Ontario Transmission System

Power to Ontario. On Demand.

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Caution and Disclaimer

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1.0 Introduction

The Ontario Electricity Market Rules (Chapter 5) require that the Independent Electricity System Operator (IESO) provide forecasts and assessments of the reliability of the existing and committed resources and transmission facilities of the Ontario Market.

These forecasts and assessments of the Ontario Electricity System are contained in the IESO 18-Month and Ontario Reliability Outlooks.

This document is intended to complement the transmission assessments contained in both Outlooks by providing specific details on the Ontario transmission system, including the major internal transmission interfaces and interconnections with neighbouring jurisdictions.

Readers are invited to provide comments and/or suggestions on this document. To do so, please contact us at:

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- E-mail: customer.relations@ieso.ca.

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2.0 Current Transmission System Configuration

The Ontario transmission system is generally comprised of a 500 kV transmission network, a 230 kV transmission network and several 115 kV transmission networks.

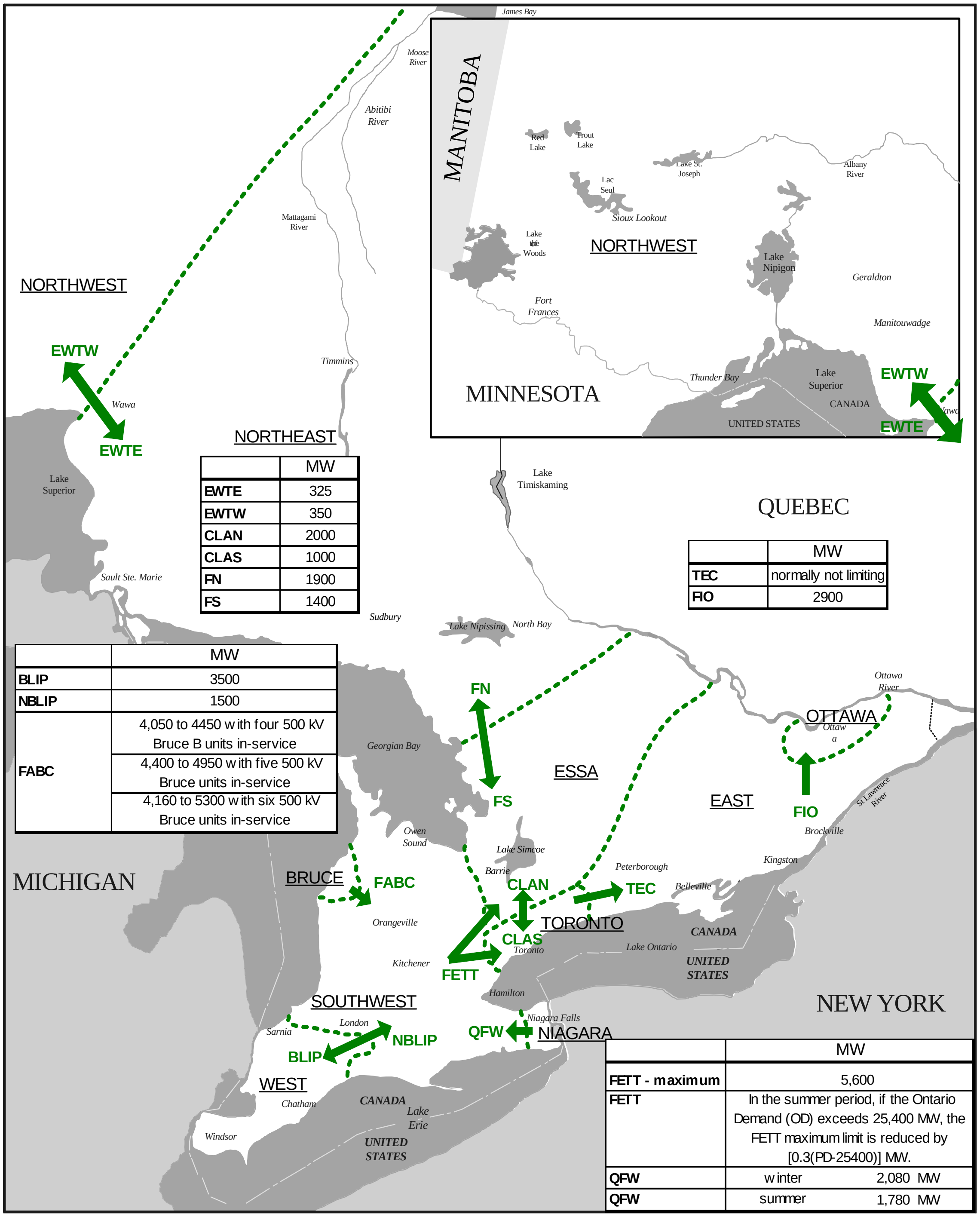
Figures 2.1.1 and 2.1.2 provide a geographic depiction of Ontario's internal transmission zones, major transmission interfaces, and transmission interconnection points with other jurisdictions.

Operating security limits for these interfaces and interconnections are also included in Figures 2.1.1 and 2.1.2. An explanation of the limit values shown in the tables is contained in Sections 3.3 and 5.3. The interconnection and interface limits are used to ensure system and/or plant stability, acceptable pre-contingency and post-contingency voltage levels and/or acceptable thermal loading levels.

Figure 2.1.3 provides a simplified depiction of Figures 2.1.1 and 2.1.2 and indicates the transmission zones that are described in more detail in Section 4.0.

Figure 2.1.4 shows Ontario with the transmission zones superimposed.

Figure 2.1.1 Ontario's Major Internal Transfer Interfaces



	MW
EWTE	325
EWTW	350
CLAN	2000
CLAS	1000
FN	1900
FS	1400

	MW
TEC	normally not limiting
FIO	2900

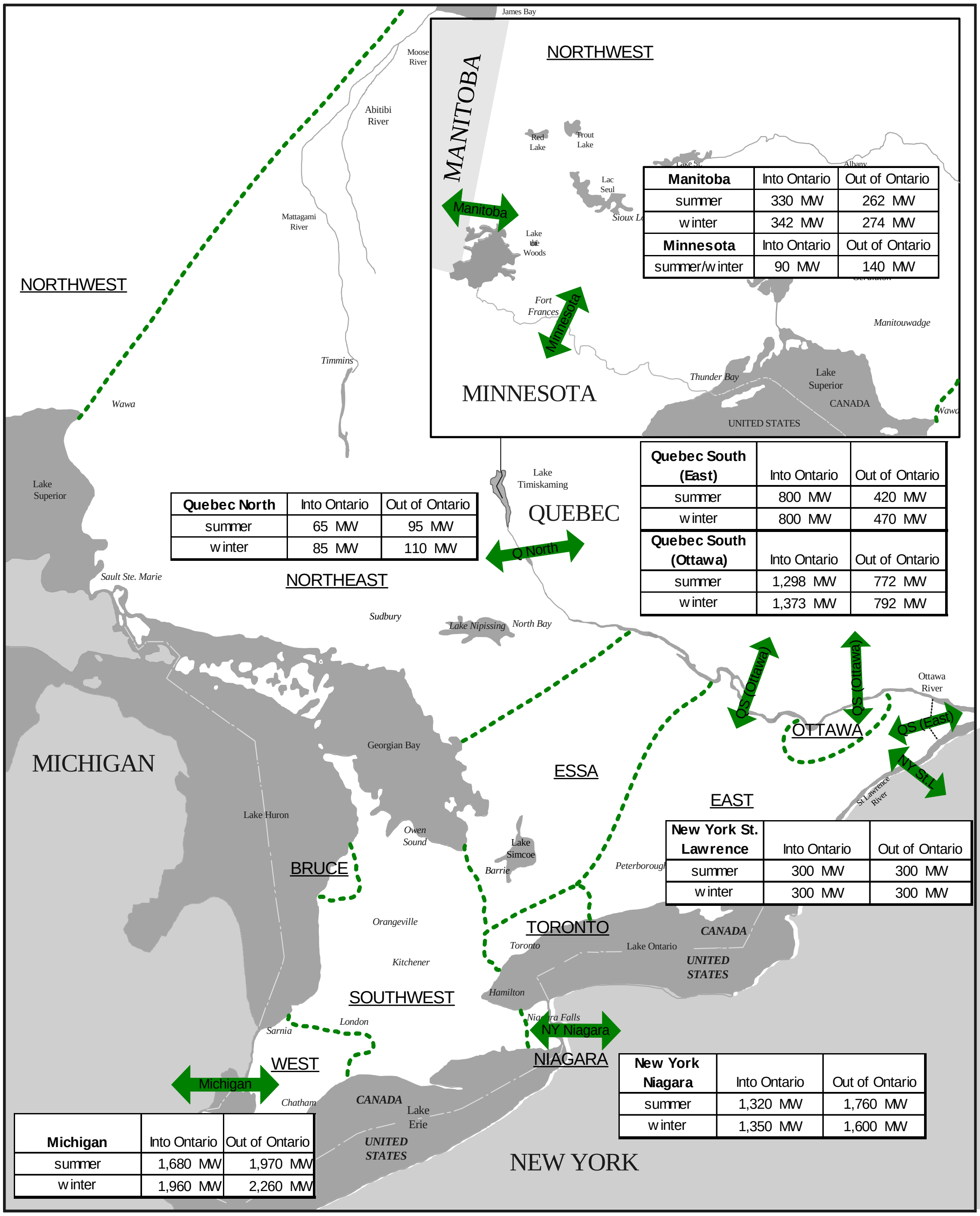
	MW
BLIP	3500
NBLIP	1500
FABC	4,050 to 4450 with four 500 kV Bruce B units in-service
	4,400 to 4950 with five 500 kV Bruce units in-service
	4,160 to 5300 with six 500 kV Bruce units in-service

	MW	
FETT - maximum	5,600	
FETT	In the summer period, if the Ontario Demand (OD) exceeds 25,400 MW, the FETT maximum limit is reduced by [0.3(PD-25400)] MW.	
QFW	winter	2,080 MW
QFW	summer	1,780 MW

Notes to Figure 2.1.1:

1. Tables indicate interface base limits (all transmission elements in-service). See Section 3.0 for further details.

Figure 2.1.2 Ontario's Points of Interconnection with Neighbouring Areas



Manitoba	Into Ontario	Out of Ontario
summer	330 MW	262 MW
winter	342 MW	274 MW
Minnesota	Into Ontario	Out of Ontario
summer/winter	90 MW	140 MW

Quebec North	Into Ontario	Out of Ontario
summer	65 MW	95 MW
winter	85 MW	110 MW

Quebec South (East)	Into Ontario	Out of Ontario
summer	800 MW	420 MW
winter	800 MW	470 MW
Quebec South (Ottawa)	Into Ontario	Out of Ontario
summer	1,298 MW	772 MW
winter	1,373 MW	792 MW

