voltage and stability limits respectively.

Quebec North Interconnection (Northeast Zone)

The Quebec North interconnection is limited to 65 MW for flows into Ontario. For flows out of Ontario, the limit is 120 MW. This interconnection is constrained by stability limitations.

Quebec South Interconnection (East-Central Zone)

The Quebec South interconnection is limited to 1,200 MW for flows into Ontario and is limited to 800 MW for flows out of Ontario. The interconnection is constrained by thermal and stability limits.

New York East Interconnection (East-Central Zone)

The limit on this interconnection is 400 MW for flows into or out of Ontario. The interconnection is constrained by thermal limitations and is under the control of phase shifters.

FETT Interface (East-Central, South-Central Zones)

The FETT (Flow East Towards Toronto) interface has a limit of 5,700 MW. The interface is constrained by a combination of stability and thermal limits. There is no limit specified for flows to the west, as the level of flows expected in that direction will not cause system concerns.

QFW Interface (Niagara, South-Central Zones)

The QFW (Queenston Flow West) interface is limited to 2,030 MW for flows to the west in the winter. In the summer, the limit is 1,830 MW to the west. This interface is constrained by thermal limitations. There is no limit specified for flows to the east, as the level of flows expected in that direction will not cause system concerns.

New York (NY) - Niagara Interconnection (Niagara Zone)

The New York Niagara interconnection, in the winter, is limited to 1,790 MW for flows into Ontario and 2,100 MW for flows out of Ontario. In the summer, the limit is 1,480 MW for flows into Ontario and 2,070 MW for flows out of Ontario. The interconnection is constrained by thermal limitations in the winter and summer.

The QFW interface is in series with the NY - Niagara interconnection. All flows entering Ontario on the NY - Niagara interconnection will also appear on the QFW interface; this includes purchases and loop flows associated with the circulation of electricity around Lake Erie. Based on past experience and studies, the QFW interface always hits its limit before the limit is reached on the NY - Niagara interconnection. For flows entering Ontario, as a result, the capability of the NY - Niagara interconnection is never fully used.

Typically, when QFW hits its limit of 1,830 MW under summer conditions, the flow across the NY - Niagara interconnection is 1,100 MW (its limit is 1,490 MW). Similarly, when QFW hits its limit of 2,030 MW under winter conditions, flow across the NY - Niagara interconnection is 1,300 MW (its limit is 1,790 MW).

BLIP Interface (Southwest, South-Central Zones)

The BLIP (Buchanan Longwood Input) interface is limited to 3,500 MW to the west and to 1,500 MW to the east; the interface is typically constrained by limitations with respect to stability and voltage.

Michigan Interconnection (Southwest Zone)

The Michigan interconnection is constrained by thermal limitations. During winter months, the limits are 1,490 MW for flows into Ontario and 2,180 MW for flows out of Ontario. In the summer, the limits are 1,390 MW for flows into Ontario and 1,970 MW for flows out of Ontario. Quite often, conditions that result in high flows on the interconnection with Michigan also present coincident conditions on the BLIP and QFW interfaces and the New York Niagara interconnection. The addition of new phase shifters on the Michigan interconnection, as described below, should help to control these conditions and, hence, alleviate limitations.

