Ontario Transmission System

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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.

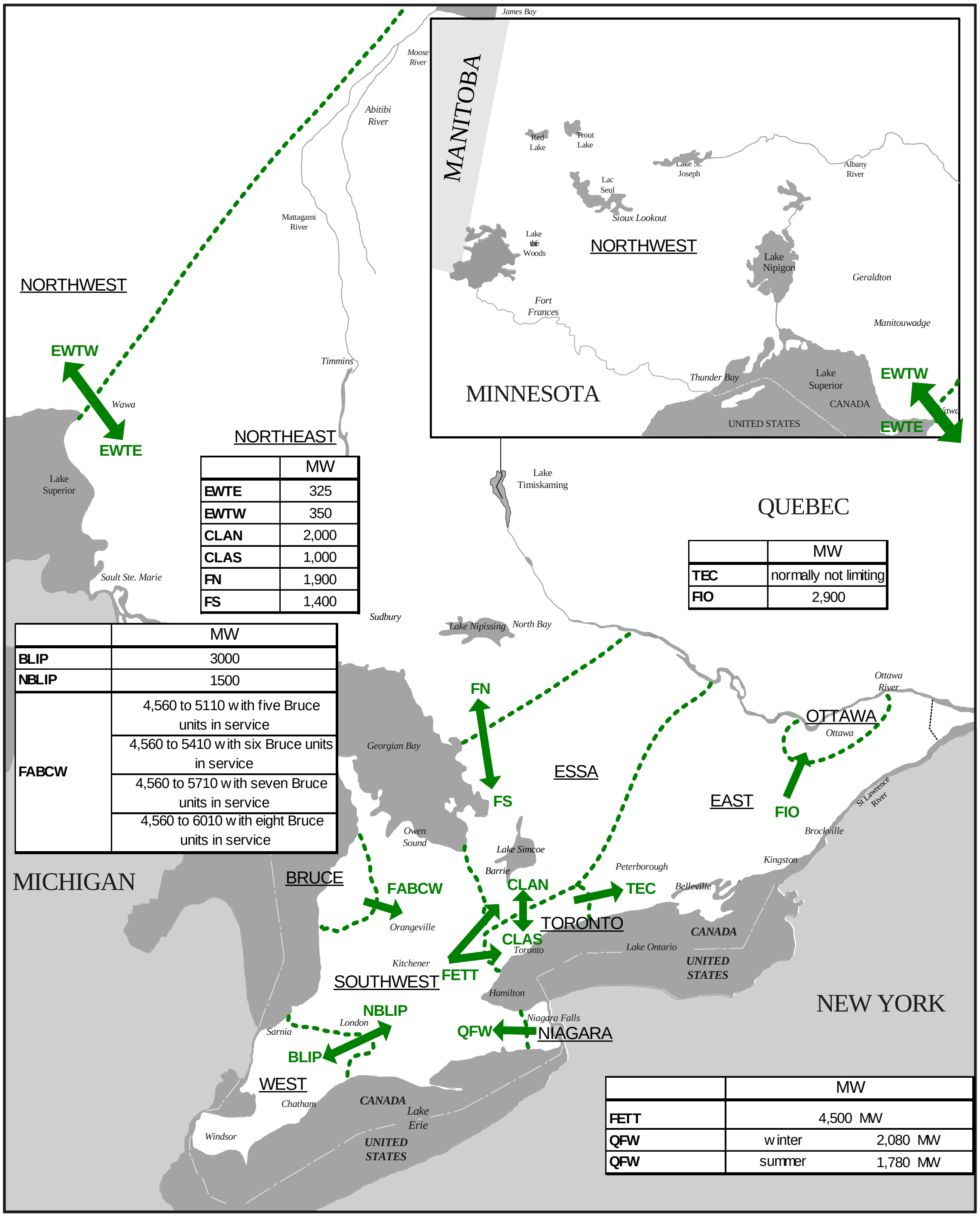
Operating security limits for these interfaces and interconnections are also included in Figures 2.1.1 and 2.1.2. An explanation of the limit values shown in the tables is contained in Sections 3.3 and 5.3. The interconnection and interface limits are used to ensure system and/or plant stability, acceptable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

The reader should be aware that this release of the document includes significant revisions of the internal transmission interfaces in Southern Ontario and their limits resulting from the latest major limit review study.

Figure 2.1.1 Ontario's Major Internal Transfer Interfaces



	MW
EWTE	325
EWTW	350
CLAN	2,000
CLAS	1,000
FN	1,900
FS	1,400

	MW
TEC	normally not limiting
FIO	2,900

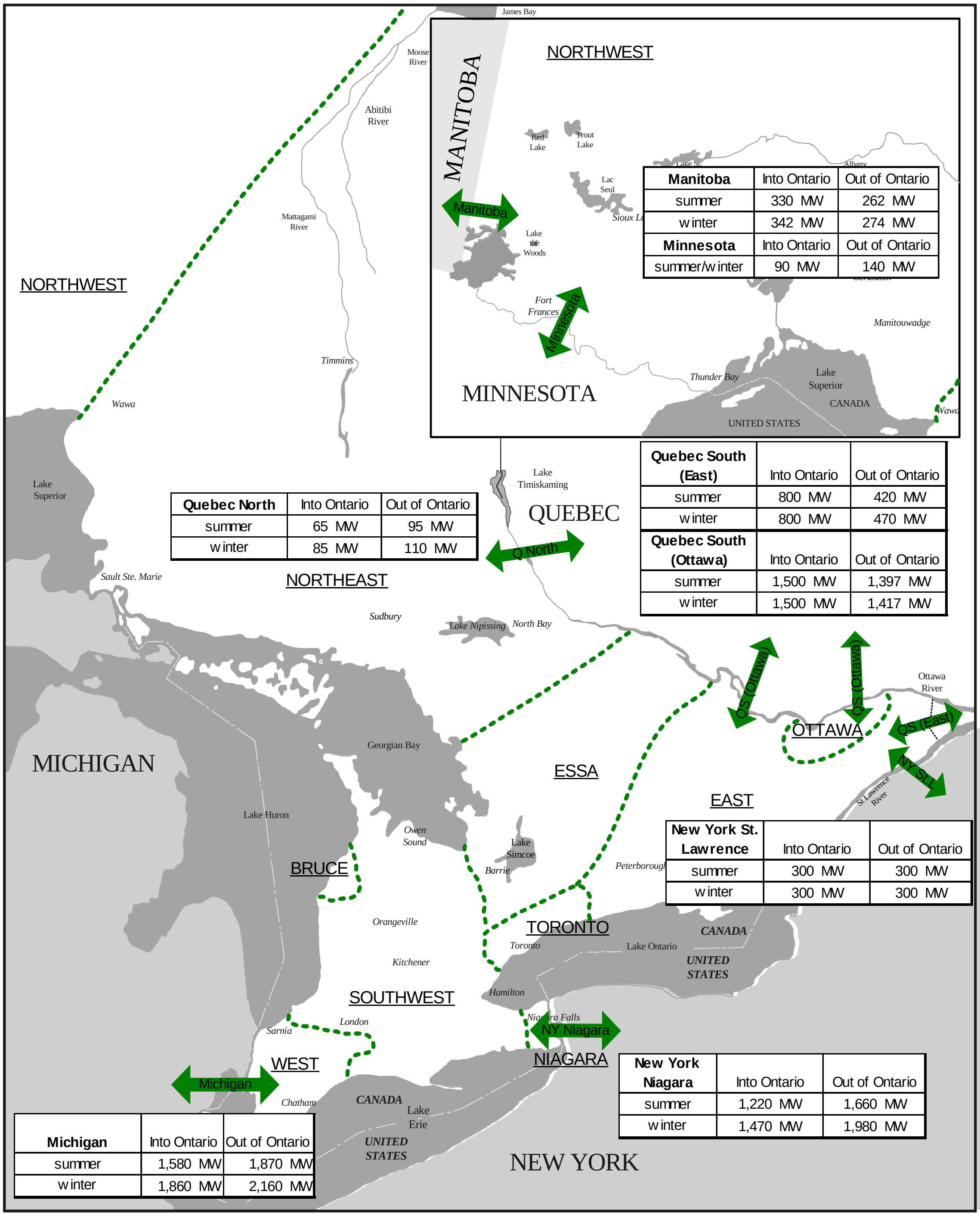
	MW
BLIP	3000
NBLIP	1500
FABCW	4,560 to 5110 with five Bruce units in service
	4,560 to 5410 with six Bruce units in service
	4,560 to 5710 with seven Bruce units in service
	4,560 to 6010 with eight Bruce units in service