New York St. Lawrence	Into Ontario	Out of Ontario
summer	300 MW	300 MW
winter	300 MW	300 MW

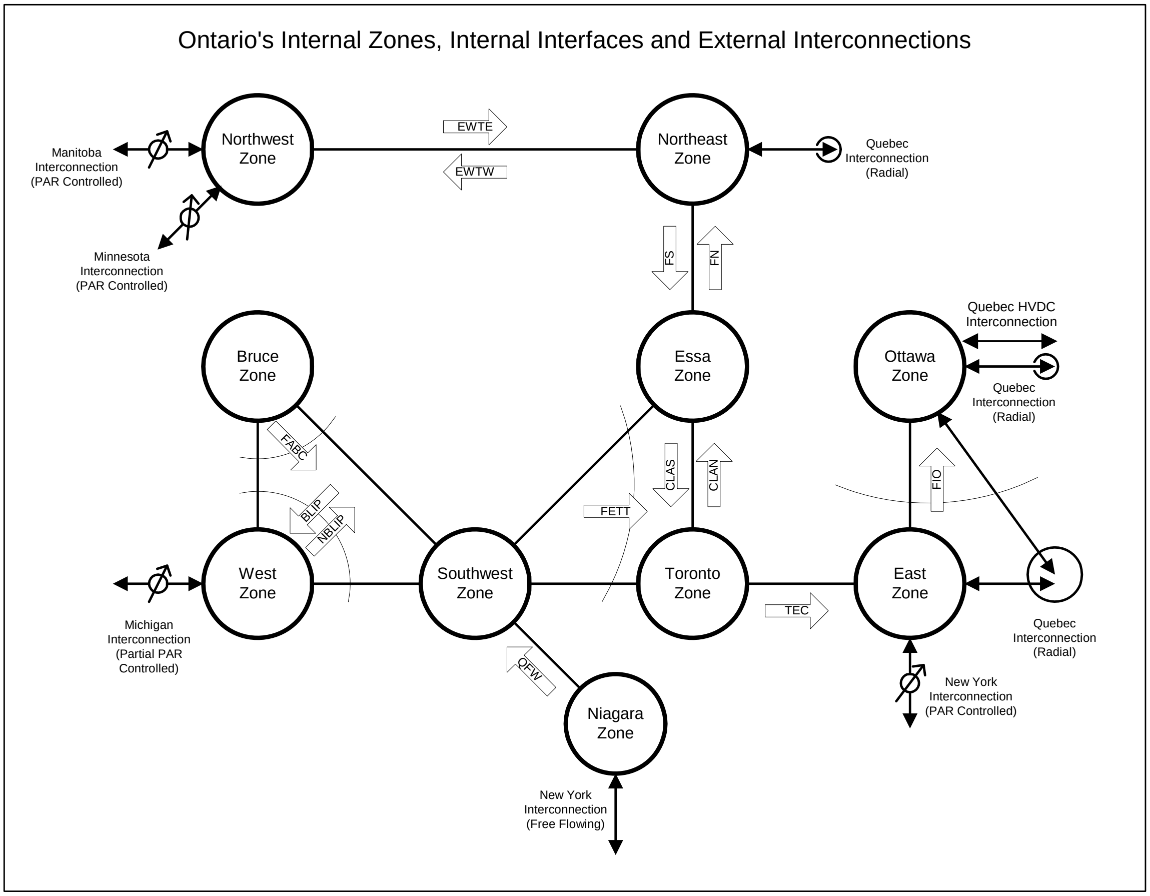
New York Niagara	Into Ontario	Out of Ontario
summer	1,320 MW	1,760 MW
winter	1,350 MW	1,600 MW

Michigan	Into Ontario	Out of Ontario
summer	1,680 MW	1,970 MW
winter	1,960 MW	2,260 MW

Notes to Figure 2.1.2:

1. Tables indicate flow limits for each interconnection. Note the Ontario coincident import/export capability is not necessarily the arithmetic sum of the individual flow limits. See Section 5.0 for further details.

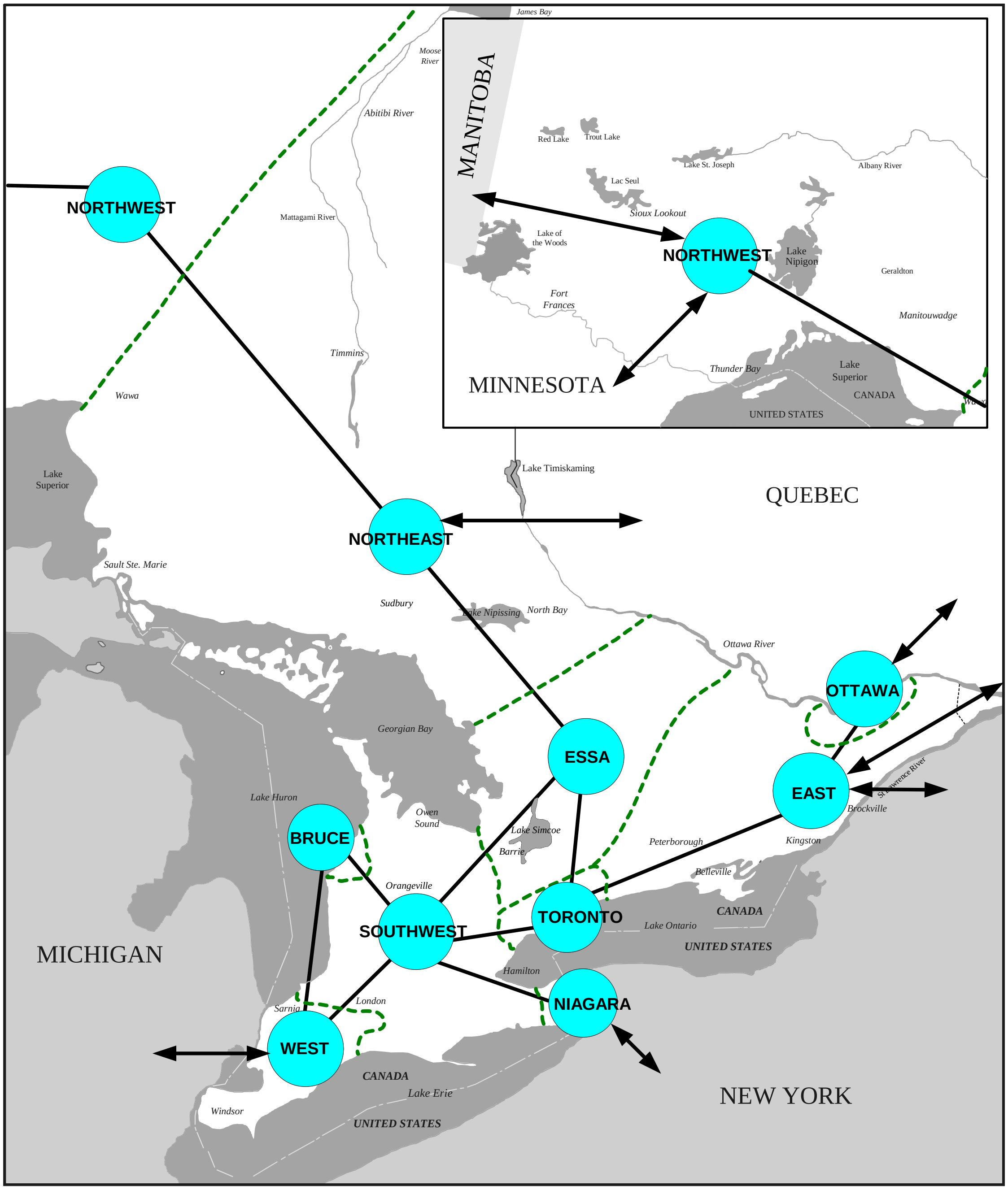
Figure 2.1.3 Ontario's Zones, Interfaces and Interconnections



Notes to Figure 2.1.3:

1. See Section 4.0 for further details on the Ontario transmission zones.

Figure 2.1.4 Ontario with Zones Superimposed



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3.0 Transmission Interfaces

There are nine major internal interfaces in the Ontario transmission system as illustrated in Figure 2.1.3. Detailed information on interface definitions and limits can be found in IESO System Control Orders (SCOs). The release of SCO limit related information to market participants will be considered by the IESO on a need to know and case by case basis. Requests for further information should be directed to the IESO Customer Relations.

3.1 Interface Definitions

Interface definitions are formed by grouping one or more lines for the purpose of measuring their combined flow and enforcing a power flow limit or, as it is more commonly, called an interface limit. Interface limits are directional and interfaces may have limits imposed in one or both directions.

3.2 Interface Capability Limits

Table 3.2 summarizes the base limits for the major interfaces in Ontario; normal system (all transmission elements in-service) limits are shown. Emergency transfer limits are also shown where there are different limits for emergency conditions.

Note that some limits are simple constants (e.g. BLIP) whereas others are more complicated and may depend on parameters such as status of specific generator units, other transmission flows, Ontario demand, etc. (e.g. NBLIP, FETT, FABC). In cases where interface limits are based on thermal capability, separate ratings are shown for summer and winter conditions.

Table 3.2 Interface Base Limits

Interface	Operating Security Limits (MW)			
BLIP	3,500			
NBLIP	1,500			
QFW	1,780 Summer,		2,080	Winter
Emergency Limit	2,150 Summer,		2,500	Winter
FABC	4,050	to	4,450	with four 500 kV Bruce B units in-service*
	4,400	to	4,950	with five 500 kV Bruce units in-service*
	4,160	to	5,300	with six 500 kV Bruce units in-service*
FETT	5,600 **			
Emergency Limit	6,100 **			
CLAN	2,000			
CLAS	1,000			
FIO	2,900			
FN	1,900			
FS	1,400			
EWTE	325			
EWTW	350			

Summer Limits apply from May 1 to October 31. Winter Limits apply from November 1 to April 30.
Emergency Limits of each interface are identical to the Normal Limits unless otherwise stated

(*) FABC limit varies according to BLIP flow. For each recognized contingency, separate voltage and stability limit ranges are defined.
Published limit range based on the most restrictive contigency.
Lower limit based on NBLIP @ 1500MW. Upper limit based on BLIP @ 3500MW

(**) In the summer period, if the Ontario Demand (OD) exceeds 25,400 MW, the FETT maximum limit is reduced by [0.3(PD-25400)] MW.

3.3 Interface Characteristics

The EWTE/EWTW Interface

The East-West Transfer East (EWTE) and East-West Transfer West (EWTW) flows are functionally related to the power flows between Ontario and Manitoba, and Ontario and Minnesota. In this relationship, the Ontario – Manitoba and Ontario – Minnesota flows can be generally thought of as the independent variables as they are under phase angle regulator control.