5.3 Significant New Transmission Projects

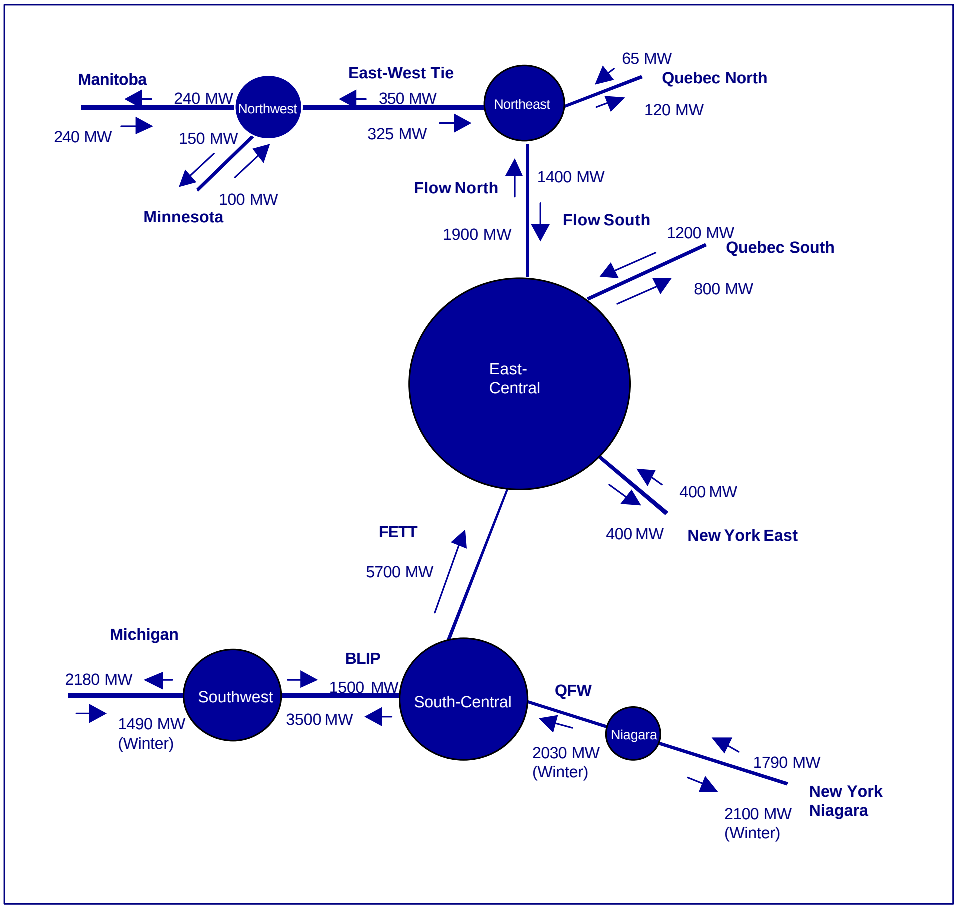
The existing interconnection between Ontario and Michigan consists of 4 circuits: two of these are 345 kV and two are 230 kV; one of the 230 kV circuits has a phase shifter. There is a project underway to install 3 additional phase shifters to the circuits that do not presently have one, resulting in full control across this interface. The in-service date for the 3 additional phase shifters is July 4, 2000.

The purpose of the new phase shifters is to control a loop flow that enters Ontario at the New York Niagara interconnection and exits Ontario at the Michigan interconnection. Most of the time, power flows associated with this condition are greater than 500 MW; on occasion they exceed 1,000 MW. As noted above, loop flow conditions also affect the BLIP and QFW interfaces. With the incorporation of the new phase shifters it is expected that the incidence of constrained operation of QFW will be greatly reduced.

5.4 Summary of Transmission Capability

The electricity system in Ontario consists of 500, 230, and 115 kV transmission elements. It has interconnections with Manitoba, Minnesota, Quebec, Michigan, and New York. Internally, the system contains a number of transmission interfaces that are likely to be limited because expected flows are forecast to be high enough to approach or exceed their capability. These interfaces and interconnections bisect the system into electrical zones as shown in the Figure 5.

Figure 5: Limits on Major Interfaces and Interconnections



6.0 Transmission Capability Assessment

6.1 Method to Assess Transmission Capability

Power flow limits across interconnections and interfaces are calculated using off-line simulations of the steady state, post fault, and transient behaviour of the transmission system.

Judgement, operating experience, and historical performance are employed to assess the capability of the transmission system to deliver power without forcing the dispatch of generation to depart from an economically optimal schedule. It is intended that such assessments in future issues of this report will evolve into more exact procedures and algorithms based on engineering and statistical principles, and applied through the use of existing computer tools. These refinements will allow the constraining parameters to be fine tuned, thus allowing more optimal use of the transmission system, while still maintaining continued safe operation.

6.2 Assessment of Transmission Capability

For the period of this assessment, the interconnection capability of the transmission system is:

Out of Ontario 5,750 / 5,990 MW

Into Ontario 4,495 / 4,795 MW

With new phase shifters, after July 4, 2000:

Out of Ontario 6,080 / 6,110 MW

Into Ontario 4,705 / 4,905 MW

Values are shown for summer / winter; they respect the more constraining influence of the QFW limit on the maximum flow across the Niagara interconnection during imports.

Based on the availability of forecast resources within each zone and the transfer capability across interfaces, each zone is forecast to be adequately supplied during the period of this assessment. The reliability of meeting forecast demands is also expected to be good throughout the period. However, it is expected that there will be intervals during which the dispatch of generation could depart from an economically optimal schedule in order to respect operating security limits, as follows.

