



System Impact Assessment Report

Final Report - Public

CAA ID: 2023-766

Project: Centennial TS – New Station

Connection Applicant: Hydro One Networks Inc.

September 19, 2025



Acknowledgement

The IESO wishes to acknowledge the assistance of Hydro One in completing this assessment.

Disclaimers

IESO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IESO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IESO should issue a notice of conditional approval or disapproval of the proposed connection under Chapter 4, section 6 of the Market Rules.

Conditional approval of the project is based on information provided to the IESO by the connection applicant and Hydro One at the time the assessment was carried out. The IESO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by Hydro One at the request of the IESO. Furthermore, the conditional approval is subject to further consideration due to changes to this information, or to additional information that may become available after the conditional approval has been granted.

If the connection applicant has engaged a consultant to perform connection assessment studies, the connection applicant acknowledges that the IESO will be relying on such studies in conducting its assessment and that the IESO assumes no responsibility for the accuracy or completeness of such studies including, without limitation, any changes to IESO base case models made by the consultant. The IESO reserves the right to repeat any or all connection studies performed by the consultant if necessary to meet IESO requirements.

Conditional approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed project to the IESO-controlled grid. However, the conditional approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. This report has been prepared solely for use by the connection applicant and the IESO in accordance with Chapter 4, section 6 of the Market Rules. This report does not in any way constitute an endorsement of the proposed connection for the purposes of obtaining a contract with the IESO for the procurement of supply, generation, demand response, demand management or ancillary services.

The IESO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IESO may have to the connection applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. In the event that the IESO provides a draft of this report to the connection applicant, the connection applicant must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to the connection applicant. Although the IESO will use its best efforts to advise you of any such changes, it is the responsibility of the connection applicant to ensure that the most recent version of this report is being used. The IESO provides no comment, representation or opinion, express or implied, with respect to who should bear

the cost of IESO requirements for connection in this report and disclaims any liability in connection therewith.

Hydro One

The results reported in this report are based on the information available to Hydro One, at the time of the study, suitable for a System Impact Assessment of this connection proposal.

The short circuit and thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection information changes as a result of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed facilities on load and generation customers.

In this report, short circuit adequacy is assessed only for Hydro One circuit breakers. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One circuit breakers and identifying upgrades required to incorporate the proposed facilities. These results should not be used in the design and engineering of any new or existing facilities. The necessary data will be provided by Hydro One and discussed with any connection applicant upon request.

The ampacity ratings of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades which are required to incorporate the proposed facilities have been identified to the extent permitted by a System Impact Assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.



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Project Description

Hydro One Networks Inc. (the "connection applicant" and the "transmitter") is planning to build a new Transformer Station (TS) near St. Thomas, Ontario, namely Centennial TS, to supply a maximum load of 331.2 MW (the "project"). Centennial TS is planned to include two switchyards, each will include three Dual Element Spot Networks (DESNs). Each DESN will be equipped with two 50/66.7/83.3 MVA, 230/27.6 kV transformers and one 21.6 Mvar capacitor. The connection will proceed in two phases:

- **Phase 1:** The first switchyard will connect to the transmitter's 230 kV circuits W44LC and W45LS via a new ~2 km 230 kV double-circuit transmission line tap to supply a maximum load of 165.6 MW. The tap lines will be connected to W44LC and W45LS at about 0.12 km from Edgeware TS. The proposed in-service date for this phase is October 2026.
- **Phase 2:** The second switchyard will connect to the transmitter's 230 kV circuits M31W and M33W via a new ~20 km 230 kV double-circuit transmission line tap to supply a maximum load of 165.6 MW. The tap lines will connect to M31W and M33W at a point approximately 3.63 km from Buchanan TS. The proposed in-service date for this phase is October 2027.

The connection applicant understands that the load addition at Centennial TS will result in increased flows and thermal overloads on W44LC, S47C, W45LS, M31W and M33W and has started working with the IESO to reinforce the transmission system to address these overloads. During the interim period before future transmission reinforcement is in place, the connection applicant will install contingency-based load rejection (L/R) scheme to protect from thermal overloads, as shown in Table 17 in Appendix D of this report.