The maximum limits on the East-West tie are 325 MW to the east and 350 MW to the west. The EWTE and EWTW interfaces are constrained by voltage and stability limitations. A sample of historical flow distribution on the East West Interface is shown in the Figures 3.3.1.

The FN/FS Interface

The Flow South (FS) limit is 1,400 MW and the Flow North (FN) limit is 1,900 MW. The Flow North and Flow South interfaces are constrained by voltage and stability limits respectively. A sample of historical flow distribution on the FN/FS interface is shown in the Figures 3.3.1.

The CLAN/CLAS Interface

The Claireville North (CLAN) limit is 2,000 MW and the Claireville South (CLAS) limit is 1,000 MW. These limits have been defined to determine the boundary conditions for which the other system limits, in particular FABC and FETT, are valid. A sample of historical flow distribution on the CLAN/CLAS interface is shown in the Figures 3.3.1.

The FABC Interface

The Flow Away from Bruce Complex (FABC) limit depends on the number of Bruce units in-service, the BLIP/NBLIP interface flow and a number of other system parameters. The FABC limit is required for preserving system and/or plant stability, and maintaining acceptable post-contingency voltages. Separate stability and voltage limits are defined for each recognized contingency. The limit ranges presented in this document are based on the most restrictive contingency.

With four Bruce B units and all transmission elements in-service, the FABC interface limit will range from 4,050 MW to 4,450 MW depending on the BLIP/NBLIP interface flow. The unavailability of other system parameters such as reactive support provided from other generating stations and reactor switching would likely result in a lower limit.

With five Bruce units and all transmission elements in-service, the FABC interface limit will range from 4,400 MW to 4,950 MW depending on the BLIP/NBLIP interface flow. With six 500 kV Bruce units and all transmission elements in-service, the FABC interface limit will range from 4,160 MW to 5,300 MW depending on the BLIP/NBLIP interface flow. For both of these cases, the impact of other system conditions would likely result in lower limits.

With four or more Bruce units in-service, the FABC limit can be improved through the use of generation rejection (G/R) of Bruce units, such that the full station output can normally be achieved. The resulting limit improvements with G/R are not specified in this document, but are described in detail in the appropriate SCO.

The increased presence of large wind generation facilities connected to the transmission out of Bruce will also result in variations in the FABC limit.

A sample of historical flow distribution on the FABC interface is shown in the Figures 3.3.1.

The BLIP/NBLIP Interface

Buchanan Longwood Input (BLIP) interface is limited to 3,500 MW to the west due to stability and voltage limitations. The Negative Buchanan Longwood Input (NBLIP) interface limit is a function of a variety of parameters. Normally the limit is near its high end of about 1,500 MW. The interface is typically constrained by voltage limitations. A sample of historical flow distribution on the BLIP interface is shown in the Figures 3.3.1.

The QFW Interface

The Queenston Flow West (QFW) interface is limited to 2080 MW for flows to the west in the winter. In the summer, the limit is 1,780 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. A sample of historical flow distribution on the QFW interface is shown in the Figures 3.3.1.

The FETT Interface

The Flow East Towards Toronto (FETT) interface limit is a function of a variety of parameters such as Ontario demand and reactive support provided from various generating stations. As a result, the limit of this interface is generally lower than its maximum limit of 5,600 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 current level of flows expected in that direction are low. A sample of historical flow distribution on the FETT interface is shown in the Figures 3.3.1.

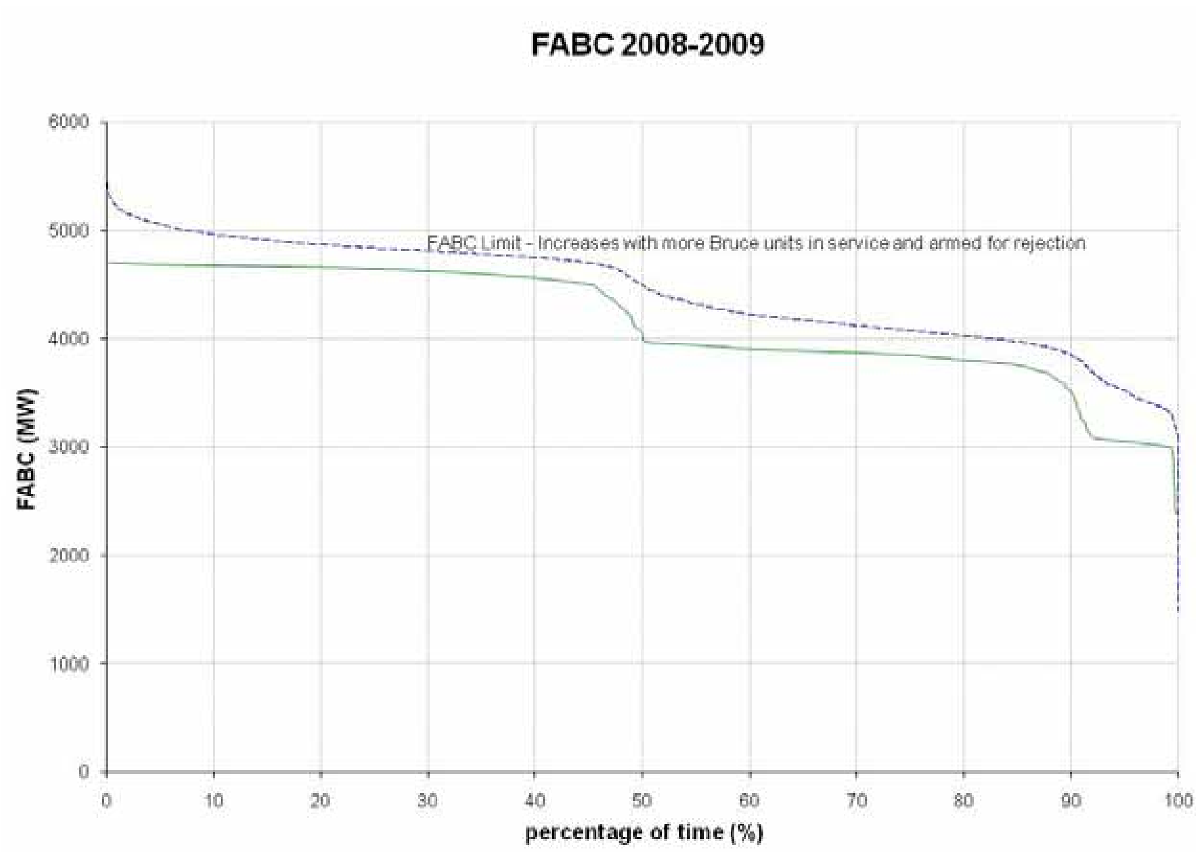
The TEC Interface

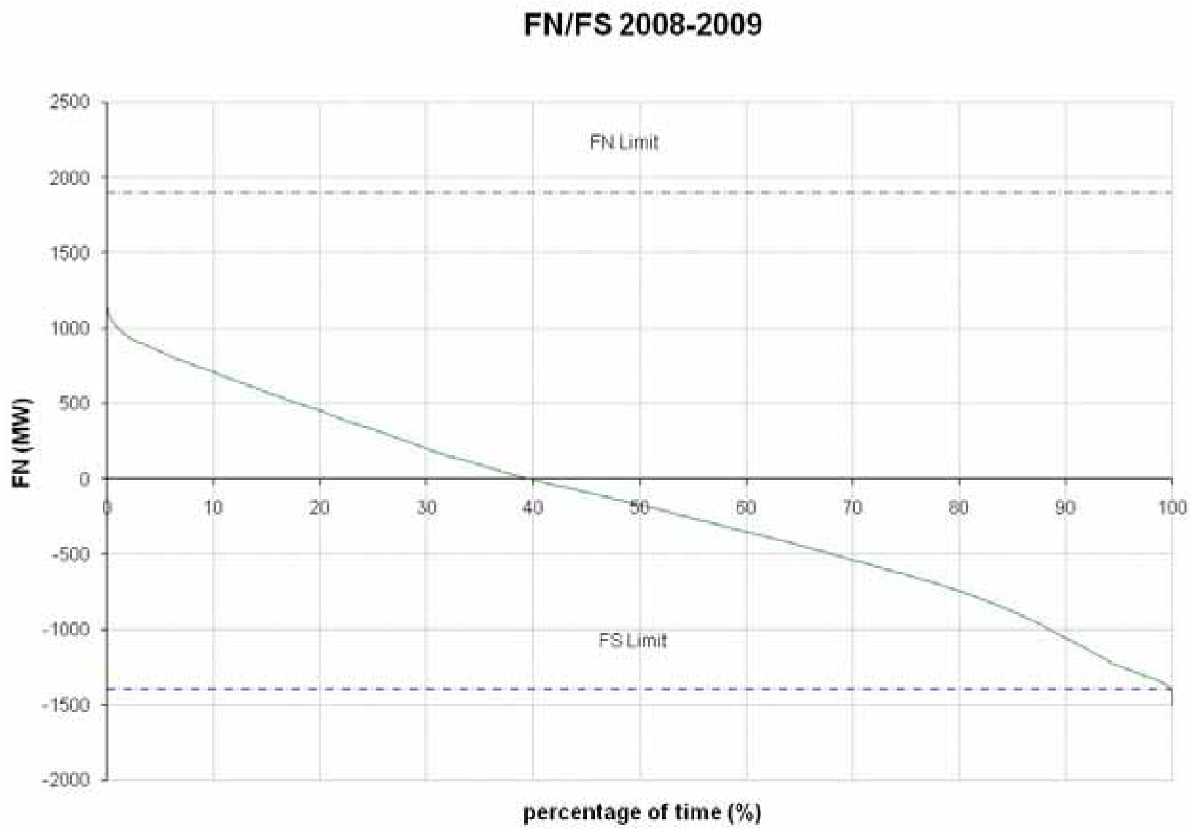
The Transfer East from Cherrywood (TEC) interface does not have a pre-defined limit for up to any one single element out of service. The TEC interface is included to provide a boundary between the Toronto and East transmission zones. With these zones defined, specific studies can be conducted to consider the impact of varying resource dispatch scenarios on reliability.