	MW	
FETT	4,500 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	1,500 MW	1,397 MW
winter	1,500 MW	1,417 MW

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

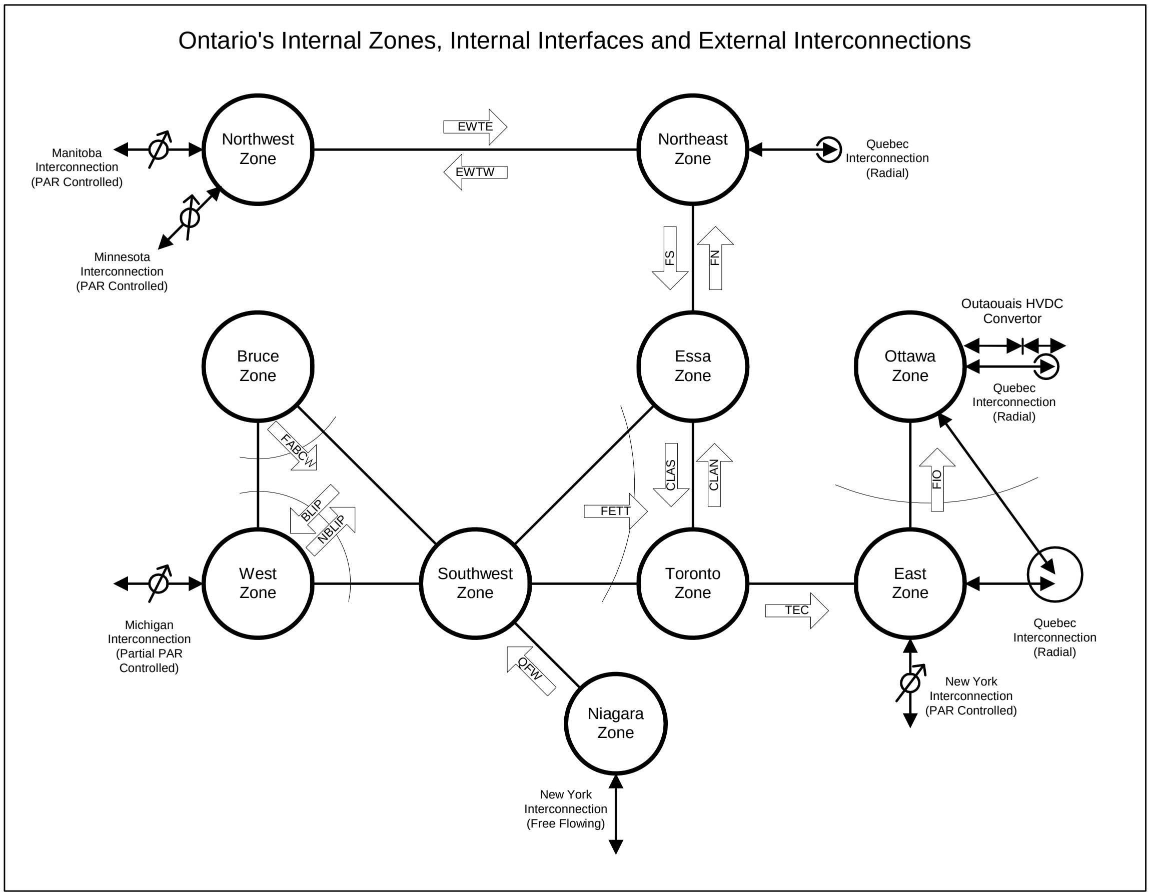
New York Niagara	Into Ontario	Out of Ontario
summer	1,220 MW	1,660 MW
winter	1,470 MW	1,980 MW

Michigan	Into Ontario	Out of Ontario
summer	1,580 MW	1,870 MW
winter	1,860 MW	2,160 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.

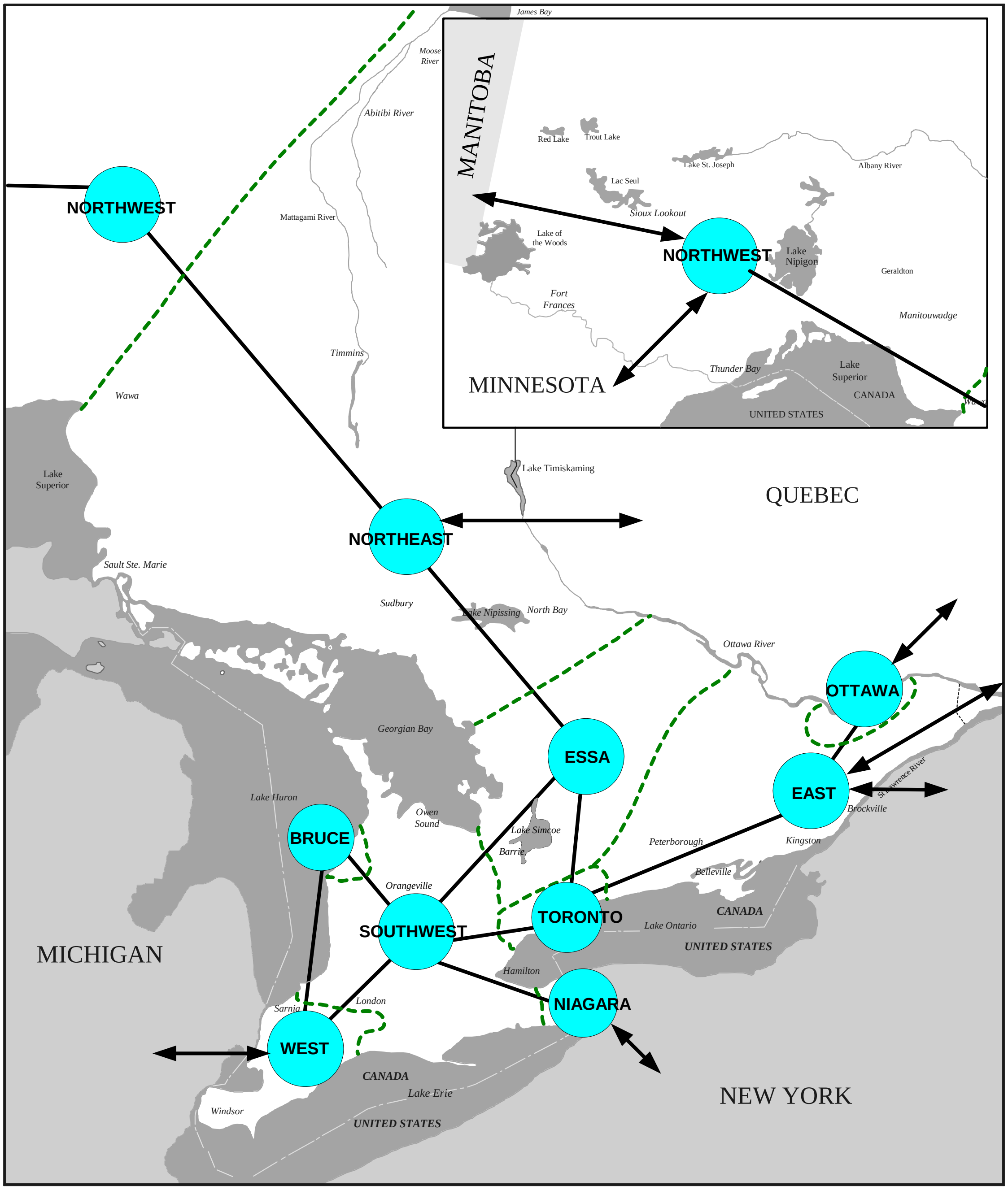
Figure 2.1.3 Ontario's Zones, Interfaces and Interconnections



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 2.1.1. 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 under normal conditions are shown.

Note that some limits are simple constants (e.g. BLIP, FETT) 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, FABCW). 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	3,000			
NBLIP	1,500			
QFW	1,780 Summer,		2,080	Winter
FABCW	4,560	to	5,110	with five Bruce units in-service*
	4,560	to	5,410	with six Bruce units in-service*
	4,560	to	5,710	with seven Bruce units in-service*
	4,560	to	6,010	with eight Bruce units in-service*
FETT	4,500 **			
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.

(*) FABCW limit varies according to BLIP flow and QFWN (QFW plus Nanticoke) 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 and QFWN @ 4000MW.
Upper limit based on BLIP @ 3000MW and QFWN @ 4000MW.