- In the Northwest zone, there is more generation than load during freshet and generation tends to be locked in under such conditions; generation is also locked in when more stringent limits need to be observed, as under storm conditions. New special protection systems on generation equipment are to be installed in the summer of 2000. They will alleviate but not remove these problems, given the necessary move toward respecting the more stringent criteria being followed by the Mid-Continent Area Power Pool (MAPP) in the Northwest zone.[8]
- In the Northeast zone, the transmission system is weak and there is very little redundancy, unlike systems in other zones of the province. The Flow South limit of 1,400 MW limits transfers from the Northeast and Northwest areas of the province to Southern Ontario during freshet, resulting in resources being locked in. Any substantial increase in generation north of Porcupine and Dymond may trigger a need for re-enforcement of the transmission system; the reliance on special protection systems, including generation and load rejection, may have been exhausted.
- In the Niagara zone, when loop flows are present or when there are imports from New York, the Queenston Flow West interface is generally limiting. The incorporation of the new phase shifters on the Michigan ties is expected to alleviate this problem.
- In the South-Central zone, during summer peak load conditions, there is a potential shortage of reactive power support that affects the scheduling of resources.[9] For the period covered by this assessment, the situation is expected to be manageable with the installation of the new phase shifters across the Ontario - Michigan interconnection.

---

[8] In the Northwest zone under normal operating conditions, the following contingencies are not respected: double circuit; 3-phase faults; breaker failure; and Manitoba's DC line bipole block. Once the plan to move toward respecting all of these contingencies is completed, the IMO will be in full compliance with MAPP security criteria.

[9] On the Milton 500 kV bus, there is a minimum voltage limit of 520 kV to protect the system from excessive voltage decline following a contingency.

7.0 Conclusion

The results of this 18-month outlook show that there are adequate resources and a capable transmission system to meet forecast demands for most time periods under normal weather conditions. The few periods showing inadequate resources, as determined by the requirement to maintain a minimum reserve margin, are expected to be manageable with various options including the rescheduling of planned generator and transmission outages and the procurement of resources from external, interconnected sources. For situations where transmission and generation facilities are to be removed for maintenance or are removed for other reasons, or during periods of high load, particular attention must be given to the coordination of activities to ensure a capable and adequate operation of the electricity system in Ontario. It is fully expected that as the periods of concern approach, some or all of the corrective actions available will be implemented to maintain an acceptable level of adequacy and capability.

Glossary

20-minute Peak: the maximum, average demand over any 20-minute interval.

Adequacy: the ability of the electric system (generation and transmission) to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.

Available Resources: includes resources that are available to the system to meet forecast demands; they include all in-service and committed resources, less reductions to in-service capacity.

Contract Generator: generators that have contracts with the Ontario Electricity Financial Corporation to deliver defined amounts of capacity and energy.

Capacity: the maximum power that a generating unit, generating station, or other electrical apparatus can supply, usually expressed in megawatts.

Demand: the sum of individual customer loads plus system losses. In this report the term is used to mean the total demand in what is to be the IMO-administered market, as seen by the generators.

Dispatchable Demand: customer demand that can be adjusted in response to dispatch directions from the system operator.

Electricity System: the integrated power system and all registered facilities connected to that system, including associated generation and transmission and distribution networks for the supply of electricity.

End-use Customer: a residential, commercial, or industrial customer in the electricity marketplace who buys electric power for its own use and not for resale.

Facility: a generation facility, a load facility, a transmission system, a distribution system or any other equipment that is a component or part of the electricity system.

Forced Outage: an unanticipated intentional or automatic removal from service of equipment or the temporary de-rating of, restriction of use or reduction in performance of, equipment.

Freshet: a situation where melting snow and seasonal rain in the spring can result in a sudden and significant (up to ten-fold) increase in flow to rivers and streams.

Generation Capacity: the maximum power that a generation unit, generation station or other electrical apparatus can supply, usually expressed in megawatts.

IMO-administered Markets: the markets to be established by the market rules.

In-service capacity: includes capacity that is generally available to the system over the assessment period. It therefore excludes capacity that is either laid up or mothballed.

Locked-in Capacity or Energy: Generation capacity or energy that is available for use, but cannot be transmitted to where ever it is needed on the power system due to a transmission constraint.

Loop Flow: unscheduled power flow on a transmission system that arises due to the physical nature of electricity as it follows the path of least resistance. The flow of electricity on the transmission system around Lake Erie (termed Lake Erie Circulation) is an example of loop flow.

Outage: the removal of equipment from service, unavailability for connection of equipment or temporary derating, restriction of use, or reduction in performance of equipment for any reason including, but not limited to, to permit the performance of inspections, tests or repairs on equipment, and shall include a planned outage, a forced outage and an automatic outage.

Phase Shifter: a transformer that has the ability to introduce a shift in the phase angle between the input voltage and current as compared to the output, thus controlling the amount of power passing through the transformer.

Planned Outage: an outage which is planned and is therefore intentional.