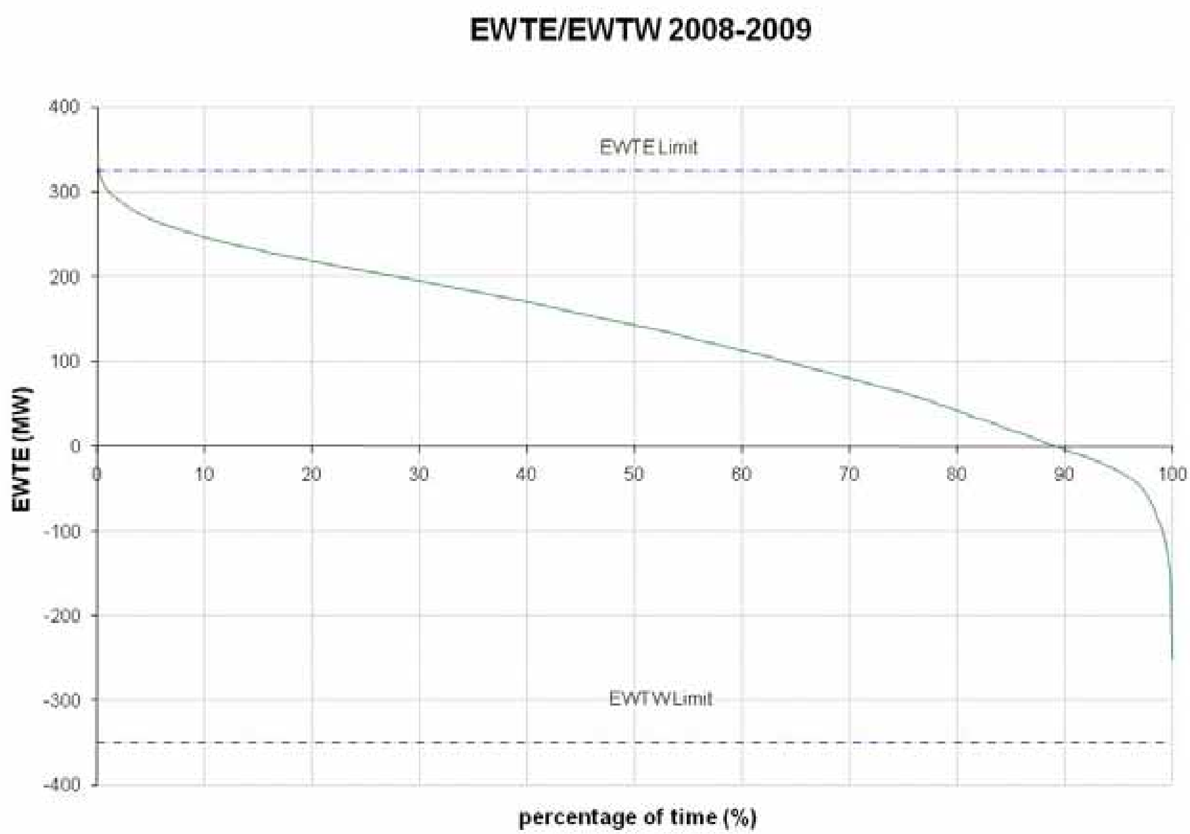
The FIO Interface

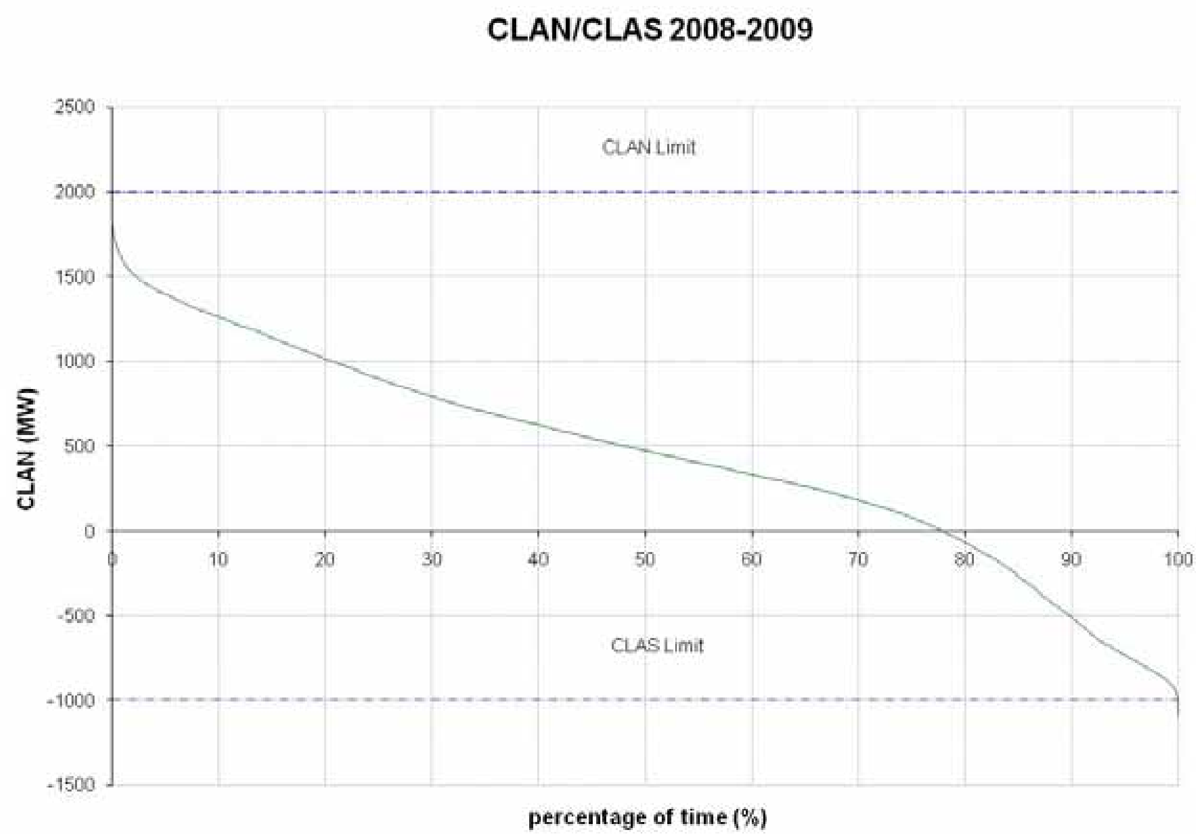
With the addition of the HVDC link between Ontario and Quebec, the Flow Into Ottawa (FIO) interface is limited to 2,900 MW to control pre-contingency and post-contingency voltage instability in the Ottawa zone. There is no limit specified on this interface for flows to the East zone. Under certain conditions, the FIO limit can be improved with the use of load rejection in the Ottawa zone. A sample of the historical flow distribution on the FIO interface is shown in Figures 3.3.1.

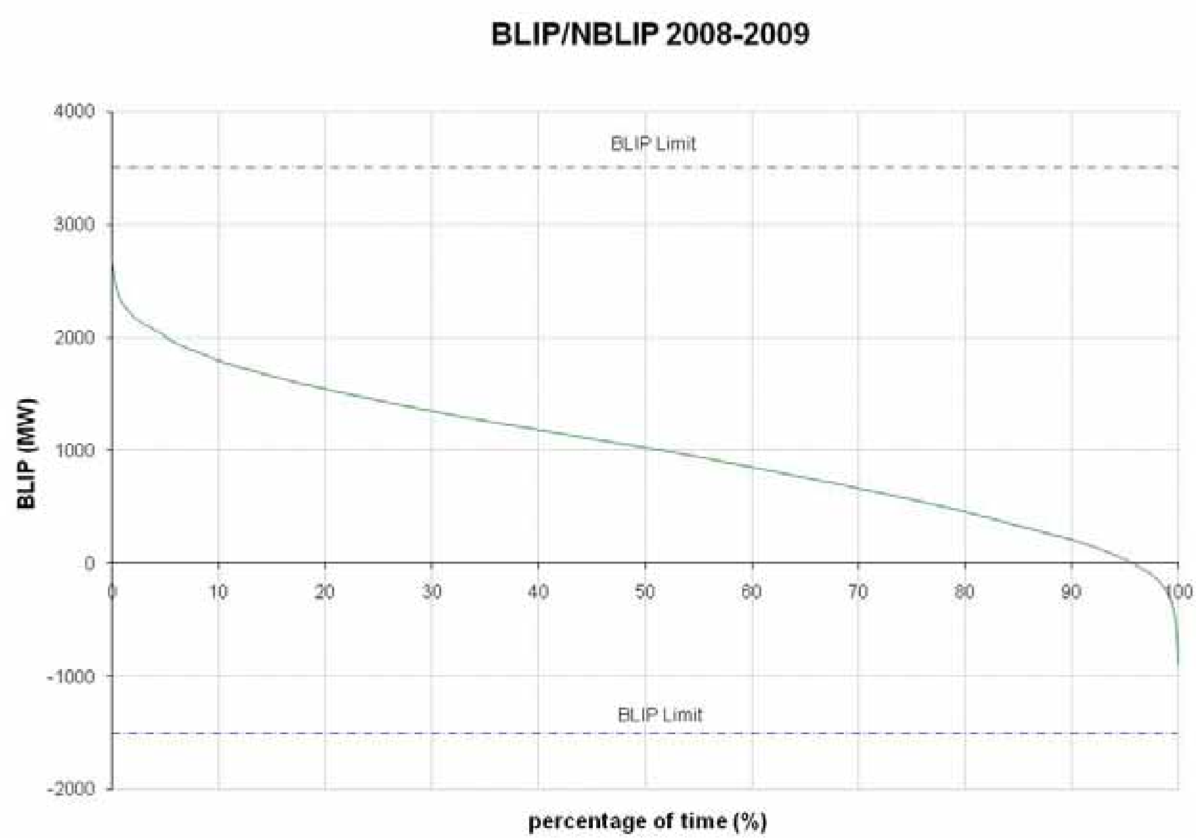
Figures 3.3.1 Historical Flow Distribution – Interfaces