(**) FETT is a fixed boundry condition limit.

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 Figure 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 Figure 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 FABCW, are valid. A sample of historical flow distribution on the CLAN/CLAS interface is shown in Figure 3.3.1.

The FABCW Interface

The Flow Away from Bruce Complex plus Wind (FABCW) is the sum of power flows away from the Bruce Complex plus the power output from the wind farms in the Bruce zone. The limit depends on the number of Bruce units in-service, the BLIP/NBLIP interface flow, the sum of the QFW interface flow and the output of Nanticoke generating station, as well as a number of other system parameters. The FABCW limit is required for preserving system and/or plant transient stability, and to protect against post-contingency voltage collapse in Southwestern Ontario. 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.

The limits provided in table 3.2 are calculated for a combined QFW flow and Nanticoke output of 4000 MW, with 6 Nanticoke units in service. The unavailability of other system parameters such as reactive support provided from major generating stations and reactor switching would likely result in a lower limit.

The FABCW limit can be improved through the use of generation rejection (G/R) of Bruce 500 kV units. The resulting limit improvements with G/R are not specified in this document, but are described in detail in the appropriate SCO.

A sample of historical flow distribution on the FABCW interface is shown in Figure 3.3.1.

The BLIP/NBLIP Interface

Buchanan Longwood Input (BLIP) interface is limited to 3,000 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 Figure 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 Figure 3.3.1.

The FETT Interface

The Flow East Towards Toronto (FETT) interface limit was defined to prevent voltage collapse in the Toronto Area. Based on historical and expected flows, it was determined that the FETT interface is no longer limiting under normal conditions. As a result, the FETT interface limit becomes a boundary condition for which the other Southern Ontario limits are valid. The limit of this interface is 4,500 MW.

There is no limit specified for flows to the west, as the current level of flows expected in that direction is low. A sample of historical flow distribution on the FETT interface is shown in Figure 3.3.1.

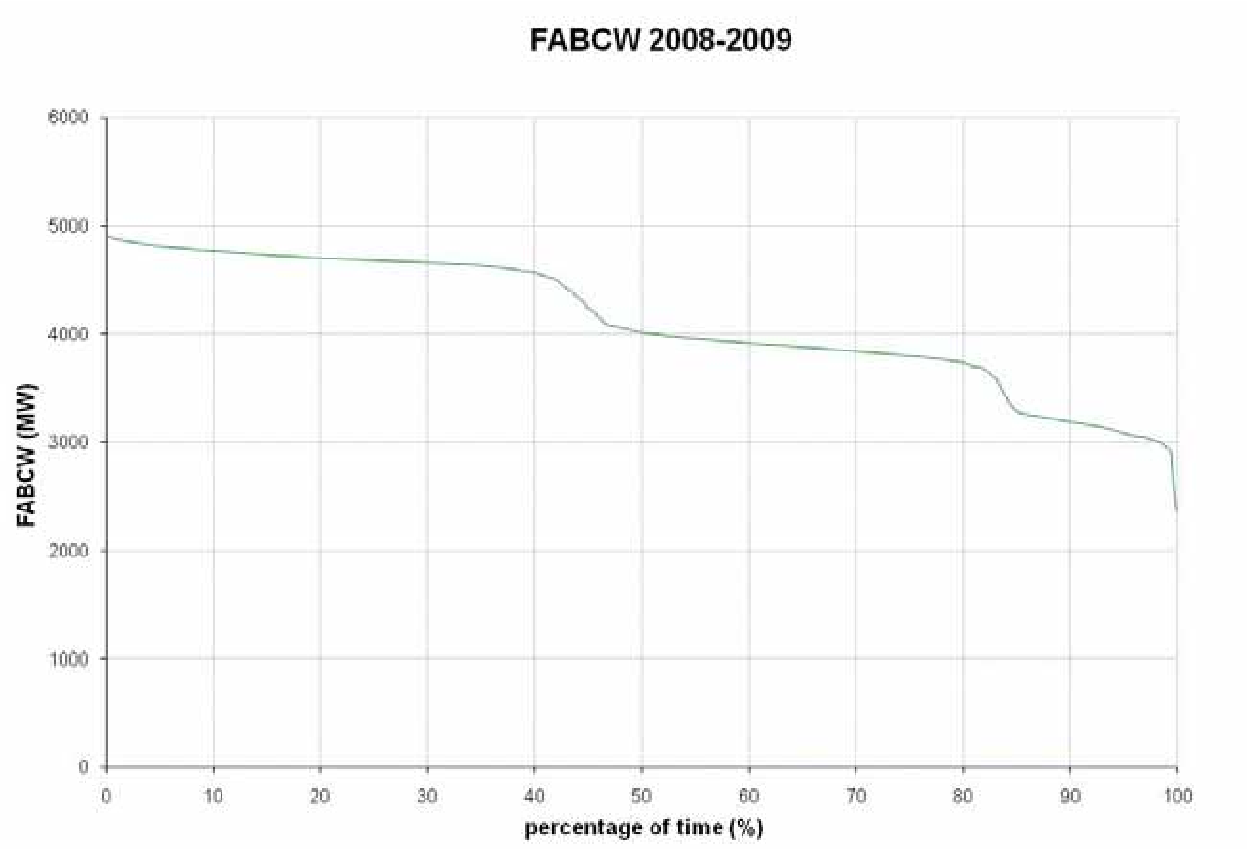
The TEC Interface

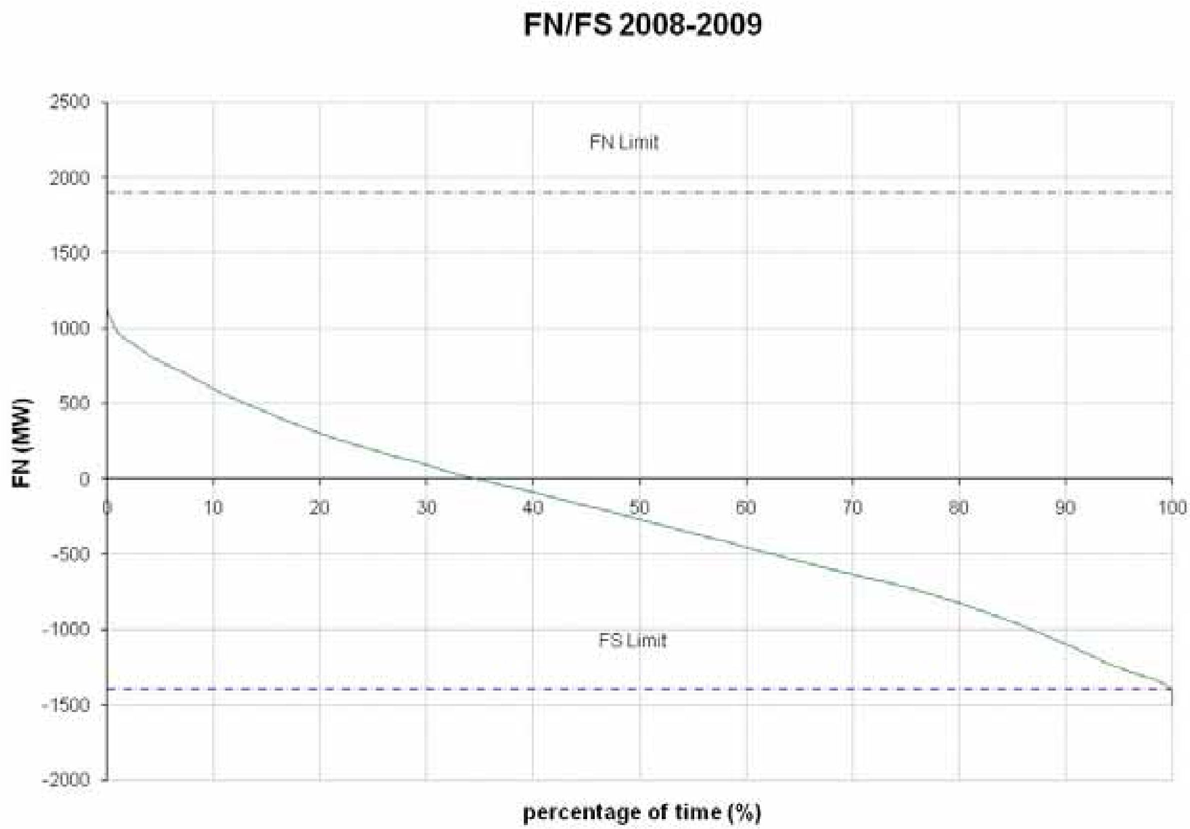
The Transfer East from Cherrywood (TEC) interface does not have a pre-defined limit for up to any one single element out of service. The TEC interface is included to provide a boundary between the Toronto and East transmission zones. With these zones defined, specific studies can be conducted to consider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