Reliability: in respect of electricity service, the ability to deliver electricity within reliability standards and in the amount desired and means; in respect of the electricity system or a transmission system, the ability of the electricity system or that transmission system to operate within reliability standards in an adequate and secure manner.

Reserve Margin: the minimum required MWs of any class of reserve required to satisfy reliability requirements. It is the criterion used to assess the adequacy of resources to meet demand; is typically stated as a percentage of available resources.

Security: the ability of the electricity system, the IMO-controlled grid, the electricity system or a transmission system to withstand sudden disturbances including, without limitation, electric short circuits or unanticipated loss of equipment or components.

Security Limits: include operating electricity system stability limits and thermal ratings.

Self Generation: generation that some distributors and end users use to supply their own load.

Special Protection System: a system that includes equipment used to increase the capability of power transfers on the transmission system or provide additional security beyond that required to manage contingency events in a normal operating state. Such protections include generation rejection and load rejection schemes.

Transmission Constraint: a restriction on a transmission system or segment of a transmission system that may limit the ability to transmit power between zones, and hence to inject or withdraw power at, various locations. Constraints may be the result of physical limitations, such as the thermal limits of a transmission line; local voltage and stability restrictions; and contingency limits that assure secure operations in the event of an unexpected failure of a transmission or generation facility.

Transmission System: a system for transmitting electricity, and includes any structures, equipment or other things used for that purpose.

Appendix A – Assessment of Resource Adequacy

Table A.1: 18-Month Assessment of Resource Adequacy

(Quantities are in MW)

Week Ending	Total Ontario Demand (1)	In-service Resources (2)	Committed Resources (3)	Total Reductions to Generation (4)	Available Resources (5) = (2)+(3)-(4)	Required Reserve (6)	Resource Excess / Shortfall [-] (7) = (5)-(6)-(1)
3/12/00	20,634	28,224	0	4,907	23,317	3,428	-745
3/19/00	20,241	28,224	0	4,681	23,543	3,413	-111
3/26/00	19,888	28,224	0	4,681	23,543	3,397	258
4/2/00	19,360	28,224	0	6,037	22,187	3,164	-337
4/9/00	19,020	28,224	0	5,743	22,481	3,177	284
4/16/00	18,740	28,224	0	6,263	21,961	3,095	126
4/23/00	18,185	28,224	0	6,699	21,525	3,018	322
4/30/00	18,649	28,224	0	6,033	22,191	3,075	467
5/7/00	18,528	28,224	0	6,083	22,141	3,052	561
5/14/00	18,407	28,224	0	6,599	21,625	3,020	198
5/21/00	18,286	28,224	0	5,848	22,376	3,178	912
5/28/00	18,206	28,224	0	4,568	23,656	3,494	1,956
6/4/00	18,971	28,224	0	4,192	24,032	3,585	1,476
6/11/00	19,495	28,224	0	3,531	24,693	3,779	1,419
6/18/00	20,088	28,224	0	3,046	25,178	3,943	1,147
6/25/00	20,612	28,224	0	2,165	26,059	4,049	1,398
7/2/00	20,372	28,224	0	2,213	26,011	4,058	1,581
7/9/00	20,795	28,224	0	2,269	25,955	4,078	1,082
7/16/00	21,299	28,224	0	2,278	25,946	3,965	682
7/23/00	21,430	28,224	0	2,289	25,935	3,956	549
7/30/00	21,208	28,224	0	2,189	26,035	3,977	850
8/6/00	20,513	28,224	0	2,287	25,937	3,921	1,503
8/13/00	20,805	28,224	0	2,292	25,932	3,919	1,208
8/20/00	21,037	28,224	0	2,236	25,988	3,966	985
8/27/00	20,613	28,224	0	2,314	25,910	4,005	1,292
9/3/00	20,030	28,224	0	2,897	25,327	3,988	1,309
9/10/00	19,400	28,224	0	3,359	24,865	3,846	1,619
9/17/00	19,566	28,224	0	5,417	22,807	3,497	-256
9/24/00	19,226	28,224	0	6,002	22,222	3,266	-270
10/1/00	18,716	28,224	0	6,457	21,767	3,039	12
10/8/00	18,856	28,224	0	6,744	21,480	2,972	-348
10/15/00	18,747	28,224	0	5,679	22,545	3,108	690
10/22/00	19,096	28,224	0	6,704	21,520	3,043	-619
10/29/00	19,597	28,224	0	6,496	21,728	3,097	-966
11/5/00	20,062	28,224	0	5,575	22,649	3,164	-577
11/12/00	20,599	28,224	0	3,584	24,640	3,387	654
11/19/00	21,128	28,224	0	3,125	25,099	3,430	541
11/26/00	21,500	28,224	0	3,136	25,088	3,467	121
12/3/00	22,070	28,224	0	2,395	25,829	3,622	137
12/10/00	22,470	28,224	0	2,399	25,825	3,662	-307
12/17/00	22,620	28,224	0	2,410	25,814	3,751	-557
12/24/00	22,480	28,224	0	1,546	26,678	3,843	355
12/31/00	21,943	28,224	0	1,544	26,680	3,788	949