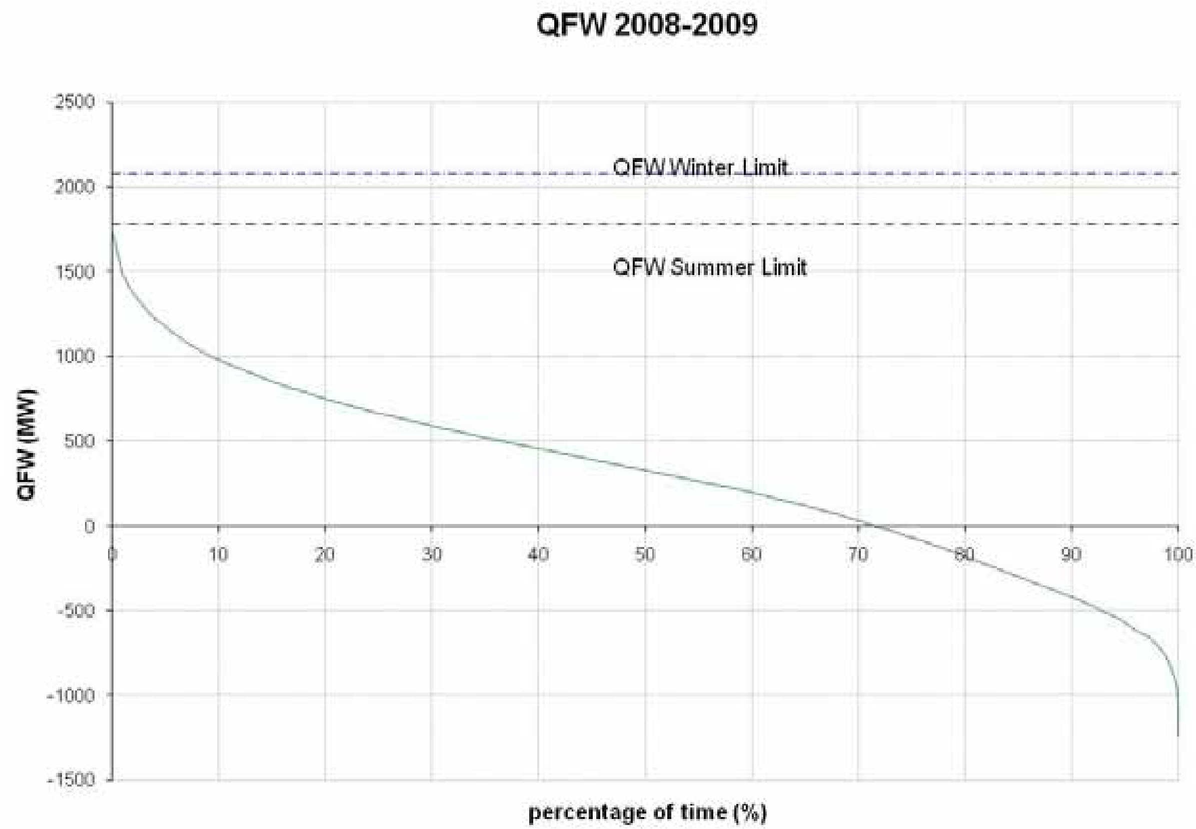


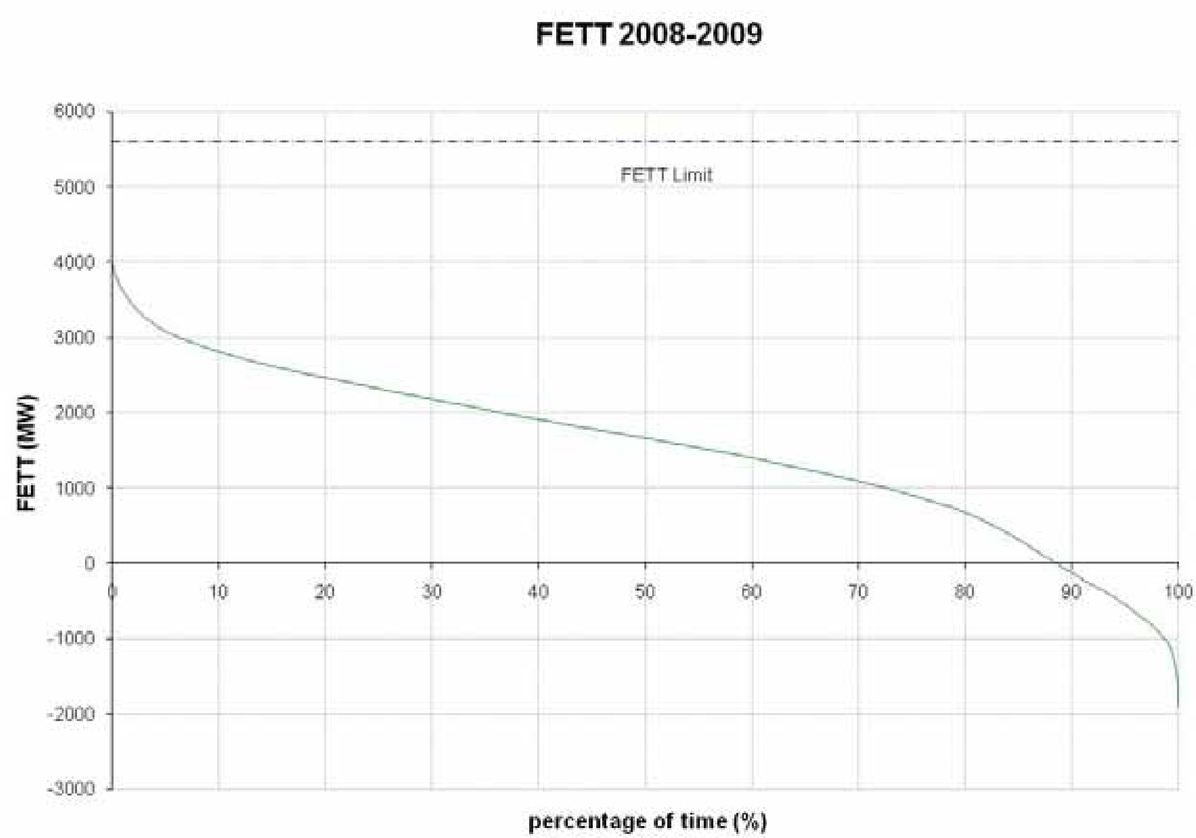

FN/FS 2008-2009
FN Limit
FS Limit
FN (MW)
2500
2000
1500
1000
500
0
-500
-1000
-1500
-2000
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)

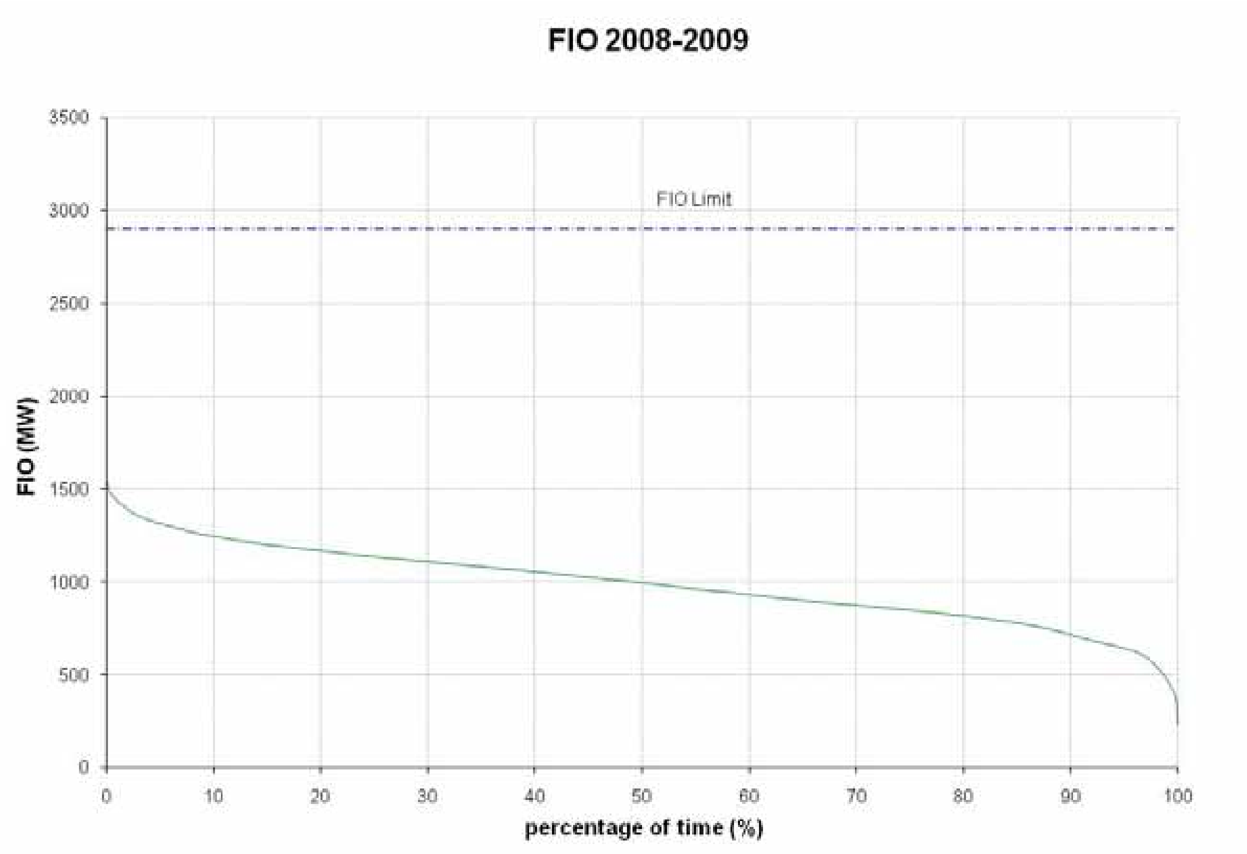

EWTE/EWTW 2008-2009
EWTE Limit
EWTW Limit
EWTE (MW)
400
300
200
100
0
-100
-200
-300
-400
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)


CLAN/CLAS 2008-2009
CLAN Limit
CLAS Limit
CLAN (MW)
2500
2000
1500
1000
500
0
-500
-1000
-1500
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)


BLIP/NBLIP 2008-2009
BLIP Limit
BLIP Limit
BLIP (MW)
4000
3000
2000
1000
0
-1000
-2000
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)


QFW 2008-2009
QFW Winter Limit
QFW Summer Limit
QFW (MW)
2500
2000
1500
1000
500
0
-500
-1000
-1500
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)


FETT 2008-2009
FETT Limit
FETT (MW)
6000
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)



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4.0 Transmission Zones

The Ontario transmission system has been divided into ten zones as illustrated in Figure 2.1.3. Zonal boundaries have been chosen to correspond with the major interfaces described in Section 3.0.

4.1 Zone Characteristics

Bruce Zone

- The total resources are much greater than the zone peak demand.
- The generation is mostly nuclear, and some wind.
- There are no external interconnections.

East Zone

- The total resources exceed the zone peak demand.
- The generation is a mix of hydroelectric, oil and gas.
- The zone is externally connected to the Quebec grid.
- The existing interconnection with Quebec is radial.
- The zone is also externally connected to the St. Lawrence interface with New York via phase angle regulator control.

Essa Zone

- The total resources are much less than the zone peak demand.
- The generation is totally hydroelectric.
- For analytical purposes, Des Joachims generation and 115 kV load, which is physically located in the East zone, has been modeled to be part of the Essa zone. The Essa zone is the primary point of receipt of Des Joachims generation.
- There are no external interconnections.

Niagara Zone

- The total resources are much higher than the zone peak demand.
- The generation is totally hydroelectric.
- There is a free-flowing interconnection with New York.

Northeast Zone

- The total resources exceed the zone peak demand.
- The generation is mainly hydroelectric with some cogeneration, wind and wood waste.
- There is some 25 Hz generation radially connected to the 60 Hz electricity system via a frequency changer.
- The existing interconnections with Quebec are radial.

