Quick Takes

Net Interchange Scheduling Limit

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Introduction

This issue of **Quick Takes** explains the Net Interface Scheduling Limit (NISL), the impact of the NISL on the scheduling of imports and exports and the NISL shadow price report.

Background

Imports and exports are ramped over a ten-minute period, starting five minutes prior to the start of the dispatch hour. Large schedule changes will result in large ramp rates. For example, a 1000 MW reduction in net imports would be ramped at a rate of 100 MW/min. It would take 15 fossil-fired units, moving at 7 MW/min, to ramp up quickly enough to compensate for this 100 MW/min reduction. Responding to these large changes can have an adverse impact on the reliability of the IESO-controlled grid. To prevent these problems, Ontario's IESO limits the change in the net interchange schedule from hour-to-hour via the net interchange schedule limit (also referred to as the inter-hour ramp limit).

The net interchange schedule is the sum of all imports (positive) and exports (negative). For example, if from one hour to the next, imports were to increase by 700 MW and exports were to decrease by 700 MW you would have a zero net interchange schedule. Table 1 below shows examples of the net change, hour-to-hour, for various combinations of imports and exports.

Hour	1	2	3	4
Total imports	700	1400	1400	1000
Total exports	100	800	0	400
Total net interchange schedule	600	600	1400	600
Net change from previous hour	N/A	0	800	-800

Table 1 – Hour to Hour Net Change example

The IESO limits the net change from hour-to-hour to 700 MW unless respecting this limit would negatively impact reliability, such as during a supply shortfall. This process occurs automatically via the dispatch algorithm or manually if the algorithm is unable to respect the limit.

Processes

Automatic Process

The dispatch algorithm schedules imports and exports in such a way that the 700 MW limit is respected. When necessary, the algorithm will reduce imports or exports that would otherwise lead to a violation of the limit. Or, in order to respect the 700 MW limit, the algorithm may schedule an offer or bid that would not have otherwise been selected.

For example, in the table above there is a net change of 800 MW from Hour 2 to Hour 3. In this case, the algorithm could either reduce 100 MW of imports or increase exports by 100 MW (assuming there are offers and bids to work with). Either change will lead to a net schedule change from the previous hour of 700 MW. All selections are done on an economic basis.

This means that even if there is no congestion on the intertie, it is possible that offers which are lower than the MCP may not be scheduled or offers which are higher than MCP may be scheduled. Similarly, bids that are above the MCP may not be scheduled or bids which are below the MCP may actually be scheduled.

We can illustrate this process with an example. For the sake of simplicity, we will assume there is only one intertie zone with no congestion.

Assume that in Hour 1, the total net interchange schedule is 500 MW. This means the total of imports into Ontario is 500 MW greater than the total of exports from Ontario.

Assume that during the pre-dispatch process for Hour 2, the IESO receives the following bids and offers. In pre-dispatch, the MCP for Ontario is $38 and there is no congestion on the intertie.

Transbord	Import 1300 MW @ $30
Pinepower	Import 300 MW @ $35
Expbord	Export 100 MW @ $50
Genbord	Export 300 MW @ $34
Total potential net interchange schedule	1500
Change from previous hour	1000

Table 2 – Bids and Offers

Ignoring any schedule change limit, both import offers and the export bid by Expbord are economic, however the bid by Genbord is not economic and would not normally be scheduled. The result is a potential net interchange schedule of 1500 MW. This is a change of 1000 MW from the previous hour, which means the algorithm cannot schedule all of the economic bids and offers and stay within the 700 MW limit.

The algorithm must either reduce imports by 300 MW, or increase exports by 300 MW to meet the required 1200 MW interchange schedule. The goal of the algorithm is to maximize gain from trade. Gain from trade is the sum of supplier and consumer Operating Profit.

In this example, increasing exports would mean scheduling Genbord. Genbord bid at $34, so scheduling Genbord would reduce the gain from trade in Ontario by $1200:

($34-$38) x 300 = -$1200

Reducing imports would mean not scheduling Pinepower. This would reduce the gain from trade by Pinepower's Operating Profit of $900:

($38-35) x 300 = $900

So, the algorithm will reduce the amount Pinepower imports rather than schedule the Genbord export because this will have a smaller impact on the net gain from trade.