Week Ending	Total Ontario Demand (1)	In-service Resources (2)	Committed Resources (3)	Total Reductions to Generation (4)	Available Resources (5) = (2)+(3)-(4)	Required Reserve (6)	Resource Excess / Shortfall [-] (7) = (5)-(6)-(1)
1/7/01	22,564	28,224	30	1,371	26,883	3,693	626
1/14/01	22,685	28,224	30	1,366	26,888	3,878	325
1/21/01	22,685	28,224	30	1,367	26,887	3,949	253
1/28/01	22,604	28,224	30	1,369	26,885	3,934	347
2/4/01	22,381	28,224	30	1,420	26,834	3,813	640
2/11/01	22,138	28,224	30	1,401	26,853	3,768	947
2/18/01	21,843	28,224	30	2,152	26,102	3,852	407
2/25/01	21,580	28,224	30	2,127	26,127	3,856	691
3/4/01	21,113	28,224	30	2,602	25,652	3,635	904
3/11/01	20,778	28,224	30	3,082	25,172	3,592	802
3/18/01	20,382	28,224	30	3,082	25,172	3,579	1,211
3/25/01	20,027	28,224	30	3,631	24,623	3,462	1,134
4/1/01	19,540	28,224	30	4,097	24,157	3,421	1,196
4/8/01	19,160	28,224	30	5,170	23,084	3,252	672
4/15/01	18,558	28,224	30	5,665	22,589	3,158	873
4/22/01	18,901	28,224	30	6,155	22,099	3,091	107
4/29/01	18,780	28,224	30	6,463	21,791	3,097	-86
5/6/01	18,658	28,224	30	7,099	21,155	3,040	-543
5/13/01	18,568	28,224	30	6,569	21,685	3,043	74
5/20/01	18,467	28,224	30	6,280	21,974	3,138	369
5/27/01	18,165	28,224	30	4,914	23,340	3,388	1,787
6/3/01	19,082	28,224	30	4,914	23,340	3,562	696
6/10/01	19,757	28,224	30	3,549	24,705	3,781	1,167
6/17/01	20,389	28,224	30	3,489	24,765	3,925	451
6/24/01	20,921	28,224	30	4,005	24,249	3,866	-538
7/1/01	20,677	28,224	30	2,725	25,529	4,040	812
7/8/01	21,107	28,224	30	2,725	25,529	4,007	415
7/15/01	21,618	28,224	30	2,240	26,014	3,960	436
7/22/01	21,751	28,224	30	2,675	25,579	3,877	-49
7/29/01	21,526	28,224	30	2,686	25,568	3,923	119
8/5/01	20,820	28,224	30	2,586	25,668	3,942	906
8/12/01	21,117	28,224	30	2,685	25,569	3,884	568
8/19/01	21,352	28,224	30	2,205	26,049	3,945	752
8/26/01	20,840	28,224	30	2,704	25,550	3,966	744

Explanatory notes:

(1) Includes line losses and dispatchable demand.
(2) Described in sections 3.1 to 3.4 of this report.
(3) Described in section 3.5 of this report.
(4) Includes planned maintenance to all units, including Contract Generators, and reductions to hydro units due to variation in water conditions, as well as unit deratings and reductions due to locked-in resources in the Niagara and the Northwest zones.
(5) Represents resources available to meet forecast demands.
(6) Represents the required reserve margin for generation.
(7) A shortfall indicates that the forecast of Ontario Demand including required reserve cannot be adequately supplied by available resources.

Appendix B – Generation from Ontario Power Generation Inc.