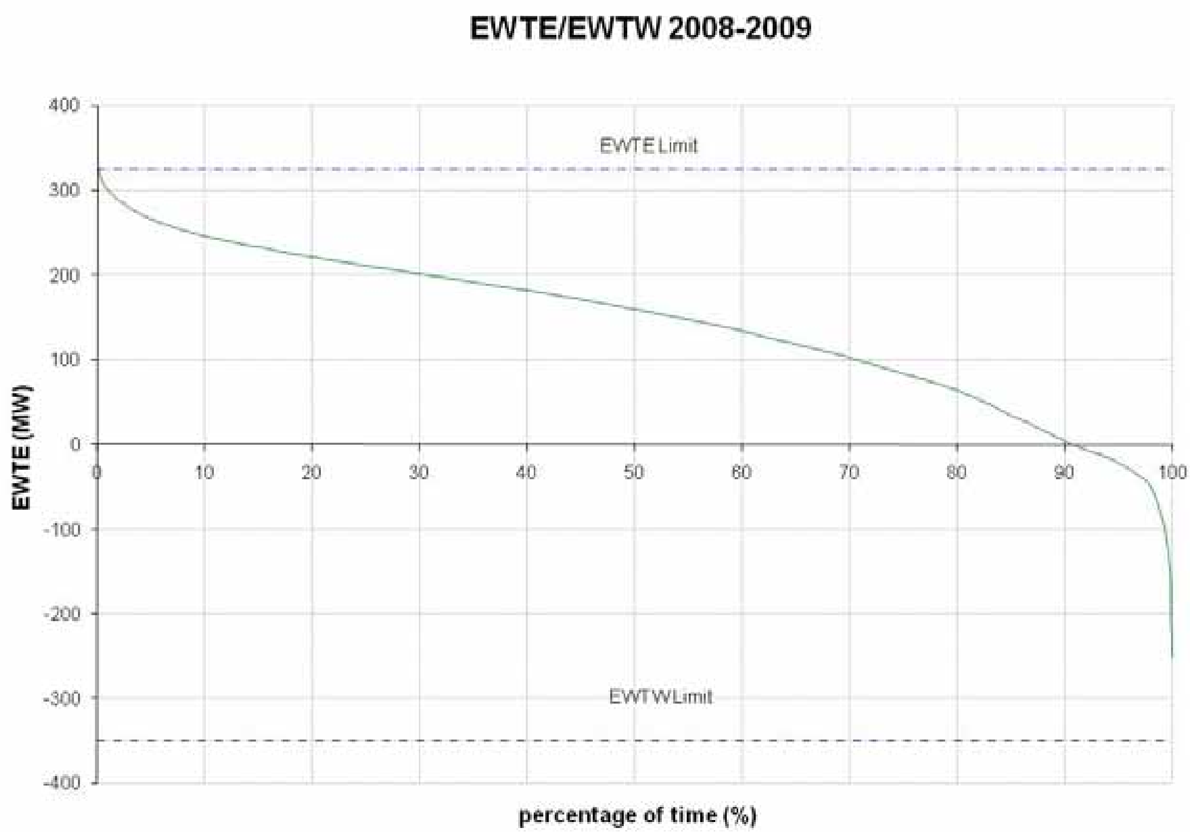
The FIO Interface

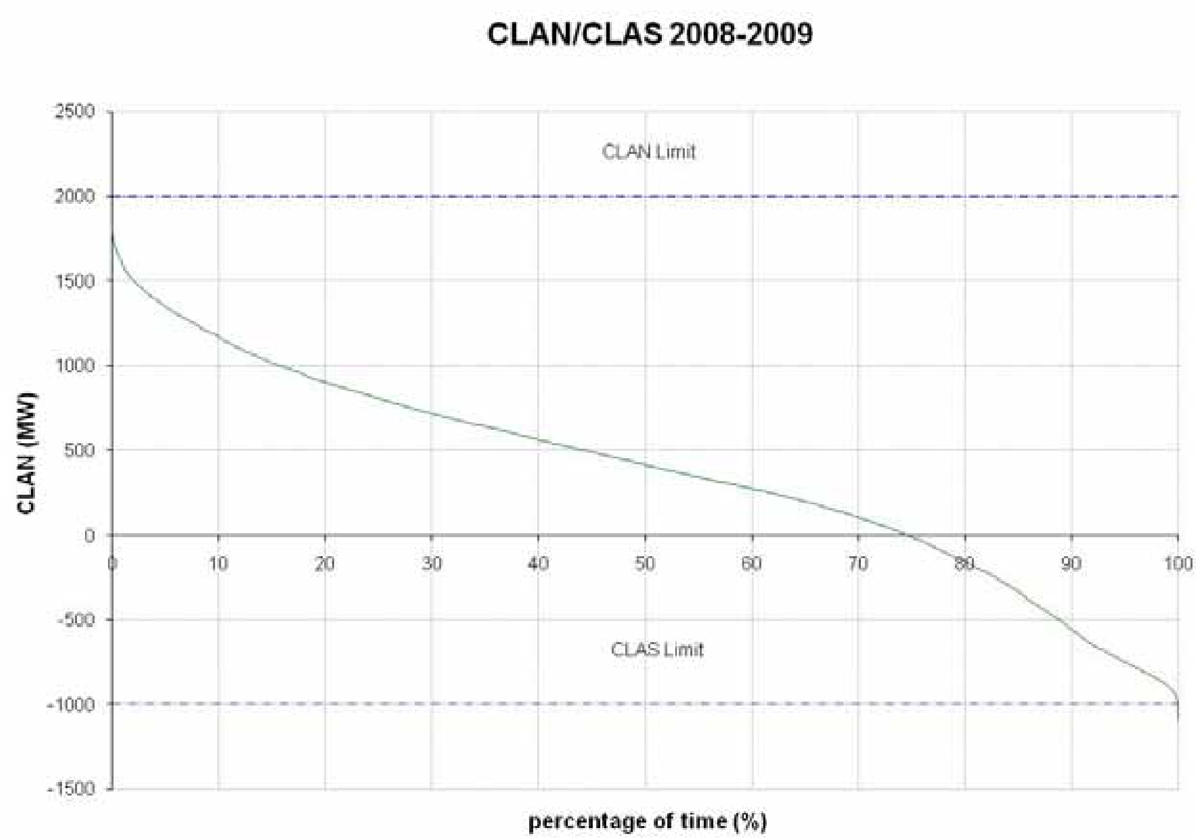
With the addition of the new interconnection between Ontario and Quebec, the Flow Into Ottawa (FIO) interface is limited to 2,900 MW to control pre-contingency and post-contingency voltage instability in the Ottawa zone. There is no limit specified on this interface for flows to the East zone. Under 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 Figure 3.3.1.