The resulting schedule becomes:

Transbord	Import 1300 MW @ $30
Expbord	Export 100 MW @ $250
Pinepower	Import 0 MW
Genbord	Export 0 MW
Net interchange schedule	1200 MW
Change from previous hour	700 MW

Table 3 - Schedule

In the previous discussion the algorithm was able to arrive at a solution for the hour. There may be situations where the algorithm cannot avoid the 700 MW limit during a given hour. For example, there may be situations where there are insufficient import offers or export bids during the hour to reduce. In these situations, the algorithm cannot create a schedule that does not violate the 700 MW limit.

If these situations are seen more than five hours prior to the dispatch hour, messages are sent to the market, via the System Status Report, so that participants can adjust their bids and offers accordingly.

Manual Process

If the problem persists, or in situations where the problem is identified less than five hours in advance, the IESO may manually initiate corrective actions to adjust intertie transactions in the hours prior to the hour where the net interchange schedule limit violation would occur.

If necessary, the IESO can reduce an offer or bid which was scheduled in pre-dispatch. If these manual adjustments are required, the following principles will apply:

- Only transactions that contribute to the intertie schedule change limit violation are reduced (i.e., transactions that changed from the previous hour, always excluding wheel-through transactions)
- To the extent possible, transactions will be reduced in the most economic order
- When two or more transactions have the same price, each transaction will be reduced on a pro-rated basis.

We can see how this works through an example.

The IESO receives the following offers to import energy. The Ontario MCP is above $100 for each of the four hours, so all offers are economical. Finally, the intertie has sufficient capacity to allow all the transactions to flow.

	Hour 1	Hour 2	Hour 3	Hour 4
Transbord	400 MW @ $75	400 MW @ $75	400 MW @ $75	400 MW @ $75
Powerport	600 MW @ $65	600 MW @ $65	700 MW @ $65	No offer
Borgpower	No offer	700 MW @ $60	700 MW @ $60	No offer
Total net intertie schedule	1,000 MW	1,700 MW	1,800 MW	400 MW
Change from previous hour	N/A	700 MW	100 MW	-1400 MW

Table 4 – Initial state before NISL limit reductions

We can see a problem from Hour 3 to 4. In this case, there is a reduction of 1400 MW hour-to-hour. There is nothing the algorithm can do to prevent the problem working with the bids and offers in Hour 4.

The IESO must take action in Hour 3 to prevent the limit violation in Hour 4. In order to ensure that the limit is not exceeded, we must ensure the total of imports in Hour 3 is no more than 1100 MW (the 400 MW of Hour 4 plus a 700 MW change).

Only Powerport and Borgpower contribute to the problem in Hour 4, so only Powerport and Borgpower will be considered for reduction in Hour 3. Powerport is the most expensive offer so it will be reduced in Hour 3.

	Hour 1	Hour 2	Hour 3	Hour 4
Transbord	400 MW @ $75	400 MW @ $75	400 MW @ $75	400 MW @ $75
Powerport	600 MW @ $65	600 MW @ $65	zero	No offer
Borgpower	No offer	700 MW @ $60	700 MW @ $60	No offer
Total net intertie schedule	1,000 MW	1,700 MW	1,100 MW	400 MW
Change from previous hour	N/A	700 MW	-600 MW	-700 MW

Table 5 – After NISL limit is applied

The 700 MW limit is now respected in all hours.

Congestion Management Settlement Credits (CMSC) and the Net Interchange Schedule Limit

Both the constrained and unconstrained algorithms are bound by the net interchange schedule limit, and the limit is applied in the same way to both algorithms. However, the starting conditions for the constrained and unconstrained algorithms may differ, typically because of transmission congestion within Ontario. And, if the starting conditions differ, the outcomes will differ. In some circumstances, this difference may result in CMSC payments.