Table B.1 Power Stations – Ontario Power Generation

Name	Fuel	In-Service Capacity (MW)	# of Units	Name	Fuel	In-Service Capacity (MW)	# of Units
Bruce B	Nuclear	3,140	4	Ear Falls	Hydro	17	4
Darlington	Nuclear	3,524	4	G.W. Rayner	Hydro	46	2
Pickering B	Nuclear	2,064	4	Harmon	Hydro	141	2
Atikokan	Coal	215	1	Kakabeka Falls	Hydro	25	4
Lakeview	Coal	1,140	4	Kipling	Hydro	141	2
Lambton	Coal	1,975	4	Little Long	Hydro	133	2
Lennox	Oil & Gas	2,140	4	Lower Notch	Hydro	274	2
Nanticoke	Coal	3,920	8	Manitou Falls	Hydro	66	5
Thunder Bay	Coal	310	2	Mountain Chute	Hydro	170	2
CTU's	Oil & Gas	22	5	Otter Rapids	Hydro	182	4
Tacke Turbine	Wind	1	1	Otto Holden	Hydro	243	8
Abitibi Canyon	Hydro	314	5	Pine Portage	Hydro	131	4
Aguasabon	Hydro	46	2	R.H. Saunders	Hydro	1,005	16
Alexander	Hydro	67	5	Red Rock Falls	Hydro	41	2
Arnprior	Hydro	82	2	Silver Falls	Hydro	48	1
Aubrey Falls	Hydro	162	2	Sir Adam Beck 1	Hydro	496	10
Barrett Chute	Hydro	176	4	Sir Adam Beck 2	Hydro	1,360	16
Cameron Falls	Hydro	78	7	Sir Adam Beck PGS	Hydro	174	6
Caribou Falls	Hydro	87	3	Smoky Falls	Hydro	56	4
Chats Falls*	Hydro	96	4	Stewartville	Hydro	182	5
Chenaux	Hydro	139	8	Wells	Hydro	232	2
Decew Falls 1	Hydro	23	4	Whitedog Falls	Hydro	68	3
Decew Falls 2	Hydro	144	2	33 Small Hydro^	Hydro	156	86
Des Joachims	Hydro	429	8				

* Capacity and units shown are for Ontario half only.

^ They include plants with station capacity of less than 15 MW (See Table B.2 for details).

Table B.2 Small Hydroelectric Power Stations – Ontario Power Generation

Name	Type	In-Service Capacity (MW)	Number of Units
Auburn	Hydro	2	3
Big Chute	Hydro	10	1
Big Eddy	Hydro	8	2
Bingham Chute	Hydro	1	2
Calabogie	Hydro	5	2
Coniston	Hydro	4	3
Crystal Falls	Hydro	8	4
Elliott Chute	Hydro	1	1
Eugenia	Hydro	6	3
Frankford	Hydro	3	4
Hagues Reach	Hydro	4	3
Hanna Chute	Hydro	1	1
Healey Falls	Hydro	11	3
High Falls	Hydro	2	3
Hound Chute	Hydro	4	4
Indian Chute	Hydro	3	2
Lakefield	Hydro	2	1
Lower Sturgeon	Hydro	5	2
Matabitchuan	Hydro	10	4
McVittie	Hydro	2	2
Merrickville	Hydro	2	2
Meyersburg	Hydro	5	3
Nipissing	Hydro	2	2
Ragged Rapids	Hydro	8	2
Ranney Falls	Hydro	9	3
Sandy Falls	Hydro	4	3
Seymour	Hydro	6	5
Sidney	Hydro	5	4
Sills Island	Hydro	2	2
South Falls	Hydro	4	3
Stinson	Hydro	5	2
Trethewey Falls	Hydro	2	1
Wawaitin	Hydro	11	4
Total Small Hydro		**156**	**86**