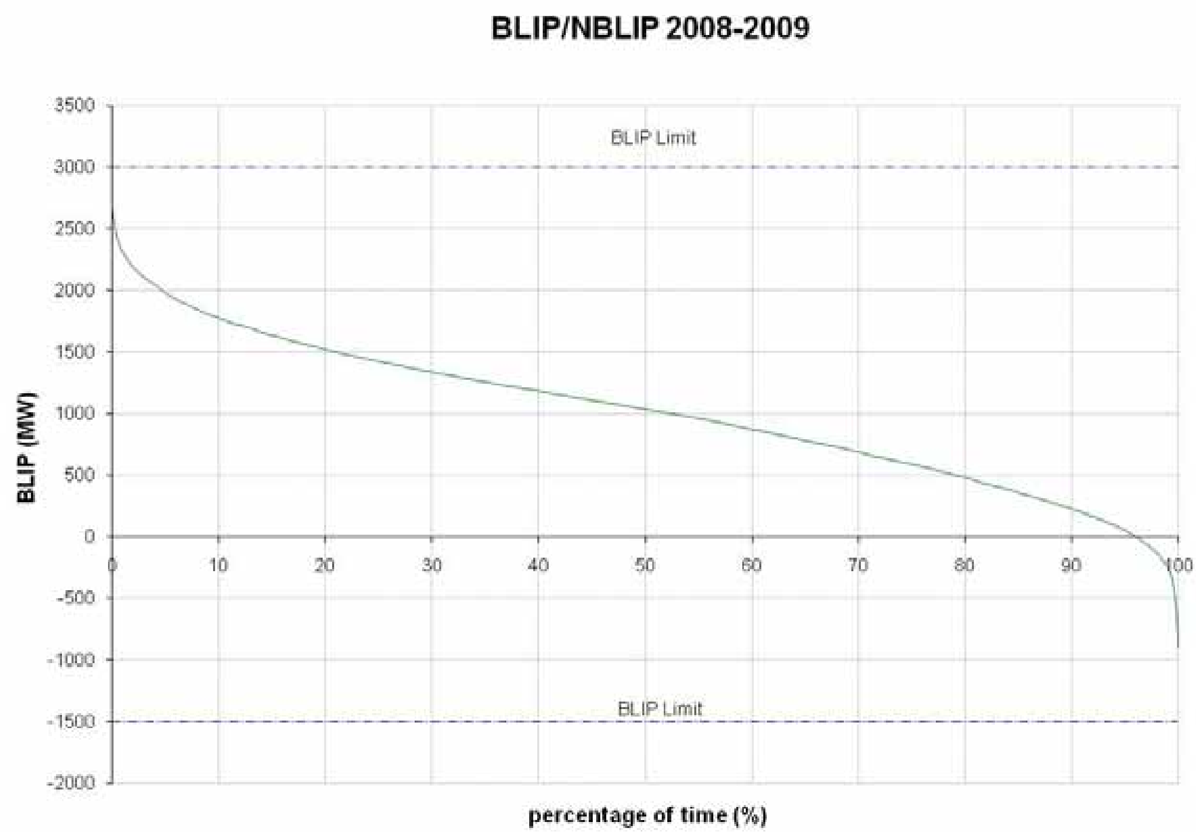
Figure 3.3.1 Historical Flow Distribution – Interfaces

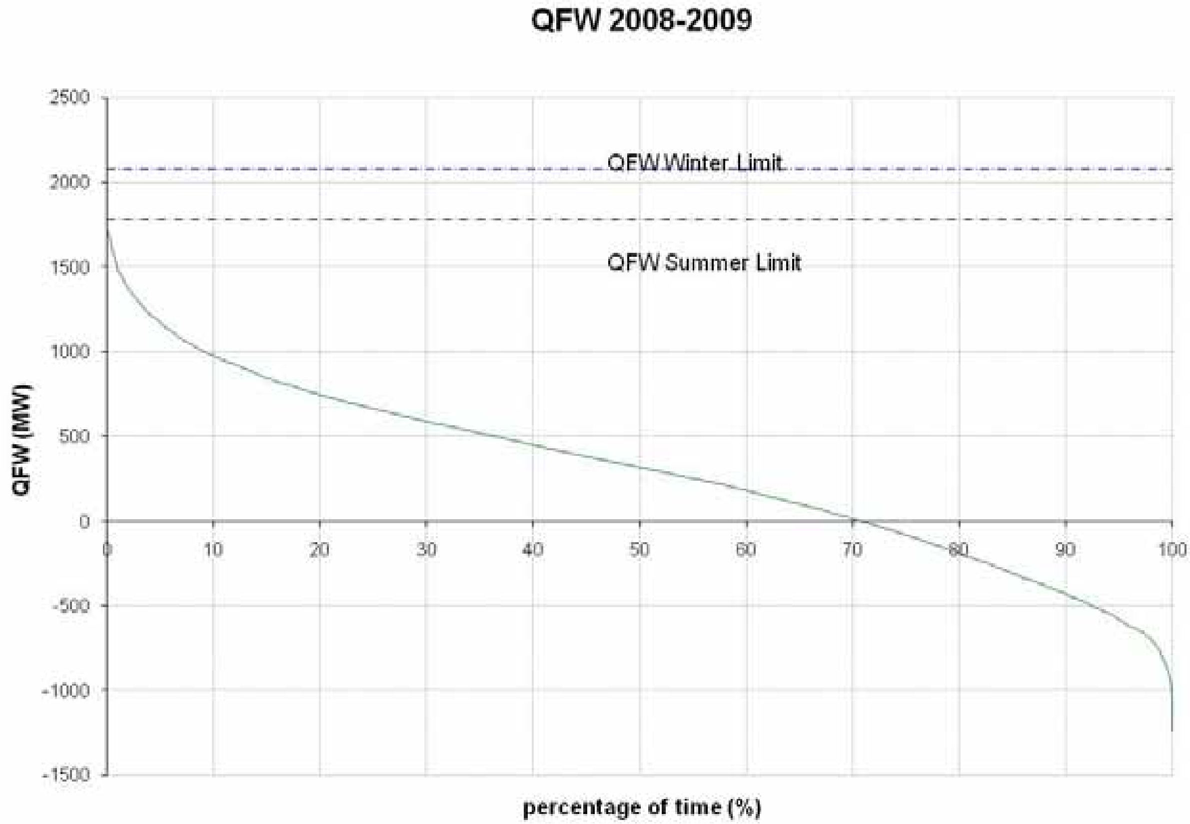


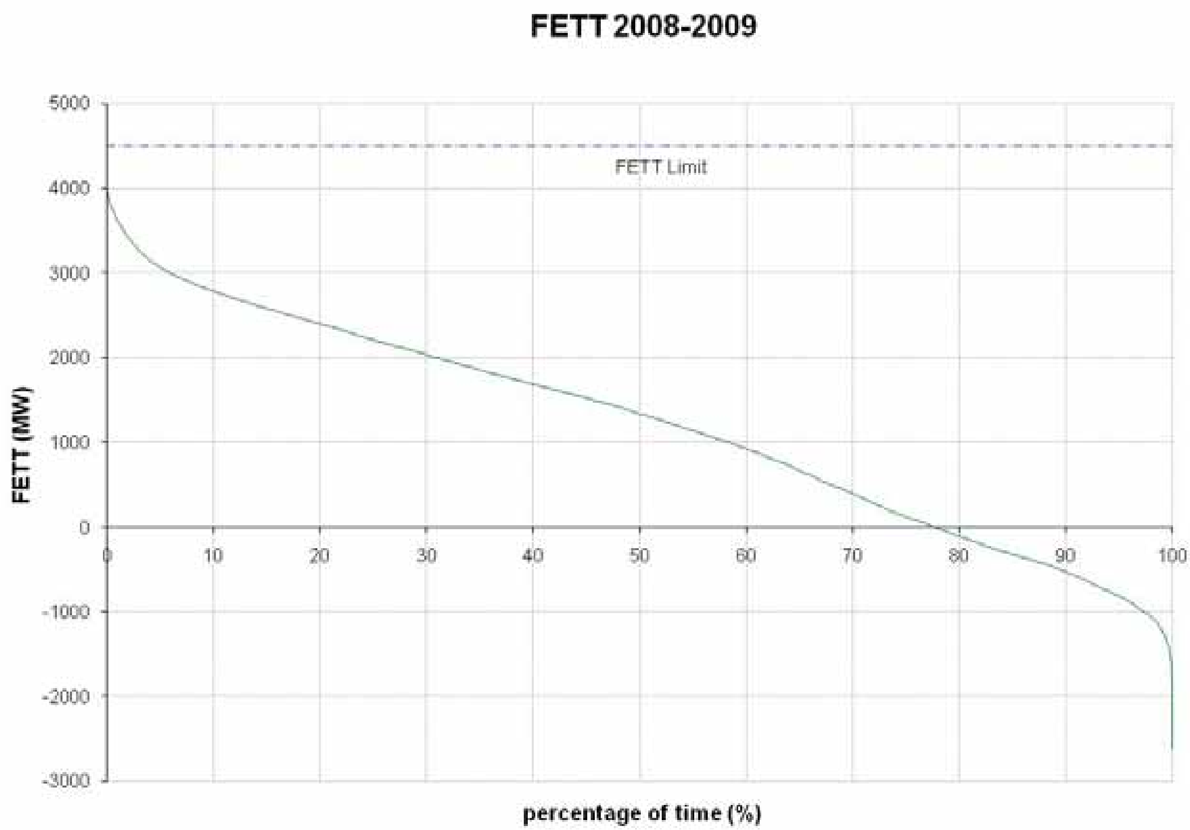

FN/FS 2008-2009
FN Limit
FS Limit
FN (MW)
2500
2000
1500
1000
500
0
-500
-1000
-1500
-2000
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)