Notification of Conditional Approval

This assessment concludes that the proposed connection of the project is expected to have no material adverse impact on the reliability of the integrated power system, provided that all requirements in this report are implemented. Therefore, the assessment supports the release of the Notification of Conditional Approval for connection of the project.

Assessment Findings

System studies were carried out to identify the impact of the project on loading of transmission facilities, system voltages, voltage stability, load security and restoration of the Ontario Resource and Transmission Adequacy Criteria (ORTAC) and in line with applicable reliability standards. The studies scenarios and main assumptions are available in Appendix C of this report. The detailed study results are available in Appendix D of this report. Based on the assessment results, we have identified the following assessment findings:

The following findings are applicable before and after the incorporation of the new Longwood to Lakeshore 500 kV circuit:

1. During outages of either N21W or N22W under peak load conditions with 1,450 MW Negative Buchanan Longwood Input Power (NBLIP) transfer level, as well as during outages of W44LC, S47C, or W45LS with 1,625 MW NBLIP transfer level, the incorporation of the project will result in thermal overloads above Long-Term-Emergency (LTE) ratings on W44LC, S47C, or W45LS immediately following recognized double circuit and breaker failure contingencies in Table 1. To mitigate the post-contingency thermal overloads, NBLIP limit shall be reduced by more than 5% violating Section 4.1 of the ORTAC criteria. Therefore, to prevent criteria violation, up to the total load at Centennial TS would need to be interrupted to prevent flows exceeding LTE ratings. Under these system conditions, interrupting up to the total load at Centennial TS is acceptable according to Section 7.1 of the ORTAC load security criteria.

The following findings are applicable only before the incorporation of the new Longwood to Lakeshore 500 kV circuit:

2. With all elements in-service and under peak load conditions with 1,625 MW NBLIP transfer level, the incorporation of the project will result in thermal overloads above LTE ratings on W44LC, S47C, or W45LS immediately following recognized double circuit and breaker failure contingencies in Table 1. To mitigate the post-contingency thermal overloads, NBLIP limit shall be reduced by more than 5% violating Section 4.1 of the ORTAC criteria. Therefore, to prevent criteria violation, up to 110 MW of load at Centennial TS would need to be interrupted to prevent flows exceeding LTE ratings. Under these system conditions, interrupting up to 110 MW of load at Centennial TS is acceptable according to Section 7.1 of the ORTAC load security criteria.
3. During outages of either N21W or N22W under peak load conditions with 1,450 MW NBLIP transfer level, as well as during outages of W44LC, S47C, or W45LS with 1,625 MW NBLIP transfer level, the incorporation of the project will result in thermal overloads above LTE ratings on W44LC, S47C, or W45LS immediately following single contingencies of loss of W44LC, S47C, and W45LS. To mitigate the post-contingency thermal overloads, NBLIP limit shall be reduced by more than 5% violating Section 4.1 of the ORTAC criteria. Therefore, to prevent criteria violation, up to 110 MW of load at Centennial TS load would need to be interrupted to prevent flows exceeding LTE ratings. Under these system conditions, interrupting up to 110 MW of load at Centennial TS is acceptable according to Section 7.1 of the ORTAC load security criteria.

Table 1: Recognized double contingencies events causing thermal overloads

Contingency Type	Contingency
Simultaneous circuit loss	W44LC + W45LS/S47C, W44LC + N582L, M31W + M32W, M32W + M33W, N21W + N22W, W42L + L24L, W42L + L26L, L24L + L26L, W42L + W43L, W45LS + N582L, W43L + L24L, W43L + L26L
Breaker failure (B/F)	Buchanan L42L45 B/F, HL45 B/F, L22L44 B/F, DL44 B/F, HL31 B/F, L21L31 B/F, PL33 B/F, DL33 B/F, L32L42 B/F Longwood AL44 B/F, AL45 B/F, T4L44 B/F, T5L45 B/F Chatham DL44 B/F, L44L65 B/F

IESO Requirements for Connection

Specific Requirements

The following specific requirements are applicable for the incorporation of the project and its connection facilities. Specific requirements pertain to the level of reactive power compensation needed, operation restrictions, remedial action scheme, upgrading of equipment and any project specific items not covered in the general requirements

1. To address the adverse impact of the project described in findings #1, #2 and #3, Hydro One shall install a new RAS facility as per the selection matrix shown in Table 17 in Appendix E of this report.