The following example illustrates the interaction of internal transmission limits and the net interchange schedule limit of 700 MW:

Assume that in **Hour One**:

- There is a single offer from Transbord to import 700 MW of energy at $10/MW
- Internal constraints limit the actual allowable flow to 500 MW
- MCP is $50
- The unconstrained schedule is a net import of 700 MW
- The constrained schedule is a net import of 500 MW

In Hour One, there will be a CMSC payment made to Transbord based on the lost operating profit from the 200 MW that did not flow due to internal constraints. (CMSC in this case is $8000, which is $40 lost operating profit per megawatt, times 200 MW. See our *Ontario Energy Trading* Capability course for additional information on the constrained and unconstrained algorithms and CMSC payments.)

Hour Two:
Even though both the constrained and unconstrained algorithm use the exact same net interchange schedule limit of 700 MW, they have different starting points when determining an acceptable net schedule for Hour Two. Applying the net interchange schedule limit of 700 MW means that in Hour Two:

- The unconstrained algorithm will allow a range of 1400 to 0 MW interchange schedule (that is, the previous hour's 700 MW, plus or minus 700 MW)
- The constrained algorithm will allow a range of 1200 to –200 MW interchange schedule (that is, the previous hour's 500 MW, plus or minus 700 MW)

Now we can examine how this difference could impact a market participant.

Assume that in Hour Two:
- There are no import offers
- Borgpower bids to export 200 MW of energy at $75/MW
- MCP is $50

The unconstrained schedule will only allow a net interchange schedule of 1400 to 0 MW. Although Borgpower's bid is economical, the net interchange schedule limit will not allow the export, and Borgpower is scheduled for 0 MW.

The constrained schedule, however, has an allowable net interchange schedule of 1200 to –200 MW because of its different starting point. The constrained algorithm schedules Borgpower to export 200 MW.

This means that Borgpower will achieve a higher operating profit based on the constrained schedule than on the unconstrained schedule. Congestion management settlement credits are used to ensure that a participant's operating profit is held to the operating profit they would receive from the unconstrained schedule. In this case, there will be a negative CMSC, or a charge to Borgpower to return them to the same operating profit:

CMSC = ($75 – $50) x (0 – 200)

= –$5000

The negative CMSC payment is the result of the different starting points used by the unconstrained and constrained algorithms. If there had been no congestion in Hour One, the starting points would have been the same for both the unconstrained and constrained, and, since both use the same net interchange schedule limit, there would have been no CMSC payment.

Note that combining the negative CMSC and the cost of the 200 MW gives a total cost that is equivalent to Borgpower's original bid price of $75/MW:

Cost of export:	*200 MW @ $50/MW*	*= $10,000*
Negative CMSC:		*= $ 5,000*
Total:		*= $15,000*
Bid price:	*200 MW @ $75/MW*	*= $15,000*

Summary

The net interchange schedule limit may cause what appears to be an economic offer or bid not to be scheduled, even though there is no congestion on the intertie and the intertie zone price is above the offer price or below the bid price. Similarly, the limit may be respected by scheduling uneconomic offers or bids.
Both the constrained and unconstrained algorithms are bound in the same way by the net interchange schedule limit, but a difference in starting points may result in CMSC payments.

Net Interchange SL Report

The Net Interchange SL price is provided for the constrained and unconstrained predispatch schedule for all intertie zones.

Whenever there is a non-zero number, the NISL is affecting the interface schedule.