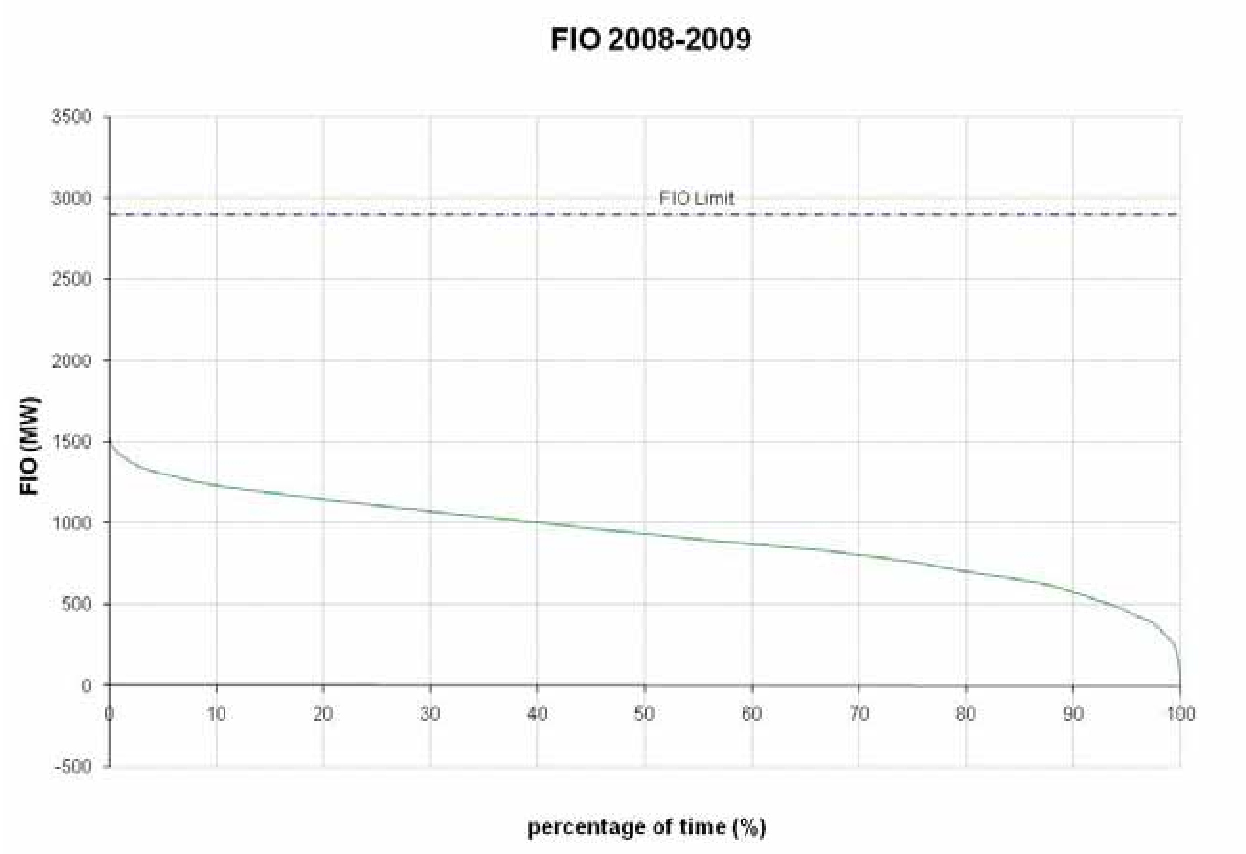

EWTE/EWTW 2008-2009
EWTE Limit
EWTW Limit
EWTE (MW)
400
300
200
100
0
-100
-200
-300
-400
0
10
20
30
40
50
60
70
80
90
100
percentage of time (%)


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)
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
-1500
-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)
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 two 115 kV circuits, three 230 kV circuits, and the new 230 kV circuits A41T and A42T. The first five interconnections are radial, while the new two interconnections are bidirectional, connecting Ontario to Quebec through two HVDC convertors located at Outaouais station, in Quebec. The convertors are currently undergoing commissioning.

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*	262 (3)	330 (3,6)
Manitoba – Winter*	274 (3)	342 (3,6)
Minnesota	140 (3)	90 (3)
Quebec North (Northeast) – Summer*	95 (5)	65
Quebec North (Northeast)– Winter*	110 (4)	85
Quebec South (Ottawa) – Summer*	1397	1,500
Quebec South (Ottawa) – Winter*	1,417	1,500
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 – Summer*	1,660 (1,8)	1,220 (1,7,8)
Emergency Transfer Limit - Summer*	2,060 (1,8)	1,760 (1,7,8)
New York Niagara – Winter*	1,980 (1,8)	1,470 (1,7,8)
Emergency Transfer Limit - Winter*	2,100 (1,8)	2,100 (1,7,8)
Michigan – Summer*	1,870 (2,3,8)	1,580 (2,3,8)
Emergency Transfer Limit - Summer*	2,450 (2,3,8)	1,850 (2,3,8)
Michigan – Winter*	2,160 (2,3,8)	1,860 (2,3,8)
Emergency Transfer Limit - Winter*	2,550 (2,3,8)	1,900 (2,3,8)

* 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.

(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.

(8) Limits account for the AGC process.

5.3 Interconnection Characteristics

All of Ontario's synchronous interconnections are linked with phase angle regulators (PARs), except for New York – Niagara.

A sample of historical flow distribution on the Ontario interconnections is shown in Figure 5.3.1. Limits are also shown on those 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 2,160 MW and 1,870 MW, respectively. For the flows into Ontario, the winter and summer limits are 1,860 MW and 1,580 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 1,470 MW for flows into Ontario and 1,980 MW for flows out of Ontario. In the summer, the limit is 1,220 MW for flows into Ontario and 1,660 MW for flows out of Ontario. The interconnection is constrained by thermal limitations in the winter and summer.

One of the 230 kV circuits, BP76, is on a long term outage because of the failure of its voltage regulator. Until its return to service, scheduled for August 2010, the transfer capability with New York at Niagara is further reduced to 810 MW in summer and 1,110 MW in winter into Ontario, and to 1,100 MW in summer and 1,390 MW in winter out of Ontario.

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 – New York Total

The power transfers on the Niagara and St. Lawrence interconnections could be further limited by the New York scheduling limits on the Ontario – New York flowgate. When all transmission circuits are in service, the scheduling limits are 1,650 MW to Ontario and 1,900 MW out of Ontario.

With BP76 circuit on outage, the New York scheduling limits on the Ontario – New York flowgate are 1,200 MW to Ontario and 1,650 MW out of Ontario.

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 – Quebec South Interconnection (60 Hz)

The Ontario – Quebec South Interconnection consists of two 230 kV circuits in the East zone, and five 230 kV circuits and two 115 kV circuits in the Ottawa zone. It includes the commissioning 230 kV interconnection from Hawthorne to the HVDC convertors located at Outaouais station in Québec.

The new interconnection has a nominal capability of 1,250 MW. However, its import and export capacity could be limited to less than nominal, depending on level of load and generation in the Outaouais region. After the completion of transmission reinforcement work in Quebec, anticipated for May 2010, the interconnection is expected to be able to operate up to its nominal capacity.

With the new interconnection operational, the Quebec South Interconnection limit is expected to be between 1,850 MW and 2,300 MW under both summer and winter conditions for flows into Ontario, depending on the level of available excess generation in Quebec. For flows out of Ontario, due to stability and thermal limitations, the limits will be 1,817 MW for the summer and 1,887 MW for the winter.

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.