To reject Centennial TS load, automatic disconnection shall be implemented by simultaneously tripping the 27.6 kV breakers at Hydro One's switchyard, and the 27.6 kV breakers at Hydro One's customer switchyard. There will be no accompanying breaker failure initiated in association with these actions.

Hydro One shall ensure that the RAS facilities comply with NPCC Reliability Reference Directory #7 as per the RAS type classification which will be finalized during the Market Registration process.

Hydro One shall provide a Facility Description Document (FDD) for the new RAS at least six months prior to placing this project in-service. The FDD must contain the finalized RAS tripping matrix as well as expected operating times. The actual operating times must be measured during commissioning and documented as a Performance Validation Record.

If the FDD or performance testing as per the Performance Validation Record indicates a change in design or slower than expected operating times than what was assumed in this assessment, then further analysis of the project will need to be done by the IESO.

Telemetry, including but not limited to, MW, Mvar and breaker status for the feeders/equipment tripped by the RAS, as specified by the IESO at the time of registration, shall be provided.

General Requirements

The connection applicant shall satisfy all applicable requirements specified in the Market Rules, the Transmission System Code (TSC) and reliability standards. Some of the general requirements that are applicable to this project are presented in detail in Appendix A: General Requirements of this report.

Recommendations

1. Power transformers with a high side, wye grounded winding with terminal voltage greater than 200 kV are subject to North American Electric Reliability Corporation (NERC) standard TPL-007, Transmission System Planned Performance for Geomagnetic Disturbance Events. As per NERC standard TPL-007, the Planning Coordinator in conjunction with its Transmission Planner are required to implement a process(es) to obtain Geomagnetic Disturbance (GMD) measurement data, via geomagnetically-induced currents (GIC) monitors, which will aid in model validation and situational awareness. This data will more accurately support the owner of the applicable power transformer(s) to conduct a thermal impact assessment if required in the future. As such, it is recommended that the connection applicant makes provision(s) to install monitoring equipment for GIC on the new transformer(s).

Appendix A: General Requirements

The connection applicant shall satisfy all applicable requirements specified in the Market Rules, the Transmission System Code and reliability standards. This section highlights some of the general requirements that are applicable to the project.

1. The connection applicant must notify the IESO at connection.assessments@ieso.ca as soon as they become aware of any changes to the project scope or data used in this assessment. The IESO will determine whether these changes require a re-assessment.
2. In accordance with Appendix 4.3 of the Market Rules, the connection applicant shall ensure the project have the capability to maintain the power factor within the range of 0.9 lagging and 0.9 leading as measured at the defined meter point of the project.
3. The connection applicant shall ensure that the project's equipment meet the voltage requirements specified in section 4.2 and section 4.3 of the Ontario Resource and Transmission Assessment Criteria (ORTAC).
4. In accordance to Reference 4 of Appendix 4.3 of the Market Rules, distributors connected to the IESO-controlled grid with directly connected load facilities of aggregated rating above 20 MVA and with the capability to regulate distribution voltages under load, shall install and maintain facilities and equipment to provide voltage reduction capability. After connecting the project, the connection applicant will have directly connected load facilities of aggregated rating above 20 MVA and the project has the capability to regulate voltages under load. As such, the connection applicant shall install and maintain facilities and equipment to provide voltage reduction capability at the project. Voltage reduction capability represents the capability of reducing demand by lowering the distribution voltage by 3% and 5% within five minutes from receiving directions from the IESO. The IESO uses voltage reductions to reduce load when supply resources are limited. The voltage reduction capability can be provided using the proposed under-load tap changers (ULTC) at the project.
5. The connection applicant has a total peak load at all its owned facilities, including the project, which is greater than 25 MW. According to Section 10.4.6 of Chapter 5 of the Market Rules and Section 11.3 of the Market Manual 7.1, the connection applicant is required to participate in the automatic Under-Frequency Load Shedding (UFLS) program and must select 35% of total peak load among its owned facilities for under-frequency tripping, based on a date and time specified by the IESO that approximates system peak, according to Section 10.4 of Chapter 5 of the Market Rules.

