REPORT

System Impact Assessment Report Addendum

CONNECTION ASSESSMENT & APPROVAL PROCESS

Addendum Report

CAA ID: 2011-428
Project: Offset Zone Development Project
Applicant: North American Palladium Ltd.

Market Facilitation Department
Independent Electricity System Operator

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System Impact Assessment Report

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 proposed connection is based on information provided to the IESO by the connection applicant 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 facility 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. 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.

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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Conditional Approval for Connection

North American Palladium Ltd. is proposing to build a new transformer station located in the Thunder Bay area, Ontario to improve the supply capability to the existing Lac Des Iles mine. The mine is connected to Ontario's power grid by a privately owned 66 km long line, tapped off 115 kV circuit S1C near the Silver Falls generating station.

The original SIA, Offset Zone Development CAA 2011-428, studied a mine load increase to 38 MW. The connection applicant notified the IESO that the projected peak load of the mine is expected to reach 47 MW. This Addendum updates the previous SIA study (CAA 2011- 428) by taking into account the new peak load level.

This assessment concludes that the proposed load increase to 47 MW, subject to the requirements specified in this report, is expected to have no material adverse impact on the reliability of the integrated power system. Therefore, the IESO recommends that a *Notification of Conditional Approval for Connection* be issued for the Offset zone development project subject to the implementation of the requirements outlined in this report.

IESO Requirements for Connection

Transmitter Requirements

1. The transmitter must submit any proposed protection modifications to the IESO at least six (6) months before any actual modifications are to be implemented on the existing protection systems.

Connection Applicant Requirements

Project Specific Requirements: The following *specific* requirements are applicable for the incorporation of the project. Specific requirements pertain to the level of reactive compensation needed, operational restrictions, special protection system, upgrading of equipment and any project specific items not covered in the *general* requirements in Section 2 of this report.

1. In order to maintain acceptable post-contingency voltages and limit the magnitude of voltage changes in the area, part of the project's load may need to be curtailed during outage conditions when Silver Falls is unavailable.

   Alternatively, the connection applicant can install an under-voltage load rejection scheme at the project. A scheme that meets the functional requirements outlined in Section 5.7 of this report would be acceptable to the IESO.

   The connection applicant may propose alternate methods of maintaining acceptable post-contingency voltages and voltage changes to the IESO for consideration and approval.

2. The connection applicant is required to have adequate provision in the design of protections and controls at the facility to allow for the installation of special protection system (SPS) equipment. Should a new SPS be installed or the existing Northwest SPS expanded, the facility may be required to participate in the SPS system and to install the necessary protection and control facilities to effect the required actions. These SPS facilities must comply with the NPCC Reliability Reference Directory #7 for Type 1 SPS.

3. The connection applicant must be prepared to manually implement load curtailment when directed by the IESO. The load curtailment shall be implemented by the connection applicant within 5 minutes

from the issuance of the IESO's directive. SIA analysis shows that the project has a low but increased likelihood of being interrupted to satisfy the IESO planning criteria, and may be the first or the only load directed to be curtailed by the IESO.

If the IESO decides at a later date that automatic load management is needed instead of manual curtailment, the connection applicant will be required to register and operate the project as a dispatchable load until the Northwest system reinforcement is completed. In this case, the registration as a dispatchable load, including the installation of the associated facilities, must be completed within 6 months after the issuance of the IESO's notification. The dispatchable facility must provide bids with a ceiling price established by the IESO and expected to be less than $2,000 per MWh. As a dispatchable load, the project shall respond to dispatch instructions from the IESO, sent via a dispatch workstation.

General Requirements*:* The connection applicant shall satisfy the applicable requirements and standards specified in the Market Rules, Market Manuals, the Transmission System Code and the Distribution System Code. The following requirements summarize some of the general requirements that are applicable to the proposed project, and presented in detail in section 2 of this report.

1. The connection applicant shall ensure that the 115 kV equipment have a maximum continuous rating of at least 127 kV, as specified in Appendix 4.1 of the Market Rules. Protective relaying must be set to ensure that transmission equipment remains in-service for voltages up to 5% above the maximum continuous value.
2. The connection applicant shall have the capability to maintain the power factor at the defined meter point of the proposed project within the range of 0.9 lagging and 0.9 leading.
3. The connection applicant shall ensure that the connection equipment is designed to be fully operational in all reasonably foreseeable ambient temperature conditions. The connection equipment must also be designed so that the adverse effects of its failure on the IESO-controlled grid are mitigated.
4. The connection applicant is required to ensure that the Under Frequency Load Shedding (UFLS) targets specified in Section 10.4.6 of Chapter 5 of the Market Rules and Section 4.5 of Market Manual 7.4 are met after the addition of the proposed project. The connection applicant is required to submit during the IESO Facility Registration/Market Entry process a revised schedule of feeder selections and their related load amounts for each shedding stage that will satisfy the UFLS targets. If the connection applicant is part of the UFLS Program Implementation Plan, the connection applicant is required to take into account the proposed project when implementing the plan.
5. The connection applicant shall ensure that the new equipment at the proposed project is designed to withstand the fault levels in the area. If any future system enhancement results in fault levels higher than the equipment's capability, the connection applicant is required to replace the equipment at its own expense with higher rated equipment capable of withstanding the increased fault level, up to maximum fault level specified in Appendix 2 of the Transmission System Code.

   Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage of 127 kV.
6. Appendix 2 of the TSC states that the maximum rated interrupting time for the 115 kV breakers must be ≤ 5 cycles. Thus, the connection applicant shall ensure that the installed breakers meet the required interrupting time specified in the Transmission System Code.
7. The connection applicant shall ensure that the telemetry requirements are satisfied as per the applicable Market Rules requirements. The finalization of telemetry quantities and telemetry testing will be conducted during the IESO Facility Registration/Market Entry process.

8. If revenue metering equipment is being installed as part of this project, the connection applicant should be aware that revenue metering installations must comply with Chapter 6 of the IESO Market Rules. For more details the connection applicant is encouraged to seek advice from their Metering Service Provider (MSP) or from the IESO metering group

9. The connection applicant shall ensure that the protection systems at the proposed project are designed to satisfy all the requirements of the Transmission System Code and any additional requirements identified by the transmitter.

   The project shall have the capability to ride through routine switching events and design criteria contingencies in the grid that do not disconnect the project by configuration. This does not included instances when the project is expected to initiate under voltage load rejection, in accordance with Section 5.7.

   The connection applicant is required to initiate an assessment of the protection systems proposed for the new facility with the transmitter.

   As currently assessed by the IESO, the facility is not part of the Bulk Power System (BPS) and, therefore it is not designated as essential to the power system.

10. The proposed facility must be compliant with applicable reliability standards set by the North American Electric Reliability Corporation (NERC) that are in effect in Ontario as mapped in the following link: http://www.ieso.ca/imoweb/ircp/orcp.asp

11. The connection applicant is not required to be a restoration participant at this time.

12. The connection applicant must complete the IESO Facility Registration/Market Entry process in a timely manner before IESO final approval for connection is granted.

    Models and data, including any controls that would be operational, must be provided to the IESO at least seven months before energization to the IESO-controlled grid. This includes both PSS/E and DSA software compatible mathematical models representing the new equipment for further IESO, NPCC and NERC analytical studies.

    The connection applicant must also provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. If the submitted models and data differ materially from the ones used in this assessment, then further analysis of the proposed project will need to be done by the IESO.

SIA Study Conclusions

We have analyzed the impact of the project on the reliability of the IESO-controlled grid, and based on our study results, we have identified that:

1. Voltage assessment study results show that under peak load and outage conditions, Silver Falls will need to operate in condense mode to avoid pre- and/or post-contingency voltage criteria violations.
2. With Birch Capacitor SC11 or R1LB or R2LB out of service and Silver Falls unavailable to condense, the loss of L3P results in post-contingency voltage level and voltage change violations at the Port Arthur A2 Bus and on S1C at Lac Des Iles junction. Voltages within the customer facilities were observed to be as low as 70.9 kV. The installation of a voltage based load rejection scheme at the project is strongly recommended to address equipment concerns and eliminate the project's contribution to the voltage violations on the transmission system. Details of the voltage based load rejection scheme are outlined in Section 5.7.

