APRIL 18, 2024

Long-Term 2 Request for Proposals

Preliminary Connection Guidance Information

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Purpose

This session will provide an opportunity for discussion, feedback and Q&A on the deliverability process for the Long Term 2 Request for Proposals (LT2 RFP), with a focus on the *Preliminary Connection Guidance for Long-Term 2 Procurement* document

Agenda

1. LT2 RFP Deliverability Process
2. Preliminary Connection Guidance for LT2 RFP Document Walkthrough
    i. Zonal Probabilistic Limitations
    ii. Inverter-based Resource (IBR) Limitations
    iii. Area and Circuit Congestion Limitations
    iv. Short Circuit & Protection Limitations
    v. Other Considerations
3. Q & A
4. Next Steps

LT2 RFP Deliverability Process

LT2 RFP Deliverability Process

As mentioned during previous LT2 RFP webinars, the IESO is developing a Deliverability Process comprised of two steps:

- **Preliminary Connection Guidance Information** - to help proponents select sites that would contribute to meeting the IESO's energy needs and avoid or minimize negative reliability effects on the grid
- **Evaluation Stage Deliverability Test** – to be performed for each project submitted to the RFP as part of the Proposal Evaluation stage, based on their evaluated price, until the procurement targets are met

Preliminary Connection Guidance Information

- The IESO released the Preliminary Connection Guidance for LT2 RFP (Guidance) document early this week - the focus of today's discussion
- The Guidance document has been prepared with support from Hydro One Networks Inc. (HONI)
- The preliminary connection guidance information is intended to help potential LT2 RFP proponents identify locations where a project is more likely to be found deliverable in the evaluation stage deliverability assessment of the LT2 RFP
- The Guidance document presents the objective, methodology, assumptions and results for the six types of limitations that were considered in the development of the document

Evaluation Stage Deliverability Test

- The evaluation stage energy deliverability test methodology is currently under development
- This test is expected to form part of proposal evaluation and would entail testing proposals in the final stack for deliverability based on their location and size
- The deliverability test methodology will be based on principles and criteria similar to those used in the Preliminary Connection Guidance document
- The methodology for the evaluation stage deliverability test will be discussed at further LT2 RFP webinars

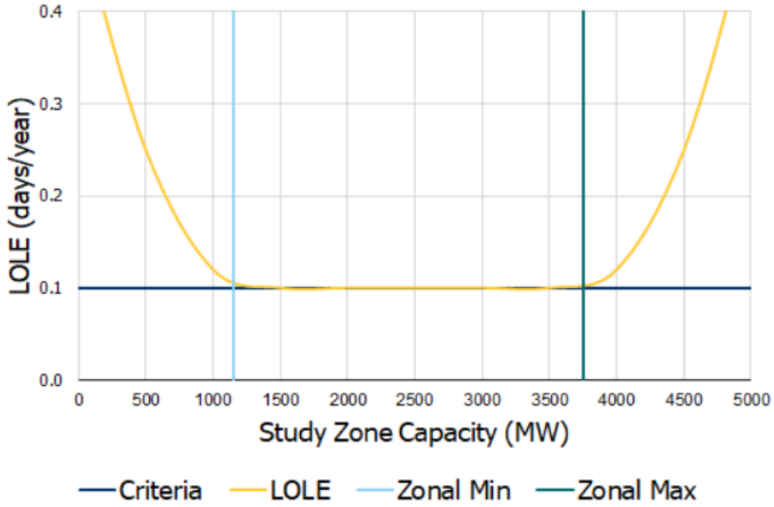
Zonal Probabilistic Limitations

Objective

The goal of the Zonal Probabilistic assessment was to determine total new capacity that could be added into an electrical zone while ensuring that energy would not be congested at times of system need

Methodology & Assumptions

- Zonal maximum capacity values were calculated using zonal constraint curves. These curves were developed by adding or removing capacity in a zone and removing or adding a corresponding amount of capacity in the rest of the system, such that the total incremental capacity is constant.
- Where the curve slopes upwards, additional MW cannot be fully utilized to offset capacity in the rest of the system and a zonal maximum can be established where the LOLE[1] is greater than the LOLE threshold.



[1] LOLE = Loss of Load Expectation. LOLE criterion is 1 day in 10 years, or 0.1 days per year.