Northwest Zone

- The total resources generally exceed the zone peak demand.
- The generation is mainly hydroelectric with some coal and gas.
- The zone is externally connected to the Manitoba and Minnesota systems.
- The 230 kV Manitoba interconnections and the Minnesota 115 kV interconnection are under phase angle regulator control. The Manitoba 115 kV interconnection is radial.

Ottawa Zone

- The total resources are much less than the zone peak demand.
- The generation is cogeneration.
- The interconnections with Quebec consist of the 115 kV circuit D5A, the 230 kV circuit H9A, and the 230 kV HVDC link comprising the A41T and A42T circuits. All the interconnections are radial, with the exception of the HVDC interconnection.

Southwest Zone

- The total resources are generally balanced with the zone peak demand.
- The generation is mostly coal with some wind.
- There are no external interconnections.

Toronto Zone

- The total resources are less than the zone peak demand.
- The generation is mostly nuclear with some gas.
- There are no external interconnections.

West Zone

- The total resources generally exceed the zone peak demand.
- The generation is mostly coal and gas with some wind.
- There is partial phase angle control on the interconnection with Michigan. At some future date, the interconnection will be under full phase angle regulator control.

- End of Section -

5.0 Transmission Interconnections

The term interconnection is used to describe interfaces that join Ontario to other jurisdictions (external control areas).

Ontario has interconnections with Manitoba, Minnesota, Quebec, Michigan, and New York.

5.1 Interconnection Definitions

Like transmission interfaces, interconnection definitions are formed by grouping one or more lines for the purpose of measuring their combined flow and enforcing a power flow limit. Interconnections limits are defined for flows into Ontario (imports) and out of Ontario (exports).

5.2 Interconnection Flow Limits

Table 5.2 summarizes the flow limits for the interconnections; normal system (all transmission elements in-service) limits are shown. In addition, emergency transfer limits are shown when they differ from the normal system limits.

For Manitoba and Minnesota, the flow limits recognize dead-band margins associated with the phase angle regulator taps.

For Michigan and New York, flow limits are given for summer and winter flows into and out of Ontario. The flow limits account for the automatic generation control (AGC) process required to match load and generation within Ontario. With favourable conditions, the flow capabilities of the interconnections will not be affected by internal limitations in the transmission network. The amount of power that can be transferred may be lower than the table values under unfavourable dispatch and weather conditions. With unfavourable conditions, the flow capabilities may also be affected by internal limitations in the transmission network, in Ontario or in external areas.

When ambient weather conditions permit, flow limits over paths restricted by thermal considerations may be increased during real-time operation.

Table 5.2 Interconnection Limits

Interconnection	Limit - Flows Out of Ontario MW	Limit - Flows Into Ontario MW
Manitoba – Summer*[3]	262	330 [6]
Manitoba – Winter*[3]	274	342 [6]
Minnesota[3]	140	90
Quebec North (Northeast) – Summer*	95 [5]	65
Quebec North (Northeast) – Winter*	110 [4]	85
Quebec South (Ottawa) – Summer*	772	1,298
Quebec South (Ottawa) – Winter*	792	1,373
Quebec South (East) – Summer*	420	800
Quebec South (East) – Winter*	470	800
New York St. Lawrence – Summer*	300	300
New York St. Lawrence – Winter*	300	300
New York Niagara (60 Hz and 25 Hz) – Summer*	1,760 [1]	1,320 [1,7]
(Emergency Transfer Limit - Summer)	2,100 [1]	1,750 [1,7]
New York Niagara (60 Hz and 25 Hz) – Winter*	1,600 [1]	1,350 [1,7]
(Emergency Transfer Limit - Winter)	2,100 [1]	2,100 [1,7]
Michigan – Summer*[2,3]	1,970	1,680
Emergency Transfer Limit - Summer*[2,3]	2,550	1,950
Michigan – Winter*[2,3]	2,260	1,960
Emergency Transfer Limit - Winter*[2,3]	2,650	2,000

* Summer Limits apply from May 1 to October 31. Winter Limits apply from November 1 to April 30.

(1) Flow limits depend on generation dispatch outside Ontario. Values presented here are based on generation dispatch provided by New York.

(2)Normal limits are based on LT ratings and phase shifters bypassed and Emergencty limits are based on ST ratings and phase shifters regulating . Flow limits vary depending on the generation dispatch within Ontario.

(3) For real time operation of the interconnection, limits are based on ambient conditions.

(4) Limit based on 0-4 km/hr wind speed and 10 Deg.C ambient temperature.

(5) Limit based on 0-4 km/hr wind speed and 30 Deg.C ambient temperature.

(6) Flows into Ontario include flows on circuit SK1.

(7) Flow Limits into Ontario are shown here without considering QFW transmission constraints within Ontario.

5.3 Interconnection Characteristics

All of Ontario's non-radial interconnections are linked with phase angle regulators (PARs), except for New York – Niagara and the HVDC link with Quebec.

A sample of historical flow distribution on the Ontario interconnections is shown in Figure 5.3.1. Limits are also shown on the diagrams except for New York and Quebec where flows are derived from more than one interconnection.

The Ontario – Manitoba Interconnection (60 Hz)

The Ontario – Manitoba interconnection consists of two 230 kV circuits and one 115 kV circuit.

The 230 kV interconnection is defined as the Ontario- Manitoba Transfer. The transfers on this interconnection are the Ontario – Manitoba Transfer East (OMTE) and the Ontario – Manitoba Transfer West (OMTW), and are constrained by stability and thermal limitations. The OMTW and OMTE limits are 274 MW in the winter and 262 MW in the summer.

The 115 kV interconnection is limited to 68 MW for flows into Ontario in the wintertime and summertime, increasing the total transfer capability from Manitoba into Ontario to 330 MW in summer and 342 MW in winter. No flow out of Ontario is allowed on the 115 kV interconnection.

Ontario and Manitoba are synchronously connected on the 230 kV interconnection, but are not on the 115 kV interconnection.

The Ontario – Minnesota Interconnection (60 Hz)

The Ontario – Minnesota interconnection consists of one 115 kV circuit. The transfers on this interconnection are the Minnesota Power Flow North (MPFN) and the Minnesota Power Flow South (MPFS).

The MPFN and MPFS limits are 90 MW and 140 MW respectively and are constrained by stability and thermal limitations. Ontario and Minnesota are synchronously connected.

The Ontario – Michigan Interconnection (60 Hz)

The Ontario – Michigan interconnection consists of two 230/345 kV circuits, one 230/115 kV circuit and one 230 kV circuit. The interconnection is constrained by thermal limitations.

At the present time, the interconnection is operated with one phase angle regulator (PAR) in-service at Keith T.S and three others by-passed; two located at Lambton and one at Bunce Creek, Michigan.

With the three PARS by-passed, for the flows out of Ontario, the winter and summer limits are 2,260 MW and 1,970 MW, respectively. For the flows into Ontario, the winter and summer limits are 1,960 MW and 1,680 MW, respectively.

The Ontario – New York Niagara Interconnection (60 Hz)

The Ontario – New York Niagara interconnection consists of two 230/345 kV circuits, two 230 kV circuits and one 115 kV circuit.

The New York (NY) Niagara interconnection, in the winter, is limited to 1,350 MW for flows into Ontario and 1,600 MW for flows out of Ontario. In the summer, the limit is 1,320 MW for flows into Ontario and 1,760 MW for flows out of Ontario. The interconnection is constrained by thermal limitations in the winter and summer, or NY scheduling limits.

The Queenston Flow West (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 imports and parallel path flows. 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 utilized. The QFW interface is constrained by thermal limitations, which are very dependent on weather conditions.

Typically, when QFW hits its limit of 1,780 MW under summer conditions, the flow across the NY Niagara interconnection is 1,000 MW. Similarly, when QFW hits its limit of 2,080 MW under winter conditions, flow across the NY Niagara interconnection is 1,300 MW.

Similarly, at worst, internal constraints in New York can limit flows leaving Ontario to 700 MW and 1,000 MW during the summer and winter periods, respectively.

Ontario and New York Niagara are synchronously connected.

The Ontario – New York St. Lawrence Interconnection (60 Hz)

The Ontario – New York St. Lawrence interconnection consists of two 230 kV circuits. The interconnection is constrained by thermal limitations and is under the control of phase angle regulators.

The limit on this interconnection is 300 MW for flows into Ontario and out of Ontario. The interconnection is constrained by thermal limitations in the winter and summer or NY scheduling limits.

Ontario and New York St. Lawrence are synchronously connected.

The Ontario – Quebec North Interconnection (60 Hz)

The Ontario – Quebec North Interconnection consists of two 115 kV circuits and is thermally limited.

For flows into Ontario from radial generation in Quebec, the limit is 85 MW under winter conditions and 65 MW under summer conditions. For flows out of Ontario, the limit is 110 MW in the wintertime and 95 MW in the summertime. Ontario and Quebec North are non-synchronously connected.

The Ontario (Ottawa and East zones combined) – Quebec South Interconnection (60 Hz and HVDC)

The Ontario – Quebec South Interconnection consists of five 230 kV circuits, two 115 kV circuits and the HVDC interconnection. The HVDC interconnection has one convertor already in service, with the second convertor expected to be in operation by early fall of 2009.

With only half of the HVDC link operational, the Quebec South Interconnection is limited to 2,098 MW under summer conditions and 2,173 MW under winter conditions for flows into Ontario due to stability limitations and available radial generation. For flows out of Ontario the limits, due to stability and thermal limitations, are 1,192 MW for the summer and 1,262 MW for the winter.

The transfer capabilities will increase by up to 625 MW when the entire HVDC interconnection becomes operational.

Parallel Path flows between Michigan & New York Niagara

With partial phase angle regulator (PAR) control the Ontario – Michigan interconnection scheduled imports and exports between Ontario – Michigan and/or Ontario – New York Niagara are subjected to parallel path flows. These flows occur between Michigan and New York Niagara, north of Lake Erie through Ontario and south of Lake Erie through Pennsylvania, due to a combination of transmission system impedance with interconnection-wide load/generation dispatch. As a result, the actual flows on the Michigan and New York Niagara interconnections may not equal the scheduled flows. For scheduled Ontario – Michigan power flows, part of the scheduled flows may flow on the NY Niagara interconnection due to parallel path flows. Likewise, for scheduled Ontario – New York Niagara power flows, part of the scheduled flows may flow on the Ontario – Michigan interconnection.

Lake Erie Circulation (LEC) is a measure of the use of the Ontario transmission system by external parties in neighbouring jurisdictions. It is calculated using measured flows on the Michigan interconnection, measured flows on the New York interconnection, scheduled Michigan transactions and scheduled New York transactions, and measured internal generation located close to these interconnections. The flow can circulate through Ontario in a clockwise direction, in at Michigan and out at New York, or in counterclockwise direction, in at New York and out at Michigan. LEC flows also appear on the BLIP and QFW interfaces as they are in a direct series path.