   Alternatively, in the absence of the load rejection scheme, the project's load will be curtailed pre-contingency to prevent the post-contingency voltage level and change violations. The connection applicant may propose alternate methods of mitigating the criteria violations to the IESO for consideration and approval.
3. During outages to circuits P3B or L3P, loss of the companion results in circuit P5M/S1C being supplied radially from the Port Arthur DESN LT bus. This can lead to voltage collapse during peak load conditions. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.
4. Without the incorporation of a voltage based load rejection scheme, voltages as low as 96.2 kV were observed at the project while transmission system voltages were within criteria. With the incorporation of the voltage based load rejection scheme, voltages as low as 101 kV were observed at the project after the operation of the scheme. Since the project's facilities are not part of the transmission system and the connection applicant deems the voltage levels to be acceptable, the IESO has no further requirements. The connection applicant has indicated that they have installed adequate voltage support to meet their voltage needs. The pre- and post-contingency voltages on the IESO controlled grid are within criteria after the incorporation of the project and the installation of a voltage based load rejection scheme or implementation of pre-contingency load curtailment. Should the project experience voltages they deem to be unacceptable at their facility, it will be up to the connection applicant to address the issue to their satisfaction.
5. The load level at the Lac Des Iles mine is approaching the level of the rated output power of Silver Falls G1. For an inadvertent breaker operation of breaker 2P5M at Port Arthur, the island formed by Silver Falls GS and Lac Des Iles mine could be sustained. Ontario Power Generation has confirmed that Silver Falls is equipped with a governor that is capable of operating in the island and has no concerns.
6. With Silver Falls G1 condensing to support the voltage with L3P out of service, the loss of P3B could result in Port Arthur T1 being loaded above its 10 day rating due to the back feed through T2 to supply P5M/S1M. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.
7. Thermal overloads observed in the study are largely attributed to the increase in Lakehead area generation dispatch and to a lesser extent by the increased load at the project.

In the low probability event that peak load levels occur during the summer, there is potential for multiple transmission line rating violations when transferring elevated levels of power from stations near Alexander TS to the Birch Area. The violations are limited to instances with a single element out of service pre-contingency.

However, peak load levels studied in the Birch Area are more likely to occur during the winter. Using winter ratings, P7B was loaded above its long term emergency rating for the loss of R1LB with L3P out of service pre-contingency. Also, A6P was loaded above its STE for loss of R2LB and L3P above its LTE for the loss of P7B, with R1LB out of service pre-contingency.

Any STE rating violations can be mitigated by constrained resource dispatch. The Bowater G6 generator would also push back on these violations; however it is not under the dispatch control of the IESO. LTE rating violations can be addressed by post-contingency resource dispatch within 15 minutes

8. Load increase at Lac Des Iles mine will not impact the load security in the Lakehead area.

9. At the time of this study, the IESO has received System Impact Assessment (SIA) applications for almost 400 MW of new load applications in Northwest.

   A resource adequacy assessment for this area determined that additional resources would be needed in the Northwest to meet the Loss of Load Expectation (LOLE) criterion of 0.1 days per year under low water conditions, to supply this project and other loads willing to connect in the area. Consistent with the current resource adequacy assessment practice for system planning purposes only firm imports from neighbouring jurisdictions should be relied on. As such, the import capability from Manitoba and Minnesota was not taken into account in this assessment. In the analysis, the load in the Northwest was supplied internally, largely by hydroelectric generation and Atikokan on bio-mass, and transfers into the area via the East-West Tie.

   Plans to strengthen the Northwest transmission system such as the East-West Tie reinforcement project between Wawa and Lakehead are currently under development. Interim measures to bridge the gap between Northwest reinforcement timelines and potentially earlier supply needs are being investigated by the agencies and include an upgraded Northwest SPS, demand response programs, firm import purchases, and additional internal resources.

   However, until the system reinforcements or additional resources are in place there may be an increased risk of load curtailment in the area, and the connection applicant’s project will have a higher likelihood to be interrupted if load curtailment is needed to safeguard the security of the IESO-controlled grid in the Northwest zone.

– End of Section –

1. Project Description

North American Palladium Ltd. is proposing to build a new transformer station located in the Thunder Bay area, to improve the supply capability to the existing Lac Des Iles mine. The mine is connected to Ontario's power grid by a privately owned 66 km long line, tapped off 115 kV circuit S1C near the Silver Falls generating station.

The original SIA, Offset Zone Development CAA 2011-428, studied a mine load increase to 38 MW. The connection applicant notified the IESO that the projected peak load of the mine is expected to reach 47 MW. The new load increase is primarily attributed to a greater percentage of the existing equipment being operated simultaneously and at higher loadings.

The expected in-service date for the project is February 2014.

– End of Section –

2. General Requirements

The connection applicant shall satisfy all applicable requirements and standards specified in the Market Rules and the Transmission System Code. The following sections highlight some of the general requirements that are applicable to the proposed project.

2.1 Voltage Requirements

Appendix 4.1, reference 2 of the Market Rules states that under normal conditions voltages are maintained within the range of 113 kV to 127 kV. Thus, the IESO requires that 115kV equipment have a maximum continuous voltage rating of at least 127 kV.

Protective relaying must be set to ensure that transmission equipment remains in-service for voltages up to 5% above the maximum continuous value specified in Appendix 4.1 of the Market Rules, to allow the power system to recover from transient disturbances.

2.2 Power Factor

Appendix 4.3 of the Market Rules requires wholesale customers and distributers connected to the IESO-controlled grid to 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 facility.

The connection applicant shall have the capability to maintain the power factor at the defined meter point of the proposed facility within the range of 0.9 lagging and 0.9 leading

2.3 Connection Equipment Design

The connection applicant shall ensure that the connection equipment is designed to be fully operational in all reasonably foreseeable ambient temperature conditions. The connection equipment must also be designed so that the adverse effects of its failure on the IESO-controlled grid are mitigated.

2.4 Under-frequency Load Shedding Facilities

The connection applicant has an aggregate peak load at all its stations that is greater than 25 MW. Thus, the connection applicant is required to participate in the under frequency load shedding (UFLS) according to Section 4.5 of the Market Manual Part 7.4.

In all automatic UFLS areas, there must be at least 30% of area load connected to under-frequency relays according to Section 10.4 of Chapter 5 of the Market Rules. In order to ensure at least 30% of area load shedding is achieved while taking into account UFLS relay and feeder outages as well as generation units that trip prematurely for low frequencies, 35% of the load of those distributors and connected wholesale customers with a peak load of 25 MW or greater must be connected to UFLS relays.

Each distributor and connected wholesale customer shall select load for UFLS based on their load distribution at a date and time specified by the IESO that approximates system peak.

For distributors and connected wholesale customers with a peak load of 25 MW or more and less than 50 MW, the UFLS relay connected loads shall be set to achieve the amounts to be shed stated in the following table:

UFLS Stage	Frequency Threshold (Hz)	Total Nominal Operating Time (s)	Load Shed at stage as % of MP Load	Cumulative Load Shed at stage as % of MP Load
1	59.5	0.3	≥ 35	≥ 35

The requirements in the table above are currently under review. The IESO will notify the connection applicant of any impending changes to which the connection applicant will have to comply.

Distributors and connected wholesale customers, in conjunction with the relevant transmitter shall also shed those capacitor banks connected to the same station bus as the load to be shed by the UFLS facilities, at 59.5 Hz with a time delay of 3 seconds.

Inadvertent operation of a single under-frequency relay during the transient period following a system disturbance should not lead to further system instability. For this reason, the maximum amount of load that can be connected to any single under-frequency relay is 150 MW.

2.5 Fault Levels Requirement

The Transmission System Code requires the new equipment to be designed to withstand the fault levels in the area where the equipment is installed. Thus, the connection applicant shall ensure that the new equipment at the facility is designed to withstand the fault levels in the area. If any future system changes result in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment with higher rated equipment capable of withstanding the increased fault level, up to maximum fault level specified in the Transmission System Code. Appendix 2 of the Transmission System Code establishes the maximum fault levels for the transmission system. For the 115 kV system, the maximum 3 phase and single line to ground symmetrical fault levels are 50 kA.

Appendix 2 of the Transmission System Code states that the maximum rated interrupting time for the 115 kV breakers must be ≤ 5 cycles. Thus, the connection applicant shall ensure that the installed breakers meet the required interrupting time specified in the Transmission System Code. Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage of 127 kV.

2.6 IESO Telemetry Data

In accordance with Section 7.5 of Chapter 4 of the Market Rules, the connection applicant shall provide to the IESO the applicable telemetry data listed in Appendix 4.17 of the Market Rules on a continual basis. The data shall be provided in accordance with the performance standards set forth in Appendix 4.22, subject to Section 7.6A of Chapter 4 of the Market Rules. The whole telemetry list will be finalized during the IESO Facility Registration/Market Entry process.

The connection applicant must install monitoring equipment that meets the requirements set forth in Appendix 2.2 of Chapter 2 of the Market rules. As part of the IESO Facility Registration/Market Entry process, the connection applicant must also complete end to end testing of all necessary telemetry points with the IESO to ensure that standards are met and that sign conventions are understood. All found anomalies must be corrected before IESO final approval to connect any phase of the proposed project is granted.

2.7 Revenue Metering

If revenue metering equipment is being installed as part of this project, the connection applicant should be aware that revenue metering installations must comply with Chapter 6 of the IESO Market Rules. For more details the connection applicant is encouraged to seek advice from their Metering Service Provider (MSP) or from the IESO metering group.

2.8 Protection Systems

The connection applicant shall ensure that the protection systems are designed to satisfy all the requirements of the TSC as specified in Schedules E, F and G of Appendix 1 and any additional requirements identified by the transmitter. New protection systems must be coordinated with the existing protection systems.