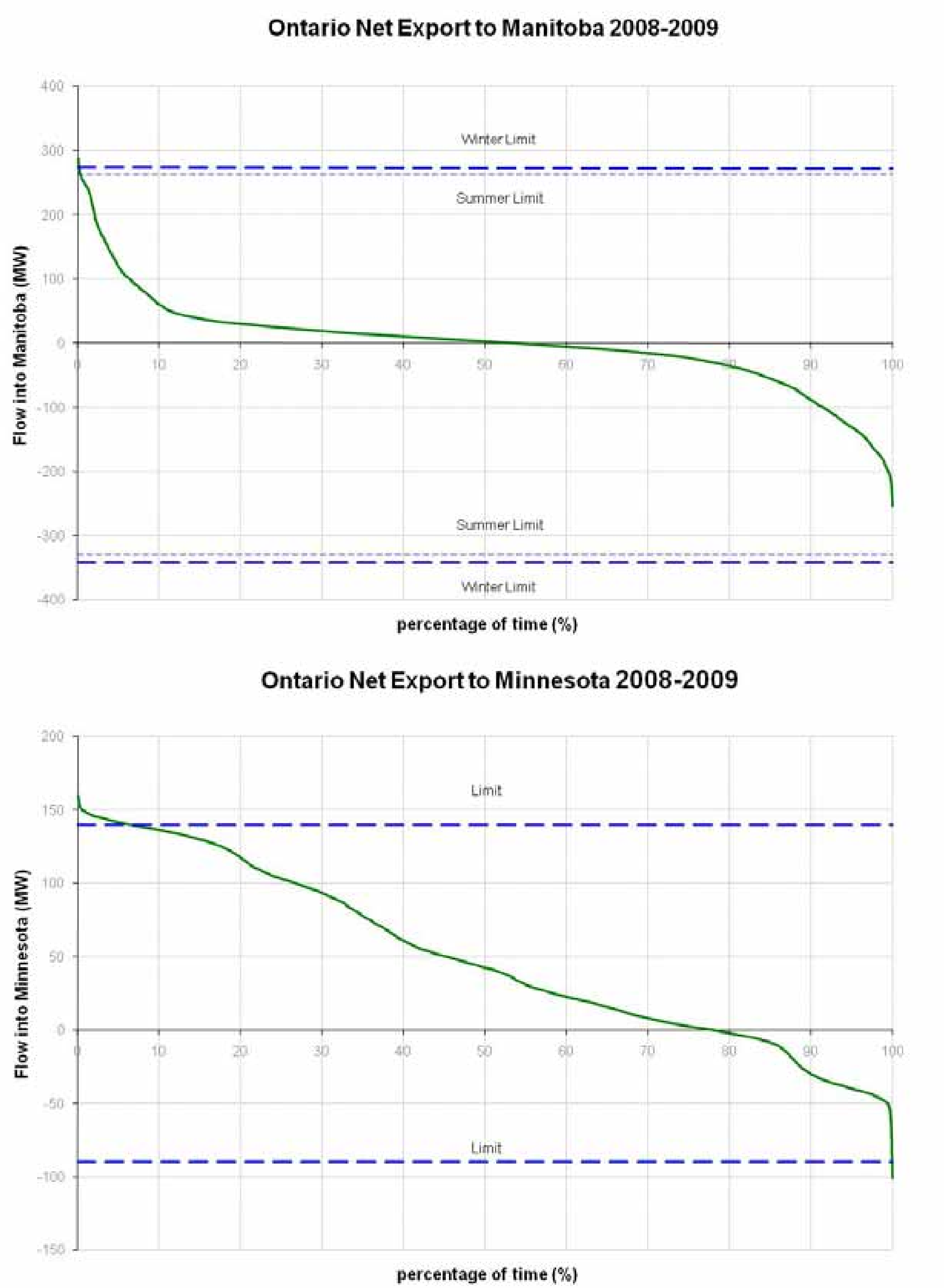
Ontario Coincident Import/Export Capability

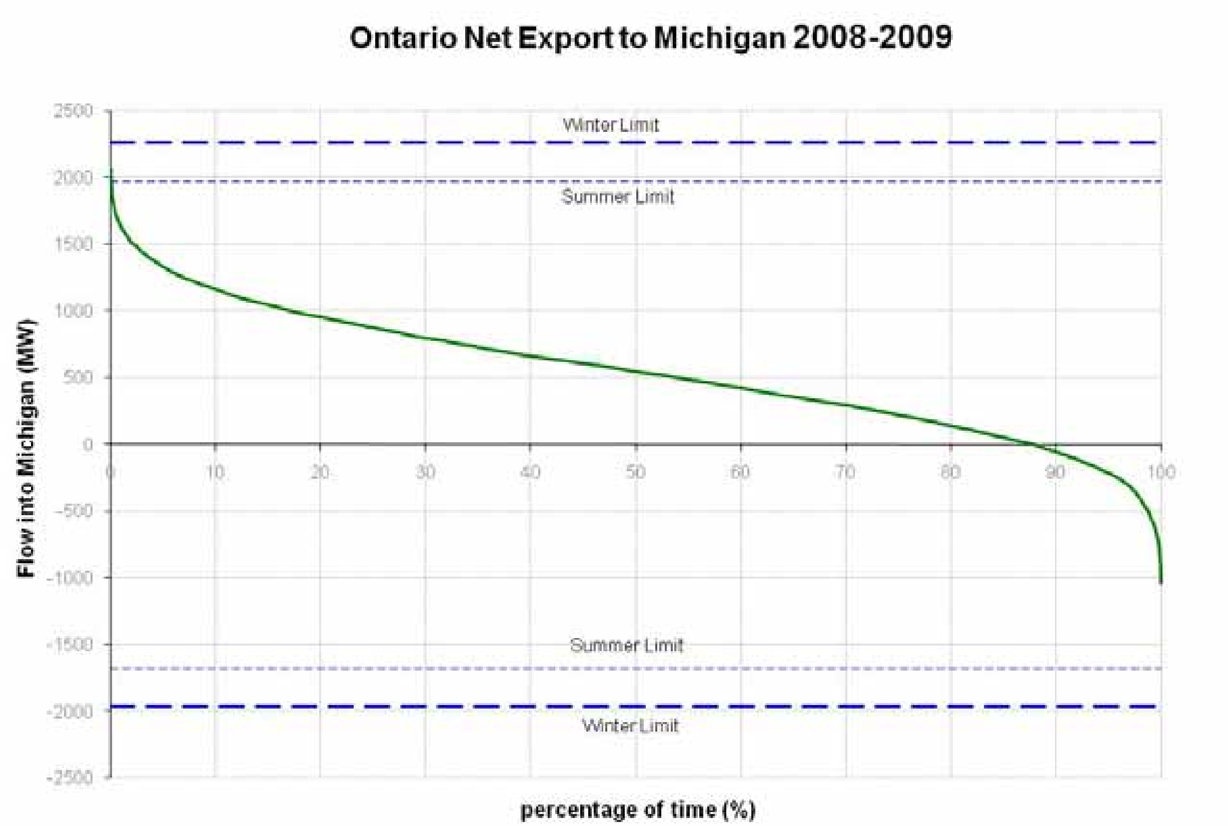
With partial phase angle (PAR) control of the Ontario – Michigan interconnection, the coincident import/export capability is unlikely to equal the arithmetic sum of the individual flow limits. At best, the total transfer capability is slightly less than the sum of the interconnection flow limits. At worst, the total transfer capability will equal the minimum of 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 exports could be up to 6,000 MW, and imports up to 5,850 MW; in the winter, 6,350 MW and 6,300 MW respectively.

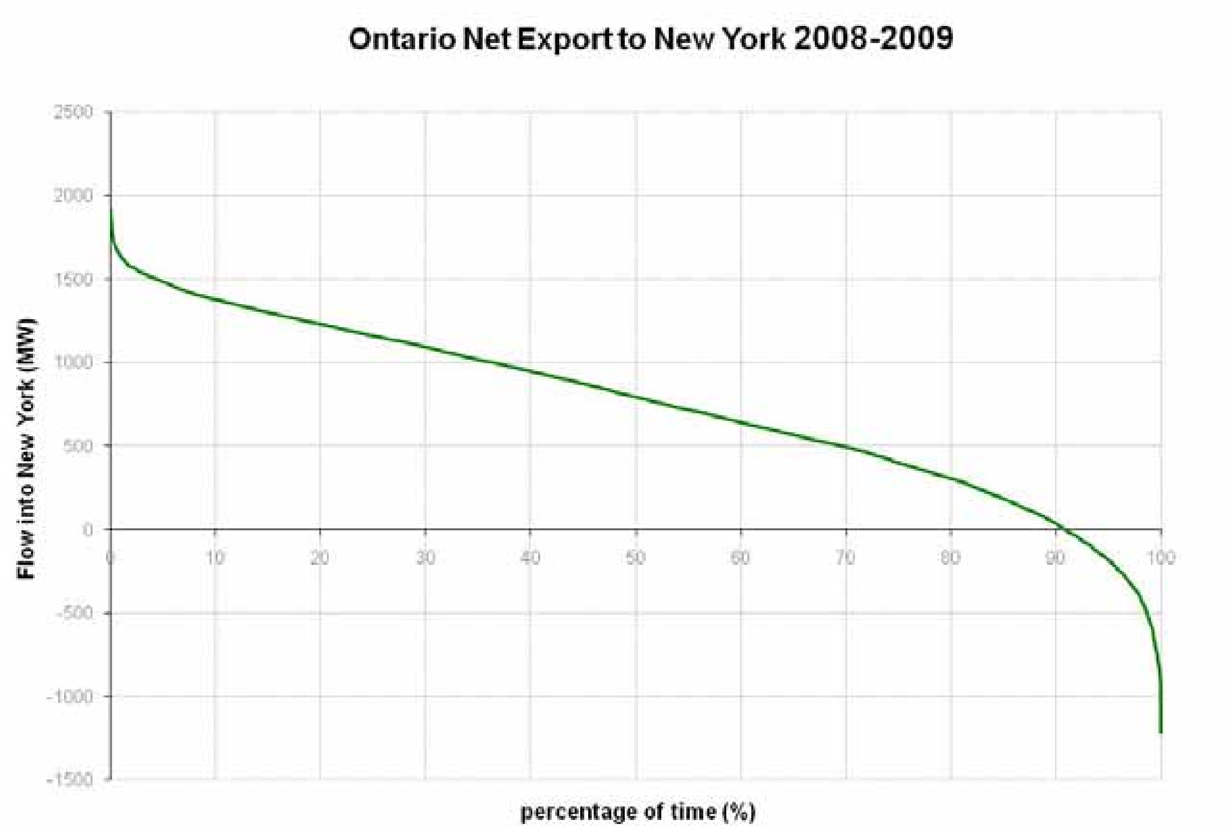
These values represent theoretical levels that could be achieved only with a substantial reduction in generation dispatch in the West and Niagara transmission zones. In practice, the generation dispatch required for high import levels would rarely, if ever, materialize. Therefore, at best, due to internal constraints in the Ontario transmission network in conjunction with external scheduling limitations, Ontario has an expected coincident import capability of approximately 4,600 MW.