Appendix C - Generation from Contract Generators

Table C.1 Power Stations – Contract Generators

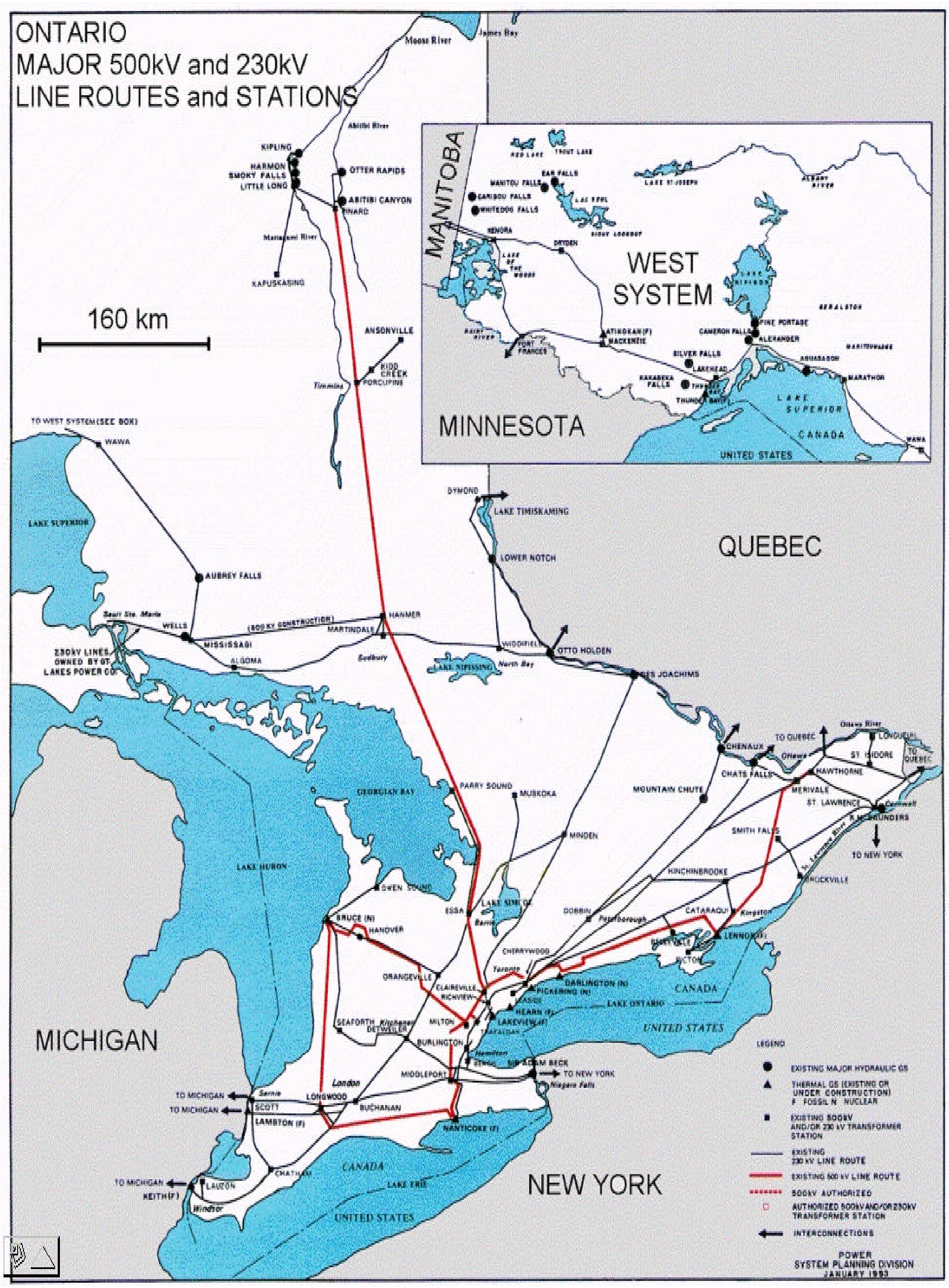
Fuel Type	In-Service Capacity (MW)
Natural Gas	1002
Landfill Gas/ Natural Gas	27
Landfill Gas	30
Natural Gas/ Waste Heat	431
Hydro	72
Total (10 MW in size or greater)	**1,562 MW**
Total (less than 10 MW in size) (See Table C.2 for Details)	**128 MW**
Total	**1,690 MW**

Table C.2 Small Power Stations – Contract Generators

Fuel Type	In-Service Capacity (MW)
Natural Gas	19
Landfill Gas	5
Municipal Solid Waste	12
Wood Waste	17
Hydro	61
Total (greater than or equal to 1 MW in size and less than 10 MW)	**114 MW**
Total (less than 1 MW in size)	
– Mostly Hydro Fuel Type, with some Natural Gas	**14 MW**
Total	**128 MW**

Appendix D – Ontario Electricity System

Figure D.1 – The Ontario Electricity System



Appendix E – Ontario's Interfaces and Interconnections

Table E.1: Ontario's Interfaces

Buchanan Longwood Input (BLIP) Interface consists of the following circuits:

- B562L Bruce A to Longwood 500 kV
- B563L Bruce B to Longwood 500 kV
- N582L Nanticoke to Longwood 500 kV
- D4W Detweiler to Buchanan 230 kV
- D5W Detweiler to Buchanan 230 kV
- M31W Middleport to Buchanan 230 kV
- M32W Middleport to Buchanan 230 kV
- M33W Middleport to Buchanan 230 kV

Queenston Flow West (QFW) Interface consists of the following circuits:

- Q23BM Beck2 to Burlington and Middleport (Neale Junction) 230 kV
- Q25BM Beck2 to Burlington and Middleport (Neale Junction) 230 kV
- Q24HM Beck2 to Hamilton and Middleport (Hannon Junction) 230 kV
- Q29HM Beck2 to Hamilton and Middleport (Hannon Junction) 230 kV
- Q30M Beck 2 (Allanburg Junction) to Middleport 230 kV