Facilities that are essential to the power system must be protected by two redundant protection systems according to section 8.2.1a of the TSC. These redundant protections systems must satisfy all requirements of the TSC, and in particular, they must not use common components, common battery banks or common secondary CT or PT windings. As currently assessed by the IESO, this facility is not on the current BPS list, and therefore, is not considered essential to the power system. In the future, as the electrical system evolves, this facility may be placed on the BPS list.

The connection applicant is required to have adequate provision in the design of protections and controls at the project to allow for future installation of SPS equipment. Should a future SPS be installed or an existing SPS be expanded to improve the transfer capability in the area or to accommodate transmission reinforcement projects, the project may be required to participate in the SPS system and to install the necessary protection and control facilities to affect the required actions. These SPS facilities must comply with the NPCC Reliability Reference Directory #7 for Type 1 SPS. In particular, if the SPS is designed to have 'A' and 'B' protection at a single location for redundancy, they must be on different non-adjacent vertical mounting assemblies or enclosures. Two independent trip coils are required on the breakers selected for L/R. The applicant will be required to provide two dedicated communication channels, separated physically and geographically diverse, between the project and the SPS.

The protection systems within the project must only trip the appropriate equipment required to isolate the fault. After the facility begins commercial operation, if an improper trip of the 115kV circuit S1C occurs due to events within the facility, the facility may be required to be disconnected from the IESO-controlled grid until the problem is resolved.

The project shall have the capability to ride through routine switching events and design criteria contingencies in the grid that do not disconnect the project by configuration. Standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times are to be assumed. This does not included instances when the project is expected to initiate under voltage load rejection, in accordance with Section 5.7.

Any modifications made to protection relays after this SIA is finalized must be submitted to the IESO as soon as possible or at least six (6) months before any modifications are to be implemented on the existing protection systems. If those modifications result in adverse impacts, the connection applicant and the transmitter must develop mitigation solutions.

The IESO will not assess aspects of protection systems which are solely the accountability of the transmitter (e.g. coordination of protection relays).

2.9 Reliability Standards

Prior to connecting to the IESO controlled grid, the proposed facility must be compliant with the applicable reliability standards established by the North American Electric Reliability Corporation (NERC) and reliability criteria established by the Northeast Power Coordinating Council (NPCC) that are in effect in Ontario. A mapping of applicable standards, based on the proponent's/connection applicant's market role/OEB license can be found here: http://www.ieso.ca/imoweb/ircp/orcp.asp

This mapping is updated periodically after new or revised standards become effective in Ontario.

The current versions of these NERC standards and NPCC criteria can be found at the following websites:
http://www.nerc.com/page.php?cid=2|20

http://www.npcc.org/documents/regStandards/Directories.aspx

The IESO monitors and assesses market participant compliance with a selection of applicable reliability standards each year as part of the Ontario Reliability Compliance Program. To find out more about this program, write to orcp@ieso.ca or visit the following webpage: http://www.ieso.ca/imoweb/ircp/orcp.asp

Also, to obtain a better understanding of the applicable reliability compliance obligations and engage in the standards development process, we recommend that the proponent/ connection applicant join the IESO's Reliability Standards Standing Committee (RSSC) or at least subscribe to their mailing list by contacting rssc@ieso.ca. The RSSC webpage is located at:
http://www.ieso.ca/imoweb/consult/consult_rssc.asp.

2.10 Restoration Participant Requirements

According to the Market Manual 7.8 which states restoration participant criteria and obligations, the connection applicant is not required to be a restoration participant at this time.

2.11 Facility Registration/Market Entry

The connection applicant must complete the IESO Facility Registration/Market Entry process in a timely manner before IESO final approval for connection is granted.

Models and data, including any controls that would be operational, must be provided to the IESO. This includes both PSS/E and DSA software compatible mathematical models representing the new equipment for further IESO, NPCC and NERC analytical studies. The connection applicant may need to contact the software manufacturers directly, in order to have the models included in their packages. This information should be submitted at least seven months before energization to the IESO-controlled grid, to allow the IESO to incorporate the proposed project into IESO work systems and to perform any additional reliability studies.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site. In either case, the testing must be done not only in accordance with widely recognized standards, but also to the satisfaction of the IESO. Until this evidence is provided and found acceptable to the IESO, the Facility Registration/Market Entry process will not be considered complete and the connection applicant must accept any restrictions the IESO may impose upon this proposed project's participation in the IESO-administered markets or connection to the IESO-controlled grid. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

If the submitted models and data differ materially from the ones used in this assessment, then further analysis of the proposed project will need to be done by the IESO.

– End of Section –

3. Data Verification

As mentioned in Section 1, the new load increase is primarily attributed to a greater percentage of the existing equipment being operated simultaneously and at higher loadings. The connection arrangement and equipment specifications remain unchanged from the original SIA (Offset zone development CAA 2011-428).

To mitigate low voltages within the mine site at the new peak load level, the proponent is proposing to add a 6.4 MVar capacitor bank to the 4.16 kV bus behind station transformer T3.

– End of Section –

4. Fault Level Assessment

The proposed load increase will not significantly change the fault levels in the area and as a result fault level studies were not conducted.

– End of Section –

5. Local Area Impact Assessment

5.1 Load Security Criteria

The Ontario Resource and Transmission Assessment Criteria (ORTAC) document defines the load security and transmission system performance standards used for this assessment.

5.1.1 Thermal Loading Criteria and Equipment Ratings

The ORTAC specifies the following load security criteria with respect to the thermal loading of transmission facilities:

- With all the transmission facilities in service, equipment loading must be within continuous ratings.
- With one element out of service, equipment loading must be within applicable long-term ratings. Planned load curtailment or rejection up to 150 MW is permissible only to account for local generation outages.
- With two elements out of service, equipment loading must be within applicable short-term emergency ratings. The equipment loading must be reduced to the applicable long-term emergency ratings in the time afforded by the short-time ratings. Planned load curtailment or load rejection exceeding 150 MW is permissible only to account for local generation outages. Not more than 600 MW of load may be interrupted by configuration and by planned load curtailment.

Transmission equipment thermal ratings were provided by Hydro One and were calculated for the summer weather conditions, namely 30^{o}C ambient temperature and 4 km/h wind speed. The continuous ratings for the conductors were calculated at the lower of the sag temperature or 93^{o}C operating temperature. The Long Term Emergency (LTE) ratings for the conductors were calculated at the lower of the sag temperature or 127^{o}C operating temperature. The Short Term Emergency (STE) ratings were calculated at the sag temperature with 100% continuous pre-load. Similarly, winter ratings were calculated for the winter weather conditions, namely 10^{o}C ambient temperature and 4 km/h wind speed.

Relevant circuit ratings for summer and winter conditions are listed in Table 1 and Table 2 respectively:

Table 1: Summer Ratings for Relevant Circuit Sections

Section	Circuit Name	Continuous Rating (A)	Long Term Emergency Rating (A)	Short Term Emergency Rating (A)
Reserve Jct to Port Arthur	A6P	260	260	260
Lakehead to Reserve Jct	A7L	340	340	340
Reserve Jct to Alexander	A7L	310	310	310
Alexander to Lakehead	A8L	420	420	420
Alexander to Pine Portage	R9A	420	420	420
Birch to Port Arthur	P7B	620	790	870
Birch to Lakehead	R1LB	620	790	870
Birch to Lakehead	R2LB	620	790	890
Lakehead to Port Arthur	L3P	720	920	1130
Lakehead to Port Arthur	L4P	620	790	960

Table 2: Winter Ratings for Relevant Circuit Sections

Section	Circuit Name	Continuous Rating (A)	Long Term Emergency Rating (A)	Short Term Emergency Rating (A)
Reserve Jct to Port Arthur	A6P	350	350	350
Lakehead to Reserve Jct	A7L	430	430	440
Reserve Jct to Alexander	A7L	440	440	440
Alexander to Lakehead	A8L	540	540	540
Alexander to Pine Portage	R9A	540	540	540
Birch to Port Arthur	P7B	720	870	940
Birch to Lakehead	R1LB	720	870	940
Birch to Lakehead	R2LB	720	870	960
Lakehead to Port Arthur	L3P	840	1000	1200
Lakehead to Port Arthur	L4P	720	870	1020

5.1.2 Voltage Performance Criteria

The ORTAC requires that with all facilities in service or with one critical element out of service pre-contingency, the following criteria shall be satisfied:

- The pre-contingency voltages on 115kV buses must not be less than 113 kV.
- The post-contingency voltages on 115kV buses must not be less than 108 kV.
- The voltage change on transmission system buses following a contingency must not exceed 10% pre-ULTC and 10% post-ULTC.

- The voltage change on distribution system buses following a contingency must not exceed 10% pre-ULTC and 5% post-ULTC.

The ORTAC also requires that there must be sufficient margin from the voltage instability point, with loads modeled as constant MVA, such that the maximum pre-contingency transfer is the lesser of:

- a pre-contingency power transfer that is 10% lower than the voltage instability point of the pre-contingency P-V curve.
- a pre-contingency transfer that results in a post-contingency power flow that is 5% lower than the voltage instability point of the post-contingency curve.