Without full PAR control of the Ontario – Michigan interconnection, power flows across the Michigan interconnection are comprised of scheduled direct flows, scheduled New York Niagara parallel path flows and LEC. Likewise, power flows across the New York Niagara interconnection are comprised of scheduled direct flows, scheduled Michigan parallel path flows and LEC. This means that the total transfer from these two areas is usually limited to a flow that is less than the sum of the two interconnection flow limits.

When full PAR control of the Ontario – Michigan interconnection is utilized, parallel path flows of up to 600 MW in either direction are expected to be controlled. Control of parallel path flows to levels less than 600 MW should allow scheduled power flows to be maintained between Ontario, Michigan and New York, and should also greatly reduce the incidence of constrained operation of QFW interface.

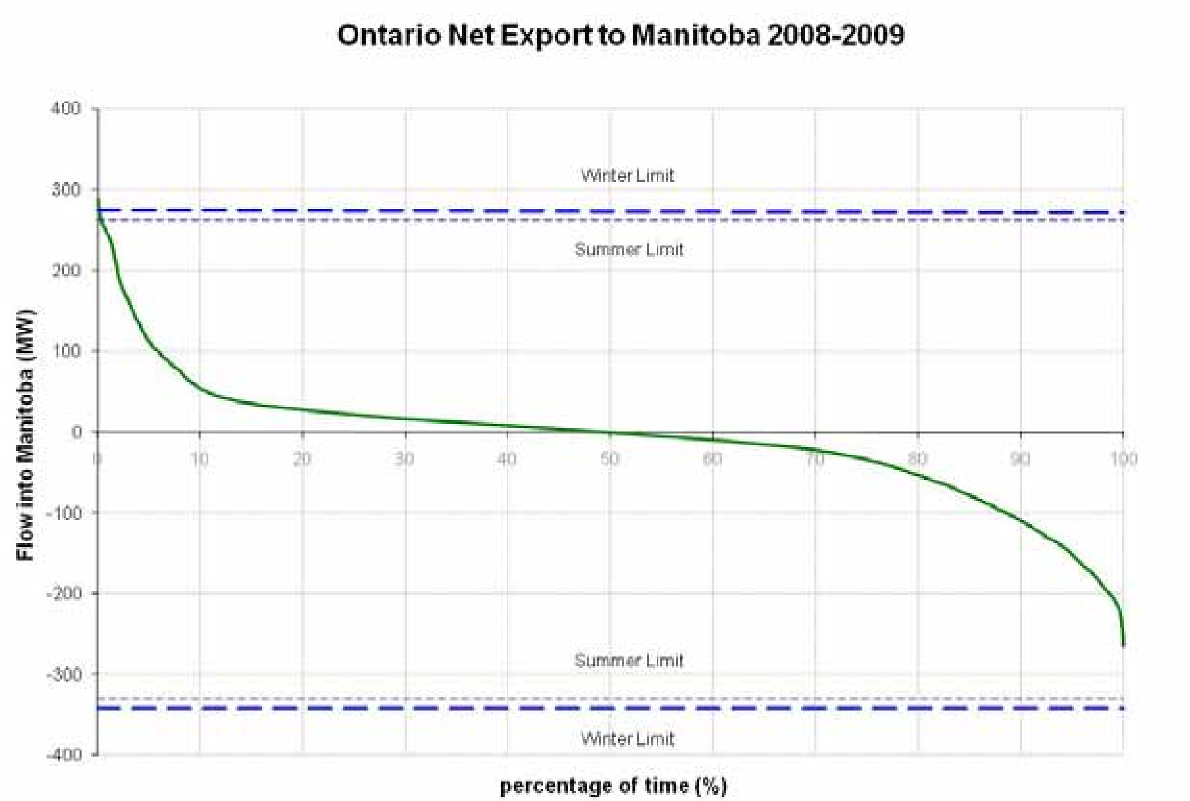
Ontario Coincident Import/Export Capability

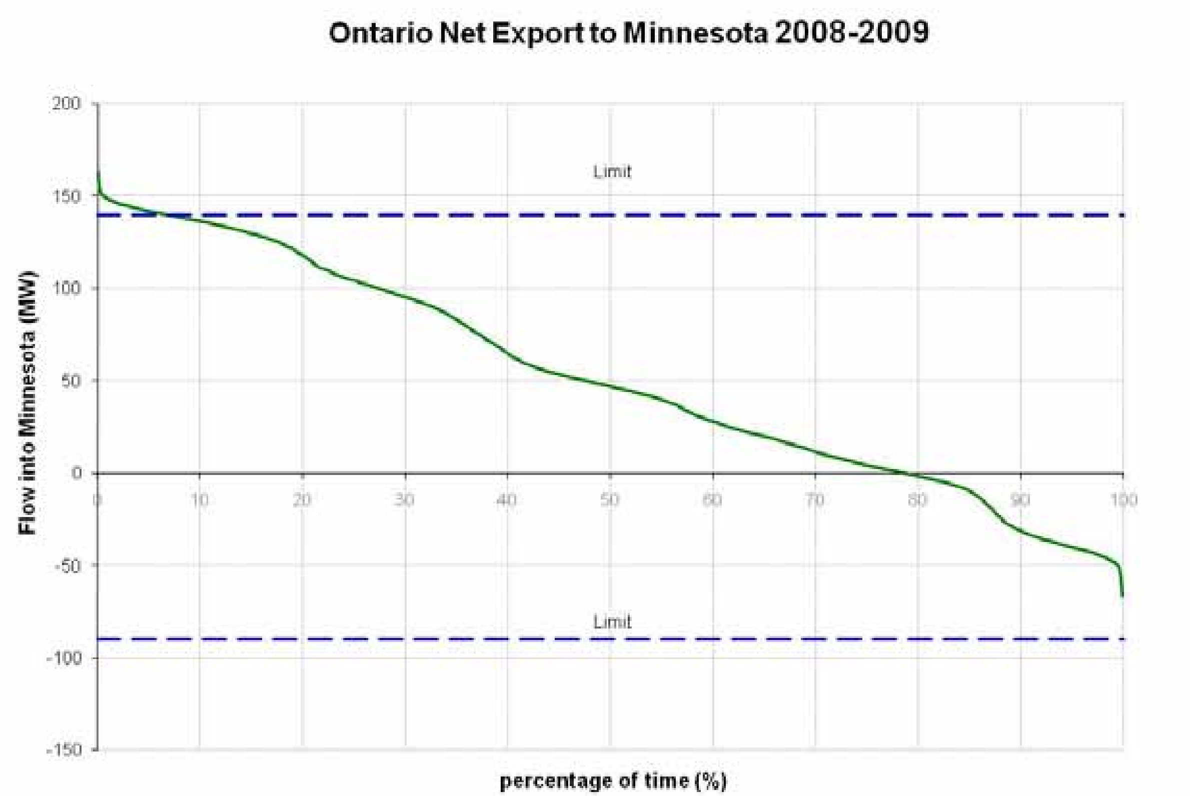
With partial phase angle (PAR) control of the Ontario – Michigan interconnection, the coincident import/export capability is unlikely to equal the arithmetic sum of the individual flow limits. At best, the total transfer capability is slightly less than the sum of the interconnection flow limits. At worst, the total transfer capability will equal the minimum of either the New York (St. Lawrence plus Niagara) or Michigan interconnection flow limit, plus all other interconnection flow limits. In the summer, the theoretical maximum capability for coincident exports could be up to 5,550 MW, and coincident imports up to 5,800 MW. In the winter, 5,750 MW and 6,200 MW respectively.

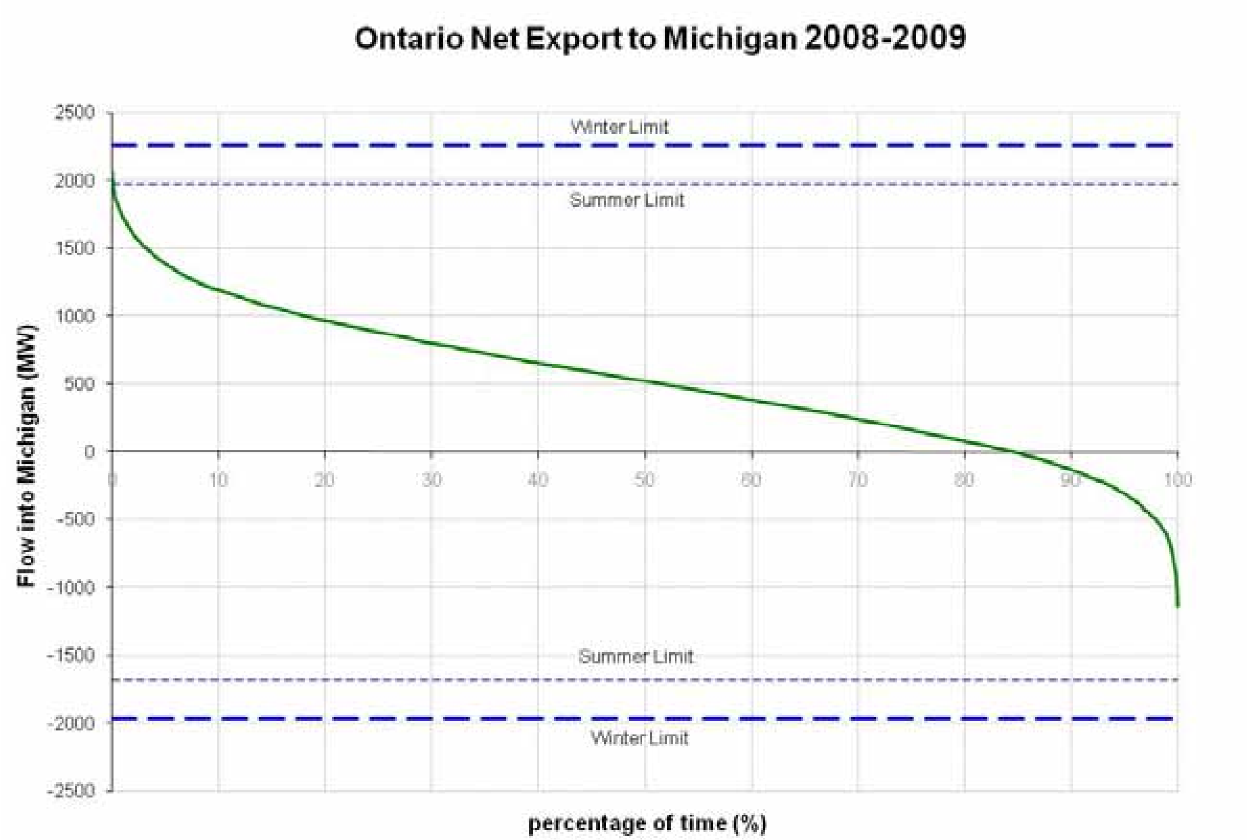
These values represent theoretical levels that could be achieved only with a substantial reduction in generation dispatch in the West and Niagara transmission zones. In practice, the generation dispatch required for these high import levels would rarely, if ever, materialize. Therefore, at best, due to internal constraints in the Ontario transmission network, Ontario has an expected coincident import capability of approximately 4,600 MW. With the Ontario to Quebec HVDC link fully operational, this value is expected to increase by up to 625 MW.