Results: LT2 RFP Zonal Capacity Limits

Zone	Solar only Maximum (MW)[1]	Wind only Maximum (MW)[1]	Mix Solar & Wind Maximum (Solar MW, Wind MW)[1]	Other Non-Emitting Technologies
Northwest	1,200	1,400	1,200, 600	Zone limits are project dependent
Northeast	2,000	1,800	1,600, 800	
NE + NW	2,000	1,800	1,600, 800	
East	Maximum Studied	1,800	Maximum Studied, 1,800	
Ottawa	2,400	Maximum Studied	1,600, 800	
Essa	Maximum Studied	Maximum Studied	Maximum Studied	
Southwest	Maximum Studied	Maximum Studied	Maximum Studied	
West	2,000	800	1,600, 800	
Niagara	800	0	N/A	
Bruce	0	1,800	N/A	
Toronto	2,400	0	N/A	

[1] The studies for each zone have tested up to 2,000 MW of wind, and 4,000 MW of solar generation, (solar has a lower capacity factor than wind), and 1,000 MW wind + 2,000 MW solar in the mixed case.

Inverter Based Resource (IBR) Limitations

Objective

The goal of the Inverter Based Resource (IBR) limitations guidance assessment is to provide information on the amounts of IBR generation that could connect to different parts of the grid while minimizing:

- The risk of introducing Sub-Synchronous Resonance (SSR) with existing series capacitors at Nobel, and
- The risk of introducing undesirable Sub-Synchronous control interactions (SSCI) between adjacent IBRs

Assumptions and Methodology

To minimize the risk of SSR

A topology scan tool was developed to identify and exclude connection points that could become radially connected to the series compensated circuits during credible contingencies.

To minimize the risk of SSCI

A screening tool was developed in-house.

- System configuration (considering credible outages).
- Ratings and location of IBRs.
- Minimum Short Circuit Ratio (SCR) specified by OEMs for stable operation of the IBR.

Assumptions and Methodology (cont.)

Northern Ontario

- 2,200 MW of IBR capacity was tested
- Limit IBRs capacities to 30 MW per 115 kV circuit, and 100 MW per 230 kV circuit
- Maximum of one IBR per circuit

Southern Ontario

- Avoid the limiting circuits of major transmission interfaces
- Limit IBRs capacities to 30 MW per 115 kV circuit, 150 MW per 230 kV circuit, and 100 MW per 230 KV radial circuits.
- Maximum of one IBR connection per circuit
- 2,650 MW of IBR capacity tested for **West of Toronto**
- 1,400 MW of IBR capacity tested for **East of Toronto**

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Results

Sub-Synchronous Resonance

The topology scan tool identified certain high-risk circuits that were excluded to avoid radial connections to the series compensated circuits for credible contingencies

* The "Area to avoid" in the figure represents the approximate region of circuits to avoid due to potential SSR issues

Sub-Synchronous Control Interaction

Northern Ontario
- Injections of 1,200 MW were feasible from a SSCI perspective

West of Toronto
- Injections of 2,650 MW were feasible from a SSCI perspective

East of Toronto
- Injections of 1,400 MW were feasible from a SSCI perspective

Considerations

- The potential LT1 RFP IBR projects were not considered; however, their size and locations could potentially impact the availability for potential LT2 RFP resources
- This analysis is meant to be used for high-level screening purposes only, and is not expected to cover all possible LT2 RFP project combinations that may be submitted
- A sub-sequent IBR SSCI assessment will be performed by the IESO during the evaluation stage deliverability test, once the size and point of connection of proposed LT2 RFP projects are known, and detailed Electromagnetic Transient assessments will be performed during the Connection Assessments stage

Area and Circuit Congestion Limitations

Objective

The goal of the Area Congestion and Circuit Congestion assessments was to determine the total amount of new generation that can connect into an area or a circuit and have a minimum risk of energy curtailment

Main Assumptions

- Three independent basecases were used, one for each of the Northern Ontario, West of Toronto and East of Toronto sub-systems, delivering energy towards Toronto
- A set of reasonable scenarios that included a number of combinations of demand and resources dispatches were evaluated
- Committed transmission upgrades, new resources and forecasted loads with an expected in-service date by 2030 were included
- New generation was injected at major stations until post-contingency thermal limits were reached, which is an approximation for the upstream area limit