5.2 Load Forecast

The load forecast for relevant stations in the Lakehead area, provided by Hydro One, is summarized in Table 3 below. The Lac Des Iles mine and Thunder Bay Bowater loads were assumed to be at 47 MW 125MW, respectively.

Table 3: Load Forecast for relevant stations in Lakehead Area

Year	Port Arthur	Birch	Fort William	Beardmore	Jellicoe	Longlac	Marathon	Nipigon	Schreiber Winnipeg # 2	Red Rock
2012	39.9	70.1	78	1.2	0.5	10.5	7.8	2.4	4.7	4.1
2013	40.0	70.2	78.2	1.2	0.5	10.6	7.8	2.4	4.7	4.1
2014	40.3	70.5	78.5	1.2	0.5	10.6	7.8	2.4	4.8	4.1
2015	40.5	70.8	78.8	1.2	0.5	10.6	7.8	2.4	4.8	4.1
2016	40.7	71.0	79.1	1.2	0.5	10.7	7.9	2.4	4.8	4.1
2017	40.9	71.2	79.4	1.2	0.5	10.7	7.9	2.4	4.8	4.1
2018	41.1	71.5	79.7	1.2	0.5	10.7	7.9	2.4	4.8	4.1
2019	41.3	71.7	80.0	1.2	0.5	10.7	7.9	2.4	4.8	4.1
2020	41.5	72.0	80.2	1.2	0.5	10.7	7.9	2.4	4.8	4.1
2021	41.7	72.2	80.5	1.3	0.5	10.7	7.9	2.4	4.8	4.1
2022	41.9	72.4	80.8	1.3	0.5	10.7	7.9	2.4	4.9	4.1
2023	42.1	72.7	81.1	1.3	0.5	10.8	7.9	2.4	4.9	4.1

5.3 Lakehead Area Hydroelectric Generation Assumptions

Hydroelectric generation plays an important role in supplying the Northwest area in general. Since water levels can be quite variable, hydroelectric generation assumptions are vital in determining what planning decisions are required to ensure long term area reliability.

Based on the ORTAC and past planning practice, the following philosophy was adopted for hydroelectric generation dispatch:

- 98% of the time dependable hydroelectric generation was assumed available with all transmission elements in service pre-contingency.
- 85% of the time dependable hydroelectric generation was assumed available with any one transmission element out of service pre-contingency.

Dependable hydroelectric generation values were obtained using 25 years of historical hydroelectric production data.

5.4 Specific Study Assumptions

The following summarize the assumption used for this study:

1- 2023 forecast load levels.

2- Loads modeled as constant PQ unless stated otherwise.

3- The Lac Des Iles mine power factor was assumed to be 0.9 lagging at the high voltage side of the mine transformers with the shunt capacitors out of service.

4- The project currently has 2 capacitors, one 9 MVar and one 10.5 MVar. In order to support the higher load level at the project, an additional 6.4 MVar of capacitors will be installed at the project.

5- Silver Falls generation station assumed out of service unless otherwise indicated.

6- Bowater G6 assumed out of service to maximize the flow west from Lakehead TS to Birch TS.

A high level single line diagram for the Birch Area is provided in Figure 1 below:

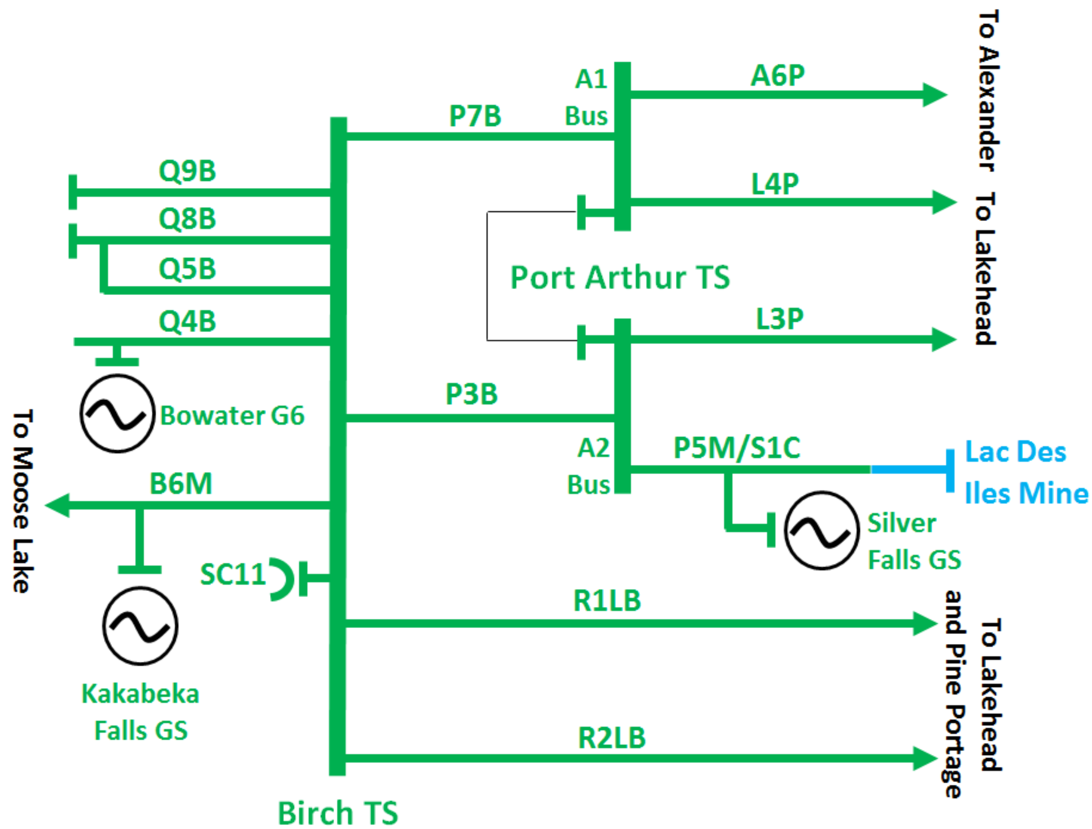

Figure 1: High Level Birch Area Single Line Diagram

A high level single line diagram of the Lakehead Area is provided in Figure 2 below:

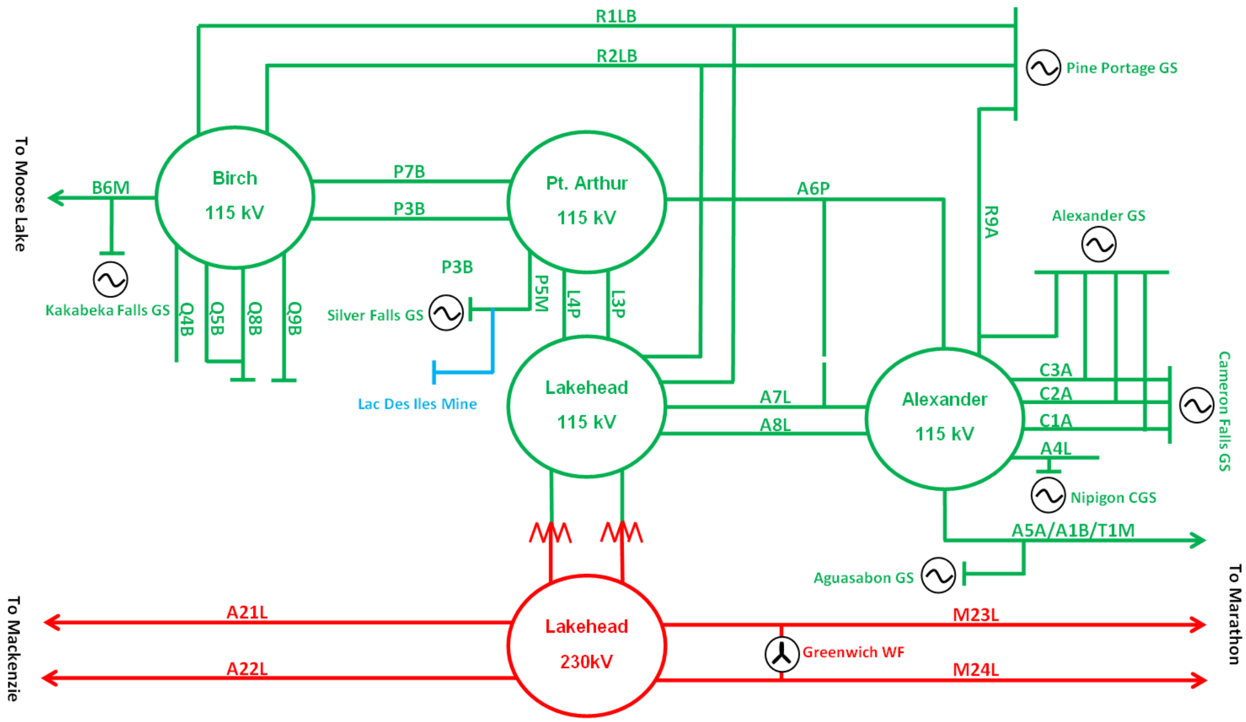

Figure 2: High Level Lakehead Area Single Line Diagram

5.5 Study Scenarios

The following study scenarios were formulated to stress the Birch area transmission system following the load increase at the Lac Des Iles mine:

(1) Scenario 1 - All Elements in service

This scenario was used to evaluate the performance of the Birch area transmission system following the load increase at the Lac Des Iles mine. Contingency analysis was performed to assess potential voltage, thermal and transient limitations.