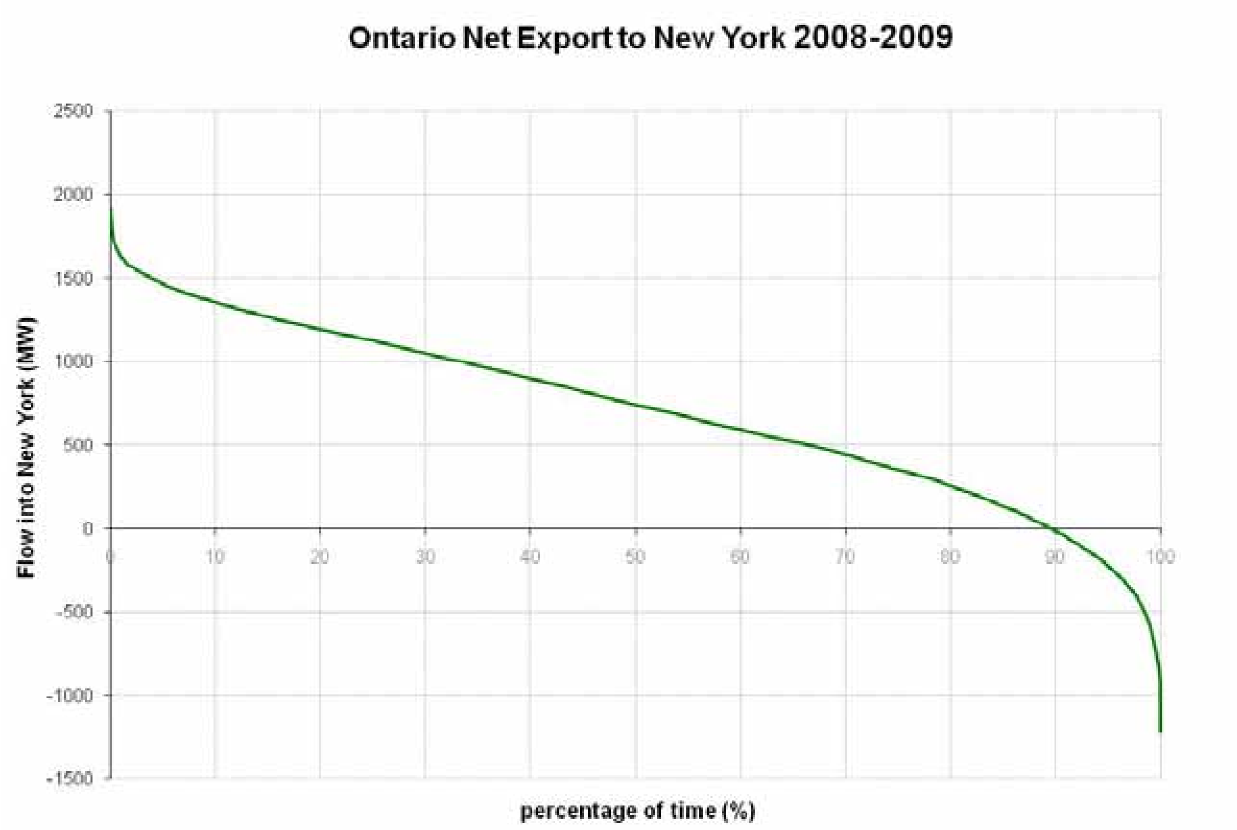
Previous studies have shown that when full PAR control is available on the Ontario – Michigan interconnection, flow control of up to 600 MW could be achieved. When circulation is limiting, this control will act to improve the coincident import/export capability.

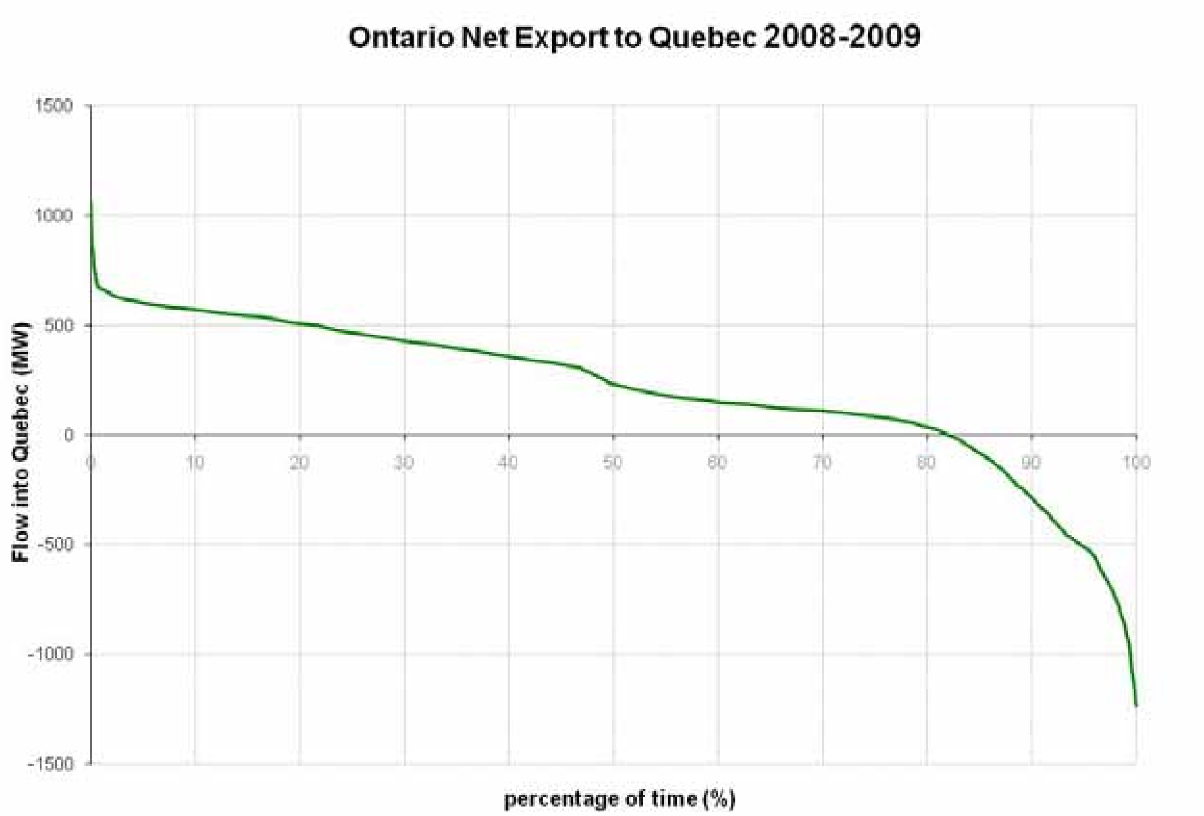
Figures 5.3.1 Historical Flow Distribution – Interconnections

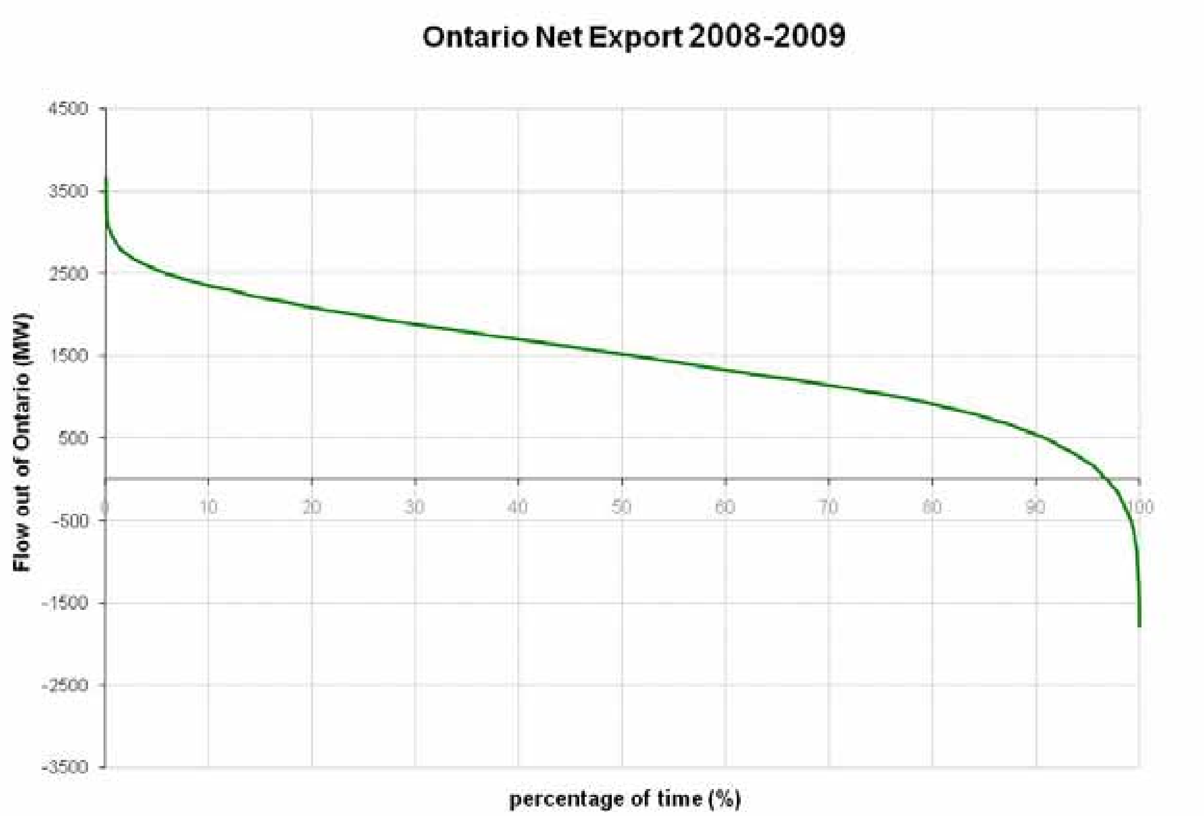





Ontario Net Export to Michigan 2008-2009
Winter Limit
Summer Limit
Summer Limit
Winter Limit
Flow into Michigan (MW)
percentage of time (%)
2500
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
0
10
20
30
40
50
60
70
80
90
100


Ontario Net Export to New York 2008-2009
Flow into New York (MW)
percentage of time (%)
2500
2000
1500
1000
500
0
-500
-1000
-1500
0
10
20
30
40
50
60
70
80
90
100





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