The UFLS relay connected loads shall be set to achieve the amounts to be shed as stated in Section 11.3 of Market Manual 7.1. Table 2 summarizes UFLS relay settings as a function of the total peak load of all facilities, including the project, owned by the connection applicant.

Table 2: UFLS Relay Settings

Aggregate Summer Peak Load	UFLS Stage	Frequency Threshold (Hz)	Total Nominal Operating Time (s)	Load Shed at stage as % of Connection Applicant's Load	Cumulative Load Shed at stage as % of Connection Applicant's Load
25 MW or more and less than 50 MW	1	59.5	0.3	≥ 35	≥ 35
50 MW or more and less than 100 MW	1	59.5	0.3	≥ 17	≥ 17
	2	59.1	0.3	≥ 18	≥ 35
100 MW or greater	1	59.5	0.3	7 – 9	7 – 9
	2	59.3	0.3	7 – 9	15 – 17
	3	59.1	0.3	7 – 9	23 – 25
	4	58.9	0.3	7 – 9	32 - 34
	Anti-Stall	59.5	10.0	3 – 4	35 - 37

The connection applicant, in conjunction with the transmitter, must also ensure that capacitor banks connected to the same station bus as the load are shed by UFLS facilities at 59.5 Hz with a time delay of 3 seconds.

The maximum load that can be connected to any single UFLS relay is 150 MW to ensure that the inadvertent operation of a single under-frequency relay during the transient period following a system disturbance does not lead to further system instability.

The IESO will review the requirements annually and inform the relevant market participants of their automatic UFLS obligations.

6. In accordance with Section 7.4 of Chapter 4 of the Market Rules, the connection applicant shall provide to the IESO the applicable telemetry data listed in Appendix 4.16 of the Market Rules on a continual basis. The data shall be provided in accordance with the performance standards set forth in Appendix 4.20 and Appendix 4.21, subject to Section 7.6A of Chapter 4 of the Market Rules.
7. The connection applicant must initiate the IESO's Market Registration process at least eight months prior to the commencement of any project related outages.
The connection applicant is required to provide "as-built" equipment data for the project during the IESO Market Registration process. If the submitted equipment data differ materially from the ones used in this assessment, then further analysis of the project may need to be done by the IESO before final approval to connect is granted.
8. The connection applicant shall ensure that wholesale revenue metering installations comply with Chapter 6 of the Market Rules. This includes any intermediate project stages such as installation of temporary equipment or the use of mobile transformers. For more details, the connection applicant is encouraged to seek advice from their Metering Service Provider (MSP) or from the IESO metering group in early stages of project design.

9. As per Market Manual 1.4: Connection Assessment and Approval, the connection applicant will be required to provide a status report of its proposed project with respect to its progress upon request of the IESO using the [project status report form](#) on the IESO website. Failure to comply with project status requirements listed in Market Manual 1.4: Connection Assessment and Approval will result in the project being withdrawn.
10. The connection applicant will be required to also provide updates and notifications in order for the IESO to determine if the project is “committed” as per Section 3.3 of Market Manual 1.4: Connection Assessment and Approval.



Appendix B: Project Data (Confidential)
Appendix C: Facility Classification (Confidential)
Appendix D: Study Scope of Work (Confidential)
Appendix E: Detailed Study Results (Confidential)
Appendix F: Protection Description – Centennial
TS (Confidential)

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