(2) Scenario 2 – Birch TS 115 kV Capacitor SC11 out of service

This scenario was used to examine the impact on Birch area voltages with the Birch 115 kV capacitor out of service. Contingency analysis was performed to determine if the voltage performance of the Birch area transmission system was within the criteria specified in Section 5.1.

(3) Scenario 3 – Lakehead-to-Port Arthur 115 kV circuit L3P out of service

This scenario was used to evaluate the performance of the Birch area transmission system with the primary circuit supplying the Port Arthur A2 Bus out of service. Contingency analysis was performed to determine if local thermal loadings and the voltage performance was within the criteria specified in Section 5.1.

(4) Scenario 4 – Port Arthur-to-Birch 115 kV circuit P3B out of service

This scenario was used to evaluate the performance of the Birch area transmission system with the other circuit supplying the Port Arthur A2 Bus out of service. Contingency analysis was performed to determine if local thermal loadings and the voltage performance was within the criteria specified in Section 5.1.

(5) Scenario 5 – Pine Portage-to-Lakehead-to-Birch 115 kV circuit R1LB out of service

This scenario was used to evaluate the performance of the Birch area transmission system with one of the main area circuits out of service. Contingency analysis was performed to determine if local thermal loadings and the voltage performance was within the criteria specified in Section 5.1.

5.6 Voltage Change Assessment

Voltage assessment study results show that under peak load conditions with L3P out of service, Silver Falls may need to operate in condense mode to avoid pre-contingency voltage criteria violations.

With Birch Capacitor SC11 or R1LB or R2LB out of service and Silver Falls unavailable to condense, the loss of L3P results in post-contingency voltage level and change violations at the Port Arthur A2 Bus and on S1C at Lac Des Iles junction. The installation of a voltage based load rejection scheme at the project is strongly recommended to address equipment concerns and eliminate the project's contribution to the voltage violations on the transmission system. Details of the voltage based load rejection scheme are outlined in Section 5.7.

Otherwise, in the absence of the load rejection scheme, the project's load will be curtailed pre-contingency to prevent the post-contingency voltage level and voltage change violations. The connection applicant may propose alternate methods of mitigating the criteria violations to the IESO for consideration and approval.

During outages to circuits P3B or L3P, loss of the companion results in circuit P5M/S1C being supplied radially from the Birch DESN LT bus. This can lead to voltage collapse during peak load conditions. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.

A voltage change assessment was carried out for the peak load case with load at Lac Des Iles mine at 47 MW. The assessment evaluated the Birch area transmission system under the five scenarios listed in Section 5.5. The following contingencies were studied:

- Loss of Lakehead-to-Port Arthur A2 Bus 115 kV circuit L3P
- Loss of Lakehead-to-Port Arthur A1 Bus 115 kV circuit L4P
- Loss of Port Arthur A2 Bus-to-Birch 115 kV circuit P3B
- Loss of Port Arthur A1 Bus-to-Birch 115 kV circuit P7B
- Loss of Pine Portage-to-Lakehead-to-Birch 115 kV circuit R1LB or R2LB
- Loss of the Birch 115 kV capacitor
- Loss of the 10.5 MVar Lac Des Iles capacitor
- Loss of Silver Falls G1 when on
- Loss of the project

5.6.1 Scenario 1 – All Elements in Service Pre-Contingency Voltage Change Results

The pre-contingency voltage at the proponent's point of interconnection on S1C at Lac Des Iles junction was observed to be 119.2 kV. The voltage observed at the Lac Des Iles load station (approximately 66 km from the tap point) was observed to be 108.3 kV. However, since the low voltage condition is within the proponent's facility and not part of the IESO-Controlled Grid, it is up to the proponent to deem what voltage levels are acceptable at their facility. The connection applicant has indicated that they have installed adequate voltage support to meet their voltage needs.

The study results do not show any transmission voltage criteria violations with all elements in service or following the contingencies considered. At the project, voltages dropped to 98.2 kV for the loss of L3P. The analysis in Sections 5.6.2 and 5.6.5 strongly recommend an under voltage load rejection scheme at the project, which is described in further detail in Section 5.7. If the scheme is incorporated, the voltage level at the project following the loss of L3P dropped to 107.5 kV.

5.6.2 Scenario 2 – Birch 115 kV Capacitor SC11 Out of Service Pre-Contingency Voltage Change Results

Under 85% water conditions, Silver Falls' generation output was determined to be 0 MW. However, Silver Falls does have the ability to operate in condense mode, allowing it to support local area voltages without using water. With Silver Falls operating in condense mode with Birch SC11 out of service, the study results do not show any transmission voltage criteria violations before or following the contingencies considered

If Silver Falls in unavailable, voltage decline and minimum level violations were observed for the loss of L3P with the Birch 115 kV capacitor out of service pre-contingency. The violations are present in

Table 4 below. It is strongly recommended that the project install a local under voltage load rejection scheme in order to address these violations. Upon detection of low voltage conditions, the project would reject 20 MW of its load. The under voltage scheme is described in further detail in Section 5.7.

Otherwise, in the absence of the load rejection scheme, the project's load will be curtailed pre-contingency to prevent the post-contingency voltage level and voltage change violations. The connection applicant may propose alternate methods of mitigating the criteria violations to the IESO for consideration and approval.

Table 4: Scenario 2 – Birch 115 kV Capacitor Out of Service Voltage Change Results for loss of L3P

					Loss of L3P			
Bus Name	Minimum Continuous Voltage (kV)	Maximum Voltage (kV)	Minimum Post-Contingency Voltage (kV)	Pre-Contingency Voltage (kV)	Pre-ULTC Post-Contingency Voltage (kV)	Pre-ULTC Voltage Change (%)	Post-ULTC Post-Contingency Voltage (kV)	Post-ULTC Voltage Change (%)
Port Arthur A2 Bus	118	127	108	121.5	108.8	-10.45	107.1	-11.85
LAC_DES_ILSJ	113	127	108	116.9	98.8	-15.48	96.5	-17.45
LAC_DES_H-T1	N/A	N/A	N/A	105.1	77.1	-26.64	73.5	-30.07

With the incorporation of the under voltage load rejection scheme or the implementation of pre-contingency load curtailment, the post-contingency voltages on the grid remain within criteria, as presented in Table 5 below. Note that the voltage at the project was observed to be 101 kV following the loss of L3P with the initiation of the under voltage load rejection scheme or with pre-contingency load curtailment in place . Since the low voltage condition is within the proponent's facility and not part of the IESO-Controlled Grid, and the connection applicant deemed that these voltage levels are acceptable at their facility, the IESO has no further requirements.

Table 5: Scenario 2 – Voltage Change Results for loss of L3P after Incorporating the Under Voltage Load Rejection Scheme

		Loss of L3P			
Bus Name	Minimum Post-Contingency Voltage (kV)	Pre-ULTC Post-Contingency Voltage (kV)	Pre-ULTC Voltage Change (%)	Post-ULTC Post-Contingency Voltage (kV)	Post-ULTC Voltage Change (%)
Port Arthur A2 Bus	108	114.4	-5.84	114.4	-5.84
LAC_DES_ILSJ	108	110.6	-5.39	110.6	-5.39
LAC_DES_H-T1	N/A	101.0	-3.90	101.0	-3.90

5.6.3 Scenario 3 – Circuit L3P Out of Service Pre-Contingency Voltage Change Results

Pre-contingency voltage violations were observed with circuit L3P out of service. The voltage on circuit S1C at Lac Des Iles junction was below the minimum continuous voltage required by the ORTAC, the voltage at the Port Arthur A2 Bus was below its minimum operational voltage, and the voltage at the project was 96.2 kV. The pre-contingency results are listed in Table 6 below:

Table 6: Scenario 3 – L3P Out of Service Pre-Contingency Voltage Results

Bus Name	Minimum Continuous Voltage (kV)	Maximum Voltage (kV)	Minimum Post-Contingency Voltage (kV)	Pre-Contingency Voltage (kV)
Port Arthur A2 Bus	118	127	108	116.7
LAC_DES_ILSJ	113	127	108	110.7
LAC_DES_H-T1	N/A	N/A	N/A	96.2

The project would be unable to reach its peak load level with L3P out of service and Silver Falls G1 offline, as the under voltage scheme would activate based on the project's voltage is listed in Table 6. In order to bring pre-contingency voltages up to acceptable levels, Silver Falls was put in service on condense mode.

Without the under voltage load rejection scheme, the voltage level at the project dropped to 96.2 kV for the loss the condensing Silver Falls unit. With the incorporation of the under voltage load rejection scheme, the voltage level at the project dropped to 106 kV.