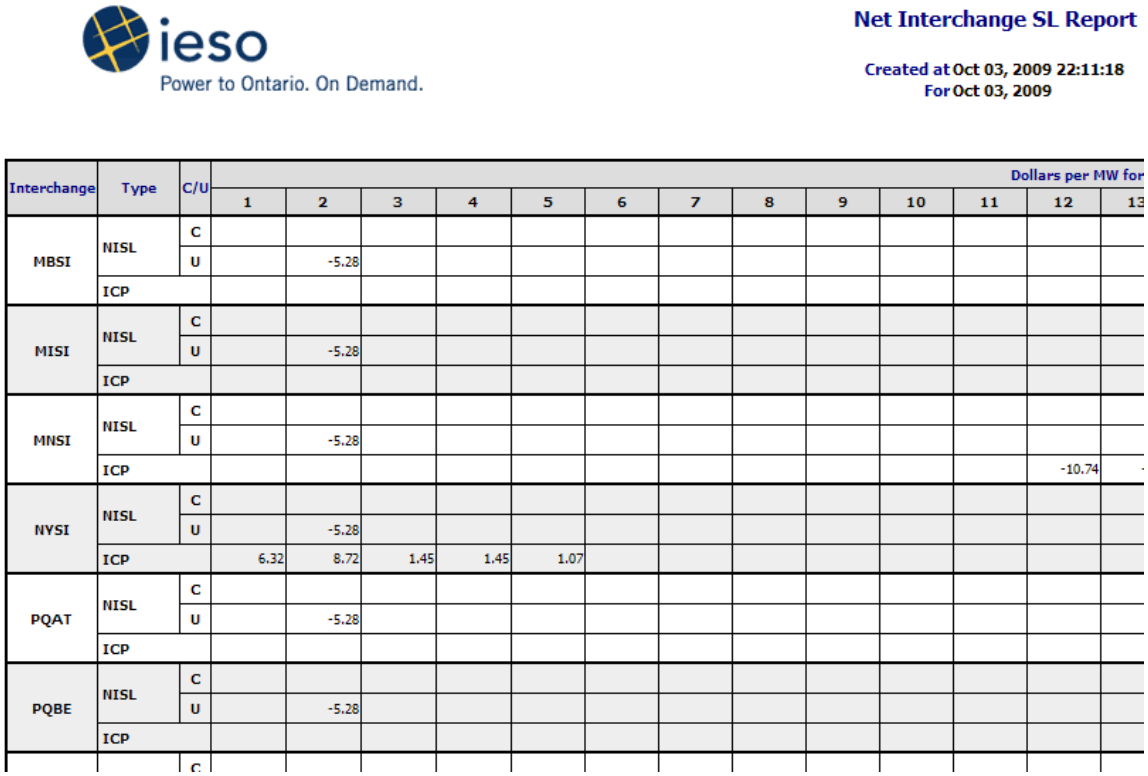
- If NISL > 0, then net imports are being limited. The DSO[1] would prefer to increase imports and/or decrease exports).
- If NISL < 0, then net exports are being limited. The DSO would prefer to decrease imports and/or increase exports).

The report also provides the Intertie Congestion Price (ICP) for each intertie zone; a positive ICP value indicates export congestion on the intertie zone, while a negative value indicates import congestion.

You can access the NISL Shadow Price report at reports.ieso.ca. Net Interchange SL information is formatted in XML - see *Quick Take 12: Accessing IESO Reports Formatted in XML).*

[1] The DSO tool is the software program that implements the dispatch algorithm and is used by the IESO to determine schedules and prices for the Ontario Electricity Market.

Example of Report



Net Interchange SL Report

Created at Oct 03, 2009 22:11:18
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Interchange	Type	C/U	Dollars per MW for 1	2	3	4	5	6	7	8	9	10	11	12	13
MBSI	NISL	C													
		U		-5.28											
	ICP														
MISI	NISL	C													
		U		-5.28											
	ICP														
MNSI	NISL	C													
		U		-5.28											
	ICP													-10.74	
NYSI	NISL	C													
		U		-5.28											
	ICP		6.32	8.72	1.45	1.45	1.07								
PQAT	NISL	C													
		U		-5.28											
	ICP														
PQBE	NISL	C													
		U		-5.28											
	ICP														
		C													

Additional Information

Introduction to Ontario's Physical Markets (includes a detailed explanation of how Ontario's wholesale electricity prices are determined.)

Interjurisdictional Energy Trading (provided a detailed explanation of how energy is moved across intertie transmission lines to or from other control areas)

QT15: Retrieving Reports via IESO Reports Site (provides instructions for viewing reports via the IESO Reports site.)

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