Methodology

- The area limitations were determined as the maximum amount of generation that could connect into the area upstream of a particular station without resulting in thermal overloads or contributing to transient instability
- The circuit limitations were calculated as the difference between their thermal capability and the flow following the most limiting recognized contingency; potential impact on operability of existing units was also considered

Results – Northern Ontario Example

Bright-line limitations

- Limit new 115 kV connections to 30 MW per circuit
- Limit new 230 kV connections to 100 MW per circuit
- The IBR tested values were observed when establishing the available circuit capacity

Northern Ontario circuits to Avoid

115 kV						230 kV	
A1B	A9K	D4	H7T	M2W	SK1	D23G	T27P
A4H	B15	D4Z	H6T	M3E	T1B	D5H	T28P
A4L	B5	D6T	H9K	M3K	T7M	H22D	
A4L	B6M	E1C	K2	M9K	T8M	K21W	
A5A	C1A	E2R	K4W	R1LB	T1M	K22W	
A5H	C1C	F1E	K5A	R2LB	W3C	K38S	
A7L	C2A	F3M	K5W	R9A		L20D	
A7V	C3A	H2N	L8L	S1C		L21S	
A8K	D3K	H4Z	M1S	S2B		R21D	

Northern Ontario Area limits

Considerations

- Connections to 500 kV circuits and interties should be avoided
- Any connection to HONI transmission circuits will need to comply with Hydro One Transmission Generation Interconnection Requirements document
- Connection to circuits forming a parallel path may require a configuration that balances the flows on all circuits in the path
- Where upstream transmission circuits are recommended to be avoided, new generators may be required to connect directly into the stations. However, station configuration restrictions were not assessed

Short Circuit & Protection Limitations (Hydro One System)

Objective

- Short-circuit limitations identify areas to avoid where short-circuit levels are close to/exceed the capability of transmission equipment
- Protection limitations identify areas to avoid that may be limited due to line protection constraints
- Distribution asset limitations identify capacity at distribution assets owned by Hydro One

Short-Circuit Limitations

- Short-circuit assessment considered all committed generation and transmission projects prior to connection of LT2 RFP projects
- If available fault current at a station exceeds breaker interrupting capability, then that station is flagged
- HONI recommended to avoid connection within 50 km from the stations with short-circuit limitations
- Several stations are currently under review by HONI; updates will be made available
- Additional assessment will be performed during the evaluation stage deliverability test

Short-Circuit Limitations

Stations that are short-circuit limited and the approximate areas to be avoided:

Station
Cherrywood
Burlington
Owen Sound
Manby
Lennox
Clarington
Trafalgar
Richview
Beck #2

Protection Limitations

- Total additional capacity and number of taps into a circuit may be limited due to risk that line protections may not reliably operate. A final determination will be made after new generator parameters and connection points are known
- It's recommended to avoid circuits protected by line differential as new connections may require solutions that could introduce major complexities and increased costs

Distribution Asset Limitations

- HONI Station and Feeder Capacity Calculator (link) provides approximate amount of distributed generation that can be added at each bus or station owned by HONI
- Upstream restrictions on the high voltage stations may limit the number of resources connecting at the distribution level
- The guidance document does not provide limitations or availability for connections to distribution systems owned by LDCs beyond HONI; interested proponents are recommended to contact LDCs operating the distribution system they intend to connect to

Further Considerations

Further Considerations

The "General Considerations" section of the document provides additional context to help the reader understand and use the Guidance information. Main considerations include:

- Multiple types of limitations exist at some locations; the most restrictive should be used
- Connection limitations are highly dependent on size and location of proposals in the same electrical proximity
- Proposals for projects are at higher risk for locations either not assessed in this document or recommended to avoid and for sizes that exceed limitations
- This guidance information should not be used for future energy/capacity procurements
- To avoid infeasible connection configurations, discuss with us (IESO), Hydro One (or other applicable transmitter) and LDCs prior to making a submission into the LT2 RFP

Next Steps

- The IESO is inviting participants to submit written feedback on the Guidance document by **May 3, 2024**
- Feedback should be directed to engagement@ieso.ca utilizing the IESO Feedback Form to ensure AODA compliance (the form is available on the LT RFP engagement webpage)
- The IESO is currently developing details of the Evaluation Stage Deliverability Test. The test methodology will be shared with Proponents in upcoming LT2 RFP engagements
- The next LT2 RFP engagement session will be scheduled in May

Q&A

Thank You

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