The loss of P3B results in P5M and S1C being supplied via the Port Arthur DESN low voltage bus. The post-contingency voltage levels at and near the project are acceptable following the loss of P3B after the incorporation of the L/R scheme and with Silver Falls condensing. Under different system conditions, Silver Falls may not be required to support pre-contingency voltages. With Silver Falls G1 offline, the loss of P3B with L3P out of service pre-contingency can result in voltage collapse. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.

After the incorporation of a voltage based load rejection scheme and with Silver Falls condensing, no pre-contingency or post-contingency voltage criteria violations were observed.

5.6.4 Scenario 4 – Circuit P3B Out of Service Pre-Contingency Voltage Change Results

The loss of L3P results in P5M and S1C being supplied via the Port Arthur DESN low voltage bus, which results in voltage collapse. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.

With the aforementioned issue addressed, no pre-contingency or post-contingency voltage criteria violations were observed. Without the under voltage load rejection scheme, voltages dropped to 101.7 kV for the loss of the 10.5 MVar capacitor. After incorporating the under voltage load rejection scheme, the voltage level at the project following the loss of L3P dropped to 107.5 kV.

5.6.5 Scenario 5 – Circuit R1LB Out of Service Pre-Contingency Voltage Change Results

Under 85% water conditions, Silver Falls' generation output was determined to be 0 MW. However, Silver Falls does have the ability to operate in condense mode, allowing it to support local area voltages without using water. With Silver Falls operating in condense mode with R1LB out of service, the study results do not show any transmission voltage criteria violations before or following the contingencies considered

If Silver Falls in unavailable, voltage decline and minimum level violations were observed for the loss of L3P with R1LB out of service pre-contingency. The violations are presented in Table 7 below. It is strongly recommended that the project install a local under voltage load rejection scheme in order to address these violations. Upon detection of low voltage conditions, the project would reject 20 MW of its load. The under voltage scheme is described in further detail in Section 5.7.

Otherwise, in the absence of the load rejection scheme, the project's load will be curtailed pre-contingency to prevent the post-contingency voltage level and change violations. The connection applicant may propose alternate methods of mitigating the criteria violations to the IESO for consideration and approval.

Table 7: Scenario 5 – R1LB Out of Service Voltage Change results for loss of L3P

					Loss of L3P			
Bus Name	Minimum Continuous Voltage (kV)	Maximum Voltage (kV)	Minimum Post-Contingency Voltage (kV)	Pre-Contingency Voltage (kV)	Pre-ULTC Post-Contingency Voltage (kV)	Pre-ULTC Voltage Change (%)	Post-ULTC Post-Contingency Voltage (kV)	Post-ULTC Voltage Change (%)
Port Arthur A2 Bus	118	127	108	122.6	105.5	-13.95	108	-11.91
LAC_DES_ILSJ	113	127	108	118.5	94.5	-20.25	97.9	-17.38
LAC_DES_H-T1	N/A	N/A	N/A	107.7	70.9	-34.17	75.9	-29.53

With the incorporation of the under voltage load rejection scheme or the implementation of pre-contingency load curtailment, the post-contingency voltages on the grid remain within criteria, as presented in Table 5 below. Note that the voltage at the project was observed to be 101.3 kV following the loss of L3P with the initiation of the under voltage load rejection scheme or with pre-contingency load curtailment in place . Since the low voltage condition is within the proponent's facility and not part of the IESO-Controlled Grid, and the connection applicant deemed that these voltage levels are acceptable at their facility, the IESO has no further requirements.

Table 8: Scenario 2 – Voltage Change Results for loss of L3P After Incorporating the Under Voltage Load Rejection Scheme

		Loss of L3P			
Bus Name	**Minimum Post-Contingency Voltage (kV)**	**Pre-ULTC Post-Contingency Voltage (kV)**	**Pre-ULTC Voltage Change (%)**	**Post-ULTC Post-Contingency Voltage (kV)**	**Post-ULTC Voltage Change (%)**
Port Arthur A2 Bus	108	114.2	-6.85	115.0	-6.20
LAC_DES_ILSJ	108	110.6	-6.67	111.5	-5.91
LAC_DES_H-T1	N/A	101.3	-5.94	102.4	-4.92

5.7 Under-Voltage Load Rejection Scheme

As previously demonstrated, the load increase at the project can result in the transmission system not meeting minimum voltage performance criteria. Accordingly, it is strongly recommended that the connection applicant install an under-voltage load rejection scheme at the project, otherwise the project's load will be curtailed to ensure the voltage performance of the grid is acceptable. The scheme would reject load at the project such that the IESO-controlled-grid voltages remain within criteria. Rejecting 20 MW of mill load if voltages at the project drop below a set point, adjustable and set to 104 kV, would be acceptable to the IESO. The low voltage condition would have to persist for a set time, adjustable and set to 250 ms, before the scheme initiates load shedding in order to avoid tripping during out-of-zone faults. Armed load would have to be rejected within 0.5s after the initial low voltage condition is detected.

The under-voltage scheme would have to be fully duplicated and send a single pair (A & B) of load rejection (L/R) signals to the participating loads using two dedicated channels. To reduce the risk of both protection systems being disabled simultaneously by a single contingency, the two protection systems shall not use common components.

Scheme implementation that differs from the aforementioned arrangement would require IESO approval.

5.8 Thermal Loading Assessment

With Silver Falls G1 condensing to support the voltage with L3P out of service, the loss of P3B could result in Port Arthur T1 being loaded above its 10 day rating due to the back feed through T2 to supply P5M/S1M. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.

Thermal overloads observed in the study are largely attributed to the increase in Lakehead area generation dispatch and to a lesser extent by the increased load at the project.

In the low probability event peak load levels occur during the summer, there is potential for multiple transmission line rating violations when transferring elevated levels of power from stations near Alexander TS to the Birch Area. The violations are limited to instances with a single element out of service pre-contingency.

However, peak load levels studied in the Birch Area are more likely to occur during the winter. Using winter ratings, P7B was loaded above its long term emergency rating for the loss of R1LB with L3P out of service pre-contingency. Also, A6P was loaded above its STE for loss of R2LB and L3P above its LTE for the loss of P7B, with R1LB out of service pre-contingency.

Any STE rating violations can be mitigated by constrained resource dispatch. The Bowater G6 generator would also push back on these violations; however it is not under the dispatch control of the IESO. LTE rating violations can be addressed by post-contingency resource dispatch within 15 minutes.

Thermal assessment was carried out for the peak load case with load at Lac Des Iles mine at 47 MW. The assessment evaluated the Birch area transmission system under the five scenarios listed in Section 5.5. The following contingencies were studied:

- Loss of Lakehead-to-Port Arthur A2 Bus 115 kV circuit L3P
- Loss of Lakehead-to-Port Arthur A1 Bus 115 kV circuit L4P
- Loss of Port Arthur A2 Bus-to-Birch 115 kV circuit P3B
- Loss of Port Arthur A1 Bus-to-Birch 115 kV circuit P7B
- Loss of Pine Portage-to-Lakehead-to-Birch 115 kV circuit R1LB or R2LB

The under voltage load rejection scheme mentioned in Section 5.7 was assumed to initiate 20 MW of load rejection whenever voltages at the project dropped below 104 kV.

5.8.1 Scenario 1 – All Elements in Service Pre-Contingency Thermal Results

The study results do not show any thermal violations pre-contingency with all elements in service or following the contingencies considered.

5.8.2 Scenario 2 – Birch 115 kV Capacitor SC11 Out of Service Pre-Contingency Thermal Results

The study results do not show any thermal violations pre-contingency with all elements in service or following the contingencies considered.

5.8.3 Scenario 3 – Circuit L3P Out of Service Pre-Contingency Thermal Results

As mentioned in Section 5.6.3, Silver Falls G1 was assumed to be in service in condense mode, as pre-contingency voltages were below acceptable levels with unit offline.

The loss of P3B could result in Port Arthur T1 being loaded above its 10 day rating due to the back feed through T2 to supply P5M/S1M. This can be mitigated by opening the Port Arthur T2 low voltage circuit breaker T2B or by offloading the T2 transformer, which would disconnect P5M and S1C from the system post-contingency.

The following summer rating thermal violations, which are largely attributed to the increase in Lakehead area generation dispatch and to a lesser extent by the increased load at the project, were observed:

- Circuits R2LB and L4P were loaded above their LTE ratings, while A6P and P7B were loaded above their STE ratings for the loss of R1LB.
- Circuits R1LB and R2LB were loaded above their LTE ratings, while A6P was loaded above its STE rating for the loss of L4P.
- Circuits R1LB and R2LB were loaded above their LTE ratings for the loss of P7B.

However, peak load levels studied in the Birch Area are more likely to occur during the winter. Using winter ratings, only P7B was loaded above its long term emergency rating for the loss of R1LB.