Flow East To Toronto (FETT) Interface consists of the following circuits:

- B560V Bruce A to Claireville 500 kV
- M570V Milton to Claireville 500 kV
- M571V Milton to Claireville 500 kV
- V586M Middleport to Claireville 500 kV
- R14T Trafalgar to Richview 230 kV
- R17T Trafalgar to Richview 230 kV
- R19T Trafalgar to Richview 230 kV
- R21T Trafalgar to Richview 230 kV
- E8V Orangeville to Essa 230 kV
- E9V Orangeville to Essa 230 kV

Flow North (FN) and Flow South (FS) Interface consists of the following circuits:

- X503E Essa to Hamner 500 kV
- X504E Essa to Hamner 500 kV
- D5H Des Joachims to Holden 230 kV

East-West Tie (EWTE & EWTW) Interface consists of the following circuits:

- W21M Wawa to Marathon 230 kV
- W22M Wawa to Marathon 230 kV

Table E.2: Ontario's Interconnections

The Ontario – Manitoba interconnection consists of the following circuits:

- K21W Kenora 230 kV to Whiteshell 115 kV including combination voltage regulator and phase shifting transformer bank T7 at Whiteshell,
- K22W Kenora 230 kV to Whiteshell 115 kV including combination voltage regulator and phase shifting transformer bank T8 at Whiteshell,
- SK1 Rabbit Lake 115 kV to Seven Sisters 115 kV including an in-line voltage regulating transformer at Seven Sisters.

The Ontario – Minnesota interconnection consists of the following circuits:

- F3M Fort Frances 115 kV to International Falls 115 kV including two phase shifting transformers operated in series, T10 and T11, located at International Falls.

The Ontario – Quebec North interconnection consists of the following circuits:

- D4Z Dymond to Rapide Des Iles 115 kV,
- H4Z Holden to Kipawa 115 kV,

The Ontario – Quebec South interconnection consists of the following circuits:

- X2Y Chenaux to Bryson 115 kV,
- Q4C Chats Falls to Quoyon 230 kV,
- P33C Chats Falls to Paugan 230 kV,
- H9A Hawthorne to Maclaren 115 kV,
- H2AR Hawthorne to Maclaren 115 kV,
- B5D St. Isidore to Beauharnois 230 kV,
- B31L St. Lawrence to Beauharnois 230 kV.

The Ontario – Michigan interconnection consists of the following circuits:

- B3N Scott 230 kV to Bunce Creek 120 kV, including in-line 230-120 kV autotransformer T201 at Bunce,
- L4D Lambton 230 kV to St. Clair 345 kV, including in-line 240-345 kV autotransformer T7 at Lambton,
- L51D Lambton 230 kV to St. Clair 345 kV, including in-line 240-345 kV autotransformer T8 at Lambton,
- J5D Keith 230 kV to Waterman 230 kV, including in-line combination voltage regulator and phase shifting transformer PSR5.

After July 4, 2000 phase shifters will also be in-service on B3N, L4D, and L51D

The New York – Niagara interconnection consists of the following 60 Hz circuits to the New York Power Authority (NYPA) and Niagara Mohawk (NiaMo):

- BP76 Beck2 230 kV to Packard 230 kV (NiaMo), including in-line voltage regulating transformer R76,
- PA27 Beck2 230 kV to Niagara Moses 230 kV (NYPA), including in-line voltage regulating transformer R27,
- PA301 Beck2 230 kV to Niagara Moses 345 kV (NYPA), including in-line 220 to 345 kV autotransformers T310 and T302,
- PA302 Beck2 230 kV to Niagara Moses 345 kV (NYPA), including in-line 220 to 345 kV autotransformers T310 and T302,
- BL104 Beck1 115 kV to Lockport 115 kV (NiaMo),

and the following two 25 Hz circuits

- BSC105 Beck1 115 kV to Harper 69 kV (NiaMo), including an in-line 115 to 69 kV transformer at Parks TS,
- BSH106 Beck G7 to Harper 69 kV (NiaMo).

The Ontario – New York East interconnection consists of the following 60 Hz circuits to the New York Power Authority (NYPA):

- L33P St. Lawrence 230 kV to FDR Moses 230 kV (NYPA) including in-line voltage regulating transformer R33 and in-line phase shifting transformer PS33,
- L34P St. Lawrence 230 kV to FDR Moses 230 kV (NYPA) including in-line combination voltage regulator and phase shifting transformer PSR34,