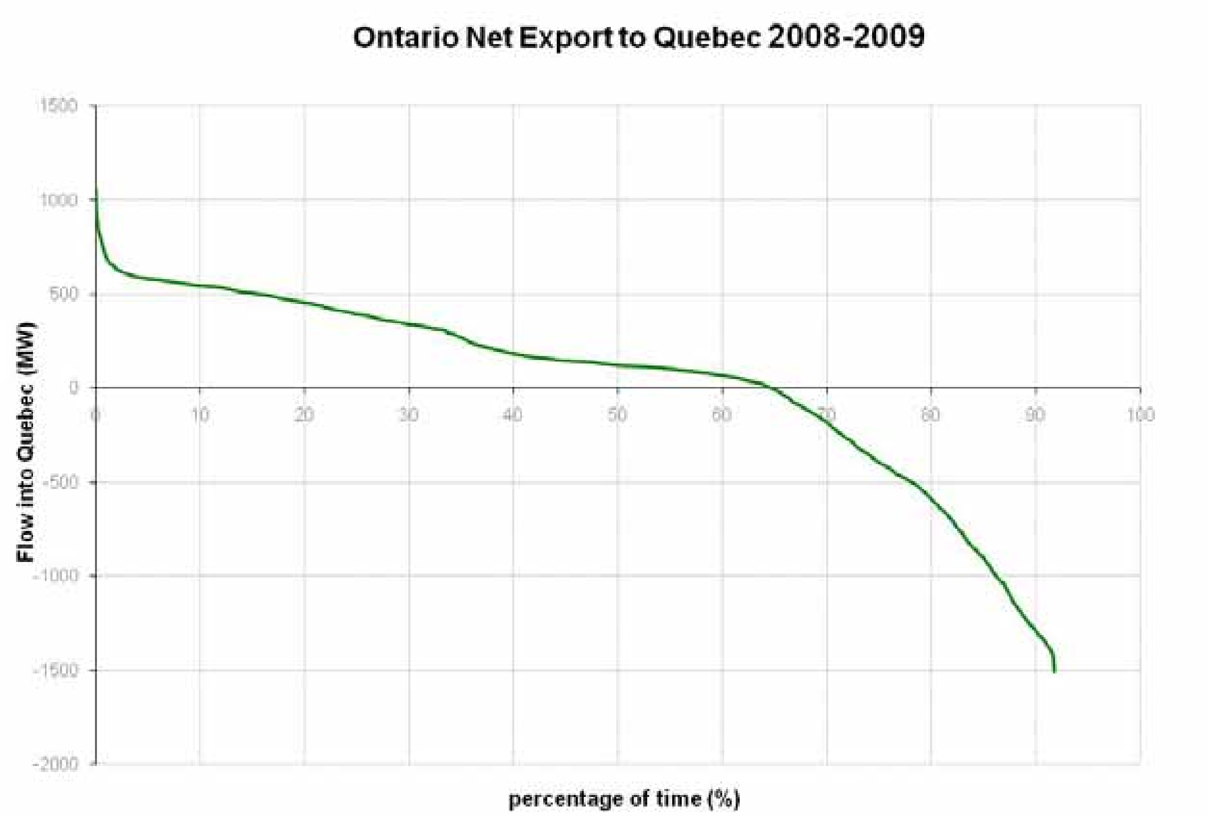
Previous studies have shown that when full PAR control is available on the Ontario – Michigan interconnection, flow control of up to 600 MW could be achieved. When circulation is limiting, this control will act to improve the coincident import/export capability.

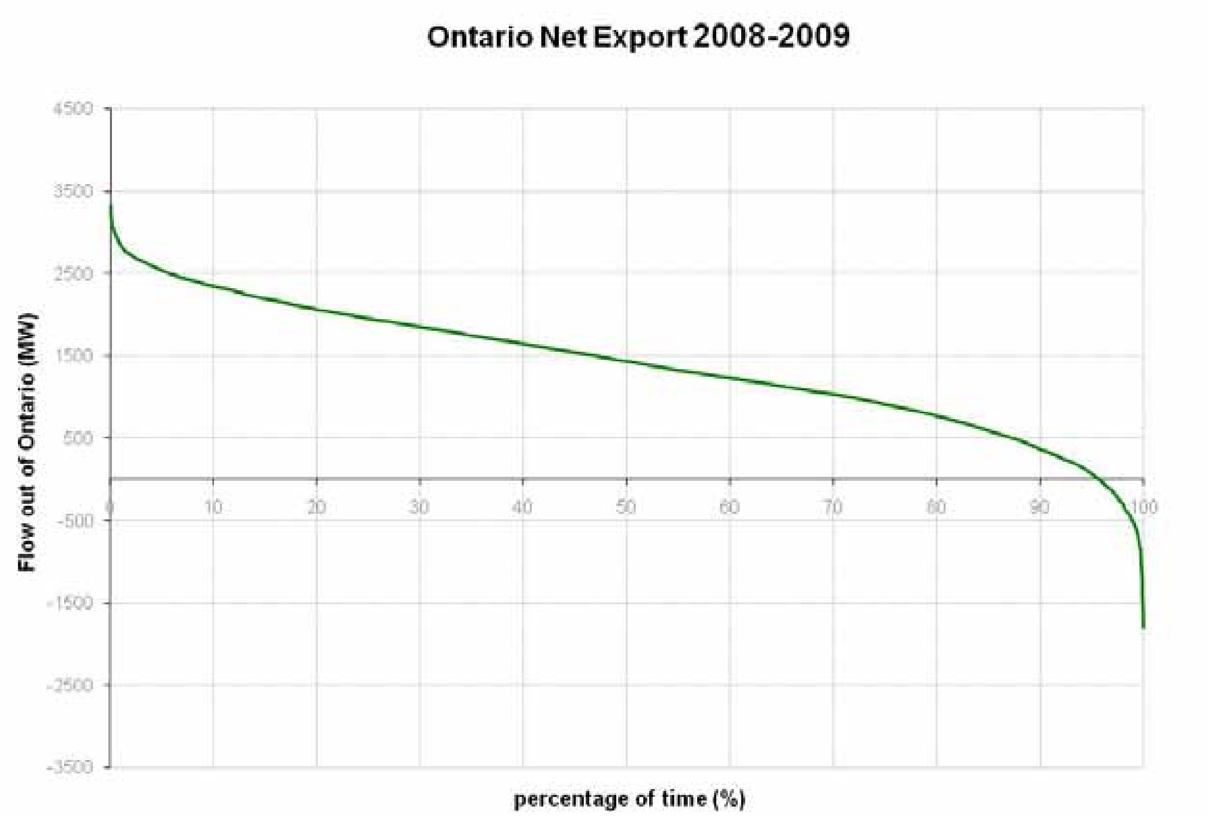
Figure 5.3.1 Historical Flow Distribution – Interconnections




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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