In the low probability event peak load levels occur during the summer, any STE rating violations can be mitigated by constrained resource dispatch. The Bowater G6 generator would also push back on these violations; however it is not under the dispatch control of the IESO. LTE rating violations can be addressed by post-contingency resource dispatch within 15 minutes. The violations are presented inTable 9 below.

Summer and winter ratings are accompanied by a (S) and (W) to their right, respectively. Cells highlighted in red denote a STE rating violation, while cells highlighted in beige denote a LTE violation.

Table 9: Scenario 3 – L3P Out of Service Pre-Contingency Thermal Results

Section	Circuit Name	Circuit Loading Pre-Contingency (A)	Continuous Rating (A)	Long Term Emergency Rating (A)	Short Term Emergency Rating (A)	Percent of Continuous Rating (%)	Loss of R1LB		Loss of L4P		Loss of P7B	
							Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)	Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)	Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)
Reserve Jct to Port Arthur	A6P	239	260 (S)	260 (S)	260 (S)	91.92 (S)	283	108.85 (S)	311	119.62 (S)	220	84.62 (S)
			350 (W)	350 (W)	350 (W)	68.29 (W)		80.86 (W)		88.86 (W)		62.86 (W)
Birch to Port Arthur	P7B	592	620 (S)	790 (S)	870 (S)	95.48 (S)	886	112.15 (S)	210	24.14 (S)	N/A	N/A
			720 (W)	870 (W)	940 (W)	82.22 (W)		101.84 (W)		22.34 (W)		N/A
Birch to Lakehead	R1LB	579	620 (S)	790 (S)	870 (S)	93.39 (S)	N/A	N/A	832	105.32 (S)	868	109.87 (S)
			720 (W)	870 (W)	940 (W)	80.42 (W)		N/A		95.63 (W)		99.77 (W)
Birch to Lakehead	R2LB	554	620 (S)	790 (S)	890 (S)	89.35 (S)	832	105.32 (S)	796	100.76 (S)	831	105.19 (S)
			720 (W)	870 (W)	960 (W)	76.94 (W)		95.63 (W)		91.49 (W)		95.52 (W)
Lakehead to Port Arthur	L4P	554	620 (S)	790 (S)	960 (S)	89.35 (S)	838	106.08 (S)	N/A	N/A	168	21.27 (S)
			720 (W)	870 (W)	1020 (W)	76.94 (W)		95.63 (W)		N/A		19.31 (W)

5.8.4 Scenario 4 – Circuit P3B Out of Service Pre-Contingency Thermal Results

As mentioned in Section 5.6.4, a control action to prevent post-contingency voltage collapse for the loss of L3P was implemented.

Thermal violations that are largely attributed to the increase in Lakehead area generation dispatch were observed.

The study results show that circuit A6P was loaded above its summer thermal rating following the loss of Pine Portage-to-Lakehead-to-Birch 115 kV circuit R1LB. The violation is largely attributed to the increase in Lakehead area generation dispatch and to a lesser extent by the increased load at the project.

However, peak load levels studied in the Birch Area are more likely to occur during the winter. Using winter ratings, no thermal violations are present.

In the low probability event peak load levels occur during the summer, the STE rating violation can be mitigated by constrained resource dispatch. The Bowater G6 generator would also push back on these violations; however it is not under the dispatch control of the IESO. The violation is presented in Table 10 below:

Table 10: Scenario 4 – P3B Out of Service Pre-Contingency Thermal Results for loss of R1LB

							Loss of R1LB	
Section	Circuit Name	Circuit Loading Pre-Contingency (A)	Continuous Rating (A)	Long Term Emergency Rating (A)	Short Term Emergency Rating (A)	Percent of Continuous Rating (%)	Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)
Reserve Jct to Port Arthur	A6P	234	260 (S)	260 (S)	260 (S)	90.00 (S)	276	106.15 (S)
			350 (W)	350 (W)	350 (W)	66.86 (W)		78.86 (W)

5.8.5 Scenario 5 – Circuit R1LB Out of Service Pre-Contingency Thermal Results

The connection applicant has not determined if they will be pursuing a voltage based load rejection scheme or pre-contingency load curtailment as their mitigation method for post-contingency voltage criteria violations. As such, pre-contingency results assumed the scheme to be in place as it would allow for higher loadings. Post-contingency loadings for the loss of L3P or R2LB assume the voltage based load rejection scheme operated or the implementation of pre-contingency load curtailment.

The following summer rating thermal violations, which are largely attributed to the increase in Lakehead area generation dispatch and to a lesser extent by the increased load at the project, were observed.

- Circuits L3P and A6P were loaded above their continuous rating pre-contingency.
- Circuit A6P was loaded above its STE rating, while P7B, R2LB and L4P were loaded above their LTE ratings for the loss of L3P.
- Circuit A6P was loaded above its STE ratings, while L3P was loaded above its LTE rating for the loss of R2LB.
- Circuit L3P was loaded above its LTE for the loss of P7B.

However, peak load levels studied in the Birch Area are more likely to occur during the winter. Using winter ratings, only A6P was loaded above its STE for loss of R2LB and L3P above its LTE for the loss of P7B.

STE rating violations can be mitigated by constrained resource dispatch. The Bowater G6 generator would also push back on these violations; however it is not under the dispatch control of the IESO. LTE rating violations can be addressed by post-contingency resource dispatch within 15 minutes. The violations are presented in Table 11 below.

Summer and winter ratings are accompanied by a (S) and (W) to their right, respectively. Cells highlighted in red denote a STE rating violation, while cells highlighted in beige denote a LTE violation.

Table 11: Scenario 4 – R1LB Out of Service Pre-Contingency Thermal Results

							Loss of L3P		Loss of R2LB		Loss of P7B	
Section	Circuit Name	Circuit Loading Pre-Contingency (A)	Continuous Rating (A)	Long Term Emergency Rating (A)	Short Term Emergency Rating (A)	Percent of Continuous Rating (%)	Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)	Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)	Circuit Loading Post-Contingency (A)	Percent of Long Term Emergency Rating (%)
Reserve Jct to Port Arthur	A6P	271	260 (S) 350 (W)	260 (S) 350 (W)	260 (S) 350 (W)	104.23 (S) 77.43 (W)	278	106.92 (S) 79.43 (W)	373	143.46 (S) 106.57 (W)	255	98.08 (S) 72.86 (W)
Birch to Port Arthur	P7B	525	620 (S) 720 (W)	790 (S) 870 (W)	870 (S) 940 (W)	84.68 (S) 72.92 (W)	848	107.34 (S) 97.47 (W)	759	96.08 (S) 87.24 (W)	N/A	N/A N/A
Birch to Lakehead	R2LB	476	620 (S) 720 (W)	790 (S) 870 (W)	890 (S) 960 (W)	76.77 (S) 66.11 (W)	800	101.26 (S) 91.95 (W)	N/A	N/A N/A	731	92.53 (S) 84.02 (W)
Lakehead to Port Arthur	L3P	767	720 (S) 840 (W)	920 (S) 1000 (W)	1130 (S) 1200 (W)	106.53 (S) 91.31 (W)	N/A	N/A N/A	921	100.11 (S) 92.10 (W)	1038	112.83 (S) 103.80 (W)
Lakehead to Port Arthur	L4P	447	620 (S) 720 (W)	790 (S) 870 (W)	960 (S) 1020 (W)	72.10 (S) 62.08 (W)	820	103.80 (S) 94.25 (W)	645	81.65 (S) 74.14 (W)	207	26.20 (S) 23.79 (W)

5.9 Pre- and Post-Contingency Steady State Voltage Stability Assessment

Pre-contingency and Post-contingency steady state stability criteria were met.

Pre-contingency steady state voltage stability margins were verified by scaling up the load in the Lakehead area by 10%.

Similarly, the post-contingency steady state voltage stability margins were verified by scaling up the load in the Lakehead area by 5%.

With all elements in service or with a single element out of service pre-contingency, and following the studied contingencies, steady state stability criteria were met.

5.10 Capacitive Element Switching Assessment

Switching a 6.4 MVar capacitor results in a voltage changes below 4 %, meeting the ORTAC switching requirement.

Section 4.3.2 of ORTAC states that capacitive devices should be sized to ensure that voltage declines or rises at delivery point buses on switching operations will not exceed 4% of the steady state rms voltage. This 4% is based on load flows before tap changer action using a voltage dependent load model.

A switching study was carried out to investigate the effect of switching the new 6.4 MVar bank at the mine. As a worst case scenario the whole bank is assumed to be switched at the same time. Table 12 shows that switching a 6.4 MVar capacitor results in a voltage change that is less than 4 %, meeting the switching requirement. Therefore, the IESO has no specific requirement for the size of the capacitor bank steps.

Table 12: Voltage Change after Switching in the 6.4 MVar capacitor bank

Bus Name	Pre-switching Voltage (kV)	Post-switching Voltage (kV)	Voltage Change (%)
Birch TS	122.0	122.4	0.3
Lakehead 115 kV	124.7	125.1	0.3
Port Arthur A1	123.6	124.0	0.3
Port Arthur A2	123.3	123.8	0.4
Lac Des Iles tap point off S1C	117.8	119.0	1.0
HV side of Lac Des Iles mine	103.8	106.8	2.9

5.11 Silver Falls and Lac Des Iles Mine Island

The load level at the Lac Des Iles mine is approaching the level of the rated output power of Silver Falls G1. For an inadvertent breaker operation of breaker 2P5M at Port Arthur, the island formed by Silver Falls G1 and Lac Des Iles mine could be sustained. Ontario Power Generation has confirmed that Silver Falls G1 is equipped with a governor that is capable of operating in the island and has no concerns.

– End of Section –

6. Lakehead Area Impact Assessment

The study results demonstrate that the project will not have a material impact on the Lakehead area supply capability. The most limiting case, suffering the loss of the Lakehead T8 autotransformer with the Lakehead T7 autotransformer out of service pre-contingency, was investigated.

Rejecting 120 MW of load in the Lakehead area is sufficient to be able to sustain the loss of a Lakehead autotransformer, when the companion autotransformer is on an outage. Load curtailment of up to 150 MW is permissible with two elements out of service; therefore the rejection of 120 MW of load is acceptable.

Power flow studies were performed to determine the impact of increasing the load at Lac Des Iles mine on the transmission system supplying the overall Lakehead area. The most limiting case, suffering the loss of the Lakehead T8 autotransformer with the Lakehead T7 autotransformer out of service pre-contingency, was investigated.

Table 13 and Table 14 list the thermal loading and voltage change results of the power flow studies, respectively. The study results demonstrate that rejecting 120 MW of load in the Lakehead area is sufficient to be able to sustain the loss of a Lakehead autotransformer, when the companion autotransformer is on an outage. Rejecting up to 150 MW of load is permitted when not accounting for local generation outages, therefore the rejection of 120 MW of load is acceptable.

Table 13: Lakehead Area Thermal Study Assessment Results

Circuit			Rating		Pre-Contingency		Loss of T8 – Reject Fort William and Port Arthur	
Name	From	To	Cont. (A)	LTE (A)	Loading (A)	% Cont.	Loading (A)	% LTE
A8L	ALEXANDER_SS	LAKEHEAD_TS	430	430	275	63.95	268	62.33
A7L	ALEXANDER_SS	LAKEHEAD_TS	340	340	249	73.24	242	71.18
A6P	ALEXANDER_SS	RESERVE_JA6P	490	490	253	51.63	244	49.80
A6P	RESERVE_JA6P	PT_ARTH	260	260	219	84.23	211	81.15
L3P	LAKEHEAD_TS	PT_ARTH	720	920	529	73.47	341	37.07
L4P	LAKEHEAD_TS	PT_ARTH	620	790	338	54.52	129	16.33
R1LB	PINE_PORTAGE	LAKEHEAD_TS	330	330	206	62.42	200	60.61
R1LB	LAKEHEAD_TS	BIRCH_TS	620	790	346	55.81	231	29.24
R2LB	PINE_PORTAGE	LAKEHEAD_TS	420	420	234	55.71	228	54.29
R2LB	LAKEHEAD_TS	BIRCH_TS	620	790	331	53.39	221	27.97
B6M	BIRCH_TS	MURILLO_J	440	440	28	6.36	50	11.36
B6M	MURILLO_J	STANLEY_JB6M	430	430	49	11.40	95	22.09
B6M	STANLEY_JB6M	SHABAQUA_JB6	470	470	52	11.06	96	20.43
B6M	SHABAQUA_JB6	INCO_SHEB_J	470	470	58	12.34	104	22.13
B6M	INCO_SHEB_J	KASHABOWIE_J	460	460	63	13.70	105	22.83
B6M	KASHABOWIE_J	SAPAWE_J_B6M	430	430	63	14.65	105	24.42
B6M	SAPAWE_J_B6M	CALAND_ORE_J	620	740	74	11.94	110	14.86
B6M	CALAND_ORE_J	MOOSE_LK_TS	620	740	74	11.94	110	14.86
A5A	Alexander	MINNOVA_J	430	430	62	14.42	81	18.84
A5A	MINNOVA_J	SCHREIBER_J	430	430	60	13.95	69	16.05
A5A	SCHREIBER_J	AGUASABON_SS	430	430	36	8.37	53	12.33
A1B	AGUASABON_SS	TER_BAY_PU_J	570	570	173	30.35	184	32.28
A1B	TER_BAY_PU_J	TERRACE_BAY	620	790	93	15.00	131	16.58
T1M	TERRACE_BAY	PIC_J_T1M	460	460	78	16.96	117	25.43
T1M	PIC_J_T1M	MARATHON_TS	620	790	103	16.61	138	17.47

Table 14: Lakehead Area Voltage Study Assessment Results

Bus	Pre-Contingency Voltage (kV)	Loss of T8 – Reject Fort William and Port Arthur			
		Pre ULTC (kV)	Change (%)	Post ULTC (kV)	Change (%)
Lakehead 115 kV	125.5	120.6	-3.90	120.3	-4.14
Alexander SS 115 kV	123.7	121.8	-1.54	121.7	-1.62
Port Arthur 115 kV #1	124.4	120.1	-3.46	119.8	-3.70
Port Arthur 115 kV #2	124.4	120.2	-3.38	119.9	-3.62
Fort William 115 kV Q4B	121.2	117.5	-3.05	117.1	-3.38
Fort William 115 kV Q5B	122.6	119	-2.94	118.6	-3.26
Bowater Load 115 kV	119.4	115.6	-3.18	115.3	-3.43

– End of Section –

7. Northwest Area System Impact Study

At this time, there are SIA applications for about 400 MW of new load connections in the Northwest zone. Previous IESO transmission analyses for the Northwest area have identified system limitations under planning criteria, limitations which will be exacerbated by the connection of this project.

7.1 Northwest Zone Assessment

A resource adequacy assessment for this area determined that additional resources would be needed in the Northwest to meet the Loss of Load Expectation (LOLE) criterion of 0.1 days per year under low water conditions, to supply this project and other loads willing to connect in the area. Consistent with the current resource adequacy assessment practice for system planning purposes only firm imports from neighbouring jurisdictions should be relied on. As such, the import capability from Manitoba and Minnesota was not taken into account in this assessment. In the analysis, the load in the Northwest was supplied internally, largely by hydroelectric generation and Atikokan on bio-mass, and transfers into the area via the East-West Tie.

Plans to strengthen the Northwest transmission system such as the East-West Tie reinforcement project between Wawa and Lakehead are currently under development. Interim measures to bridge the gap between Northwest reinforcement timelines and potentially earlier supply needs are being investigated by the agencies and include an upgraded NW SPS, demand response programs, firm import purchases, and additional internal resources.

However, until the system reinforcements or additional resources are in place there may be low but increased risk of load curtailment in the area, and the connection applicant's project will have a higher likelihood to be interrupted if load curtailment is needed to safeguard the security of the IESO-controlled grid in the Northwest zone.

7.1 Northwest Area Study Conclusions

The addition of the project will exacerbate load supply limitations in the Northwest area. Therefore, the following requirements are applicable.

The connection applicant is required to have adequate provision in the design of protections and controls at the facility to allow for the installation of SPS equipment. Should a new SPS be installed or an existing SPS be expanded to improve the transfer capability in the area or to accommodate transmission reinforcement projects, the facility will be required to participate in the SPS system and to install the necessary protection and control facilities to affect the required actions. The SPS facilities to be installed at the project must be able to accept a single pair (A & B) of load rejection (L/R) signals from the SPS, and disconnect the project from the system with no intentional time delay. These SPS facilities must also comply with the NPCC Reliability Reference Directory #7 for Type 1 SPS. In particular, if the SPS is designed to have 'A' and 'B' protection at a single location for redundancy, they must be on different non-adjacent vertical mounting assemblies or enclosures. Two independent trip coils are required on the breakers selected for L/R. The applicant must provide two dedicated communication channels, separated physically and geographically diverse, between the project and the SPS. After being tripped by the SPS, the closing of the breakers is not permitted until approval is obtained from the IESO

The connection applicant must be prepared to manually implement load curtailment when directed by the IESO. The load curtailment shall be implemented by the connection applicant within 5 minutes from the issuance of the IESO's directive. This requirement complements demand control rules as specified in the IESO Market Rules Chapter 5 section 10, and is intended to make the connection applicant aware that its project has a higher likelihood of being interrupted if load curtailment is needed to safeguard the security of the IESO-controlled grid in the Northwest zone, and the connection applicant may be the first and/or only load directed to be curtailed by the IESO.

If the IESO decides at a later date that automatic load management is needed instead of manual curtailment, the connection applicant will be required to register and operate the project as a dispatchable load until the Northwest system reinforcement is completed. In this case, the registration as a dispatchable load, including the availability of the associated facilities, must be completed within 6 months after the issuance of the IESO's notification. The dispatchable facility must provide bids with a ceiling price established by the IESO and expected to be less than $2,000 per MWh. As a dispatchable load, the project shall respond to dispatch instructions from the IESO, sent via a dispatch workstation.

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